APRIL
2014

WORKING DRAFT

MID & UPPER Sacramento RIVER

REGIONAL FLOOD MANAGEMENT PLAN

FUNDED BY CALIFORNIA DEPARTMENT OF WATER RESOURCES WITH PROP 1E FUNDS

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Abbreviations and Acronyms

Acre-Feet (AF)

Alternative Licensing Process (ALP)

Assistant Secretary of the Army (ASA)

Bald and Golden Eagle Protection Act (BGEPA)

Basin-Wide Feasibility Studies (BWFS)

Biggert-Waters Flood Insurance Reform Act of 2012 (BW-12)

Butte Basin Overflow Area (BBOA)

Butte Regional Conservation Plan (BRCP)

California Air Resources Board (ARB)

California Central Valley Flood Control Association (Association)

California Debris Commission (CDC)

California Department of Conservation (DOC)

California Department of Fish and Wildlife (CDFW)

California Department of Food and Agriculture (CDFA)

California Department of Water Resources (DWR)

California Endangered Species Act (ESA)

California Environmental Protection Agency (CAL/EPA)

California Nevada River Forecast Center (CNRFC)

California Office of Emergency Services (Cal OES)

California Regional Water Quality Control Board, Central Valley Region (CRWQCB)

California Surface Mining and Reclamation Act (SMARA)

California Trout (CalTrout)

California Water Code (CWC)

Central Valley Flood Protection Board (Board or CVFPB)

Central Valley Flood Protection Plan (CVFPP)

Central Valley Flood System Conservation Strategy (Conservation Strategy)

Central Valley Floodplain Evaluation and Delineation Program (CVFED)

Central Valley Hydrology Study (CVHS)

Clean Water Act (CWA)

Code of Federal Regulations (CFR)

Community Rating System (CRS)

Comprehensive Preparedness Guide (CPG)

Corridor Management Plans (CMP)

Corridor Management Strategy (CMS)

Cubic Feet per Second (CFS)

Deep Soil Mixing (DSM)

Delta Working Landscapes Program (Working Landscapes)

"departmental operating centers (DOC)"

Disaster Mitigation Act of 2000 (DMA 2000)

Division of Flood Management (DFM)

Downstream (D/S)

Draft Urban Level of Flood Protection Criteria (ULOP, November 2013)

DWR Flood Operations Center (FOC)

DWR Flood System Repairs Program (FSRP)

DWR's Division of Operation and Maintenance (O&M)

Emergency Operations Center (EOC)

Emergency Operations Plan (EOP)

Emergency Spillway Release Diagram (ESRD)

Endangered Species Act (ESA)

Engineering Documentation Report (EDR)

Engineering Manual (EM)

Enhanced Flood System Operations and Maintenance (EFSOM)

Environmental Impact Statement (EIS)

Environmental Impact Statement/ Environmental Impact Report (EIS/EIR)

Expected Annual Damage (EAD)

Farmland Mapping and Monitoring Program (FMMP)

Farmland Security Zone (FSZ)

Federal Emergency Management Agency (FEMA)

Federal Energy Regulatory Commission (FERC)

Federal Integrated Planning System (IPS)

Feet (FT)

Fish and Wildlife Coordination Act (FWCA)

Flood Control Diagram (FCD)

Flood Hazard Boundary Maps (FHBMs)

Flood Insurance Rate Maps (FIRM)

Flood Insurance Study (FIS)

FloodSAFE California (FloodSAFE)

FloodSAFE Environmental Stewardship and Statewide Resources Office (FESSRO)

Forecast-Based Operations (F-BO)

Forecast-Coordinated Operations (F-CO)

Geotechnical Assessment Report (GAR)

Geotechnical Design Recommendations Report (GDRR)

Giant Garter Snake (GGS)

Good Neighbor Policy (GNP)

Hamilton City Flood Damage Reduction and Ecosystem Restoration Project (Hamilton City Project)

Hazard Mitigation Grant Programs (HMGP)

Hazard Mitigation Plan (HMP)

Hazard Mitigation Plan (HMP)

HEC-FDA = Hydrologic Engineering Center Flood Damage Analysis

Incident Command System (ICS)

Integrated Regional Water Management Plan (IRWMP)

Joint Powers Agency (JPA)

Kopta Slough Flood Damage Reduction and Habitat Restoration Project (Kopta Slough Project)

Lands, Easements, Real Estate, Relocations (LERRDs)

Levee Flood Protection Zone (LFPZ)

Levee Maintaining Agency (LMAs)

Levee Miles (LM)

Levee Safety Program (LSP)

Levees that are a part of the SPFC (Project levees)

Locally Preferred Plan (LPP)

Lower Deer Creek Restoration and Flood Management Project (Lower Deer Creek Project)

Magnuson-Stevens Fishery Conservation and Management Act (MSA)

Maintenance Areas (MAs)

Marine Mammal Protection Act (MMPA)

Master SAA (Master Agreement)

Mid and Upper Sacramento River Regional Flood Management Plan (MUSR RFMP)

Migratory Bird Treaty Act (MBTA)

Million acre-feet (MAF)

Most Likely Descendants (MLDs)

National Economic Development (NED)

National Flood Insurance Program (NFIP)

National Geodetic Vertical Datum of 1929 (NGVD 29)

National Historic Preservation Act (NHPA)

National Incident Management System (NIMS)

National Ocean and Atmospheric Administration (NOAA)

National Ocean and Atmospheric Administration (NOAA)

National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (collectively, the Services)

National Resources Conservation Service (NRCS)

National Weather Service (NWS)

Natural Community Conservation Plans/Habitat Conservation Plans (NCCPs/HCPs)

Non-Governmental Organization (NGO),

Non-Urban Levee Evaluation (NULE)

North American Vertical Datum of 1988 [NAVD88]

Northern Sacramento Valley Integrated Regional Water Management (NSVIRWM)

Not applicable (NA)

Operation, Maintenance, Repair, and Rehabilitation (OMRR)

Operation, Maintenance, Repair, Replacement, or Rehabilitation (OMRR&R)

Operational Areas (OA)

Operations and Maintenance (O&M)

Oroville Wildlife Area (OWA)

Physical Map Revision (PMR)

Pre-Disaster Mitigation (PDM)

Princeton-Codora-Glenn & Provident Irrigation Districts (PCGID-PID)

Procedure Memorandum (PM)

Procedure Memorandum 34 (PM 34)

Programmatic SAAs (Programmatic Agreement)

Project Partnership Agreement (PPA)

Provisionally Accredited Levee (PAL)

Public Law 84-99 (PL 84-99)

Reclamation District (RD)

Regional Advance Mitigation Planning (RAMP)

Regional Flood Management Plan ("RFMP" or "Plan")

Regional General Permit (RGP)

Rehabilitation and Inspection Program (RIP)

Risk and Uncertainty (R and U)

River and Harbors Act (RHA)

River Mile (RM)

Rural Levee Repair Criteria (RLRC)

Rural LMA Work Group (Workgroup)

Sacramento Area Flood Control Agency (SAFCA)

Sacramento River Conservation Area Forum (SRCAF)

Sacramento River Flood Control Project (SRFCP)

Sacramento River Hydrologic Region (SRHR)

Sacramento River National Wildlife Refuge (SRNWR)

Sacramento-San Joaquin Delta (Delta)

Senate Bill (SB)

Senate Bill 5 (SB 5)

Shaded riverine aquatic (SRA)

Small Erosion Repair Program (SERP)

Special Flood Hazard Area (SFHA)

Standardized Emergency Management System (SEMS)

State Historic Preservation Office (SHPO)

State Plan of Flood Control (SPFC) State Water Project (SWP)

State Systemwide Investment Approach (SSIA)

State Water Resources Control Board (SWRCB)

Streambed Alteration Agreement (SAA)

Supplemental Geotechnical Data Report (SGDR)

System-Wide Improvement Frameworks (SWIFs)

Tentatively Selected Plan (TSP)

Union Pacific Railroad (UPRR)

United States Army Corps of Engineers (USACE)

United States Environmental Protection Agency (USEPA)

United States Fish and Wildlife Service (USFWS)

Urban Levee Design Criteria (ULDC)

Urban Levee Evaluation (ULE)

Urban Level of Protection (ULOP)

USFWS Habitat Evaluation Procedure (HEP)

Valley elderberry long horn beetle (VELB)

Western Pacific Railroad (WPRR)

Yolo Natural Heritage Program (YNHP)

Yuba-Sutter Regional Conservation Plan (YSRCP)

Executive Summary

<< Under Development >>

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1. Introduction

<< Note to Reviewer: Welcome to the Working Draft of the Mid & Upper Sacramento River Regional Flood Management Plan (MUSR RFMP). Over the last 9 months, stakeholders within the Mid & Upper Sacramento River Regions have been meeting to discuss the current state of flood management within the Regions. These discussions have been open and forthright, and have highlighted differences in opinion between stakeholders in their visions for the Regions' flood management future. Key themes/issues which have emerged during development of this Working Draft include:

- To have any hope for implementation, system-wide flood management planning must recognize, respect, and represent local interests;
- The current Operations and Maintenance paradigm is not sustainable and must change;
- The tension between desires to improve the natural environment, and the need to maintain and improve the flood protection system, has a high potential to delay implementation of needed improvements to the system within the Regions. Searching for 'common ground' will need to be a high priority in the next phase of the RFMP development process.

The purpose of this Working Draft is to further facilitate the discussion on these and other issues as we move towards a final draft of the MUSR RFMP in fall 2014. It is important to note that this a working draft, and substantial changes are likely as work continues and as additional input and information is received in the coming months. We anticipate that the Focus Area Workgroups will be key in helping to review the Working Draft and in shaping the final RFMP.

Our goal is to begin working on the final draft of the MUSR RFPM beginning July 2014. Therefore, we would like to receive comments and suggestions on the Working Draft by June 30, 2014. Questions or written comments can be sent to:

Kim Floyd
Public Outreach Coordinator
Kim@FloydCommunications.com.
Hotline: 530-809-9317 >>

1.1. Background

The Mid & Upper Sacramento River Regional Flood Management Plan (MUSR RFPM) is a locally-driven assessment of regional flood management issues within the Mid Sacramento Region and the Upper Sacramento River Region (collectively referred to as the Planning Area or Regions). The Mid and Upper Sacramento River regions comprises portions of Butte, Colusa, Glenn, Lake, Sutter, Tehama, and Yolo counties (see Figure 1-1), and contain a diverse set of stakeholder groups in urban cities, small communities, and rural areas. The MUSR RFMP is a follow up to the 2012 Central Valley Flood Protection Plan (CVFPP) and will be used to inform

the 2017 update of the CVFPP. The MUSR RFMP will outline the long-term vision for flood management in the Regions and will include, among other things, a description of the current flood management conditions, opportunities for improving flood management within the Planning Area, needed projects based upon priority, and a preliminary financing plan.

The Mid Sacramento River and Upper Sacramento River Regions joined together in this planning effort because the Regions share common interests and goals, along with interconnected flood control facilities and systems. The MUSR RFMP was developed by participants from the Regions' counties, cities, local levee maintaining agencies (LMAs), water agencies, emergency response agencies, citizen groups, tribes, resource agencies, nongovernmental organizations (NGOs), and other interested stakeholders. The MUSR RFMP effort was funded by a Proposition 1E grant through the California Department of Water Resource (DWR).

1.2. MUSR RFMP Purpose, Goals, and Objectives

The MUSR RFMP is intended to provide the framework for the Mid and Upper Sacramento River Regions' vision for managing flood risk, and was developed using local experience, knowledge and expertise. It provides a reconnaissance-level assessment of regional flood risks, and presents a prioritized list of short-term and long-term flood risk reduction projects for the Regions. The Regions intend for the MUSR RFMP to be used by DWR to inform the Sacramento River Basin-Wide Feasibility Study (BWFS), Central Valley Flood System Conservation Strategy (Conservation Strategy), and 2017 update to the CVFPP.

The goals and objectives of the MUSR RFMP include:

- Assemble, coordinate, inform, and direct the regional participants for the organization, preparation, and completion of the MUSR RFMP using available financial and technical resources.
- Define opportunities and problems concerning flood management and protection issues within the Regions to be addressed in the MUSR RFMP.
- Cooperatively and collaboratively determine appropriate regional flood management/protection actions and projects that meet priority benefits and needs, and provide public safety and reduced flood risks for the Regions.
- Identify funding needs and resources in order to implement flood management/protection actions and projects included in the MUSR.
- Using local expertise and knowledge create a thoughtful flood management plan for the future in a directed, consistent, and sustainable manner to allow better economic and social certainty for the Regions and the State.
- Protect the agricultural, environmental, and urban infrastructure and resources of the Regions in an integrated and practical way that improves and benefits all sectors in the future.
- Assist the State in moving forward in its path of continuing to develop and implement a workable and progressive CVFPP that is in the best interest of the Regions and State.

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1.3. Relationship to Other Planning Efforts

1.3.1. *2012 Central Valley Flood Protection Plan*

The Central Valley Flood Protection Act of 2008 mandated that DWR prepare the 2012 CVFPP to guide the State's participation in managing flood risk along the Sacramento River and San Joaquin River systems. The CVFPP proposes a State Systemwide Investment Approach (SSIA) for sustainable, integrated flood management in areas currently protected by facilities of the State Plan of Flood Control (SPFC). The primary goal of the 2012 CVFPP is to improve flood risk management by reducing the chance of flooding, and damages once flooding occurs, and improve public safety, preparedness, and emergency response. Supporting goals include improving operations and maintenance, promoting ecosystem functions, improving institutional support, and promoting multi-benefit projects.

The initial CVFPP was adopted by the Central Valley Flood Protection Board (CVFPB) in June 2012 and will be updated every five years, with each update providing support for subsequent policy, program, and project implementation. The CVFPP did not incorporate the level of detail needed to delineate refined systemwide improvement alternatives, nor did it include a detailed discussion of local flood risk reduction priorities. Instead, it provides a broad vision to help direct regional- and state-level financing plans to guide investments which may be in the range of $14 billion to $17 billion over the next 20 to 25 years.

1.3.2. *Regional Flood Management Plans*

At the urging of the CVFPB, DWR launched the Regional Flood Management Planning effort to assist local agencies in developing long-term regional flood management plans that address local needs, articulate local and regional flood management priorities, and establish the common vision of regional partners. The six planning regions (originally nine, but some combined) are the Upper/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 (see Figure 1-1).

Each of the six planning regions formed a working group led by a local agency and consisting of representatives from flood management agencies, land use agencies, flood emergency responders, permitting agencies, and agricultural and environmental interests.

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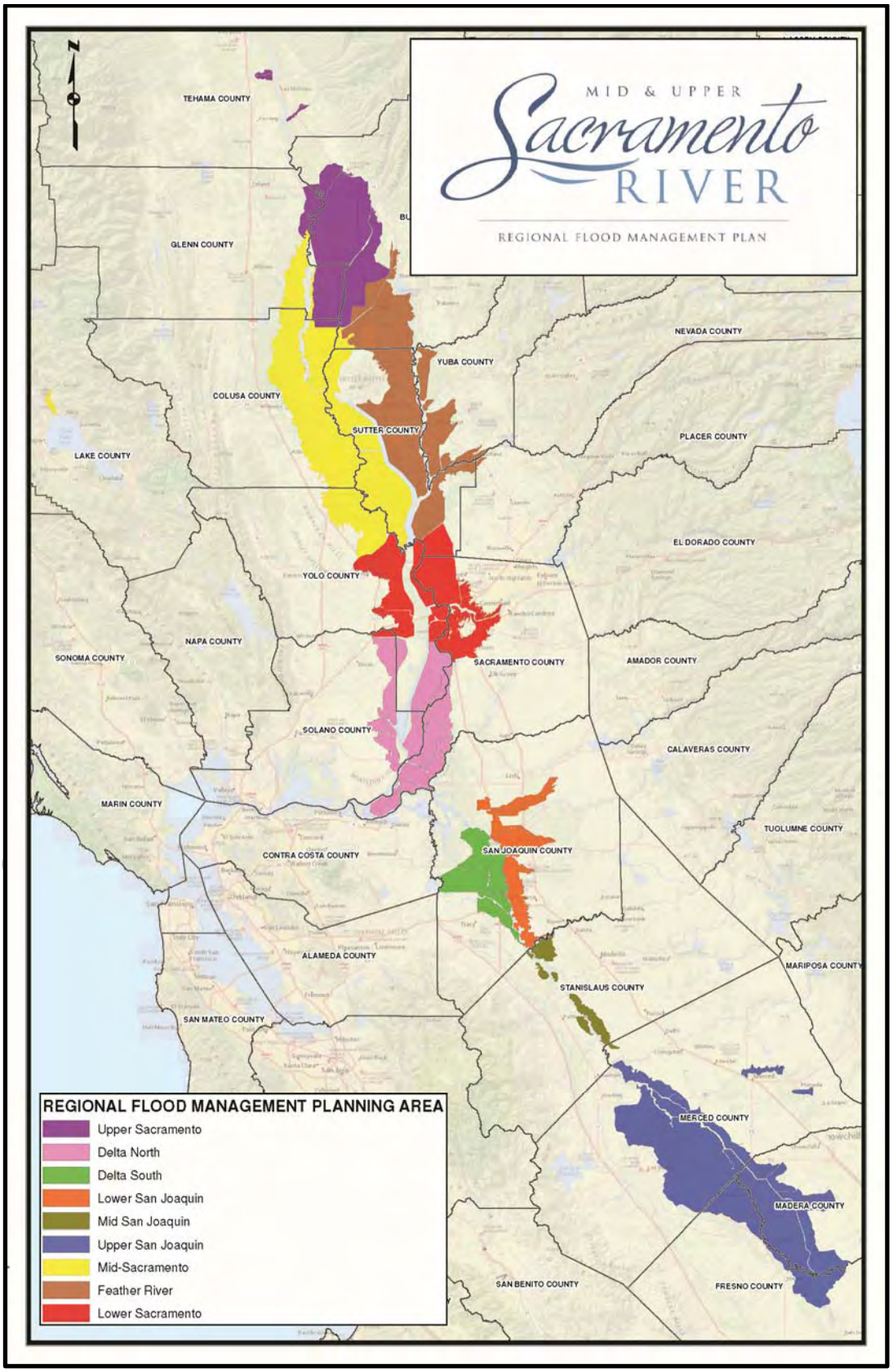
Figure 1-1. Regional Flood Management Planning Areas



The MUSR RFMP was prepared in direct coordination with both the Lower Sacramento/Delta North and Feather River Regions during this RFMP planning process. In particular, the Regions collaborated extensively in regard to operation and maintenance (O&M) issues, and on issues related to the Cherokee Canal, Butte Sink, Sutter Bypass, and Yolo Bypass.

1.3.3. *DWR Basin-Wide Feasibility Studies*

DWR intends to refine the SSIA concept proposed in the 2012 CVFPP through the development of Basin-Wide Feasibility Studies (BWFS) of the Sacramento and San Joaquin River Basins. Flood management actions that will be considered in the BWFS include system improvements such as weirs and bypasses, regional flood risk reduction actions (especially those that incorporate other benefits such as recreation or water supply), and implementation of a habitat conservation strategy which integrates environmental enhancement and sustainability objectives into flood management projects and activities.

While the BWFS will focus on refining the SSIA from the 2012 CVFPP, they will also consider and may include projects and actions recommended by the RFMPs that are determined to be consistent with the CVFPP. The improvements will be evaluated based on the ability to meet basin-wide objectives, such as resiliency, flexibility, and sustainability of the flood management system along the Sacramento and San Joaquin rivers. DWR has indicated that it intends to fully coordinate the activities of the BWFSs and RFMPs in a way that the two planning processes inform each other and are properly integrated. This integration will facilitate the further consideration of recommended regional improvements in the BWFS.

Figure 1-2 provides a graphical description of the relationship between the parallel planning efforts.

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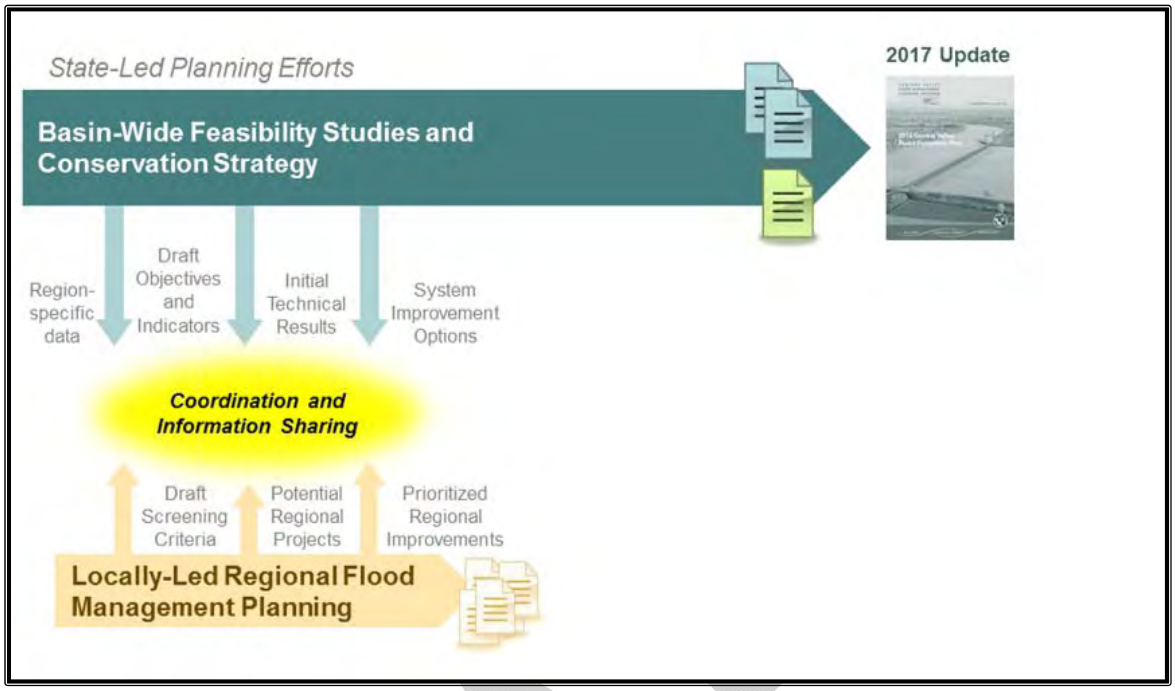
Figure 1-2. Relationship between the State-led BWFS and the locally-led RFMP



1.3.4. *Northern Sacramento Valley Integrated Regional Water Management Plan*

The MUSR RFMP was used to help develop the flood control component of the 2014 Northern Sacramento Valley Integrated Regional Water Management Plan (NSVIRWMP). The NSVIRWM is a collaborative effort to enhance coordination of the water resources management in the region. NSVIRWM involves multiple agencies, stakeholders, tribes, individuals, and groups to address water-related issues and offer solutions that can provide multiple benefits to the region. The NSVIRWMP includes representatives of the six counties working in partnership with community stakeholders, tribes, and the public to identify the water-related needs of the region.

1.4. MUSR RFMP Development Process

The MUSR RFMP Planning Area consists of portions of seven counties: Butte, Colusa, Glenn, Lake, Sutter, Tehama, and Yolo; the cities of Chico and Colusa; the smaller communities of Gerber, Hamilton City, Nord, Durham, Dayton, Nelson, Richvale, Glenn, Ord Bend, Butte City, Princeton, Meridian, Grimes, Robbins, and Afton; Levee Districts 1, 2, and 3; the Sacramento West Side Levee District; and eight Reclamation Districts (RDs): Lake County Watershed Protection District, Tehama County Flood Control & Water Conservation District, the Colusa Basin Drainage District, the Colusa Rancheria, and four DWR Maintenance Areas. An overview of the area defined as the Mid and Upper Sacramento Region is shown in Figure 1-3.

The approach for developing the MUSR RFMP consisted of first, conducting a series of individual small group meetings with all of the participating local levee maintaining agencies,

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cities, counties, small communities, and interested stakeholders within the region. The series of small group meetings were intended to reach all interested parties within the Planning Area. The initial small group meetings presented the background, purpose, and objectives of the MUSR RFMP and solicited input from attendees on their thoughts and ideas for flood management within the region.

The small group meetings were followed up with a series of Focus Area Workgroup meetings. Given the scale and complexity of the issues at hand, the Focus Area Workgroups were established to make it easier for locals to have direct involvement in the parts of the MUSR RFMP that they cared about the most. A group was established for each of the following Focus Areas: Urban Areas, Operations & Maintenance, Emergency Response, Rural Areas, Small Communities, System Improvements, Multi-Benefit, and Finance.

A MUSR RFMP webpage was created to provide information on meetings and study progress to all stakeholders (http://musacrfmp.com/), and a Project Outreach Coordinator with a telephone hotline (530-809-9317) was established to provide a single point of contact for all parties. Any and all interested parties within the Regions were encouraged to be a part of the MUSR RFMP planning effort. As of early 2014, the stakeholder database included about 450 members.

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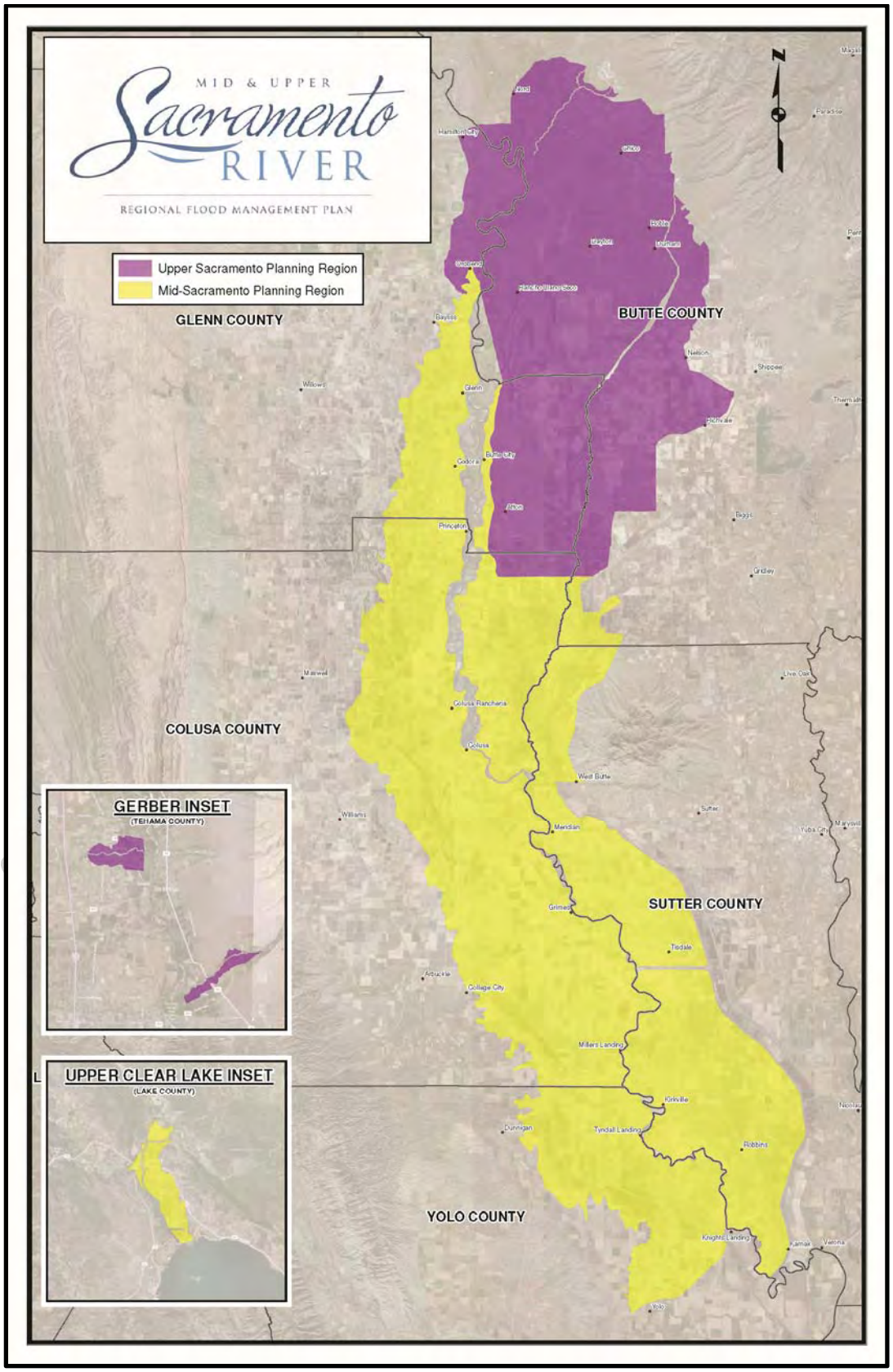
Figure 1-3. Mid and Upper Sacramento Planning Region



1.5. Organization of the Planning Team

Reclamation District 108 was the grant recipient and lead agency for preparing the MUSR RFMP. RD 108 retained Peterson Brustad, Inc. as the lead consultant to assist in the research, planning, and preparation of the RFMP. A Steering Committee was formed to help guide and assist the MUSR RFMP team with plan development. The Steering Committee consisted of representatives from the participating counties, cities, reclamation districts, levee districts, and other levee maintaining agencies. Additionally, all tribal groups, NGOs, agricultural interests, and landowners within the MUSR RFMP Planning Area were encouraged to be involved.

In addition to the Steering Committee, two smaller Administration Committees (one for the Mid Sacramento and one for the Upper Sacramento region) were formed in order to guide the day-to-day activities of the planning team. The Administration Committee members were elected by the Steering Committee in November 2012.

1.6. Organization of this Report

This report is organized to reflect the chronological sequence of the planning process. Beginning with a description of background information and the regional setting, the report describes the identified problems and opportunities. With this foundation, potential actions that may address these problems are identified. Generally, the chapters are organized to correspond with the Focus Area Workgroups, elaborating on the specific challenges and potential solutions for each topic. A summary of all of the potential flood risk management improvements is then presented, followed by an assessment of potential benefits, costs, and impacts. Based on all of these elements, a locally-determined set of priorities is formulated and documented, and the opportunities for potential financing alternatives are investigated and described.

1.7. Sources of Existing Information

The MUSR RFMP relies primarily on existing sources of information provided by local agencies, property owners, interested individuals, NGOs, as well as state and federal agencies. The major sources used to inform the RFMP include:

- Local studies and data;
- Stakeholder input;
- Central Valley Flood Protection Plan (2012), including attachments, and CVFPB Resolution 2012-2025;
- Flood Control System Status Report (2010);
- State Plan of Flood Control Descriptive Document (2010);
- Upper/Mid Sacramento River Region Flood Atlas (May 2013);
- California's Flood Future: Recommendations for Managing the State's Flood Risk (2013);
- DWR LMA Annual Reports (2013);
- DWR Non-Urban Levee Evaluations (ongoing);
- DWR Urban Levee Evaluations (ongoing);

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- DWR Central Valley Floodplain Evaluation and Delineation Hydraulic Models (ongoing); and
- DWR Flood System Repair Program (ongoing).

The MUSR RFMP also incorporated information from city and county general plans, as well as institutional knowledge of the flood management facilities system from city, county, RD, LMA, and stakeholders involved in the daily O&M of their respective facilities.

The MUSR RFMP used best available information and, therefore, data sets from existing sources may not fall entirely within the Planning Area boundaries. The information in the MUSR RFMP was compiled from a number of documents, each with differing levels of detail, completeness, and study area boundaries.

1.8. Regional Partners

Historically, major flood management initiatives in California have been undertaken by local, state, and federal agencies in an evolving cooperative relationship. Beginning in the 1850s, levee improvements were initiated as entirely local undertakings, with sporadic efforts to provide state coordination and oversight. State oversight of flood control efforts in the Sacramento Valley began in 1911, with the creation of the Central Valley Flood Protection Board (formerly the State Reclamation Board). Federal participation in California flood management, which was first authorized in the Caminetti Act of 1893, was firmly established with authorization of the Sacramento River Flood Control Project in 1917. From 1917 to 2006, the United States Army Corps of Engineers (USACE) has played a lead role in planning, authorizing, financing, constructing, and inspecting flood system improvements in the Sacramento Valley, incorporating and improving upon the levee system originally constructed by local agencies.

Since 2006, DWR and local agencies have played more prominent roles, providing leadership on major levee improvement projects in the Central Valley. The roles of the agencies involved can be expected to continue to shift in response to political and policy changes, funding availability, interest, and leadership. The roles of the key local, state, and federal agencies involved in providing and permitting flood management projects and programs are summarized below. Other organizations that were involved in the development of this MUSR RFMP are also listed.

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Figure 1-4. Upper Sacramento River Region LMAs

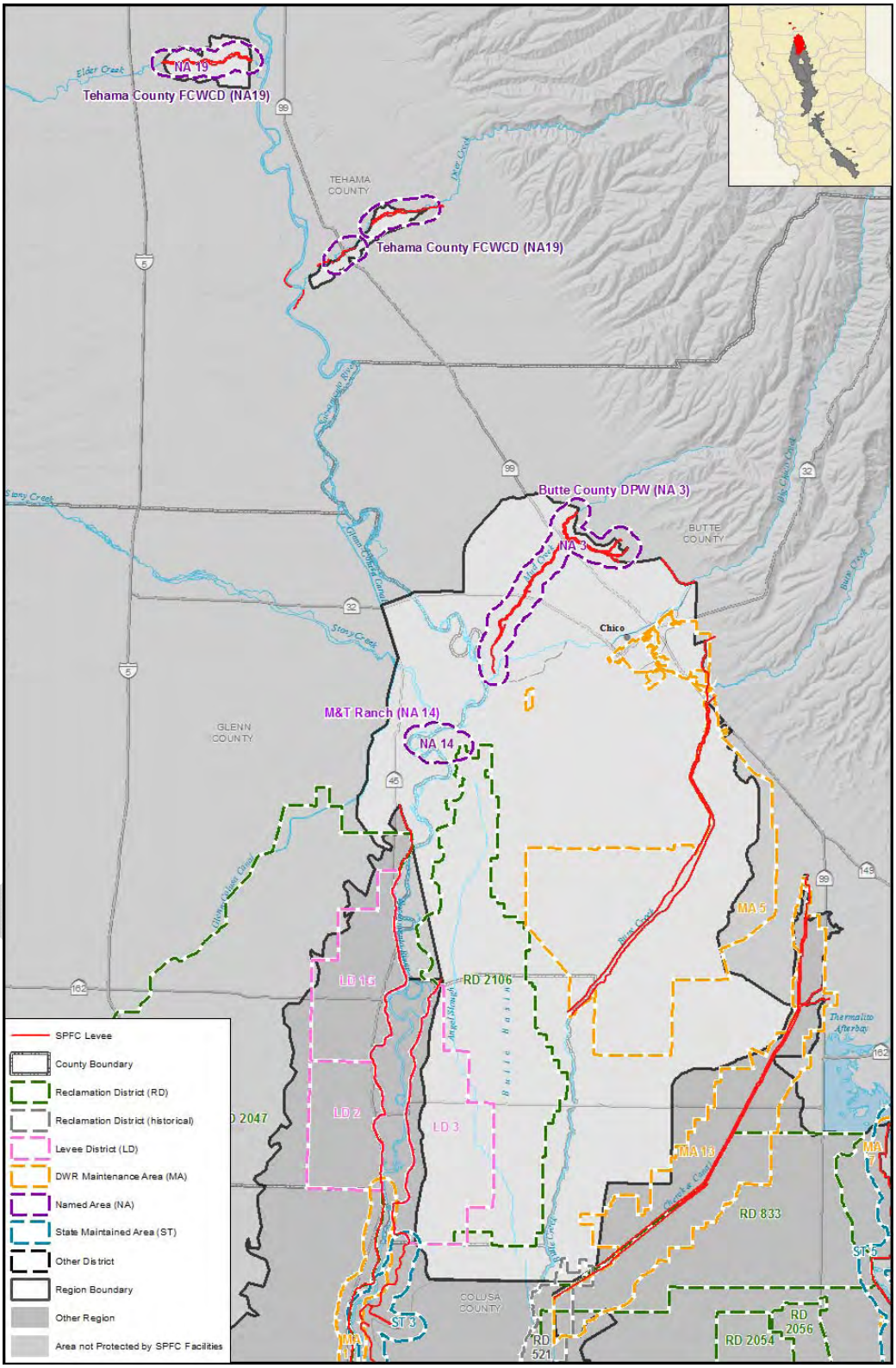
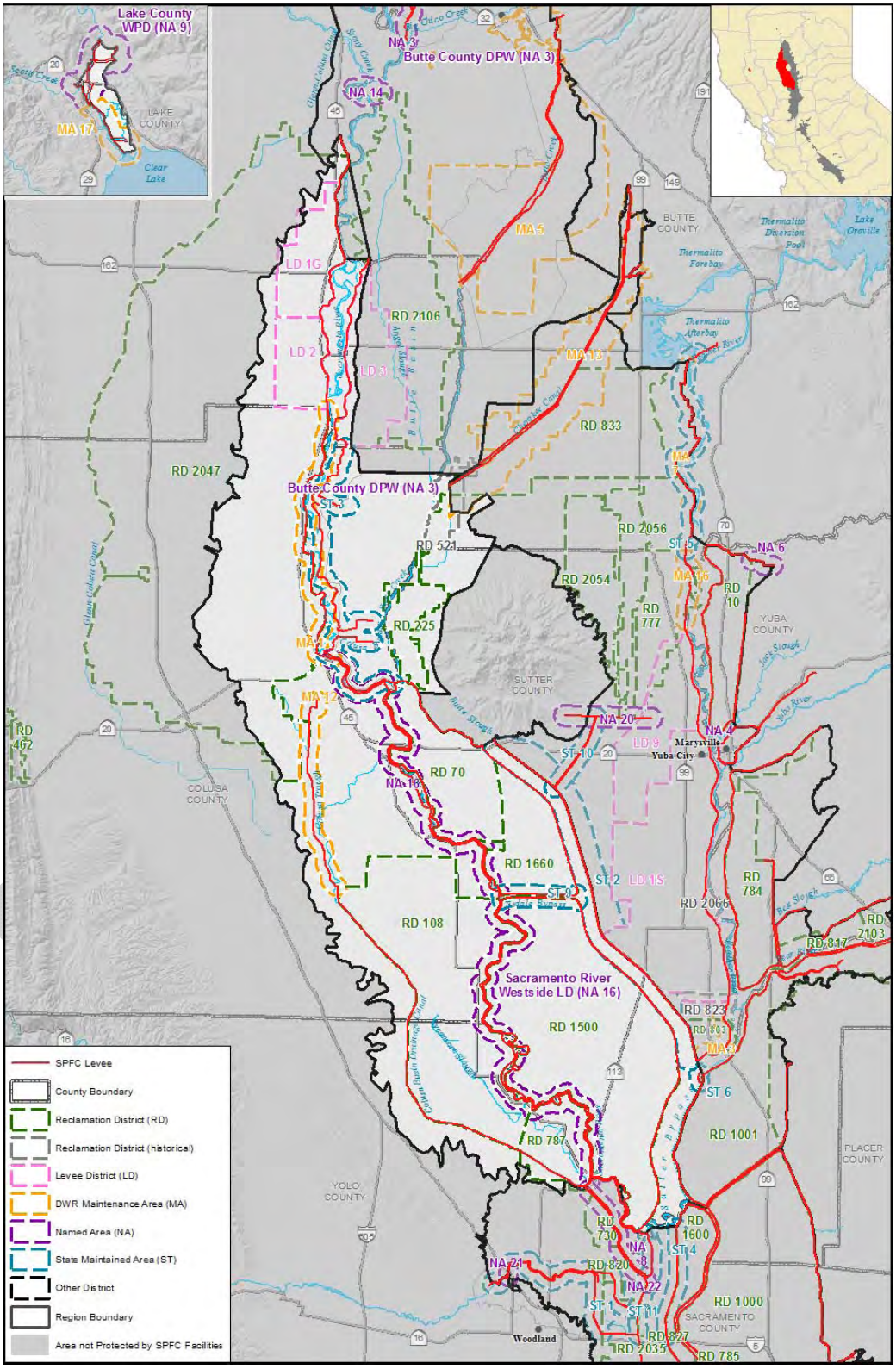


Figure 1-5. Mid Sacramento River Region LMAs



1.8.1. *Local Public Agencies*

Local levee districts, reclamation districts, and state maintenance areas, known collectively as LMAs, regularly patrol, maintain, and repair the levees within their jurisdictions as well as fight floods when they occur. The LMAs have given assurances to the CVFPB that they will operate and maintain the levees that are a part of the SPFC (Project levees) (see Table 1-1, Figure 1-4 and Figure 1-5) in perpetuity in accordance with criteria established by USACE. The LMAs were the primary local partners in this RFMP process.

Table 1-1. Local Maintaining Agencies for the SPFC Levees in the MUSR Regions

Local Maintaining Agency	County	Stream	Total Miles of Levee
Butte County Public Works	Butte	Mud Creek, Sycamore Creek, Dry Creek, Sheep Hollow Creek, Big Chico Creek Diversion Channel	24.7
Tehama County Flood Control & Water Conservation District	Tehama	Deer Creek, Elder Creek	13.6
Levee District 1	Glenn	Sacramento River	12.5
Levee District 2	Glenn	Sacramento River	4.9
Levee District 3	Glenn	Sacramento River	12.2
Reclamation District 70	Sutter	Sacramento River, Sutter Bypass	23.6
Reclamation District 108	Colusa	Colusa Basin Drain	20.9
Reclamation District 787	Yolo	Colusa Basin Drain	4.4
Reclamation District 1500	Sutter	Sacramento River, Sutter Bypass	54.4
Reclamation District 1660	Sutter	Sacramento River, Sutter Bypass	12.1
Lake County Watershed Protection District	Lake	Middle Creek, Scott's Creek, Alley Creek, Poge Creek, Clover Creek	10.5
Sacramento River Westside Levee District	Colusa	Sacramento River	50.2
DWR Sutter Yard Maintenance Area 1	Colusa	Sacramento River	17.1
DWR Sutter Yard Maintenance Area 5	Butte	Butte Creek, Little Chico Creek Diversion	33.3
DWR Sutter Yard Maintenance Area 12	Colusa	Colusa Basin Drain	11.3
DWR Sutter Yard Maintenance Area 17	Lake	Middle Creek	3.9
DWR Sutter Yard Statutory Area 3	Colusa	Sacramento River	27.2
DWR Sutter Yard Statutory Area 9	Sutter	Tisdale Bypass	8.9

In addition to the LMAs listed previously, the following list shows the other local public agencies that were involved in this Mid and Upper Sacramento River RFMP planning process:

- Glenn County Planning and Public Works
- Colusa County Department of Public Works
- City of Colusa
- City of Chico
- Colusa Basin Drainage District
- Rock Creek Reclamation District
- Reclamation District 2140
- Reclamation District 2047

- Western Canal Water District
- TC Canal Authority
- Glenn-Colusa Irrigation District
- Princeton-Codora-Glenn Irrigation District
- Gerber/Las Flores CSD
- Richvale Irrigation District
- Richvale Sanitary District
- Hamilton City F.D.
- Ord Bend F.D.
- Robbins F.D.
- Sacramento River Fire Protection District
- Glenn-Colusa F.D.
- Butte County OEM
- Sutter County OEM
- Tehama County OES
- Yolo County OES
- Colusa County OEM
- Glenn County Sheriff's Department

1.8.2. *State Agencies*

Central Valley Flood Protection Board

The CVFPB, with regulatory authority over the SPFC levees, has given assurances to USACE that the federally-authorized Project levees will be operated and maintained in accordance with those criteria. The CVFPB has the authority to serve as the non-federal sponsor for capital improvement projects for levees in the Regions, regulates encroachments, and works to assure that the various components function as a system.

California Department of Water Resources

DWR, primarily acting through the Division of Flood Management, is responsible for State-level flood management in the Planning Area, including cooperating with USACE in project planning, design, and funding; cooperating with the National Ocean and Atmospheric Administration (NOAA) in flood and water supply forecasting; operating the Flood Operations Center; providing flood fight assistance for local agencies; and maintaining portions of the flood management system.

DWR's levee maintenance responsibilities include portions of the system designated for State maintenance in the California Water Code (CWC §8361(f)) and operating Maintenance Areas (MAs) when local agencies cannot or choose not to meet the maintenance obligations established under the assurances given to the CVFPB and USACE (CWC §12878 et.seq.). Under these authorities, DWR will assume responsibility for levee maintenance.

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California Office of Emergency Services

The California Office of Emergency Services (Cal OES) has overall State emergency response management authority, which among other things, includes assuring that State and local agencies operate in accordance with the Standardized Emergency Management System (SEMS).

California Department of Fish and Wildlife

The California Department of Fish and Wildlife (CDFW) administers State laws and regulations regarding the protection of fish and wildlife resources, and as such, exerts permitting authority over flood control project construction, operation, and maintenance activities, as well as managing State wildlife areas in the region.

State Water Resources Control Board and the Regional Water Quality Control Board, Central Valley Region

The State Water Resources Control Board (SWRCB) and the Regional Water Quality Control Board, Central Valley Region (RWQCB), administer State water rights and water quality laws and regulations. The SWRCB, given its authority over water rights, including stream diversions, may exert regulatory authority over flood control or environmental restoration projects that result in new diversions from existing channels. The RWQCB requires that construction projects, such as levee improvement projects, avoid injurious discharges from worksites to streams by preparing and adhering to Stormwater Management Plans and following Best Management Practices for chemicals, diesel fuel, drilling fluid, and other typical construction fluids. The RWQCB also works closely with USACE when it issues Section 404 permits, which must include a certification by the RWQCB that water quality will not be impaired (Section 401 permit).

California Department of Conservation

The California Department of Conservation (DOC) is responsible for administering the California Surface Mining and Reclamation Act (SMARA) of 1975. It assures that local governments, such as cities and counties, adopt and administer ordinances compliant with the law. SMARA is an important consideration for most flood control projects, as it applies to any projects that disturb more than one acre of land or move more than 1,000 cubic yards of material. SMARA compliance involves formulating projects that do not result in injurious discharges from the disturbed area during the mining operation, followed by a reclamation plan which restores the mined land to beneficial use (DOC, 2013).

DOC also administers the Williamson Act, enacted in 1965, designed to help preserve agricultural land through property tax incentives and long-term contracts. It was enhanced in 1998 with the addition of Farmland Security Zone (FSZ) provisions, which offers additional incentives to extend the contract period from the normal 10-year period to 20 years. Butte, Colusa, Sutter, and Tehama Counties participate in the Williamson Act program. These counties also participate in the FSZ provisions as well.

The DOC also administers various grant programs for the acquisition of agricultural and open space preservation (DOC, 2013). Such programs may work synergistically with non-structural flood management projects, which may improve flood system capacity, reduce long-term risks to life and property, and improve resiliency through actions such as agricultural conservation

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easements, open space easements, levee setbacks and floodplain restoration, where locally supported and feasible.

1.8.3. *Federal Agencies*

U.S. Army Corps of Engineers

At the federal level, USACE is primarily responsible for planning, designing, and constructing federally-authorized flood management facilities, including dams, levees, and other structures. It also develops the operational rules for federally-funded flood control reservoirs, which include most of the major reservoirs on Central Valley streams. Following the Hurricane Katrina Gulf Coast disaster of 2005, USACE has implemented the Levee Safety Program (LSP), promulgated strict vegetation management guidelines, and strengthened its national levee inspection program.

National Weather Service

The National Weather Service (NWS), a part of NOAA, operates centers throughout the United States that monitor and forecast climate, weather, severe storms, and runoff. In California, the NWS weather forecasting centers are supplemented by the California Nevada River Forecast Center (CNRFC) which cooperates with DWR to issue flood and water supply forecasts (CNRFC, 2013). These forecasts are critically important to the Regions because under winter storm conditions, flow in the rivers and local streams can increase rapidly, causing extreme peril for residents and property. Accurate and timely flood forecasts are an important component of the Regions' flood risk management system.

NOAA Fisheries

NOAA Fisheries is responsible for the protection of anadromous fisheries, including salmon and steelhead, which migrate through and spawn in the various channels within the MUSR Regions. NOAA Fisheries plays an important role in the flood project planning process, providing guidance on ways to design and operate flood control works to minimize impacts and enhance fisheries habitat. USACE and other project proponents must consult with NOAA Fisheries in all phases of federal flood management project planning, design, and construction that have the potential for impacting species of concern. In administering various federal statutes and regulations protecting migratory species of concern, NOAA Fisheries may also impose conditions on the operation of multi-purpose dams and reservoirs with federal participation, including the major reservoirs protecting the region (NOAA Fisheries, 2013).

U.S. Fish and Wildlife Service

The United States Fish and Wildlife Service (USFWS) plays a similar role to that of NOAA Fisheries, with a focus on terrestrial, avian, and resident fish species and their habitats. In the Regions, some of the key species of concern are the Green Sturgeon (*Acipenser medirostris*), Central Valley steelhead (*Oncorhynchus mykiss*), and Central Valley Chinook salmon (*Oncorhynchus tshawytscha*). In the Mid-Sacramento Region, the Vernal Pool fairy shrimp (*Brachinecta lynchi*) is also of concern. USFWS plays an important role in the flood project planning process, providing guidance on ways to design and operate flood control works to minimize impacts and enhance fish and wildlife habitats. USACE and other project proponents must consult with USFWS in all phases of federal flood management project planning, design, and construction (DWR, 2012, Atlas Map 19A and 19B).

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The Federal Emergency Management Agency

The Federal Emergency Management Agency (FEMA) plays a multitude of flood management roles, including managing the National Flood Insurance Program (NFIP), which includes mapping of and classification of flood hazards in the Regions. FEMA administers the Disaster Mitigation Act of 2000 (DMA 2000), which requires that local communities evaluate the natural hazards within their boundaries and develop mitigation plans for those hazards in order to maintain eligibility for its Pre-Disaster Mitigation (PDM) and Hazard Mitigation Grant Programs (HMGP). FEMA also provides federal disaster recovery assistance in the event of federal emergency declarations or disaster declarations. Federal emergency management efforts are structured in accordance with the National Incident Management System (NIMS).

1.8.4. *Other Organizations*

The following lists the other organizations and agencies that were involved in this Mid and Upper Sacramento River RFMP planning process:

- Colusa Indian Community Council
- Sacramento River Conservation Area Forum
- Family Water Alliance
- County Resource Conservation Districts
- County Farm Bureaus
- M&T Ranch
- Llano Seco
- The Nature Conservancy
- River Partners
- American Rivers
- Westervelt Ecological Services

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2. Regional Setting

2.1. Area and Boundaries

The Mid and Upper Sacramento River (MUSR) Regions contain a diverse set of stakeholder groups in urban and rural-agricultural areas. Combined, the two regions encompass approximately 640,000 acres throughout seven counties (Tehama, Glenn, Lake, Colusa, Butte, Sutter, and Yolo). The major part of the Sacramento River Flood Control Project bypass system is located in the region, including the Sutter and Tisdale bypasses. About 68 percent of the Regions' floodplain area is classified as Prime and Statewide Importance Farmland. Large areas of the Regions are within the 100-year (1 percent annual chance) floodplain

As shown in Figure 2-1 and Figure 2-2, the Planning Area for these Regions (except the Lake County portion) is located within the north-central portion of the Sacramento River Valley, a broad, gently sloping valley that drains to the Sacramento River via the Fremont Weir. The Regions extend about 90 miles from north to south and approximately 25 miles from east to west. This portion of the Planning Area is dominated by the Upper Sacramento River and its numerous tributaries, which originate from the foothills of the Coastal Range west of the region and the Sierra Nevada Mountains to the north and east of the region. The Upper Sacramento River in this case is considered to be that part of the river above the Fremont Weir. Some of the primary tributaries of the Upper Sacramento River within the region include: Cottonwood Creek, Elder Creek, Deer Creek, Stony Creek, Mud Creek, and Butte Creek. Nearly all of these tributaries have at least one State Plan of Flood Control (SPFC) levee system protecting existing development, and the Planning Area is generally defined as areas protected by these SPFC levees.

The Regions are primarily dominated by farmland and a number of small communities, along with the cities of Colusa and Chico. The list of small communities within the Regions includes:

- Colusa
- Gerber
- Glenn
- Butte City
- Princeton
- Meridian
- Grimes
- Robbins
- Hamilton City
- Ord Bend
- Afton
- Richvale
- Nelson
- Durham
- Dayton
- Nord

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Figure 2-1. Overview of the Upper Sacramento River Region

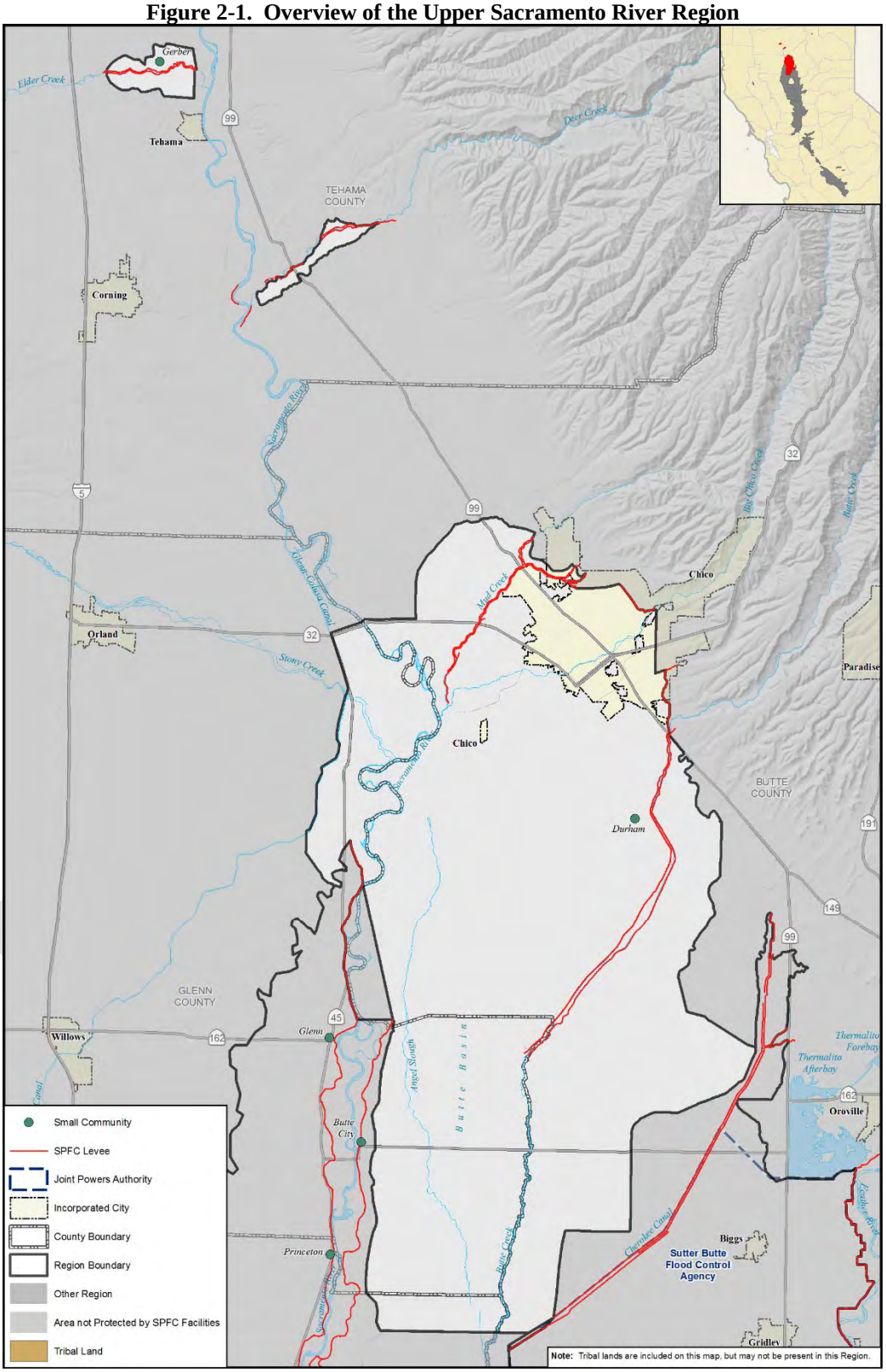
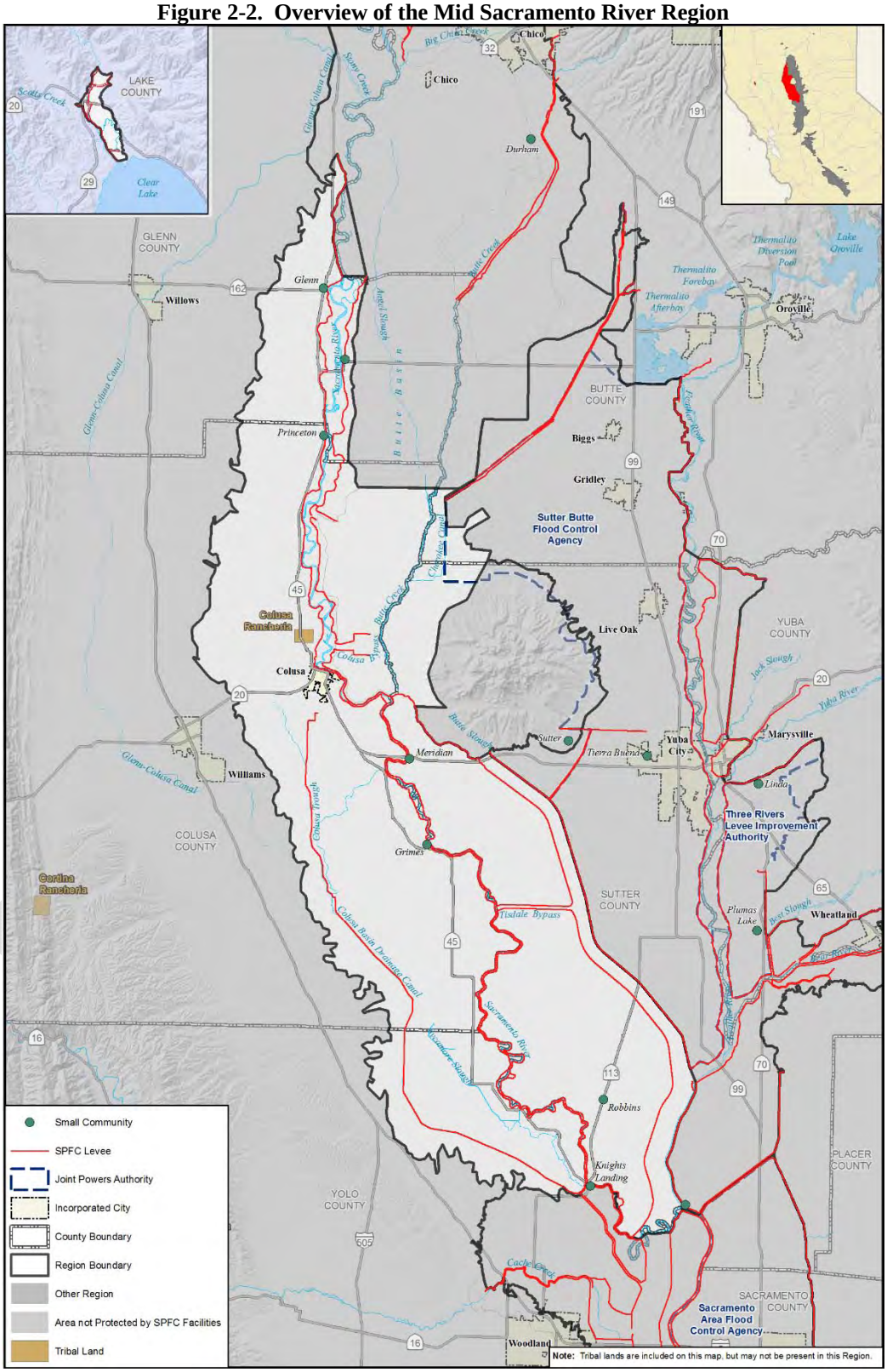


Figure 2-2. Overview of the Mid Sacramento River Region



2.2. Population and Land Use

Per 2010 U.S. Census Bureau Information, the population within the Upper Sacramento River Region is approximately 108,000. The population within the Mid-Sacramento River Region is approximately 14,000. The only urban area of 10,000 people or more in the Upper Sacramento River Region is Chico. In general, growth rates for the Regions are estimated to average around 0.6 to 1.0 percent per year for the next five years. A breakdown of population for areas with the Regions is shown below in Table 2-1.

Table 2-1. Mid and Upper Sacramento River Region 2013 Population Estimates

County/City/Small Community	2010 Total Population	Population within Upper Sacramento River Region	Population within Mid Sacramento River Region
Tehama County	**63,463**	**1,627**	**0**
Tehama[1]	418		
Gerber	1,060		
Vina[1]	237		
Glenn County	**28,122**	**3,177**	**867**
Hamilton City	1,759		
Ord Bend	37		
Glenn	42		
Butte City	107		
Afton	18		
Lake County	**64,665**	**0**	**1,396**
Lakeport[1]	4,753		
Upper Lake	1,052		
Butte County	**220,000**	**102,893**	**97**
Chico	86,187		
Nord	320		
Durham	5,518		
Nelson	88		
Richvale	244		
Colusa County	**21,419**	**86**	**9,067**
Colusa	7,380		
Princeton	303		
Grimes	391		
Sutter County	**94,737**	**0**	**1,722**
Meridian	358		
Robbins	323		
Yolo County	**201,311**	**0**	**729**

** Source: 2010 U.S. Census Bureau*

1. Located outside MUSR Regional Boundary

Land use in the MUSR Regions is primarily Prime and Statewide Importance Farmland with some large areas of Local and Unique Farmland and Native Vegetation and Grazing Land. Table 2-2 and the following figures show the land use summary for the MUSR Regions.

Figure 2-3. Upper Sacramento River Region Land Use Summary

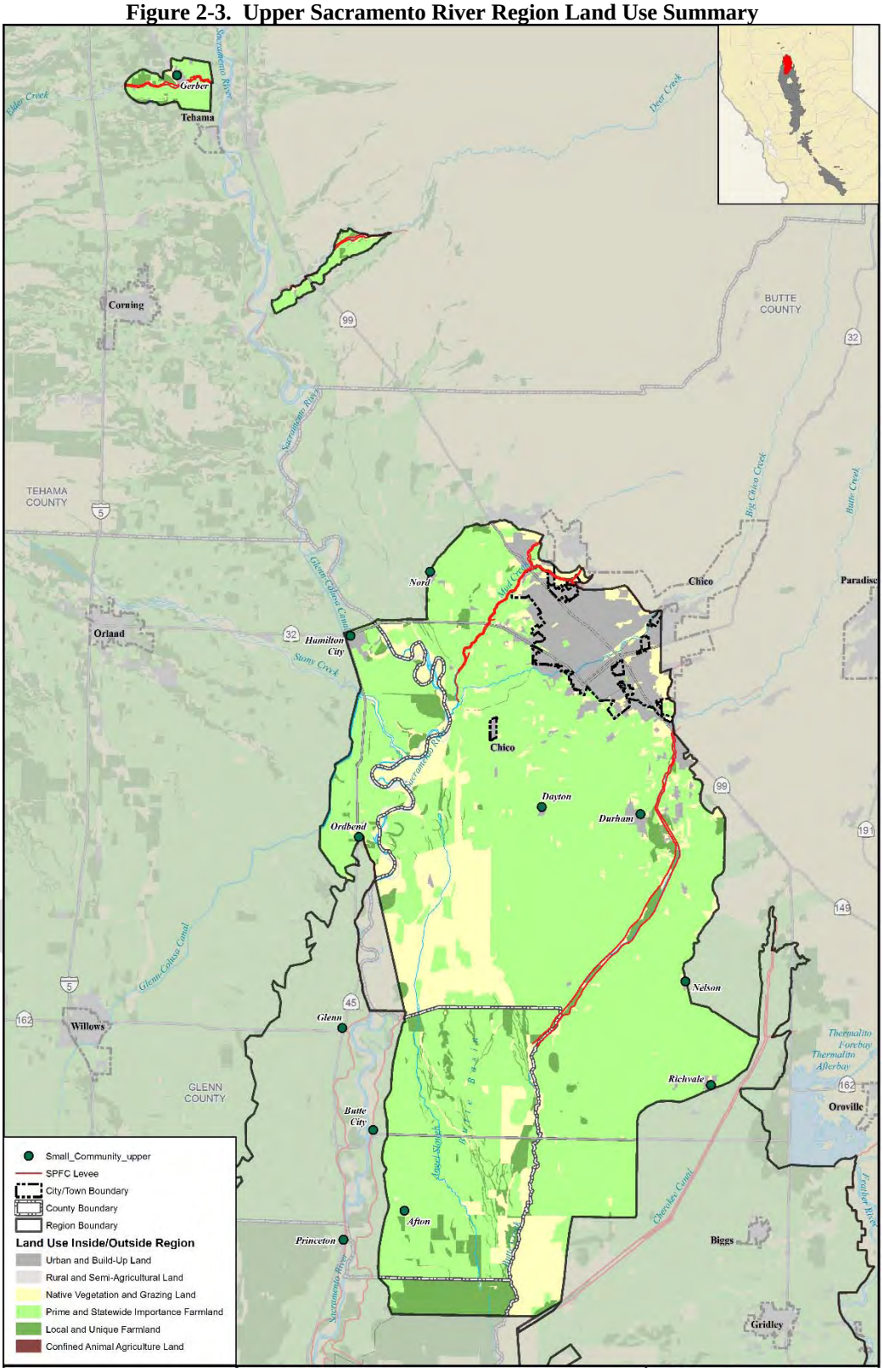


Figure 2-4. Mid Sacramento River Region Land Use Summary

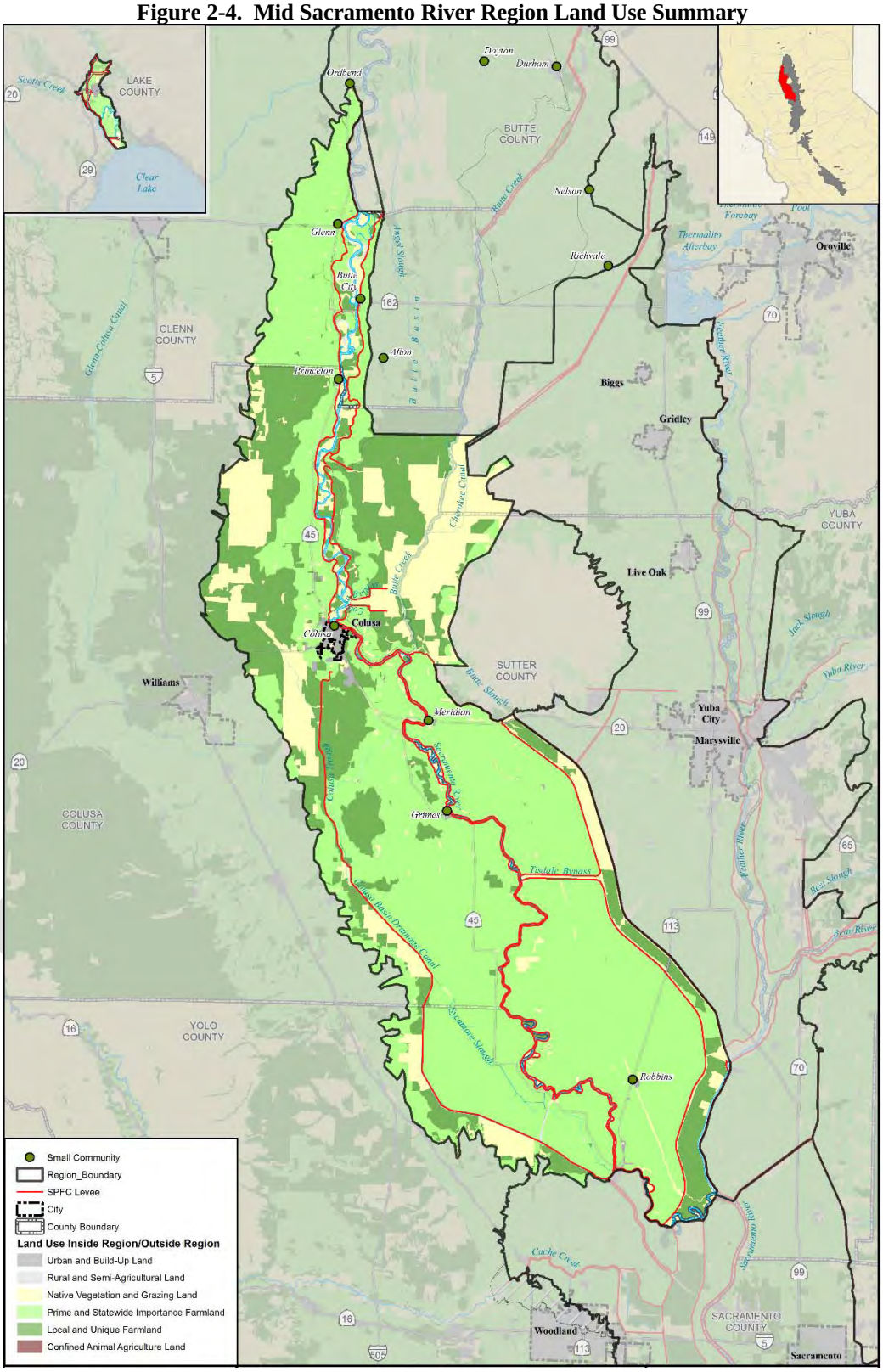
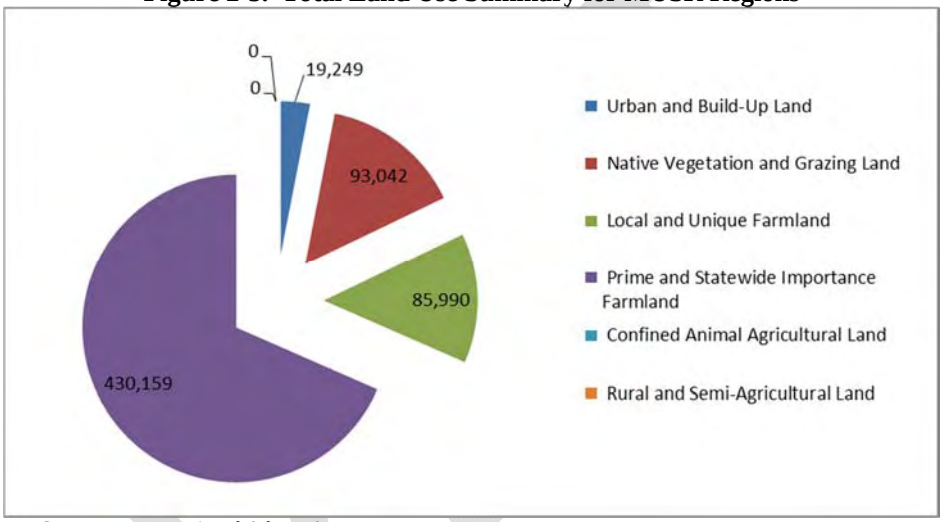


Table 2-2. Mid and Upper Sacramento River Regions Land Use

Land Type Category	Acres in Mid-Sac Region	Total % of Mid-Sac Region	Acres in Upper-Sac Region	Total % of Upper-Sac Region
Urban and Built-Up Land	3,293	1%	15,956	7%
Native Vegetation and Grazing Land	58,589	14%	34,453	16%
Local and Unique Farmland	72,476	18%	13,514	6%
Prime and Statewide Importance Farmland	277,778	67%	152,381	71%
Total	**412,135**	**100%**	**216,304**	**100%**

Figure 2-5. Total Land Use Summary for MUSR Regions



Source: DWR Regional Atlas, 2013

Land use information was obtained from the California Department of Conservation Farmland Mapping and Monitoring Program (FMMP) Land Use Data. The data is based upon countywide land use surveys performed in 2010. Land use categories are characterized by the following:

Urban and Build-Up Land:

- Urban and built-up 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 facilities, and water control structures

Native Vegetation and Grazing Land:

- Land on which the existing vegetation is suited to the grazing of livestock.
- Land that does not meet the criteria of any other category. Typical uses include low density rural development, heavily forested land, mined land, or government land with restrictions on use.
- Land that consists of open field areas that do not qualify for an agricultural category.

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.

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, dry land farming, confined livestock, and dairy, poultry facilities, aquaculture and grazing land.
- Unique Farmland: Lesser quality soils used for the production of the State's leading agricultural crops. Land must have been cropped at some time during the four years prior to the mapping date.
- Confined Animal Agriculture Land: This includes aquaculture, dairies, feedlots, and poultry facilities. Confined Animal Agriculture qualifies for Farmland of Local Importance in some counties.

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2.3. Industry and Economy

The dominant industry in the MUSR Regions is agriculture and it plays a significant role in the economies for each of the encompassing counties. Rice, almonds and walnuts are the major crops. In 2011, total crop production was valued at more than $657 million for Colusa County (ranked 16th in the State in terms of gross value), $635 million for Butte County (ranked 17th in the State), $611 million for Glenn County (ranked 18th), $549 million for Yolo County (ranked 21st), $547 million for Sutter County (ranked 22nd), $245 million for Tehama County (ranked 29th), and $67 million for Lake County (ranked 42nd).

Table 2-3. Leading Commodities for Gross Dollar Value of Agriculture Production by County

	Tehama			Yolo	
1	WALNUTS, ENGLISH	93,799	1	TOMATOES, PROCESSING	106,793
2	PLUMS, DRIED	29,75	2	RICE, MILLING	58,159
3	ALMONDS, ALL	23,10	3	GRAPES, WINE	48,757
4	MILK, MARKET, FLUID	14,42	4	HAY, ALFALFA	45,935
5	NURSERY PRODUCTS, MISC.	11,10	5	WALNUTS, ENGLISH	33,507
6	PASTURE, RANGE	11,08	6	VEGETABLES, UNSPECIFIED	33,051
7	CATTLE, STOCKERS, FEEDERS	9,475	7	FIELD CROPS, UNSPECIFIED	31,132
8	FRUITS & NUTS, UNSPECIFIED	5,75	8	ALMONDS, ALL	26,480
9	CATTLE, HEIFERS & STEERS,	4,32	9	CORN, GRAIN	24,625
10	CATTLE, CALVES ONLY	4,05	10	WHEAT, ALL	20,675
	Butte			**Glenn**	
1	WALNUTS, ENGLISH	218,680	1	RICE, MILLING	139,695
2	RICE, MILLING	141,515	2	ALMONDS, ALL	120,476
3	ALMONDS, ALL	129,080	3	WALNUTS, ENGLISH	102,567
4	PLUMS, DRIED	33,291	4	MILK, MARKET, FLUID	73,543
5	NURSERY PRODUCTS, MISC.	21,728	5	CATTLE & CALVES, UNSPECIFIED	34,135
6	RICE, SEED	15,340	6	CORN, GRAIN	23,306
7	FRUITS & NUTS, UNSPECIFIED	11,169	7	PLUMS, DRIED	14,989
8	CATTLE & CALVES,	8,913	8	HAY, ALFALFA	13,922
9	PEACHES, CLINGSTONE	7,975	9	APIARY PROD, POLLINATN FEES	9,327
10	FIELD CROPS, UNSPECIFIED	7,076	10	SEED, VEGETABLE & VINECROP	8,553
	Lake			**Colusa**	
1	GRAPES, WINE	39,993	1	RICE, MILLING	243,32
2	PEARS, BARTLETT	17,930	2	ALMONDS, ALL	132,6
3	WALNUTS, ENGLISH	3,105	3	SEED, VEGETABLE & VINECROP	52,60
4	CATTLE & CALVES,	1,892	4	TOMATOES, PROCESSING	37,33
5	PEARS, UNSPECIFIED	1,773	5	RICE, SEED	33,99
6	FIELD CROPS, UNSPECIFIED	960	6	WALNUTS, ENGLISH	24,53
7	NURSERY PRODUCTS, MISC.	793	7	VEGETABLES, UNSPECIFIED	17,28
8	PASTURE, RANGE	450	8	FRUITS & NUTS, UNSPECIFIED	15,6
9	VEGETABLES, UNSPECIFIED	296	9	HAY, ALFALFA	14,6
10	LIVESTOCK PRODUCTS, MISC.	113	10	CATTLE & CALVES, UNSPECIFIED	13,1
	Sutter				
1	RICE, MILLING	166,378			
2	WALNUTS, ENGLISH	144,674			
3	PLUMS, DRIED	38,220			
4	PEACHES, CLINGSTONE	33,247			
5	TOMATOES, PROCESSING	19,482			
6	NRSRY, FRT/VNE/NT, NON-	15,803			
7	ALMONDS, ALL	12,446			
8	RICE, SEED	12,367			
9	BIOMASS, ORCHARD	12,352			
10	CORN, GRAIN	9,895			

** Source: 2011 California County Agricultural Commissioners' Reports*

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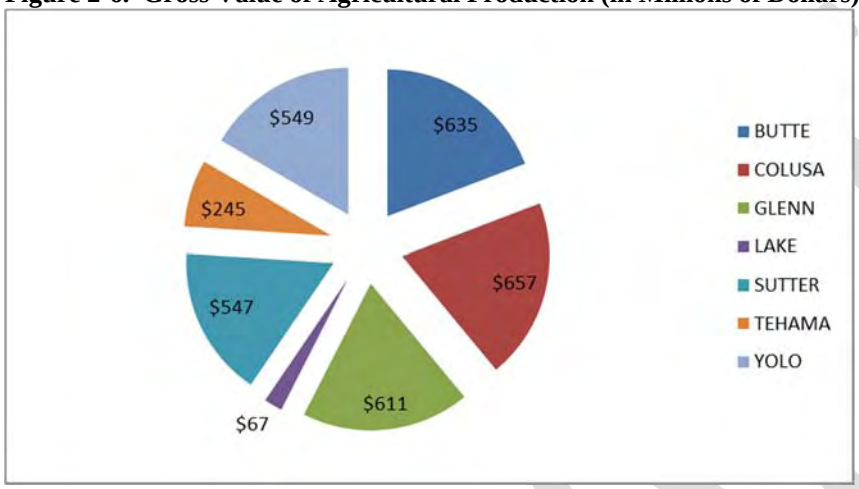
In total, the farming and agriculture industry accounts for more than $3.3 billion of the economies within the MUSR Regions. Note that this does not account for the indirect impacts from local "business-to-business" transactions necessary to support the agricultural industry (i.e., the local purchase of farm machinery, pesticides etc.), nor does it account for the induced impacts generated by the direct and indirect economic activity (i.e., when agricultural laborers or farm proprietors use earnings to purchase food, clothing, automobiles, real estate, education, and health and social services).

Figure 2-6. Gross Value of Agricultural Production (in Millions of Dollars)



Source: 2011 California County Agricultural Commissioners' Reports

In addition to the specific risks posed to the populated areas of Chico, Colusa, and the other identified small communities, a major flood event within the region has the potential to directly impact the statewide production of certain crops. For example, a very high percentage of the primary rice producing areas in the State are located in the Regions, with numerous large-scale/high-value agricultural facilities located within the floodplain. A major flood event would degrade the ability of an area to produce crops for one to two growing seasons (at minimum), and tree crops could be lost permanently with extended inundation.

Additional information regarding the Regions' economy is provided in the long-term socio-economic forecasts (completed by the California Department of Transportation Planning Division for each county), which are included in Appendix A.

2.4. Geologic Setting

The majority of the Mid-Sacramento and Upper Sacramento River Regions are located within the great Central Valley of California. This remarkable alluvial valley is about 430 miles long and about 75 miles wide, stretching from Redding to Bakersfield; the northern portion of the valley is known as the Sacramento Valley. The valley originated as a deep structural trough created by the subduction of the ancient Farallon oceanic plate starting in the Mesozoic Era, about 200 million years ago, and ending in the Cenozoic Era, approximately 25 million years ago. The structural trough remained below sea level and filled with oceanic sediments up to

40,000 feet thick, which formed rocks that are now known as the Great Valley Sequence. This subduction also resulted in the accretion and uplift of the Coast Ranges that now bound the great valley to the west and produced the volcanic range that resulted in the Sierra Nevada Mountains to the east. In the late Miocene, approximately 5 million years ago, as sedimentation continued, the sea withdrew and the great terrestrial Sacramento Valley began to emerge, filling with sediment from the rivers and streams from its bounding mountain ranges. Eroded sediment carried by powerful river systems filled the valley, with accelerated periods of sedimentation during glacial periods. In some places sediment accumulated up to 10,000 feet thick.

The Sutter Buttes, located about eight miles northwest of Marysville, is sometimes referred to as the world's smallest mountain range and is an anomaly in the generally flat alluvial valley floor with peaks rising to an elevation of 2,100 feet. The Sutter Buttes are a series of volcanic domes that formed about 1.6 million years ago and are considered the southernmost expression of the Cascade Range volcanism.

Recent geologic processes in the Sacramento valley prior to flood control structures included regular cyclic flooding of rivers and creeks in the rainy season. Typically occurring annually, these flood events could inundate portions of the valley for months and would deposit sediment creating the fertile soil that is now some of the richest agricultural land in the world. As the sediment load spilled from the rivers, heavier gravel and sand settled out close to the channel with finer silt and clay settling out further into the flood plain.

Hydraulic mining has also contributed to the valley sediment influx. In 1853, hydraulic mining began in California utilizing high pressure water jets to wash ancient river gravels from the highlands of the Sierra Nevada. This sediment was processed for gold and then washed down the streams and rivers of the Sierra's western slope into the Sacramento Valley. The vast quantities of sediment overwhelmed the streams and rivers leading to aggradation of the channels until the Sawyer decision of 1884 prohibited the in-stream disposal of hydraulic mining tailings.

Areas along the Sacramento River in the Mid-Sacramento Region are generally mapped as young Holocene alluvium that consist of unweathered gravel, sand, and silt deposited by the river (Helley and Harwood, 1985). Present in some locations is the older, lower member of the Modesto Formation described as slightly weathered gravel, sand, silt, and clay. In areas further from the Sacramento River, such as the Sutter Bypass and Colusa Drain, Holocene Basin Deposits dominate and are described as dark grey to black fine-grained silt and clay.

The Upper Sacramento River Region includes areas that are located in the eastern margins of the Sacramento Valley including the Chico area. These areas are dominated by older Quaternary alluvial fan formations such as the Upper Modesto, described as unweathered gravel, sand, silt and clay, and the Riverbank Formation described as weathered reddish gravel, sand, and silt.

The Mid Sacramento River region also includes an area just north of Clear Lake, near the City of Upper Lake, west of the Sacramento Valley in the Coast Ranges. The study area is a relatively small flood plain of Middle Creek that drains watersheds of the surrounding Coast Range highlands to Clear Lake. Clear Lake is at least 480,000 years old, one of the oldest lakes in North America. Due to various changes in the Clear Lake basin throughout its geologic history, the lake level has fluctuated and was once much higher. The majority of the Middle Creek flood

plain is mapped as Quaternary Lake deposits described as thick unconsolidated silt deposited by the ancestral Clear Lake (McNitt, 1968).

2.5. Natural Resources

The rich, productive soils represent one of the most lucrative natural resources within the Regions. As note previously, the encompassing counties rely heavily on agriculture and related services, which bring in an estimated $3.3 billion annually.

The numerous rivers, streams, creeks, sloughs and channels are also a vital resource for the Regions. The Sacramento River is the main water supply for much of California's urban and agricultural areas. Annual runoff averages about 22.4 million acre-feet (MAF), which is nearly one-third of the State's total natural runoff. Major water supplies in the Regions are provided through surface storage reservoirs, with the largest being USBR's Shasta Lake (~4.5 MAF). The water runoff also plays an important role for dedicated natural flows, which support various environmental requirements, including in-stream fishery flows and flushing flows in the Delta.

The Regions also have significant natural resources such as: aquatic habitats, wetlands, riparian habitats, and wildlife foraging areas. Many of the habitat resources are located within wildlife refuge areas within the Regions, and a diversity of habitat resources are also located outside of the wildlife refuge area boundaries. Agricultural areas and private lands also provide valuable habitat. For example, rice fields provide habitat for wintering waterfowl and Giant Garter Snake, and alfalfa fields provide foraging habitat for Swainson's Hawk.

Riparian vegetation is a habitat characterized by trees, other vegetation, and physical features normally found on the stream banks and flood plains associated with streams, lakes, or other bodies of water. Riparian systems provide several important functions to both the aquatic and terrestrial ecosystems associated with them, and they support a great diversity of wildlife including sensitive invertebrates, amphibians, reptiles, birds, and mammals.

Within the Upper Sacramento Region, riparian vegetation is associated with the following waterways: Elder Creek, Deer Creek, Mud Creek, Sycamore Creek, and Butte Creek. The Mid-Sacramento River Region has areas of riparian, wetland, annual and perennial grassland, forbs, and evergreen and deciduous woodland.

Table 2-4 and Figure 2-7 shows an overview of the managed wildlife lands within the Regions.

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Table 2-4. Summary of Managed Environmental Lands for the Regions

Managed Land Type	Acres
Upper Sacramento River Region	
U.S. Fish and Wildlife Service Lands	2,470
Department of Fish and Wildlife Lands	9,790
Private Lands	18,650
Upper Sacramento Total	**30,910**
Mid Sacramento River Region	
U.S. Fish and Wildlife Service Lands	12,650
Department of Fish and Wildlife Lands	5,400
Private Lands	35,650
Mid Sacramento Total	**53,700**

The managed lands within the Upper Sacramento River Region include:

Butte Creek Canyon Ecological Reserve

Butte Creek Canyon Ecological Reserve is located east of the Upper Sacramento River Region Boundary, along Butte Creek. The reserve supports various riparian community types, including Great Valley Oak and Great Valley Cottonwood Riparian Forests. In addition, special-status species including western pond turtle and red-legged frog are found at the reserve.

Merrill's Landing Wildlife Area

Merrill's Landing Wildlife Area, managed by the California Department of Fish and Wildlife, is located along the Sacramento River, outside the Upper Sacramento River Region Boundary. Merrill's Landing Wildlife Area is 296 acres of high terrace riparian habitat, contains a large river island, and supports a heron rookery as well as a diversity of bird and mammal species.

The Nature Conservancy Land

The Nature Conservancy manages conservation easements throughout California. There are several conservation easements occurring intermittently along the Sacramento River, with the intent of protecting and pre- serving riparian habitat. In addition, portions of Nature Conservancy lands occur within the Upper Sacramento River Region Boundary, north of the town of Chico, and are associated with Deer Creek.

Sacramento River Wildlife Area

The Sacramento River Wildlife Area is composed of approximately 3,770 acres of riparian habitat located along a seventy-mile reach of the Sacramento River. The Sacramento River Wildlife Area is managed by the California Department of Fish and Wildlife and occurs outside of the Upper Sacramento River Region Boundary.

Sacramento River National Wildlife Refuge

The Sacramento River National Wildlife Refuge, managed by US Fish and Wildlife Service, is composed of 27 units (properties) along a 77-mile stretch of the Sacramento River between Red Bluff and Princeton. The units occur outside of the Upper Sacramento River Region Boundary.

Refuge lands comprise 10,146 acres of riparian habitat, wetlands, uplands, and intensively managed walnut, almond, and prune orchards.

Stone Ridge Ecological Reserve

Stone Ridge Ecological Reserve is located in east of the Upper Sacramento River Region Boundary, and is managed by The California Department of Fish and Wildlife. The reserve consists of 754 acres, is proposed for designation as an ecological reserve for the protection of blue oak woodland, vernal pools and swales, clay flats, ephemeral and intermittent creeks, and associated uplands for mountain lion, black bear, western spadefoot, burrowing owl, ferruginous hawk, bald eagle, black-shouldered kite, the rare Adobe lily, the rare Butte County checkerbloom, Ahart's paronychia, and the federally endangered Butte County meadowfoam.

Upper Butte Basin Wildlife Area

The Upper Butte Basin Wildlife Area, managed by The Department of Fish and Game, is located in Butte and Glenn Counties and comprises three units: Little Dry Creek, Howard Slough and Llano Seco for a total of 9,375 acres. The northern most portion of the Howard Creek Unit is located within the Upper Sacramento River Region Boundary, along Butte Creek. Numerous bird, mammal, reptile, amphibian, and fish species are found seasonally or year round at all three units of Upper Butte Basin Wildlife Area.

Managed environmental lands within the Mid-Sacramento Region include:

Clear Lake Wildlife Area

Accessible only by boat, this area is one of the most significant bioregions of Lake County, comprises a combination of oak covered hills, dense tule marsh, and an extensive riparian habitat system. This habitat mix provides for a wide diversity of aquatic and terrestrial species of wildlife including herons, red-tailed hawks, osprey, songbirds, waterfowl, deer, gray fox, bobcat, and coyote.

Collins Eddy Wildlife Area

The Collins Eddy Wildlife area has many different types of animal and plant species. The vegetation communities that exist in this area include riparian forest, woodland, scrub willow and oak woodlands. There are over 100 different species of birds, which include red-tailed hawks, Bullock's oriole, horned lock, western kingbird, and many more. The mammals in the area are the American beaver, black-tailed deer, gray fox, and northern river otter.

Colusa Bypass Wildlife Area

Managed by the California Department of Fish and Wildlife (CDFW), this 1,248 acre wildlife area is mostly grasslands. Several rows of willows and cottonwood trees line the eastern edge of the property. Excess water is diverted into the area from the Sacramento River during high flows in the winter. The area provides a significant amount of cover for mammals and both resident and migratory birds. The Colusa Bypass Wildlife area is just outside the eastern border of the region.

Colusa National Wildlife Refuge

The 4,507-acre refuge primarily consists of intensively managed wetland impoundments, with some grassland and riparian habitat. Wetland impoundments are intensively managed to provide

optimal habitat for the dense concentration of wintering waterfowl, as well as habitat for resident wildlife and spring/summer migrants. The grassland habitat supports several populations of endangered and sensitive species of plants. The refuge is a stronghold for populations of the endangered palmate-bracted bird's-beak and the threatened giant garter snake. About 35,000 visitors come to the refuge each year for wildlife viewing and 4,000 come to hunt waterfowl and pheasant.

Delevan National Wildlife Refuge

The Delevan National Wildlife Refuge is a 5,797-acre refuge approximately 80 miles north of Sacramento and consists of over 4,500 acres of intensively managed wetlands and 1,200 acres of uplands. The refuge supports several endangered plants and animals: giant garter snake, wintering peregrine falcon and bald eagle, breeding tricolored blackbird, and a large colony of the endangered palmate-bracted bird's beak. Resident wildlife include grebe, heron, blackbird, beaver, muskrat, black tailed deer, and other species typical of upland and wetland habitats.

Fremont Weir Wildlife Area

The Fremont Weir Wildlife Area, managed by the California Department of Fish and Wildlife, is located east of the Mid-Sacramento River Region boundary in the southern extent of the region. It consists of 1,461 acres of tall weedy vegetation, brush, valley oaks, willows, and cottonwood trees.

Sacramento National Wildlife Refuge

The Sacramento National Wildlife Refuge includes 10,819 acres of seasonal marsh, permanent ponds, and uplands. The refuge is located west of the region at the northern extent.

Sacramento River Wildlife Area

The Sacramento River Wildlife Area is 4,014 acres of riparian forest dominated by cottonwood, willow, ash, sycamore, box elder trees with dense understory of wild grape, pipevine, poison oak, and grasslands, oxbow lakes, and gravel bars. The wildlife area is managed by CDFW for recreation such as fishing, bird watching, nature study, and trapping. Among the diversity of species that can be seen along the river are otters, beavers, gray fox, bobcat, western pond turtles, ash-throated flycatchers, great blue herons, egrets, and a variety of birds of prey.

Sutter Bypass Wildlife Area

The Sutter Bypass Wildlife Area is managed by California Department of Fish and Wildlife for fishing, hunting, and wildlife viewing. It consists of the Tisdale Bypass and two long, narrow parcels on either side of the Sutter Bypass, for a total of 3,204 acres. The wildlife area is located just east of the region at the southern extent.

Sutter National Wildlife Refuge

The Sutter National Wildlife Refuge is about 2,600 acres consisting primarily of wetland impoundments with some riparian and grassland habitats. The refuge typically supports 175,000 ducks and 50,000 geese. The refuge is located within the Sutter Bypass east of the region.

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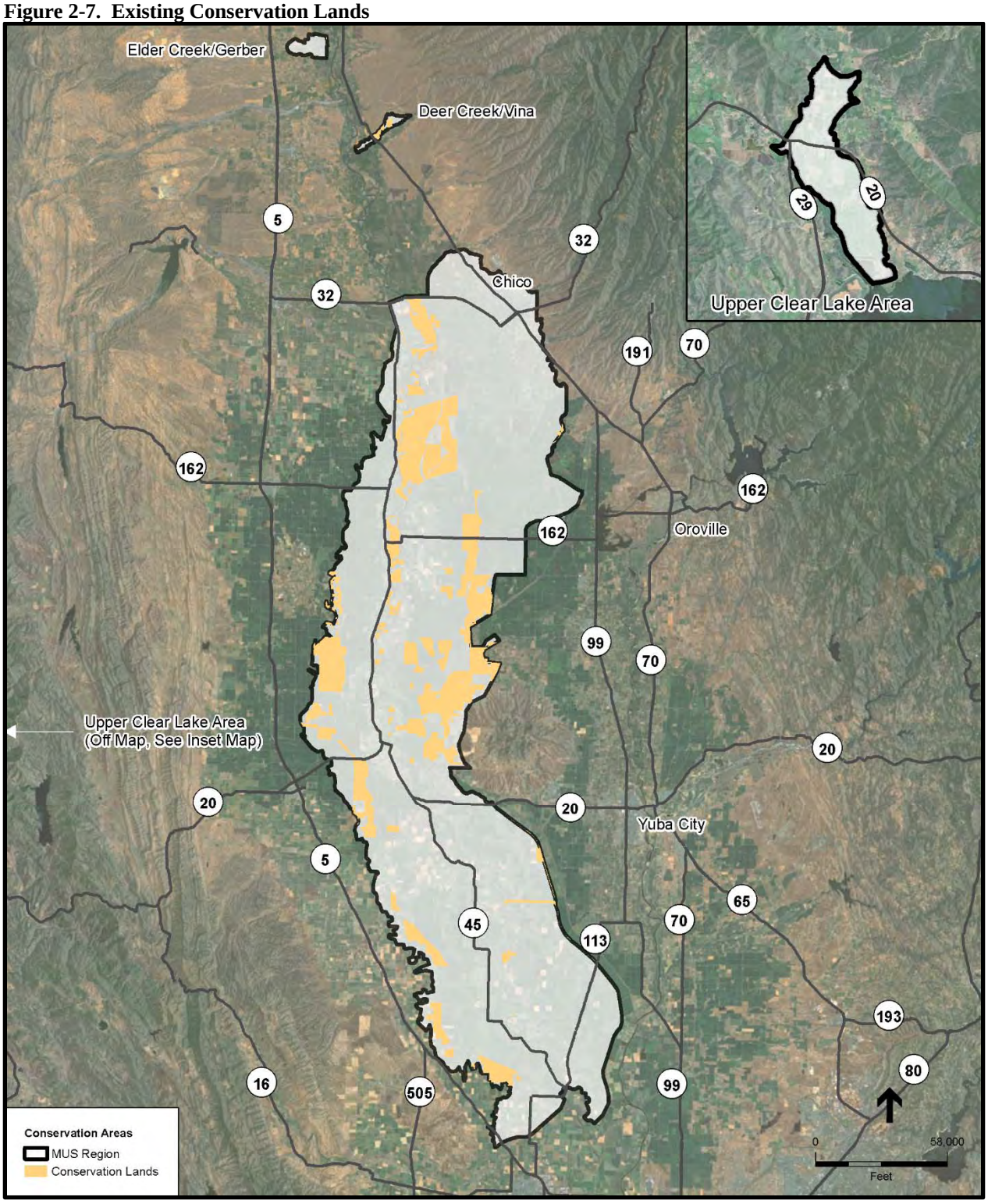
Figure 2-7. Existing Conservation Lands



** Source: National Conservation Easement Database, 2013*

2.6. Climate

The region is dominated by a Mediterranean climate with dry summers and rain during the winter months. Historically, the region has experienced extreme runoff that inundated large areas of the valley floor, resulting in standing water and sediment deposition on the floodplain. This has produced a unique and productive agricultural landscape.

The northernmost area of the Sacramento River Hydrologic Region (SRHR) is mainly high desert plateau, characterized by cold, snowy winters with only moderate rainfall, and hot, dry summers. The mountainous parts in the north and east typically have cold, wet winters with large amounts of snow that provide runoff for summer water supplies. The Sacramento Valley floor has mild winters with less precipitation and hot, dry summers. Overall annual precipitation in the region generally increases from south to north and west to east. The snow and rain that fall in the SRHR contribute to the overall water supply for 60 percent of the State (CA Flood Future).

2.7. Flood Context and History of Flooding

Several flood threats exist within the area covered by the Mid and Upper Sacramento River Regions. In general, the threats can be broken down into the following main categories (note that this is only a generalization of the overall flood threats within the Planning Area boundary):

1) Sacramento River
2) Colusa Basin Drain
3) Big Chico, Little Chico, Mud, and Butte Creeks
4) Middle Creek
5) Cherokee Canal.

<u>Sacramento River – Tehama, Glenn, Colusa, Sutter, and Yolo Counties</u>
The primary regional flood threat comes from the Sacramento River and the channels, bypasses, and weirs making up the Sacramento River Flood Control Project. The Sacramento River is the largest river in California and its watershed encompasses 27,500 square miles. The Sacramento River has been shown to be ten times as volatile as the Mississippi River and flows in the system have reached Project design criteria in the past. Since individual components of the Project carry flows as high as 380,000 cfs (e.g., Sutter Bypass) by design, a breach in the system can be catastrophic in its impacts.

In recent times, major floods have occurred on the Sacramento River in 1982-83, 1986, 1995, and 1997. During the 1997 flood, a breach in the Sutter Bypass flooded thousands of acres of productive farmland, threatened the town of Meridian, and closed Highway 20. This event, coupled with flooding in the Colusa Basin, which closed west side roads, was instrumental in the subsequent virtual physical isolation of the City of Colusa. This experience, which can be duplicated again in various forms, fully demonstrated the interdependence of the Regions for life safety.

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Below Red Bluff, the gradient of the Sacramento River flattens, requiring levees to contain flood waters within the designated floodways. Moving from north to south, the first area of concern is levees along the Sacramento River tributaries of Elder and Deer Creek in Tehama County. South of this potential flood threat is the "J" levee on the west side of the river protecting Hamilton City. County officials are concerned with the integrity of this levee and efforts are being made to re-organize a reclamation district originally created to maintain it. The Corps of Engineers is also being approached to help address needed improvements to this section of levee. Public safety concerns with this stretch of levee will remain well into the future.

A breach in the Hamilton City area could impact 2,500 residents and substantial farmland. Flood waters could also potentially impact Levee Districts 1 and 2 downstream. At a minimum, flood waters from a breach in this northerly area would eventually make their way into the Colusa Basin Drain, aggravating the flood threat from that waterway.

Moving south, one finds on the east bank of the river at the north end of the Butte Basin Overflow Area (BBOA) two structures that allow the Sacramento River, when the gage at the Ord Ferry Bridge is at 114 feet or higher, to overflow and inundate the BBOA. Those two locations are referred to respectively by locals as the "Murphy Plug" and the "3B's". During high flow events the 3B's overflow area erodes, thus lowering the effective weir height of the structure. The lowering of the structure height in turn increases flood flows and the frequency of nuisance flooding in the upper end of the BBOA. These increasing flood impacts not only inundate the agricultural lands in this area longer than normal but also reduce the holding capacity of the BBOA when it is needed for major flood events. These longer than normal flow events also increase the time that major state and local roads in the area are inundated thus prohibiting their use by emergency response personnel. In addition to the 3B's weir there is a serious bank erosion problem at R.M. 192.4 (Phelan Levee) on the east bank in the same vicinity. If the Phelan Levee is compromised additional and uncontrolled flood waters will enter the BBOA. The Phelan Levee and the 3B's weir are private structures.

Moving further downstream one comes to Levee Districts 1 and 2 (Glenn County) on the west side of the river and Levee District 3 (Glenn County) on the east side. Ongoing erosion of river banks in proximity to the toes of district levees, particularly at sharp bends in the river near Princeton, has created public safety concerns among local officials responsible for this stretch of the river. A breach on the west levee with water elevations at previously reached high water marks could potentially inundate a highly productive almond and walnut growing area and the town of Princeton and areas to the south in Colusa County. A breach on the east side of the River could inundate the Town of Butte City and cause higher flows into the Butte Sink and subsequently into the Sutter Bypass.

From Princeton to Colusa, the Department of Water Resources maintains the flood control levees on both sides of the River. Maintenance Area 1 on the west side is an important levee stretch since a breach in that area could either flood the City of Colusa directly (if close enough to the city) or greatly increase flows into the Colusa Basin causing flood water to back up into the city (see discussion on Colusa Basin below). A breach on the east side of the River in this area would, again, greatly increase flows into the Sutter Bypass creating the possibility of exceeding its design capacity and thereby greatly increasing the threat to areas along either side of the Bypass.

Starting in Colusa, the Sacramento River West Side Levee District maintains the levee on the west side of the Sacramento River and RD108 and DWR maintain levees on the east side of the Colusa Basin Drain, which runs parallel to the River to the west. Breaches in this location would inundate a major rice growing area containing several large-scale rice drying and storage facilities that hold several hundred millions pounds of rice and potentially the City of Colusa and Town of Grimes. Failures in these levees could also further complicate flood flows in the vicinity of Knights Landing, thereby increasing the danger to urban areas and areas downstream.

Reclamation Districts 70, 1660, and 1500 and the Department of Water Resources Sutter Yard maintain the levees on the east side of the Sacramento River, the west side of the Sutter Bypass, and the Tisdale Bypass. Failures in these levees would inundate thousands of acres of productive farmland, potentially close Highway 20 and/or 113, and rapidly flood the towns of Robbins and/or Meridian.

Colusa Basin Drain – Glenn, Colusa and Yolo Counties

The Colusa Basin Drain serves to carry flow from Coast Range streams on the west side of the region to the Sacramento River Knights Landing Ridge Cut where flood waters are then channeled to the Yolo Bypass. Flow within the Basin Drain in high water events necessitates the presence of levees on its east side to prevent flooding of RD787, RD108, and the City of Colusa.

A gap exists in the east side levee system of the Colusa Basin/Drain in the vicinity of Highway 20 between Colusa and Williams. In the past, floodwaters in the Colusa Basin Drain have backed up toward the City of Colusa through this gap threatening structures and property and closing the highway. Flood waters in the Colusa Basin, even without a breach upstream on the Sacramento River, can close the few other roads leading from the west into the City of Colusa, the town of Grimes and rural areas along the Sacramento River. This has often occurred even when the system is operating as designed. A breach in the west bank of the Sacramento River would greatly exacerbate this flood threat from the Basin Drain with potentially significant impacts to the City of Colusa and areas to the south.

Big Chico, Little Chico, Mud Creek, and Butte Creek – City of Chico and Butte County

Big Chico Creek originates in the foothills and flows through the City of Chico. A diversion structure on the east side of the city controls flows through the city and diverts flood flows to the north into Lindo Channel and Mud Creek. Failure of these structures could flood portions of the City of Chico. Floodwaters from Little Chico Creek to the south are also diverted away from the City of Chico into Butte Creek by a diversion structure. While these streams rise rapidly and generally flow high for a limited duration, a prolonged storm event could potentially create an extended flow situation, which would greatly increase the flood threat on this system.

Butte Creek is a major leveed stream that runs south of the City of Chico in a northeast to southwest direction until it empties into the Butte Sink on the west side of the Sutter Buttes. The Butte Creek watershed is much larger than the Big Chico and Little Chico stream systems with subsequently larger flood flows of longer duration. The upper stretch of Butte Creek is of greatest concern because of the presence of populated areas, including the Town of Durham. Flows in this reach also have the tendency to back up due to vegetation and debris collection at railroad bridges.

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In addition to these leveed waterways flooding is also a concern in the Rock Creek /Keefer Slough system in the North Chico area. There are no formal flood control structures along this system and all of the system is on private property. However, flooding events that have occurred here have closed State, county and private roads in the area. High flows have also closed Highway 99 where Keefer slough crosses the highway. Once the flows cross Highway 99 they flood the small community of Nord and the roads leading to Nord to the northwest of Chico.

Middle Creek – Small Community of Upper Lake and Lake County

The Middle Creek watershed is located to the North of Clear Lake and contains the town of Upper Lake. The streams in the area include: Middle Creek, Scotts Creek, Alley Creek, and Clover Creek. The USACE project levees were originally constructed in 1959 – 1966. Levees were built along Middle Creek and portions of Scotts Creek, Alley Creek, and Clover Creek. In addition to the levees, a diversion channel carries the flood water from Clover and Alley Creek around the town of Upper Lake and discharges it into Middle Creek. Past flooding has occurred in Upper Lake due to interior drainage issues (the drainage canal cannot empty when high water stages are observed in Middle Creek); the flooding inundates stores and closes Highway 20.

Recent historical flooding has occurred in 1995, 1997, 1998 and 2005. In 1995, overtopping occurred along the Scott Creek northern levee, upstream of Highway 29. This flooding resulted in water quality issues (flooding of a junkyard and machinery), damages to structures and closure of Highway 29. The levee was repaired in 1995 under PL 84-99. In 2005, overtopping again occurred along Middle Creek, flooding orchards, and the levee was repaired again under PL 84-99 in 2007.

Cherokee Canal – Small Community of Richvale and Butte County

Cherokee Canal is a channelized portion of Dry Creek that flows southwesterly from central Butte County to the Butte Sink. Other tributaries of Dry Creek and Cherokee Canal include Clear Creek, Gold Run Creek, and Cottonwood Creek. Cherokee Canal is mainly used for irrigation, drainage, and flood protection for agricultural lands, buildings, and homes. Cherokee Canal forms the majority of the northern boundary of the Sutter Basin area and is at the center of highly productive rice cultivation.

Cherokee Canal is a component of the SPFC that diverts excess floodwater originating in the foothills northeast of the Thermalito Afterbay, including the site of the Cherokee hydraulic mine, which continues to release sediments during high flow periods. The facilities consist of levees along Cherokee Canal, the lower reaches of Cottonwood Creek and Gold Run Creek, and irrigation and drainage structures from Butte Basin to high ground. The facilities reduce flood risk to adjacent communities, agricultural lands, area transportation facilities, and irrigation canals. The facilities are maintained by DWR Maintenance Area 13.

Major floods have occurred along Cherokee Canal in 1964, 1986, and 1997, with numerous reports of water at the levee crown. In 1986, the Cottonwood Creek levees broke at its confluence with Cherokee Canal. The right bank breach was approximately 20 feet to 30 feet wide and the breach caused ponding in the area northeast of the Cottonwood/Cherokee confluence. The left bank also failed in 1986 into the Richvale-Butte Canal. The canal contained the breach and flooding did not occur southward. Following the 1986 event, another

breach occurred along the left bank of Cherokee Canal just upstream of Nelson Shippee Road Bridge.

A summarized list of historical flooding within the Regions and surrounding areas is presented in Table 2 7. For the purpose of providing statewide context, some flooding events in areas within the Central Valley, but outside the Planning Area, are included in the table.

Table 2-5. Summary of Select Flood Events for the Regions

Date	Flood Type	Description	Impacted Counties within the Planning Area
1805	Slow Rise	Flood reportedly inundated "the entire valley floor."	Butte, Colusa, Glenn, Sutter, Tehama, Yolo
December 1861- January 1862	Slow Rise	The "Great Flood" produced valley-wide damages along the Sacramento River basin, as early-day levees failed.	Sutter, Tehama
December 1937-March 1938	Slow Rise	Many places in the valley suffered damage, including Chester, Downieville, Gerber, Tehama, and agricultural areas in Tehama, Glenn, and Colusa counties	Butte, Colusa, Glenn, Lake, Sutter, Tehama, Yolo
January-February 1942	Slow Rise, Structure Failure	A Sutter County levee failed in the floods of January-February 1942, inundating developed lands.	All Counties
November 1950-January 1951	Slow Rise, Structure Failure	A Yuba River levee breach flooded 43,000 acres of suburban and developed lands south of Marysville, damaging homes in Olivehurst and closing U.S. Highway 99 East. The American River flooded farms east of Sacramento and closed the Western Pacific Railroad.	Sutter
December 1955 "1955 Christmas Flood"	Slow Rise, Structure Failure	The flood was characterized by extremely high flows, including record flows at some locations. Most damage was along unregulated streams, which then included the Feather River. A levee failed on the west side of the Feather River, inundating Yuba City and vicinity and causing major damages. Portions of other towns and agricultural lands were also flooded; 38 persons died; total damages were estimated by USACE at $63 million.	Butte, Colusa, Glenn, Lake, Sutter, Tehama, Yolo
February 1958	Slow Rise, Structure Failure	The Sacramento River flooded areas and caused bank erosion from Keswick to Butte City. Clear Lake rose, and its tributaries flooded, causing more than $1 million damage. Cache Creek overflowed and damaged property in locations from Rumsey to Yolo. Community damage, area flooding. Levees breached in an area east of McCormack-Williamson Tract and west of Galt, flooding about 5,800 acres. Dead Horse Island flooded in the Delta, a total of 1,865 acres. Precipitation from a warm, moist air mass caused widespread flooding within the region in 1958.	Colusa, Glenn, Lake, Sutter, Yolo

Date	Flood Type	Description	Impacted Counties within the Planning Area
October 1962	Slow Rise, Coastal, Stormwater, Structure Failure	Local flooding caused crop inundation, substantial property damage, and 20 lives were lost. The Southern Pacific Railroad and State Highways 40A, 99W, and 99E were closed. Severe crop damage occurred near Chico. The North Fork Pit River flooded Alturas. Ash Creek and Dry Creek rose and flooded Adin, damaging infrastructure. The North Fork Feather River flooded Tobin and two trailer courts. Cattle drowned in the Feather River near Oroville. A levee breached on Yankee Slough near Wheatland and flooded walnut orchards. In the Delta, Prospect Island, Liberty Island, and Little Holland Tract flooded a total of about 7,300 acres.	Butte, Sutter, Yolo
January-February 1963	Slow Rise, Structure Failure	Numerous communities were flooded and damaged in the American and Yuba River basins. In the Delta, Prospect Island, Liberty Island, and Little Holland Tract flooded a total of about 7,300 acres.	Colusa, Glenn, Lake, Sutter, Tehama, Yolo
December 1964-January 1965	Slow Rise, Coastal, Structure Failure	Severe flooding occurred in the mountain communities of Chester, Downieville, and Coloma. Mountain highways, roads, bridges, public recreation areas, and cabins were extensively damaged. USACE estimated 383,500 acres in the region were flooded by stream overflow. The Southern Pacific Railroad suspended service over the Sierra Nevada due to flood damage. Highway damage closed Interstate 5 at the Oregon border and north of Redding. Daguerre Point Dam, a debris dam on the Yuba River, underwent a partial failure. Hell Hole Dam, under construction on the American River, collapsed. In the Delta, Prospect Island, Liberty Island, Little Holland Tract, Egbert Tract, and McCormack-Williamson Tract flooded, for a total of about 14,100 acres. USACE estimated $39 million flood damages in the Sacramento River basin.	Butte, Colusa, Glenn, Lake, Sutter, Tehama, Yolo
December 1966-March 1967	Slow Rise	About 219,000 acres were inundated, nearly all of which were on the valley floor and used for agriculture. Developed properties were inundated by streams of the Fairfield Streams Group. USACE estimated about $2,700,000 in flood damages.	Butte, Colusa, Glenn, Lake, Sutter, Tehama, Yolo
December 1969-March 1970	Slow Rise,	About 550,000 acres were flooded in the region, of which 82 percent was valley floor area and 50 percent was in dedicated floodways and natural overflow basins. The Pit River washed out bridges, flooded roads, and isolated Big Bend. The Sacramento River flooded parts of Anderson, Redding, Red Bluff, Hamilton City, and Tehama. Burney Creek overflowed and inundated Burney. Clear Lake rose and inundated shoreline property, particularly in Lakeport. High flows on Putah Creek above Lake Berryessa flooded resort areas and local roads in the region. USACE estimated more than $28 million in flood damage. A trailer park in the American River floodplain was flooded. Characterized by extremely large flows, including record flows at some locations. The Sacramento River Flood Control Project and other flood management programs had been implemented, and project levees, dams, reservoirs, and waterways were employed to control much of the flood flows through the Sacramento system. However, local flooding, mostly on agricultural lands, still occurred.	Butte, Colusa, Glenn, Tehama, Yolo

Date	Flood Type	Description	Impacted Counties within the Planning Area
January-April 1974	Stormwater, Structure Failure	From Mount Shasta City to Lakehead, the Sacramento River and tributaries caused extensive damage to infrastructure, homes, and a railroad. Residences were inundated due to failed levees, many roads were washed out by high flows and large sediment loads were deposited on agricultural lands. Characterized by extremely large flows, including record flows at some locations. The Sacramento River Flood Control Project and other flood management programs had been implemented, and project levees, dams, reservoirs, and waterways were employed to control much of the flood flows through the Sacramento system. However, local flooding, mostly on agricultural lands, still occurred.	Butte, Colusa, Glenn, Lake, Tehama, Yolo
December 1979 1980 March	Coastal, Structure Failure	A combination of high tides and flood-level flows caused breaches and rapid deterioration of private levees. Clear Lake rose to flood stage and damaged low-lying lakeshore development. In the Delta, approximately 1,400 acres of agricultural land were inundated when the levees of Prospect and Dead Horse Islands breached.	Colusa, Lake
1982-1983 Winter Storm	Slow Rise, Flash, Debris Flow, Coastal, Stormwater	Major flooding along Cache Creek inundated the Capay Valley. Flood waters overtopped Hamilton City levees, flooding farmland, and closed nearly every road in Colusa County. Stream overflows caused major flooding and road closures throughout Glenn County, damaged stores and homes at Oroville, and flooded homes and businesses along State Highway 20 at Colusa. A mudslide killed an equipment operator and crushed a bus in Shasta County. Prospect Island levees failed in the Delta, flooding 1,228 acres. During February, high outflow of Lake Berryessa damaged roads and parks. Stormwater inundated 80,000 acres of farmland in Butte County and businesses in the north part of Sacramento, and overflowed drains in Rocklin and Loomis, flooding streets and closing four major roads.	Butte, Colusa, Glenn, Lake, Sutter, Tehama, Yolo
February 1986 "St. Valentine's Day	Slow Rise, Stormwater	The floods caused extensive damage to the flood management system of the Sacramento Valley and led to a substantial reassessment and repairs to flood management infrastructure. Record high tides and record Sacramento River inflow both occurred. The Yuba River levee at Linda failed, spreading floodwaters over 30 square miles, inundating Linda and Olivehurst, and causing an estimated $50 million in damage. Local stormwater flooding was widespread north and east of Sacramento because of high flows in American River tributaries. Stormwater flooded streets in Dixon, Vacaville, and Rio Vista. Levees protecting Tyler and Dead Horse Islands and McCormack- Williamson Tract failed, inundating 11,802 acres in the Delta.	Butte, Colusa, Glenn, Lake, Sutter, Tehama, Yolo

Date	Flood Type	Description	Impacted Counties within the Planning Area
Winter and Spring 1995	Slow Rise, Structure Failure	Widespread stormwater and small stream flood damage was common. Numerous roadways and bridges washed out at Red Bluff. State Highway 32 was inundated between Chico and Hamilton City. Interstate 5 and State Highway 99 were also closed. Dry Creek overflows caused extensive damage in Roseville and suburban Sacramento. Orchards flooded at Hamilton City. Several local levees breached on Pine Creek and flooded the area south of Nord. A local levee breach near Wilson Landing received a repair using 43,000 sandbags. Cache Creek rose and stranded homeowners at Yolo.	Butte, Colusa, Glenn, Lake, Sutter, Tehama, Yolo
December 1996- January 1997	Slow Rise, Structure Failure	Storms caused one of the worst floods of the century. There was widespread flooding and flood damage in the region from the major rivers and creeks in the Sierra Nevada. Sacramento River exceeded flood stage at Tehama Bridge, flooding Tehama, local roads, three mobile home parks, and orchards and fields in the area, leaving deep deposits of debris. In the Delta, McCormack-Williamson Tract and Dead Horse Island levees failed again, flooding 1,865 acres. The flooding caused five deaths in the region and damaged more than 587 homes. Widespread levee failures and damages that exceeded $301 million from this event highlighted the need for a concentrated effort to rehabilitate the flood management system.	All Counties
December 2005– January 2006	Flash, Slow Rise	Levee overtopping, breaching, and river flooding, Sacramento weir was opened (1st time since 1997). Closed Interstate 5 near the Oregon border, damaged outdoor recreational facilities in Klamath National Forest and cut off power to many towns, including Trinidad and Blue Lake. Severe storms, flooding, mudslides, and landslides.	Glenn, Lake

2.8. The Regional Flood Management System

The Mid and Upper Sacramento Regions lie within the Sacramento River Watershed, the State's largest watershed. At the core of this watershed is the Sacramento River, which collects water from over 27,000 square miles and discharges through the Sacramento-San Joaquin Delta into the San Francisco Bay. California's climate patterns produce distinct wet and dry seasons that result in high volumes of water coming in short periods of time. The Sacramento River and its tributaries experience short-lived but periodic peak flows that can strain or overwhelm their natural flow channels. The State, along with local and federal stakeholders, have constructed

and implemented a vast and complex system to manage and provide flood control for both urban and non-urban areas in the Mid and Upper Sacramento River Regions.

Figure 2-8. Upper Sacramento River Region SPFC Facilities

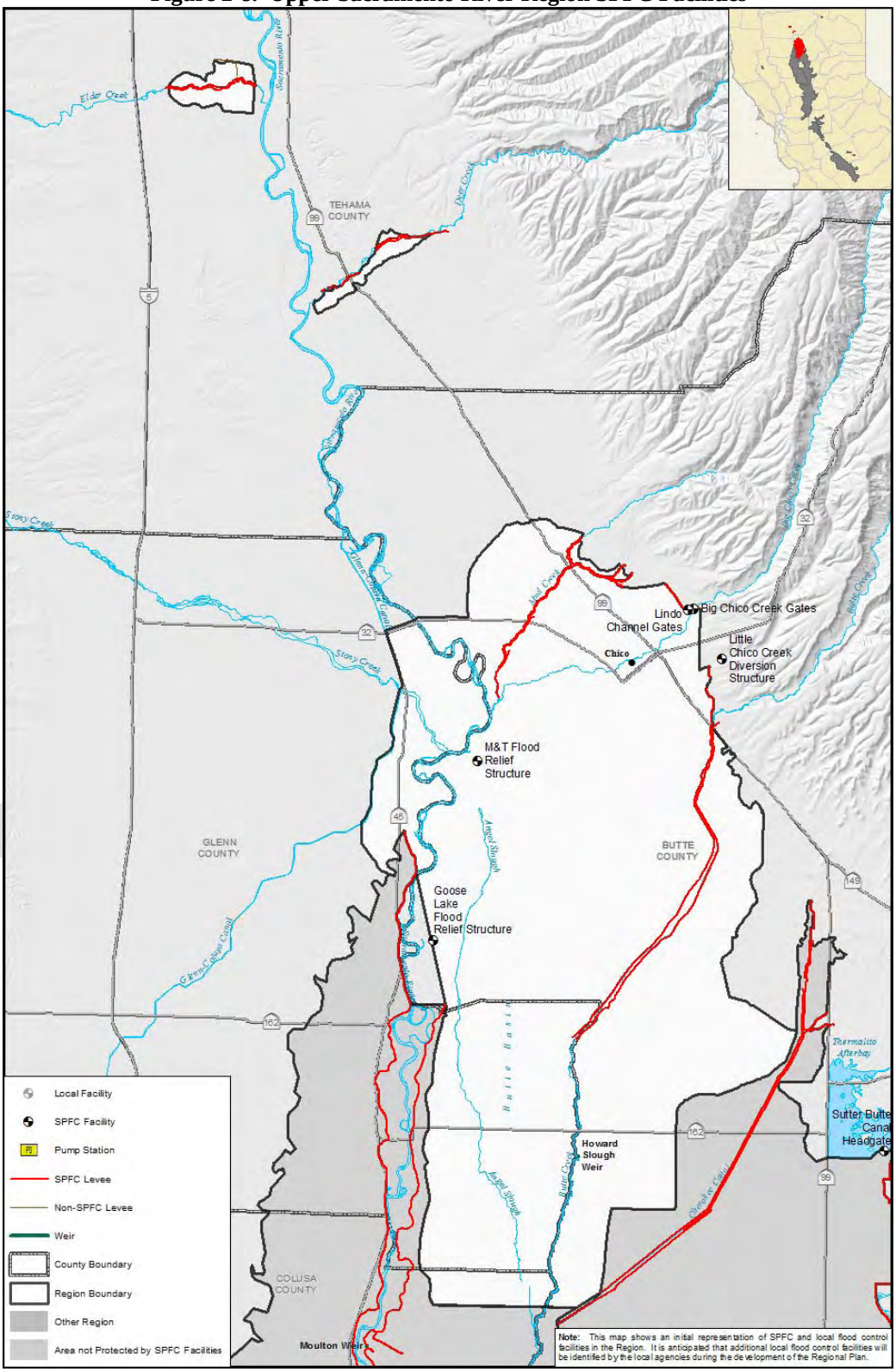
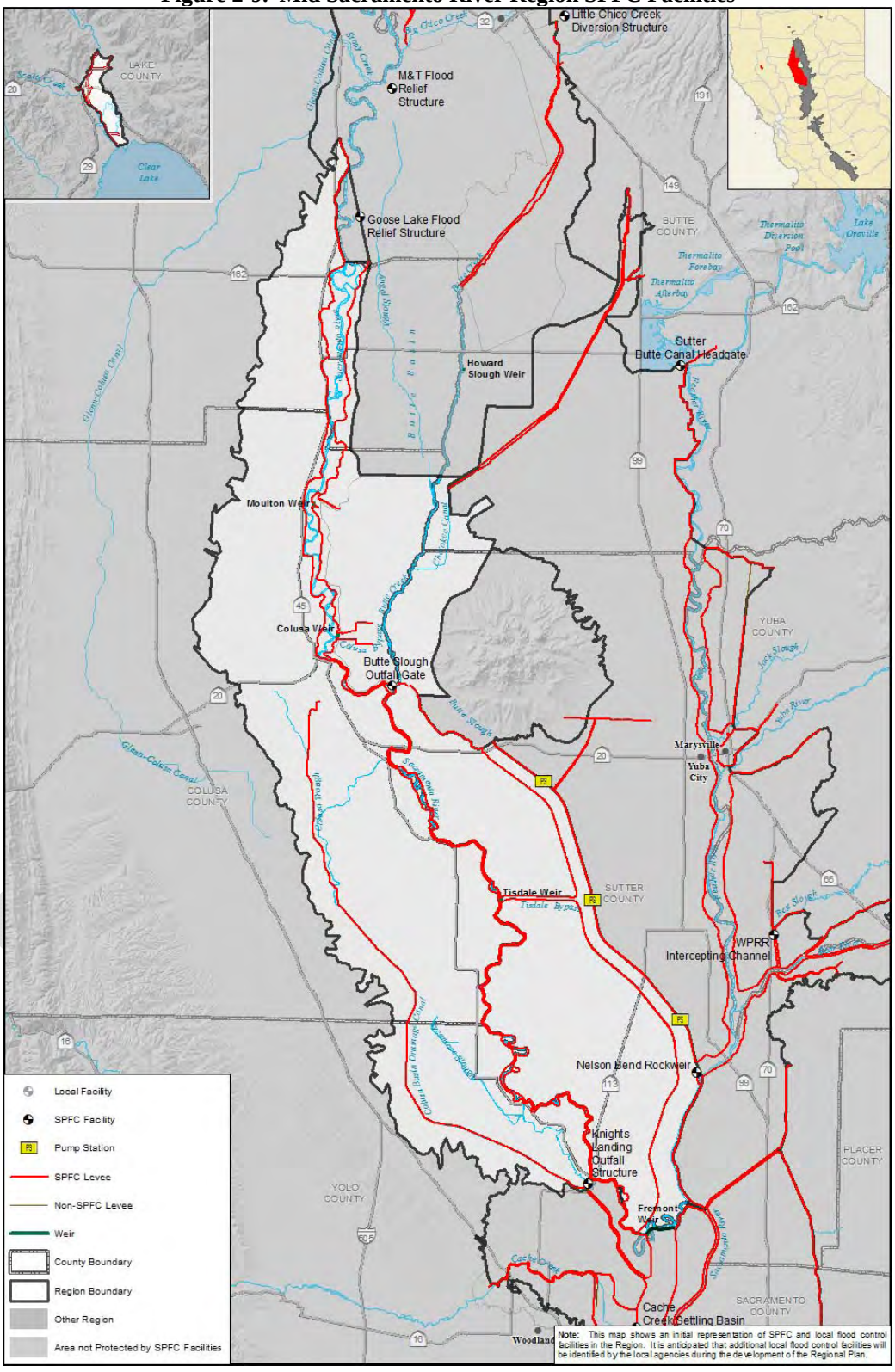


Figure 2-9. Mid Sacramento River Region SPFC Facilities



2.8.1. *Structural Elements*

Within the Mid and Upper Sacramento River Regions, the integrated structural system of flood protection includes reservoirs with active flood control space (upstream of the Planning Area boundaries), hundreds of miles of levees, multiple weirs, an outfall structure, diversion channels, massive bypasses, and drainage facilities, which pump interior runoff and seepage from levee protected areas back into the flood control channels. These structural elements work together to contain high flows within the main river channel, and when necessary, divert water out of the main river channel.

The primary structural component of this flood protection system are levees. Levees are earthen embankments constructed along the banks of rivers or manmade channels that act to constrain the lateral spread of water during high flows. There are nearly 400 miles of levees in the Mid and Upper Sacramento River Region.

Weirs and outfall structures control the diversion of water from one channel to another. The weirs within the Mid and Upper Sacramento River Regions are concrete embankments along a levee alignment that passively divert water into bypasses when the surface elevation of the river rises above the fixed elevation of the weir. There are four major weirs in the Mid and Upper Sacramento River Region: Moulton, Colusa, Tisdale and Fremont Weir, extending from north to south.

Outfall structures within the region are culverts through a levee with gates and/or flaps that can be operated to control the direction of flow between channels. The Butte Slough Outfall is the only outfall in the Mid and Upper Sacramento River Region. The bypasses within the Mid and Upper Sacramento River Region are large manmade diversion channels, bounded on both sides by levees, that serve as temporary waterways during high-water events to reduce the volume of water in the primary river channel. These include the Tisdale, Sutter, and Yolo Bypasses.

Below is a list and brief description of the major flood control structures in the Mid and Upper Sacramento Regions:

<u>Butte Basin Overflow Areas: M&T, 3B's, Goose Lake:</u>
The M&T, 3 B's and Goose Lake overflow areas and relief structures serve to divert a substantial portion of flood flows over the east bank of the Sacramento River into Butte Basin. DWR maintains all three of these flood relief structures (DWR, 2010). The existence and operation of these overflow areas is critical to downstream flood management as they relieve pressure off of the Sacramento River main channel levees.

<u>Mouton Weir:</u>
Located on the east bank of the Sacramento River, the Moulton Weir is nearly 500 feet long and diverts water from the Sacramento River into a low-lying area on the western side of the Sutter Buttes, known as the Butte Basin. Water flows through the Butte Slough and eventually into the Sutter Bypass. The Moulton Weir has a flood channel design flow of 25,000 cubic feet per second.

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Colusa Weir:
Located just over 7 miles south of the Moulton Weir, the Colusa Weir is also located on the east bank of the Sacramento River. The Colusa Weir is more than 1,500 feet long and diverts water from the Sacramento River into the Butte Slough, which eventually flows into the Sutter Bypass. The Colusa Weir has a flood channel design flow of 70,000 cubic feet per second.

Butte Slough Outfall:
Butte Slough Outfall is a gated culvert structure through a levee on the east bank of the Sacramento River located several miles downstream of the Colusa Weir. The gates control flow between the Sacramento River and Butte Slough. During high-water conditions, the gates allow Sacramento River water to enter Butte Slough, which eventually flows into the Sutter Bypass. The Butte Slough Outfall has a flood design flow of 3,500 cubic feet per second.

Tisdale Weir:
Located on the east bank of the Sacramento River, the Tisdale Weir is approximately 13 miles southeast of the Butte Slough Outfall. The Tisdale Weir is almost 1,200 feet long and diverts water from the Sacramento River into the Tisdale Bypass. The Tisdale Weir has a flood channel design flow of 38,000 cubic feet per second.

Tisdale Bypass:
The Tisdale Bypass is a man-made leveed channel that connects the Sacramento River to the Sutter Bypass during high-water events when the Sacramento River is high enough to flow over the Tisdale Weir. The Bypass is approximately 4 miles long in the east-west direction and 1,000 feet wide.

Sutter Bypass:
The Sutter Bypass is a man-made leveed channel just east and parallel to the Sacramento River. The bypass begins at Long Bridge on the south side of the Sutter Buttes near Highway 20 and continues over 20 miles southeast until it connects to the Feather River levees and eventually to the confluence of the Feather and Sacramento Rivers. The bypass can be up to ¾ of mile wide.

Fremont Weir:
The Fremont Weir is located just south of the confluence of the Sacramento and Feather Rivers, near Knights Landing. This weir allows excess flows from the Sacramento River to enter the Yolo Bypass during high-water events. The weir is approximately 1½ miles long and has a flood channel design flow of 343,000 cubic feet per second.

Yolo Bypass:
The 3-mile-wide, 40-mile-long Yolo Bypass is a man-made leveed channel that extends from the Fremont Weir to a point above the City of Rio Vista, where it returns excess flows to the Sacramento River.

Big Chico Creek Culvert (Five Mile Dam):
Located on the northeastern side of Chico in Upper Bidwell Park, this structure is the first of three flow control structures that partially divert Big Chico Creek's flow during high-water events. The Big Chico Creek Culvert uses six box culverts with slide gates to divert flow from Big Chico Creek into Lindo Channel, which runs parallel to Big Chico Creek for almost 8 miles

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before rejoining the creek about 2½ miles from the confluence with the Sacramento River. The Big Chico Creek Culvert restricts the design channel flow of Big Chico Creek to 1,500 cubic feet per second.

Lindo Channel Culvert (Lindo Channel Dam):
The Lindo Channel Culvert is the second flow control structure on Big Chico Creek. Located just downstream from the Big Chico Creek Culvert, it also diverts water from Big Chico Creek during high-water events. This structure consists of seven box culverts with slide gates capable of diverting 6,000 cubic feet per second into the Lindo Channel.

Sycamore Creek Weir and Diversion Channel:
The third flow control structure for Big Chico Creek, the Sycamore Weir is located just upstream of the Lindo Channel Culvert. The weir is 178 feet long and has dissipaters that allow water to spill in a controlled fashion into the Sycamore Creek Diversion Channel. This channel is capable of diverting 8,500 cubic feet per second from Big Chico Creek and Lindo Channel to Sycamore Creek, which drains into Mud Creek, and eventually to the Sacramento River.

Little Chico Creek Diversion Channel:
Located southeast of Chico, this diversion channel uses a weir to divert water from Little Chico Creek to Butte Creek during high-water events. The Little Chico Creek Diversion Channel has a design flow of 3,000 cubic feet per second.

Clover Creek Weir and Diversion Channel:
Located in Upper Lake, Lake County, the Clover Creek Weir diverts flow from Clover Creek into the Clover Creek Diversion channel during high-water events. The Channel has a design flow of 8,500 cubic feet per second.

Bloody Island Pump Station:
Located about 1½ miles south of Upper Lake, Lake County, the Bloody Island Pump Station collects drainage from a 3.1-square mile area east of Middle Creek between Clover Creek and Bloody Island. The pump station has three 130 cubic feet per second (average rate) pumps and a sump with an active storage capacity of 185 acre-feet. The pump station also has reverse gravity flow capabilities from Middle Creek to the sump during low flow periods.

2.8.2. *Non-Structural Elements*

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

Some of the existing non-structural flood risk management elements within the Mid and Upper Sacramento River Regions are further described below.

NFIP & Community Rating System:

One of the most significant non-structural flood risk reduction programs is FEMA's National Flood Insurance Program (NFIP), which includes mapping flood hazard areas nationwide, and requiring that homes and other structures with federally backed mortgages must carry flood insurance if the flood risks warrant it. Butte, Colusa, Glenn, Lake, Sutter, Tehama, and Yolo Counties, the City of Chico, and other permitting agencies within the Regions participate in the NFIP program, which provides community residents with reduced flood insurance rates, provided the permitting agencies meet certain requirements.

The reduction in flood insurance rates depends on the Community Rating System (CRS) rating. The purpose of the CRS is to provide incentives for flood insurance customers in the form of premium discounts if the community meets or exceeds the minimum floodplain protection requirements. The rating system works by dividing discount levels in classes with Class 10 communities receiving the least discount (5%) and Class 1 communities receiving the largest discount (45%). Class level can vary based on numerous flood preparedness measures.

The regulatory framework of the NFIP is intended to limit the life, safety, and economic impacts of flooding, but may also have unintended economic impacts on farms, which may be prevented from upgrading structures and equipment to stay competitive, or rebuilding after a flood. Therefore revisions to the NFIP regulatory framework are among the potential nonstructural flood risk management options considered in this report.

Senate Bill 5:

Senate Bill 5 (SB 5) and companion legislation passed by the State Legislature in October 2007 established flood protection requirements for urban areas and small communities and require that further floodplain development be accompanied by appropriate levels of flood protection. Details regarding the full requirements of SB 5 are discussed later in this document.

Public Law 84-99 (PL84-99) Program

PL84-99 is another program in the Regions which aims to mitigate flood risk. The financial benefits associated with PL84-99 are indirect; levee systems that are compliant with PL84-99 are eligible for assistance to repair levees, in the event of damage during a flood event.

PL 84-99 gives USACE the authority to provide emergency management services to state and local agencies in need. Acting for the Secretary of the Army, the Chief of Engineers is authorized to undertake activities including disaster preparedness, emergency response operations, and the rehabilitation of flood control works threatened or destroyed by flooding.

Many of the levees in the MUSR Regions are project levees, and therefore participate in the PL 84-99 program. In order to benefit from the federal funding of rehabilitation, a federal flood protection system (i.e., a Project levee) must be enrolled in the PL 84-99 program prior to the flood event. An eligible system would be restored to its pre-disaster status at no cost to the local LMA.

In order to remain eligible for PL 84-99 damage assistance, project levees need to receive an Acceptable or Minimally Acceptable rating. If any part of a project receives an Unacceptable rating, the project is put on probation, and if it receives another Unacceptable rating the following year, it is placed on "inactive" status and is ineligible for the PL 84-99 program until the problem is fixed. As discussed later in this report, several LMAs have received Unacceptable ratings for one or more of a variety of reasons, jeopardizing their eligibility in the program.

Flood System Repair Project

DWR has developed the Flood System Repair Project (FSRP) to help Local Maintaining Agencies reduce flood risks in non-urban areas. Through FSRP, DWR will assist LMAs by providing them with technical and financial support to repair documented critical problems with flood control facilities of the SPFC in non-urban areas. Eligible projects include erosion repairs, access road repairs, hydraulic control structures and weir repairs, channel capacity restoration, and general levee repairs. The objectives of the FSRP are to repair documented critical problems, repair deteriorated levee patrol roads that provide all-weather access to the levees, and repair minor levee problems proactively, such as erosion sites shorter than 50 feet.

DWR is working with LMAs to finalize a list of critical repair sites and identify the levee patrol road reaches that require gravel or repair. After the list of critical sites and levee patrol road repair reaches is finalized:

1. DWR will issue a notice of eligibility to LMAs describing the eligible critical sites prioritized based on flood risk.
2. Interested LMAs will submit an "intent to participate" letter to DWR.
3. DWR and interested LMAs will work together to develop project agreements that describe the percentage of cost-share and the roles and responsibilities for each of the entities in implementing the repairs.
4. After the project agreements are finalized, DWR will commit funds for the repair projects. Funds will be released based on progress of planning, design, and construction activities.

Hazard Mitigation Plans:

Hazard mitigation planning is an important non-structural flood risk management tool, particularly with regard to public safety. It includes local, regional, State, and federal efforts to promote an awareness of flood risk, planning emergency response actions such as evacuations, stockpiling supplies and equipment, conducting training exercises, and improving notification and communication capabilities. The counties in the region have participated in the hazard mitigation planning prompted by the federal Disaster Mitigation Act of 2000, with federal and State grant support. Local agencies must have official Hazard Mitigation Plan (HMP) in order to qualify for FEMA disaster assistance.

Emergency Response Programs:

Flood emergency response programs and systems are intended to address the residual risk of flooding that remains after structural elements of the flood control system are put in place. Some of the common products of this comprehensive flood preparedness strategy include flood contingency maps, evacuation maps, acquisition of flood fight supplies and key response

equipment, improved operational area logistics policies and procedures, and improved flood fight command and control. These measures are discussed further in the Emergency Response Chapter of this document.

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3. Assessment of Flood Hazards in the Region: Deficiencies, Risks, and Challenges

3.1. Flood Control System Deficiencies

3.1.1. *Channel Capacity*

Many factors contribute to a channels ability to safely convey design flood flows. Channels can have lower than designed flow capacity because of insufficient levee height or obstructions. Insufficient levee height can reduce the effective cross sectional flow area. Similarly, obstructions such as bridges, sediment deposits, pilings, docks, marinas, and increased channel roughness from vegetation can also reduce the effective cross-sectional flow area and increase water levels, leading to levee overtopping.

Vegetation can decrease channel capacity, and vegetative debris can collect at bridges and other in-channel structures, restricting and redirecting flow, and can lead to levee erosion and/or overtopping. Deposits of sediment carried by floodwaters can reduce the cross-sectional areas of flood channels, leading to decreased conveyance capacity.

Channel conveyance capacity can also be reduced by a number of other factors, such as encroachments in the channel, bank erosion, revetments, and bank caving. Localized levee settlement or original deficiencies in the levee design can also contribute to a channels inability to meet design flows. Consequently, it is often difficult to identify the specific causes of channel conveyance problems, and determining whether or not they are channel-related or levee-related often requires additional site-specific investigation. Another difficult challenge is the fact that the conveyance capacity of the system is dynamic, and therefore needs to be reevaluated at regular intervals. In addition, the complexities associated with analyzing channel capacity via hydraulic models make it a very time consuming process that involves data gathering, calibration, simulation, model refinements, and estimation of uncertainty.

Detailed evaluations regarding the ability of SPFC facilities within the Regions to convey design flows are currently underway by DWR. This work is currently in-progress and was not available for inclusion in this Working Draft version of the MUSR RFMP.

Project specific modeling is also conducted by DWR's Flood Maintenance Program to assess channel conveyance capacity data in the Sacramento River watershed and to determine where in-channel maintenance work is needed. DWR is responsible for maintaining channel flow capacity for Sacramento River Flood Control Project channels, and for performing channel-specific maintenance activities identified in the USACE O&M manuals, including channel clearance, to maintain design flow capacity. Project-specific models are used by the flood maintenance program to systematically prioritize channel vegetation management and sediment management activities by determining whether a channel capacity inadequacy is driven by sedimentation,

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channel vegetation, subsidence, flow constrictions caused by bridge crossings, or other factors. Where available, project-specific hydraulic modeling results from projects conducted by other agencies are used as the source of channel conveyance capacity data.

The basis for evaluating channel conveyance capacity in the Sacramento River watershed was refined several times after the Flood Control Act of 1917. Design flows were later amended by the Flood Control Act of 1928, Senate Document Number 23, the 1953 Memorandum of Understanding between USACE and the Reclamation Board (USACE and Board, 1953), and the 1957 design profiles for the Sacramento River (USACE, 1957). The profiles and associated design capacities were developed based on USACE analysis of the 1937, 1951, and 1955 floods on the Sacramento River at the request of the Board. For channels not delineated in the 1957, design profiles above, design capacities were determined based on as-constructed capacities specified in appendices to O&M manuals provided by USACE.

SPFC channel conveyance capacity has been estimated based on the ability of a channel to pass original design flood flows. Design flood flows (or design channel capacities) from different official sources have been sometimes inconsistent. These discrepancies have complicated the evaluation of channel conveyance capacities throughout the Sacramento River watershed. For example, design channel capacities reported in USACE O&M manuals sometimes do not agree with channel capacities associated with design profiles. This is because USACE created some O&M manuals before the design profiles were adopted. DWR operates and maintains SPFC facilities based on design capacities calculated from the design profiles when available, rather than on design capacities included in the USACE O&M manuals (USACE, 1969).

Approximately half of the 1,016 miles of SPFC channels are potentially unable to convey design flows, and approximately one-quarter of channel design capacities reported in O&M manuals do not agree with flows specified in the original 1957design profiles (DWR, Flood Control System Status Report).

Table 3-1 and Figure 3-4 shows a summary of the channel capacity results identified in the FCSSR. The existing capacities were estimated through system-wide modeling performed via the CVFED program using the best data available at the time (DWR, FCSSR). The following criteria was used to determine whether estimated current capacities of the SPFC channels were sufficient to safely convey identified design capacities in the O&M manuals or design capacities calculated from design profiles:

- If the estimate of current capacity was greater than both the design capacity reported in the O&M manual and the design capacity based on the design profile, channel status was reported as “no obvious inadequacy.”
- If the estimate of current channel capacity was less than the design capacity reported in the O&M manual, or the design capacity based on the design profile (or both), the channel status was reported as “potential inadequacy; additional evaluation required.”
- If the estimate of current channel capacity for a reach depends on backwater flow assumptions, channel status was reported as "backwater controlled; additional evaluation required."

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Please note that although Cherokee Canal, the Yolo Bypass, and their respective tributaries are technically outside of the MUSR Regional boundary, they were included in the following table for the sake of system context, and due to the inter-connectivity that they have with the Butte Basin and Colusa Drain. More specific descriptions regarding capacity and other channel deficiencies are included in the Urban Areas and System-wide Improvements Chapters of this RFMP

Table 3-1. Summary of FCSSR Channel Design Capacities for the MUSR Region

River Reach[1]	River Miles[2]		Design Flows from Senate Doc. No. 23	Design Capacity from O&M Manual (cfs)	Design Flow from 1957 Revised Profile Drawing (cfs) (basis of State operation)	Diff. Between 1957 Profile Flow and O&M Capacity (yes/no)	Estimated Current Channel Conveyance Capacity (cfs)	Channel Capacity Status	Data Source for Estimated Current Capacity	Comments
	From	To								
Red Bluff to Chico Landing										
Sacramento River										
Deer Creek to Chico Landing	No data	No data	260,000 cfs	Not specified	Not specified	N/A	No data	No data	Estimated flow at Chico Landing is 260,000 cfs (Senate Document No. 23)	None
Tributaries to Sacramento River										
Elder Creek	6	0	Not specified	17,000	17,000	No	9,000 – 17,000	Potential inadequacy; additional evaluation required	DWR Channel Evaluation Program Modeling by DWR Northern Region Office	None
Deer Creek	7.4	0	Not specified	21,000	21,000	No	11,000 – 21,000	Potential inadequacy; additional evaluation required	DWR Channel Evaluation Program Modeling by DWR Northern Region Office	None
Chico Landing to Colusa Weir										
Sacramento River										
Chico Landing to head of east levee	175	166	160,000	160,000	160,000	No	195,000	No obvious inadequacy	*Determination of Channel Capacity of the Sacramento River* (USGS, 1976) and EIR for Butte Basin Overflow Area, (Reclamation Board, 1986)	None
East levee head (Parrott Grant Line) to Princeton-Afton Road	166	153	160,000	160,000	160,000	No	159,000	Potential inadequacy; additional evaluation required	Ayers modeling for USACE and Princeton Pump Plant	None

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River Reach[1]	River Miles[2]		Design Flows from Senate Doc. No. 23	Design Capacity from O&M Manual (cfs)	Design Flow from 1957 Revised Profile Drawing (cfs) (basis of State operation)	Diff. Between 1957 Profile Flow and O&M Capacity (yes/no)	Estimated Current Channel Conveyance Capacity (cfs)	Channel Capacity Status	Data Source for Estimated Current Capacity	Comments
	From	To								
Princeton-Afton Road to Moulton Weir	153	148.25	160,000	160,000	160,000	No	110,000 – 184,000	Potential inadequacy; additional evaluation required	MBK modeling for Natomas 408 Impact Analysis – 184,000 cfs. DWR Channel Evaluation Program – 110,000 cfs.	150,000 cfs design capacity authorized with Butte Basin Bypass if it was constructed.
Moulton Weir to Colusa Weir	148.25	138	145,000	110,000	135,000	Yes	126,000	Potential inadequacy; additional evaluation required	MBK modeling for Natomas 408 Impact Analysis	None
Tributaries to Sacramento River										
Mud Creek and Big Chico Creek										
Mud Creek – end of levees to Sycamore Creek	8.22	6.82	Not specified	5,500	No data	N/A	No data	No data	N/A	None
Mud Creek – Sycamore Creek to SPRR	6.82	4.32	15,000	15,000	15,000	No	No data	No data	N/A	None
Mud Creek – SPRR to Big Chico Creek	4.32	0.00	13,000	13,000	13,000 – 15,000	No	No data	No data	N/A	None
Tributaries to Mud Creek										
Sycamore Bypass	12.4	11.0	8,500	8,500	8,500	No	>8,500	No obvious inadequacy	DWR Channel Evaluation Program Modeling by Flood Maintenance Office	None
Sycamore Creek										
Sycamore Bypass to North Sycamore Creek	11.0	9.4	10,000	10,000	10,000	No	>10,000	No obvious inadequacy	DWR Channel Evaluation Program Modeling by Flood Maintenance Office	Significant scouring of the channel bed has occurred since project was completed and appears to be migrating upstream into the bypass channel.
North Sycamore Creek to Sheep Hollow	9.4	8.6	10,000	10,000	10,000	No	>8,000	Potential inadequacy; additional evaluation required	DWR Channel Evaluation Program Modeling by Flood Maintenance Office	Recently completed sediment removal at Cohasset Bridge restored localized restriction but much conveyance in the reach remains below design

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River Reach[1]	River Miles[2]		Design Flows from Senate Doc. No. 23	Design Capacity from O&M Manual (cfs)	Design Flow from 1957 Revised Profile Drawing (cfs) (basis of State operation)	Diff. Between 1957 Profile Flow and O&M Capacity (yes/no)	Estimated Current Channel Conveyance Capacity (cfs)	Channel Capacity Status	Data Source for Estimated Current Capacity	Comments
	From	To								
										capacity.
Sheep Hollow to Mud Creek	8.6	6.8	11,000	11,000	11,000	No	5,000	Potential inadequacy; additional evaluation required	DWR Channel Evaluation Program Sycamore Creek Sediment Removal Project	None
Lindo Channel	10.3	2.75	Not specified	6,000	6,000	No	<4,000-6,000	Potential inadequacy; additional evaluation required	DWR Channel Evaluation Program Modeling by DWR Northern Region Office	Capacity inadequacies are dispersed throughout. There is a major constriction just downstream from the Lindo Channel Control Structure and at Big Chico Creek, where capacity is limited to less than 4,000 cfs.
Big Chico Creek – Mud Creek to Sacramento River	2.75	0	15,000	15,000	15,000	No	No data	No data	N/A	None
Distributaries from Sacramento River										
Overflow to Butte Basin	175	166	100,000 cfs	100,000 cfs from Senate Document No. 23		N/A	150,000	No obvious inadequacy	*Determination of Channel Capacity of the Sacramento River* (USGS, 1976) and EIR for Butte Basin Overflow Area (Reclamation Board, 1986)	None
Moulton Weir [3]	158.5	158.5	15,000	25,000	25,000	No	34,000	No obvious inadequacy	*Two-Dimensional Hydraulic Modeling of Riparian Habitat Restoration from Colusa to Princeton* (Nature Conservancy, 2007)	None

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River Reach[1]	River Miles[2]		Design Flows from Senate Doc. No. 23	Design Capacity from O&M Manual (cfs)	Design Flow from 1957 Revised Profile Drawing (cfs) (basis of State operation)	Diff. Between 1957 Profile Flow and O&M Capacity (yes/no)	Estimated Current Channel Conveyance Capacity (cfs)	Channel Capacity Status	Data Source for Estimated Current Capacity	Comments
	From	To								
Colusa Weir [3]	146.2	146.2	80,000	70,000	70,000	No	75,300	No obvious inadequacy	*Two-Dimensional Hydraulic Modeling of Riparian Habitat Restoration from Colusa to Princeton* (Nature Conservancy, 2007)	None
Colusa Weir to Fremont Weir										
Sacramento River										
Colusa Weir to Colusa Bridge	138.0	135.0	65,000	48,000	65,000	Yes	50,000	Potential inadequacy; additional evaluation required	Project-specific modeling from MBK for Natomas 408 Impact Analysis	None
Colusa Bridge to Butte Slough	135.0	130.0	47,000	48,000	65,000	Yes	50,000	Potential inadequacy; additional evaluation required	Project-specific modeling from MBK for Natomas 408 Impact Analysis	None
Butte Slough to Meridian Road	130.0	126.0	47,000	48,000	66,000	Yes	67,000	No obvious inadequacy	Project-specific modeling from MBK for Natomas 408 Impact Analysis	None
Meridian Road to Tisdale Weir	126.0	119.5	72,000	48,000	66,000	Yes	47,000	Potential inadequacy; additional evaluation required	Estimate from adjacent project- specific modeling from MBK for Natomas 408 Impact Analysis	None
Tisdale Weir to Wilkins Slough	119.5	118	33,500	30,000	30,000	No	29,000	Potential inadequacy; additional evaluation required	Project-specific modeling from MBK for Natomas 408 Impact Analysis	None
Wilkins Slough to Knights Landing	118.0	90.0	33,500	30,000	30,000	No	29,000	Potential inadequacy; additional evaluation required	Project-specific modeling from MBK for Natomas 408 Impact Analysis	None
Knights Landing to Fremont Weir	90.0	85.0	33,500	30,000	30,000	No	29,000	Potential inadequacy; additional evaluation required	Project-specific modeling from MBK for Natomas 408 Impact Analysis	None
Tributaries to Sacramento River										
Butte Slough Outfall	138.2	138.2	7,000	3,500	1,000	N/A	Not applicable	Not applicable	N/A	This facility is subject to backwater control.

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River Reach[1]	River Miles[2]		Design Flows from Senate Doc. No. 23	Design Capacity from O&M Manual (cfs)	Design Flow from 1957 Revised Profile Drawing (cfs) (basis of State operation)	Diff. Between 1957 Profile Flow and O&M Capacity (yes/no)	Estimated Current Channel Conveyance Capacity (cfs)	Channel Capacity Status	Data Source for Estimated Current Capacity	Comments
	From	To								
Knights Landing Outfall	90.2	90.2	Not specified	Not applicable	Not applicable	N/A	Not applicable	Not applicable	N/A	This facility is designed to protect the Colusa Basin from backwater from the Sacramento River – thus, capacity is not relevant.
Distributaries from Sacramento River										
Tisdale Weir and Bypass	119.2	119.2	38,500	38,000	38,000	No	15,000 – 32,000	Potential inadequacy; additional evaluation required	DWR Channel Evaluation Program 2006 sediment removal project	Backwater from Sutter Bypass limits the capacity of the weir and bypass during large floods. See Note 4.
Fremont Weir [3]	85.2	82.2	343,000	343,000	343,000	No	No data	Not applicable		Weir flow needs to be analyzed. See Note 4.
Sutter Bypass										
Butte Slough to Wadsworth Canal	93.2	83.0	178,000	178,000	150,000	Yes	111,000 – 150,000	Potential inadequacy; additional evaluation required	Project-specific modeling from MBK for Natomas 408 Impact Analysis – 111,000 cfs. DWR Channel Evaluation Program – 150,000 cfs.	DWR Channel Evaluation Program started at 1957 profile elevation, running profile irrespective of upstream levee profile.
Wadsworth Canal to Tisdale Bypass	83.0	77.8	178,000	178,000	155,000	Yes	125,000	Potential inadequacy; additional evaluation required	Project-specific modeling from MBK for Natomas 408 Impact Analysis	None
Tisdale Bypass to Feather River	77.8	67.0	216,500	216,500	180,000	Yes	142,000 – 180,000	Potential inadequacy; additional evaluation required	Project-specific modeling from MBK for Natomas 408 Impact Analysis – 142,000 cfs. DWR Channel Evaluation Program - 180,000 cfs.	In 1997, flood reverse flow occurred for a few hours due to backwater from the Sutter Bypass.
Feather River to Verona	67.0	59.0	416,500	416,500	380,000	Yes	400,000	No obvious inadequacy	Project-specific modeling from MBK for Natomas 408 Impact Analysis	Model separates flow at the training levee and splits the flow in the channel.
Tributaries to Sutter Bypass										
Butte Creek										

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River Reach[1]	River Miles[2]		Design Flows from Senate Doc. No. 23	Design Capacity from O&M Manual (cfs)	Design Flow from 1957 Revised Profile Drawing (cfs) (basis of State operation)	Diff. Between 1957 Profile Flow and O&M Capacity (yes/no)	Estimated Current Channel Conveyance Capacity (cfs)	Channel Capacity Status	Data Source for Estimated Current Capacity	Comments
	From	To								
Little Chico Creek Diversion Channel to Midway	15.32	8.2	12,000 (see comments)	27,000	27,000	No	27,000 to 44,222	No obvious inadequacy	*SPFC Existing Channel Capacity Assessment TM* (CVFED, 2009) - 44,222 cfs. *Butte Creek Watershed Floodplain Management Plan* (Butte Creek Watershed Conservancy, 2005) - 22,000 cfs.	Design flows from Senate Document 23 apply to reach SPRR to US Highway 99. Little Chico Diversion channel not specified in Senate Document 23. *SPFC Existing Channel Capacity Assessment TM* indicates uncertain estimated capacity.
Midway to 1.6 miles downstream from Aguas Frias Road	8.2	0	Not specified	22,000	22,000	No	22,000 – 44,222	No obvious inadequacy	*SPFC Existing Channel Capacity Assessment TM* (CVFED, 2009) - 44,222 cfs. *Butte Creek Watershed Floodplain Management Plan* (Butte Creek Watershed Conservancy, 2005) - 22,000 cfs.	*SPFC Existing Channel Capacity Assessment TM* indicates uncertain estimated capacity.
Cherokee Canal										
Dry Creek to Gold Run Creek at Nelson Road	21.72		Not specified	8,100	8,100	No	No data	No data	N/A	None
Gold Run Creek at Nelson Road to Cottonwood Creek at Western Canal	20.22			8,500	8,500	No	3,600 – 4,500	Potential inadequacy; additional evaluation required	DWR Channel Evaluation Program	4,050 cfs from Cottonwood Creek to Old Nelson-Shippee Road; 3,600 cfs from Old Nelson Shippee Road to Old SNNR; and 4,500 cfs from Old SNRR Road to Nelson Road.
Cottonwood Creek at Western Canal to RD 833 canal entrance at Afton Road	15.82			11,500	12,500	Yes	No data	No data	N/A	None

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River Reach[1]	River Miles[2]		Design Flows from Senate Doc. No. 23	Design Capacity from O&M Manual (cfs)	Design Flow from 1957 Revised Profile Drawing (cfs) (basis of State operation)	Diff. Between 1957 Profile Flow and O&M Capacity (yes/no)	Estimated Current Channel Conveyance Capacity (cfs)	Channel Capacity Status	Data Source for Estimated Current Capacity	Comments
	From	To								
RD 833 canal entrance at Afton Road to Lower Butte Basin about 1 mile downstream from Colusa-Gridley Road	7.92			12,500	12,500	No	No data	No data	N/A	None
Yolo Bypass										
Fremont Weir to Knights Landing Ridge Cut	57.2	54.2	343,000	343,000	343,000	No	290,000	Potential inadequacy; additional evaluation required	MBK modeling for Natomas 408 Impact Analysis	None
Knights Landing Ridge Cut to Cache Creek	54.2	51.8	362,000	362,000	362,000	No	276,000	Potential inadequacy; additional evaluation required	MBK modeling for Natomas 408 Impact Analysis	None
Cache Creek to Sacramento Bypass	51.8	45.3	377,000	377,000	377,000	No	201,000	Potential inadequacy; additional evaluation required	MBK modeling for Natomas 408 Impact Analysis	None
Sacramento Bypass to Putah Creek	45.3	39.5	480,000	480,000	480,000	No	334,000	Potential inadequacy; additional evaluation required	MBK modeling for Natomas 408 Impact Analysis	None
Putah Creek to RM 29	39.5	29.0	490,000	490,000	490,000	No	322,000	Potential inadequacy; additional evaluation required	MBK modeling for Natomas 408 Impact Analysis	None
RM 29 to Miner Slough	29.0	18.5	500,000	490,000	500,000	Yes	No data	No data	N/A	The Comprehensive Study UNET model does not provide reliable results in this reach. Additional model development will be required.
Miner Slough to Sacramento River	18.5	14.1	500,000	490,000	500,000	Yes	N/A	Backwater controlled; additional evaluation required	MBK modeling for Natomas 408 Impact Analysis	Backwater control – flows vary accordingly.
Tributaries to Yolo Bypass										

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River Reach[1]	River Miles[2]		Design Flows from Senate Doc. No. 23	Design Capacity from O&M Manual (cfs)	Design Flow from 1957 Revised Profile Drawing (cfs) (basis of State operation)	Diff. Between 1957 Profile Flow and O&M Capacity (yes/no)	Estimated Current Channel Conveyance Capacity (cfs)	Channel Capacity Status	Data Source for Estimated Current Capacity	Comments
	From	To								
Knights Landing Ridge Cut	2.6	0	16,000	20,000	20,000	No	16,000	Potential inadequacy; additional evaluation required	*SPFC Existing Channel Capacity Assessment TM* (CVFED, 2009)	None
Colusa Basin Drainage Canal	36.5	0.00	Not specified	20,000	20000	No	No data	No data	N/A	None
Cache Creek	12.9	4.50	20,000	30,000	30,000	No	27,000 – >30,000	Potential inadequacy; additional evaluation required	*SPFC Existing Channel Capacity Assessment TM* (CVFED, 2009) – 27,000 cfs DWR Channel Evaluation Program – >30,000 cfs.	Recent DWR analysis indicates additional study required due to subsidence of the levees and channel.
Cache Creek Weir and Settling Basin	4.5	0	20,000	30,000	30,000	No	0 – 30,000	Not applicable	DWR Channel Evaluation Program	Recent modeling shows weir submerged in high flows.
Tributaries to Cache Creek										
Middle Creek										
Upstream of Clover Creek Diversion	1.0	0	Not specified	12,500	Not applicable	N/A	No data	No data	N/A	None
Clover Creek Diversion to Clover Creek	2.25	1.0	Not specified	21,500	Not applicable	N/A	No data	No data	N/A	None
Clover Creek to Scott Creek	3.13	2.25	Not specified	19,000	Not applicable	N/A	No data	No data	N/A	None
Scott Creek to Clear Lake	4.18	3.13	Not specified	27,000	Not applicable	N/A	No data	No data	N/A	None
Tributaries to Middle Creek										
Scott Creek	1.38	0	Not specified	11,000	Not applicable	N/A	No data	No data	N/A	None
Clover Creek	0.5	0	Not specified	500	Not applicable	N/A	No data	No data	N/A	None
Clover Creek Diversion	1.04	0.35	Not specified	8,000	Not applicable	N/A	No data	No data	N/A	None
Tributaries to Clover Creek Diversion										
Alley Creek to Clover Creek Diversion Facilities	1.2	1.0	Not specified	8,500	Not applicable	N/A	No data	No data	N/A	None
Clover Creek	0.2	0	Not specified	5,000	Not applicable	N/A	No data	No data	N/A	None
Alley Creek	1.53	1.2	Not specified	2,800	Not applicable	N/A	No data	No data	N/A	None

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Figure 3-1. Upper Sacramento River Region Channel Capacities and Flood Forecast Network

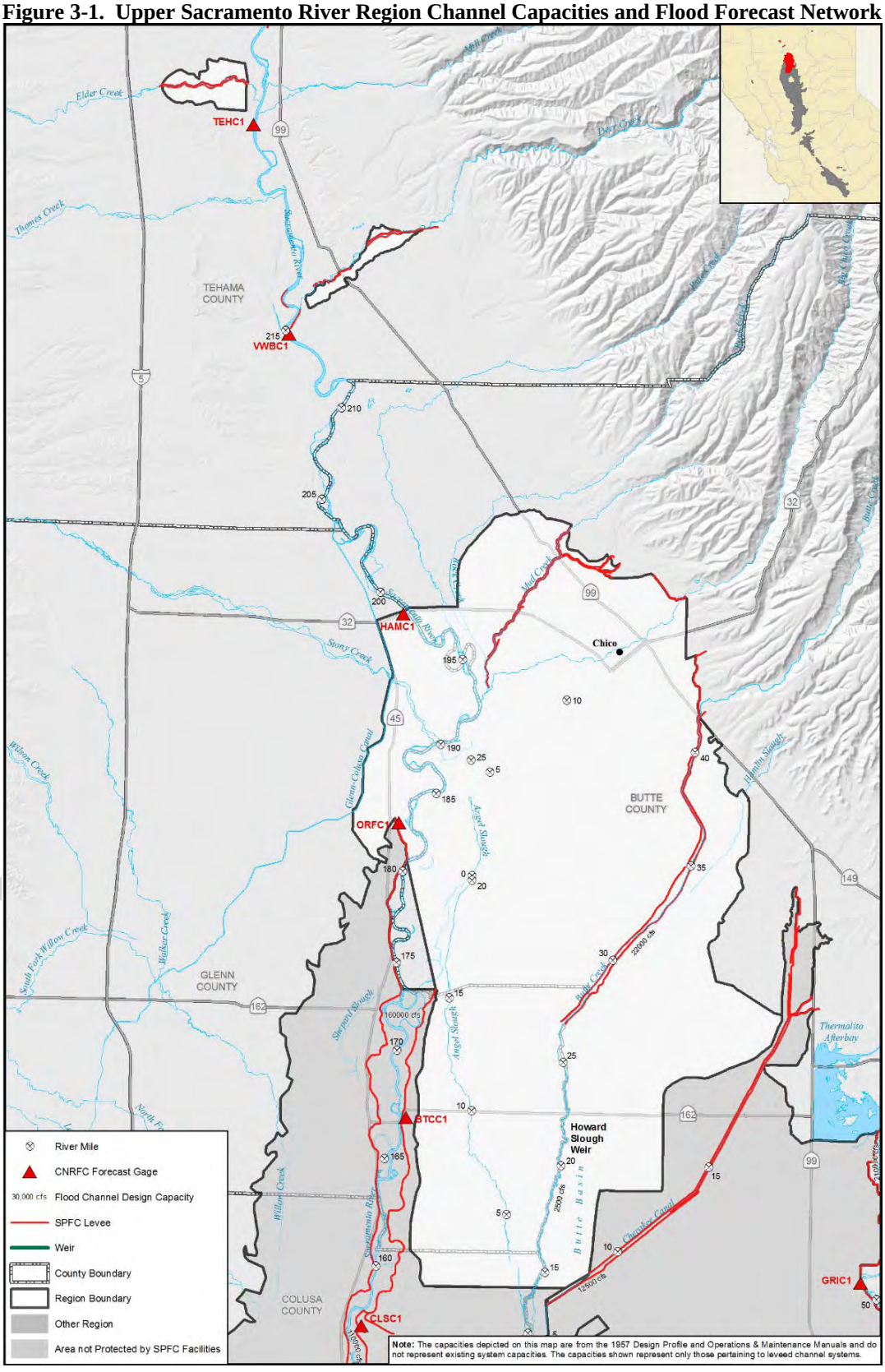


Figure 3-2. Mid Sacramento River Region Channel Capacities and Flood Forecast Network

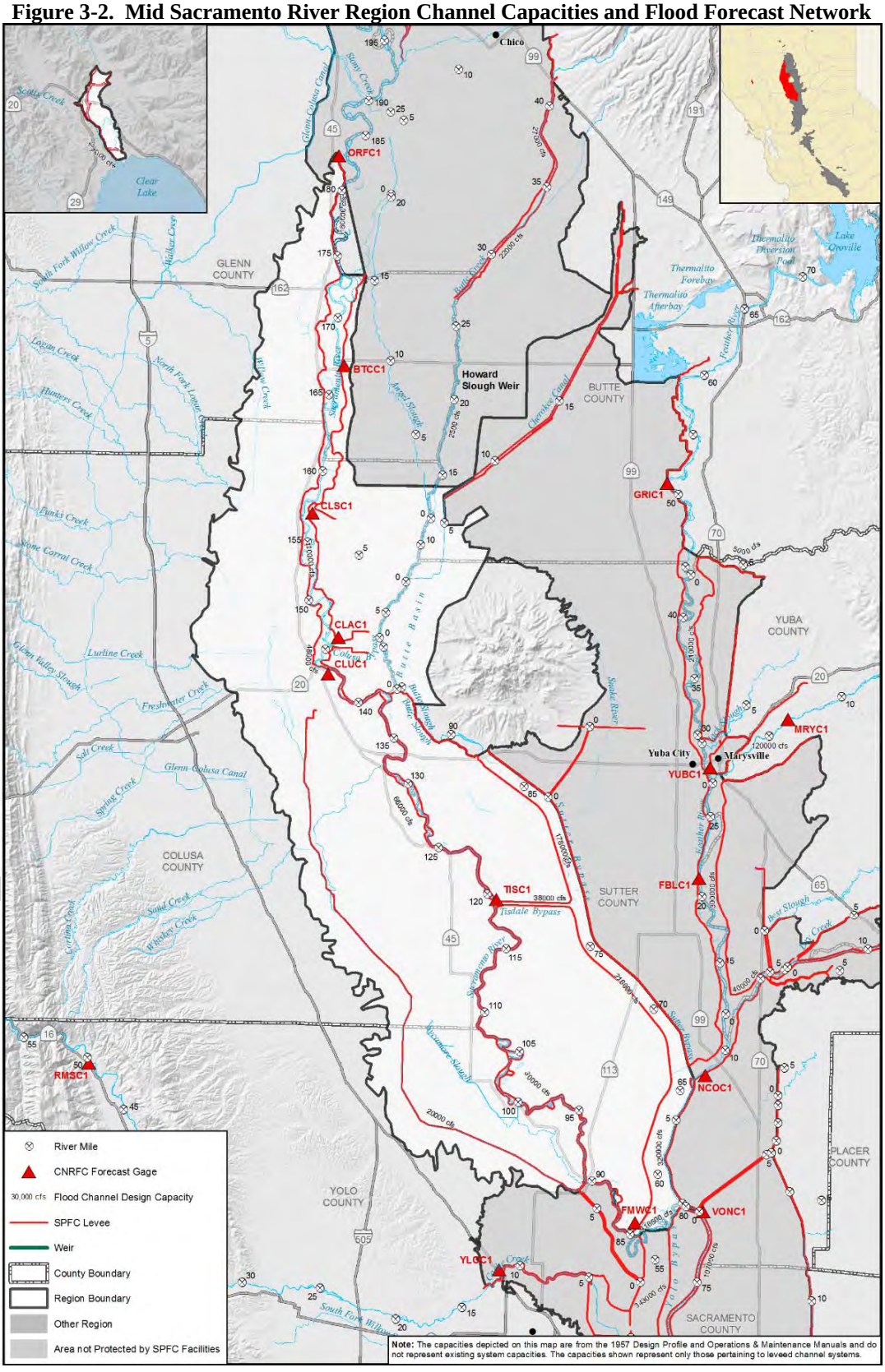


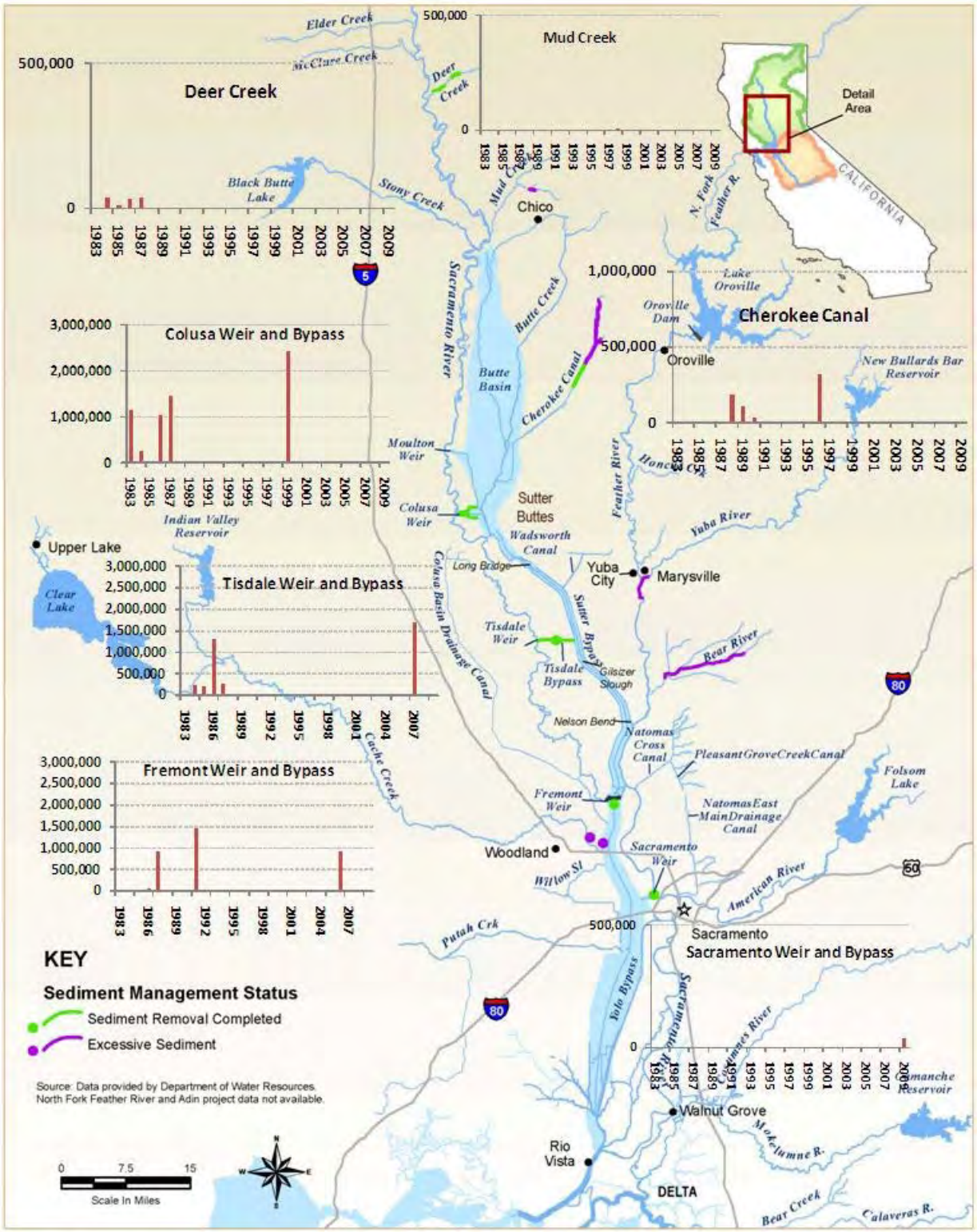
Figure 3-3. Differences between O&M Manual Design Capacities and Design Profile Flows

Source: DWR, FCSSR

Figure 3-4. Channel Capacity Status

Source: DWR FCSSR

Figure 3-5. Past Channel Sediment Removal Projects



Source: DWR FCSSR

3.1.2. *Levees*

This section presents information related to the overall condition of levees within the MUSR Regions. A 'cut sheet' which characterizes the deficiencies and remedial measures for each levee segment in the MUSR Region has been prepared and is included in Appendix B. More detailed, site specific information related to various LMA levee deficiencies is presented in Chapter 9 of this RFMP.

The information in this section was acquired from the following sources:

- Locally provided information and studies
- DWR and USACE Levee Inspection Results
- DWR Flood System Repair Project Information
- DWR NULE and ULE Information
- DWR Flood Control System Status Report

For the MUSR Region, 19 out of the 21 USACE levee systems are currently inactive in the Rehabilitation Inspection Program (RIP), and thus ineligible for PL84-99 post disaster recovery funding. Table 3-2 shows a summary of the RIP levee inspection status as of 2013 and Table 3-3 shows a summary of the fall 2013 DWR inspections.

Table 3-2. Summary of USACE Levee Inspection Status for LMAs in the MUSR Region

Levee System	Location	Maintaining Agency	Inspection Type	System Rating	RIP Status	Major Issues
Chico Creek-Mud Creek - Unit 1	Chico	Butte County Public Works	Periodic	Unacceptable	Inactive	Encroachments/ Animal Control
Chico Creek-Mud Creek - Units 2 north and 3	Chico	Butte County Public Works	Periodic	Unacceptable	Inactive	Animal Control/ Encroachments
Chico Creek-Mud Creek - Unit 3 east, Sycamore	Chico	Butte County Public Works	Periodic	Unacceptable	Inactive	Encroachments/ Animal Control
Chico Creek-Mud Creek - Units 2 south and 4	Chico	Butte County Public Works	Periodic	Unacceptable	Inactive	Encroachments/ Animal Control
Chico Creek-Mud Creek - Unit 4 east, Sycamore left	Chico	Butte County Public Works	Periodic	Unacceptable	Inactive	Encroachments/ Animal Control
Chico Creek-Mud Creek - Unit 5, diversion levee	Chico	Butte County Public Works	Periodic	Inspection to be scheduled	Inactive	Erosion/ Bank Caving/ Animal Control

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Levee System	Location	Maintaining Agency	Inspection Type	System Rating	RIP Status	Major Issues
Elder Creek left bank, Unit 4 east	Gerber	Tehama County FCWCD	Periodic	Unacceptable	Inactive	Encroachments/ Erosion/ Bank Caving
Elder Creek left bank, Unit 4 - Gerber levee	Gerber	Tehama County FCWCD	Periodic	Unacceptable	Inactive	Encroachments/ Erosion/ Bank Caving
Elder Creek right bank, Unit 5	Gerber	Tehama County FCWCD	Periodic	Unacceptable	Inactive	Encroachments/ Erosion/ Bank Caving
Deer Creek left and right banks (Unit 1 and Unit 2)	Vina	Tehama County FCWCD	Periodic	Minimally Acceptable	Active	-
Sacramento River - East Bank	Rural / Glenn & Colusa Counties	LD3, DWR (ST 3)	Periodic	Unacceptable	Inactive	Encroachments, animal control, erosion, slope stability, sod cover, depressions/rutting, cracking
Sacramento River West Bank	Colusa, Yolo	LD1, LD2, Maintenance Area 1 & 12, Sac River West Side LD, RD 108, RD 787	Periodic	Unacceptable	Inactive	Encroachments, Animal Control, Seepage, Slope Stability, Erosion/Bank Caving, Cracking
RD 70/RD 1660 and Tisdale Bypass – Sutter Basin North	Meridian	RD 70, RD 1660, DWR (ST 9)	Periodic	Unacceptable	Inactive	Encroachments, Erosion/Bank Caving
RD 1500 and Tisdale Bypass - Sutter Basin South	Robbins	RD1500, DWR (ST 9)	Routine	Unacceptable	Inactive	Encroachments, Erosion, Animal Control
Middle Creek - U1 Left Bank	Clear Lake	Lake County WPD, DWR (MA 17)	Routine	Unacceptable	Inactive	Encroachments
Middle Creek - U1 North	Clear Lake	Lake County WPD	Routine	Unacceptable	Inactive	Encroachments
Middle Creek - U1 U5	Clear Lake	Lake County WPD	Routine	Unacceptable	Inactive	Encroachments
Middle Creek - U2 U3	Clear Lake	Lake County WPD	Routine	Unacceptable	Inactive	Encroachments

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Levee System	Location	Maintaining Agency	Inspection Type	System Rating	RIP Status	Major Issues
Middle Creek - U2 North	Clear Lake	Lake County WPD	Routine	Minimally Acceptable	Active	Encroachments, unwanted vegetation
Butte Creek - Right Bank	Rural / Butte & Glenn County	DWR (MA 5)	Periodic	Unacceptable	Inactive	Encroachments, animal control, erosion
Butte Creek - Left Bank	Rural / Butte & Glenn County	DWR (MA 5)	Periodic	Unacceptable	Inactive	Encroachments, animal control, erosion

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Table 3-3. Summary of Fall 2013 DWR Levee Inspection Results (Number of M/U Miles)

LMA Name	Total Miles of Levee	2013 DWR Overall Rating	Vegetation	Thin / Trim Trees	Encroachments	Animal Control	Slope Stability	Erosion/Bank Caving	Cracking	Crown Surface / Depressions / Rutting	Under-seepage Relief Wells	Repair Gates	Flood Preparedness & Training	Emergency Supplies and Equipment	USACE Erosion
Levee District 1, Glenn - LD0001G	12.45	A	0.06	0.11	0.04	0.15	0.01								
Levee District 2	4.89	A				0.32									0.01
Levee District 3	12.24	U	0.01	0.19	0.21	1.94	0.07								0.03
Reclamation Districts No. 70, Meridian Farms	23.57	A			0.06		0.03	0.01							0.83
Reclamation District 108	20.87	A					0.01		0.05						0.01
Reclamation District No. 787, Fair Ranch	4.4	A											0.04		0.13
Reclamation District No. 1500, Sutter Basin	54.35	M*		0.01 / 0.01	0.13	0.14 / 0.01					0.42 / 0.01				0.1
Reclamation District 1600, Tisdale	14.73	U	25.6	0.03			0.03	0.78 / .02		3.28					0.05

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LMA Name	Total Miles of Levee	2013 DWR Overall Rating	Vegetation	Thin / Trim Trees	Encroachments	Animal Control	Slope Stability	Erosion/Bank Caving	Cracking	Crown Surface / Depressions / Rutting	Under-seepage Relief Wells	Repair Gates	Flood Preparedness & Training	Emergency Supplies and Equipment	USACE Erosion
Butte County Public work, NA 3	24.71	A	0.08		0.05	0.01	0.01								0.05
Lake Count Watershed Protection District, NA 9	10.47	A	0.22	0.34	0.01		0.05								
Lake Count Watershed Protection District, NA 9, Middle Creek RB, Unit 2 North	0.58	A	0.22	0.34	0.01		0.05								
Sacramento River West Side Levee District, NA 16	50.21	A	0.01		0.02	0.01									0.26
Tehama County Flood Control & Water Conservation District, NA19	13.64	M*	1.4		0.08	0.07	0.33	0.04							0.16

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LMA Name	Total Miles of Levee	2013 DWR Overall Rating	Vegetation	Thin / Trim Trees	Encroachments	Animal Control	Slope Stability	Erosion/Bank Caving	Cracking	Crown Surface / Depressions / Rutting	Under-seepage Relief Wells	Repair Gates	Flood Preparedness & Training	Emergency Supplies and Equipment	USACE Erosion
Yolo County Service Area 6, NA 22	5.97	U	10.88 / 0.34	0.04	0.28	0.06		0.01						0.06	0.39
DWR Sutter Maintenance Yard, Maintenance Area 1	17.12	A	0.04			0.01									0.66
DWR Sutter Maintenance Yard, Maintenance Area 5	33.32	A	0.02		0.08	0.01	0.04					0.01			
DWR Sutter Maintenance Yard, Maintenance Area 12	11.31	A				0.02	0.01								0.01
DWR Sutter Maintenance Yard, Maintenance Area 17	3.9	U	3.13 U	3.12 U											

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LMA Name	Total Miles of Levee	2013 DWR Overall Rating	Vegetation	Thin / Trim Trees	Encroachments	Animal Control	Slope Stability	Erosion/Bank Caving	Cracking	Crown Surface / Depressions / Rutting	Under-seepage Relief Wells	Repair Gates	Flood Preparedness & Training	Emergency Supplies and Equipment	USACE Erosion
DWR Sutter Maintenance Yard, Maintenance Area 17, Middle Creek LB, Unit 1 South	3.51	U	3.13 U	3.12 U											

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Figure 3-6. Historical Levee Breaches

Source: DWR FCSSR

Figure 3-7. Historical Levee Overtopping

Source: DWR FCSSR

Figure 3-8. Upper Sacramento River Region Overall Levee Conditions

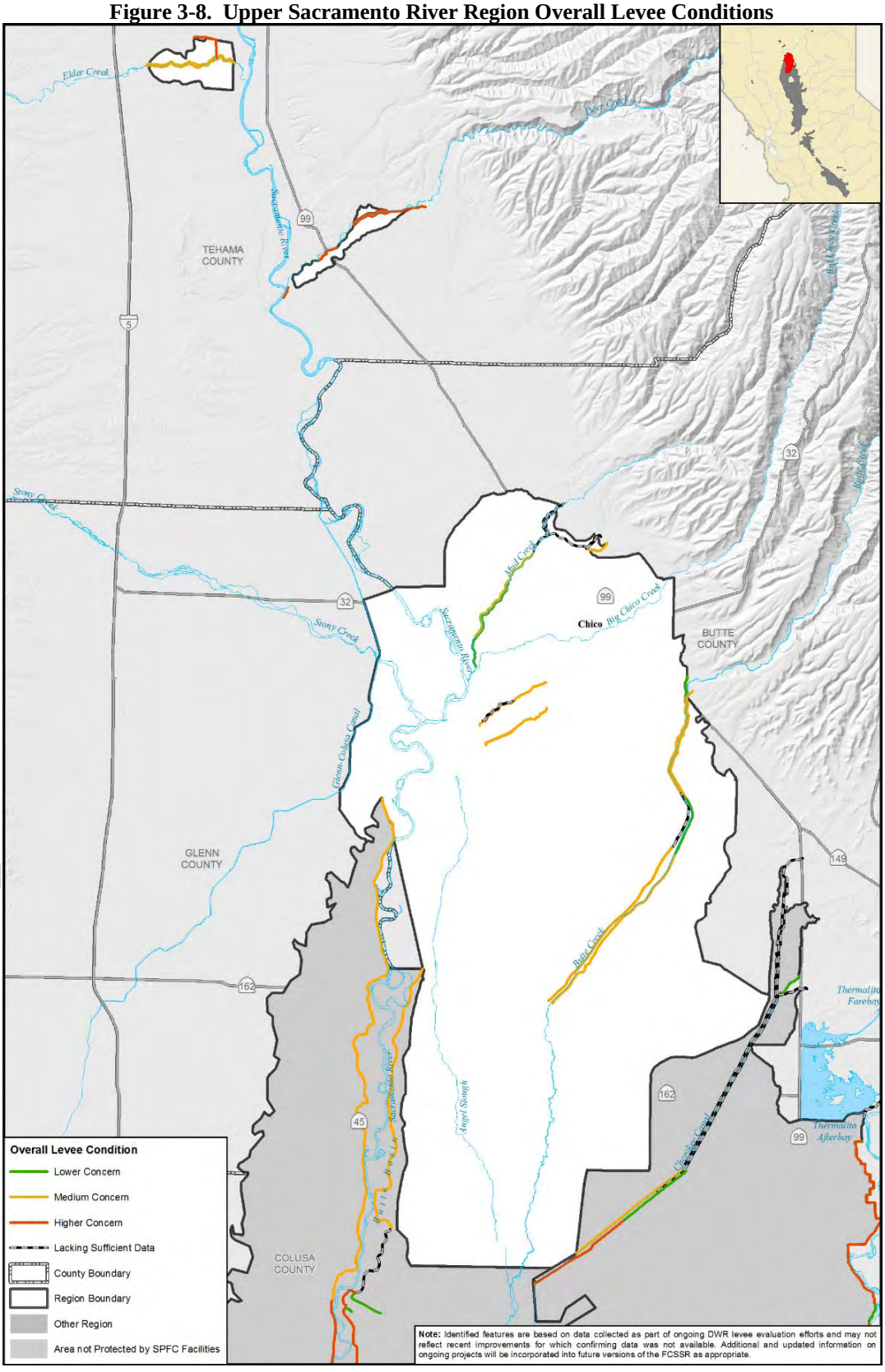


Figure 3-9. Mid Sacramento River Overall Levee Conditions

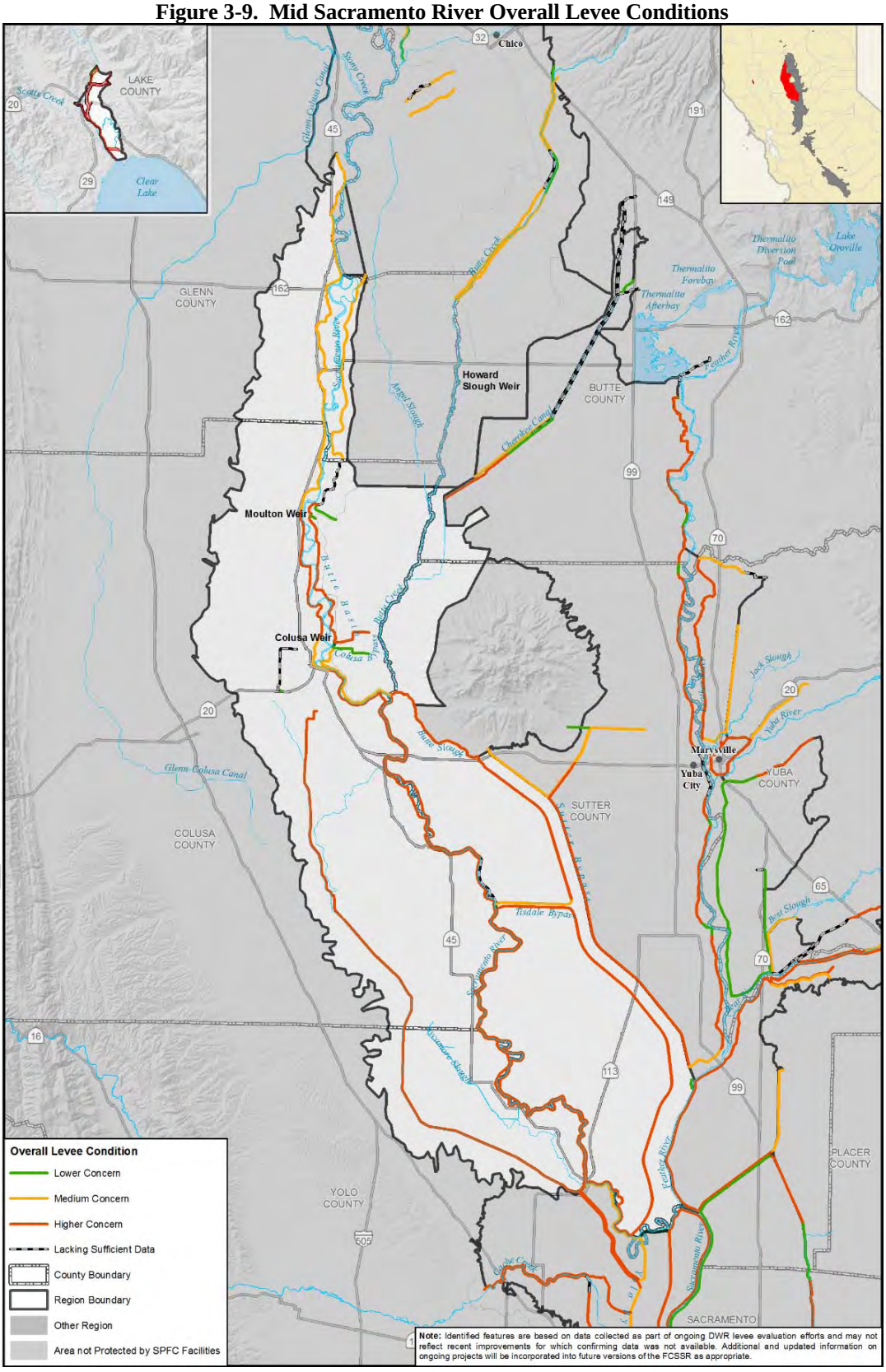


Figure 3-10. Upper Sacramento River Region Seepage Past Performance Problems

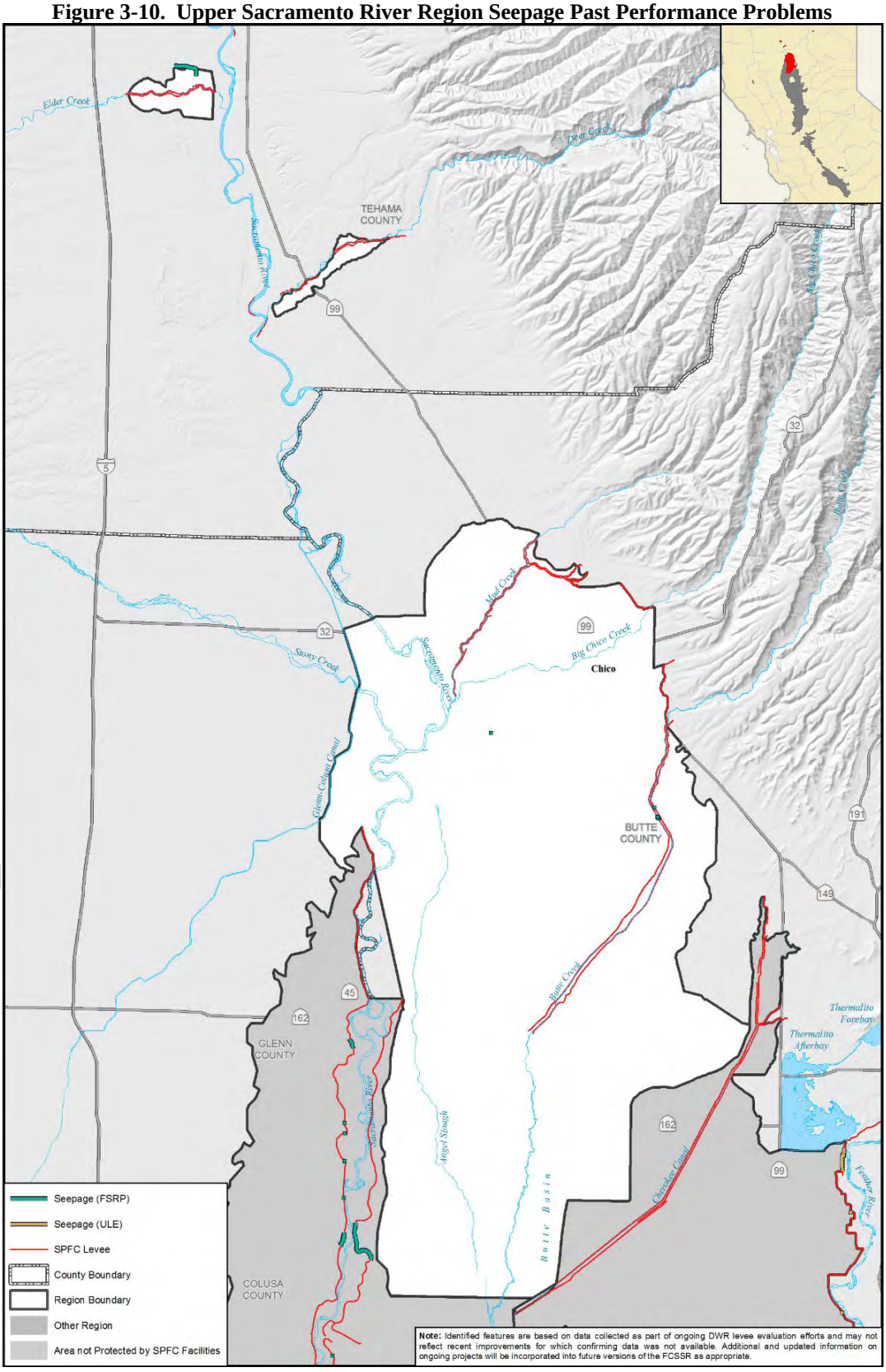


Figure 3-11. Mid Sacramento River Region Seepage Past Performance Problems

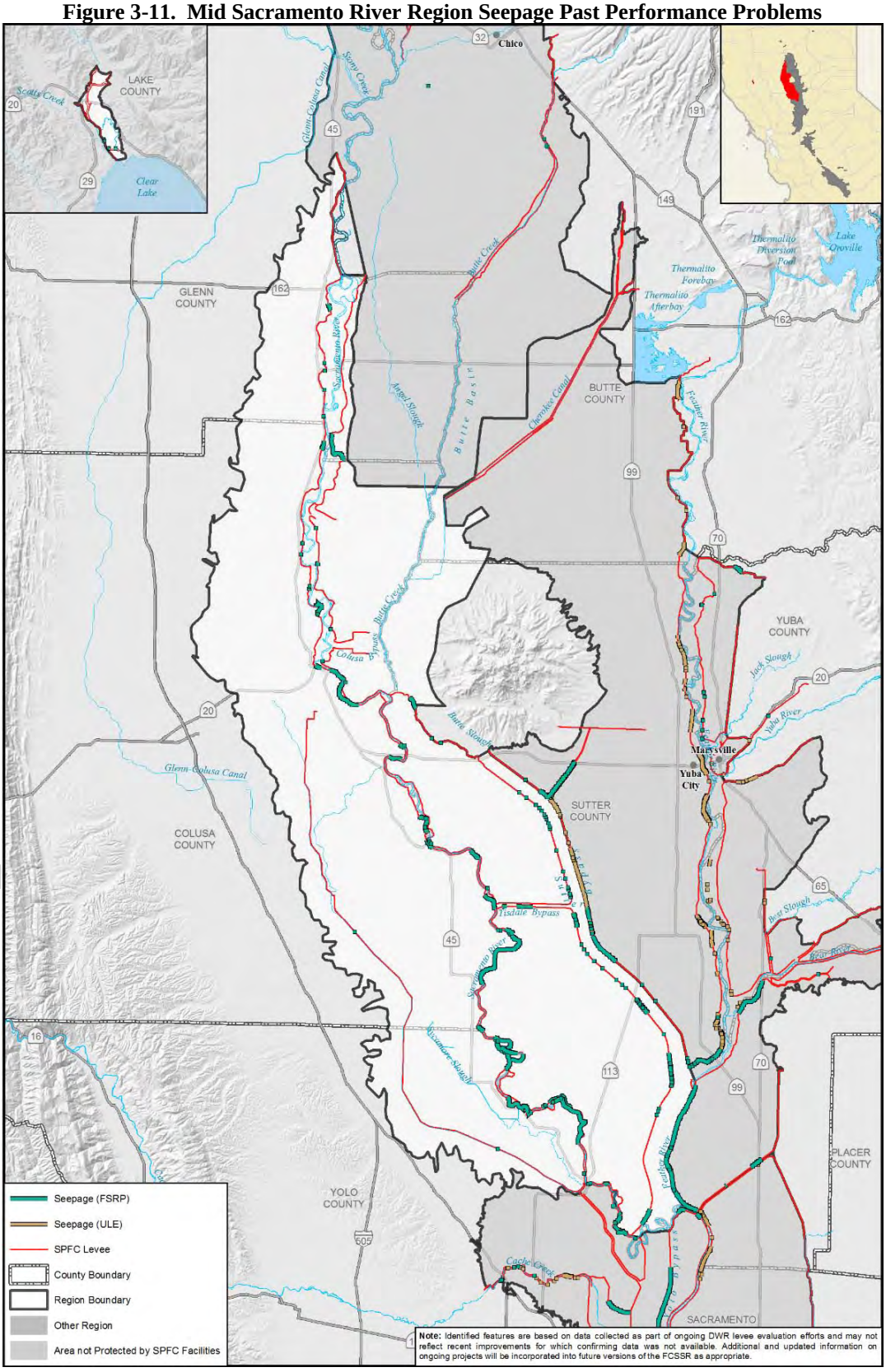


Figure 3-12. Upper Sacramento River Region Slope Stability Past Performance Problems

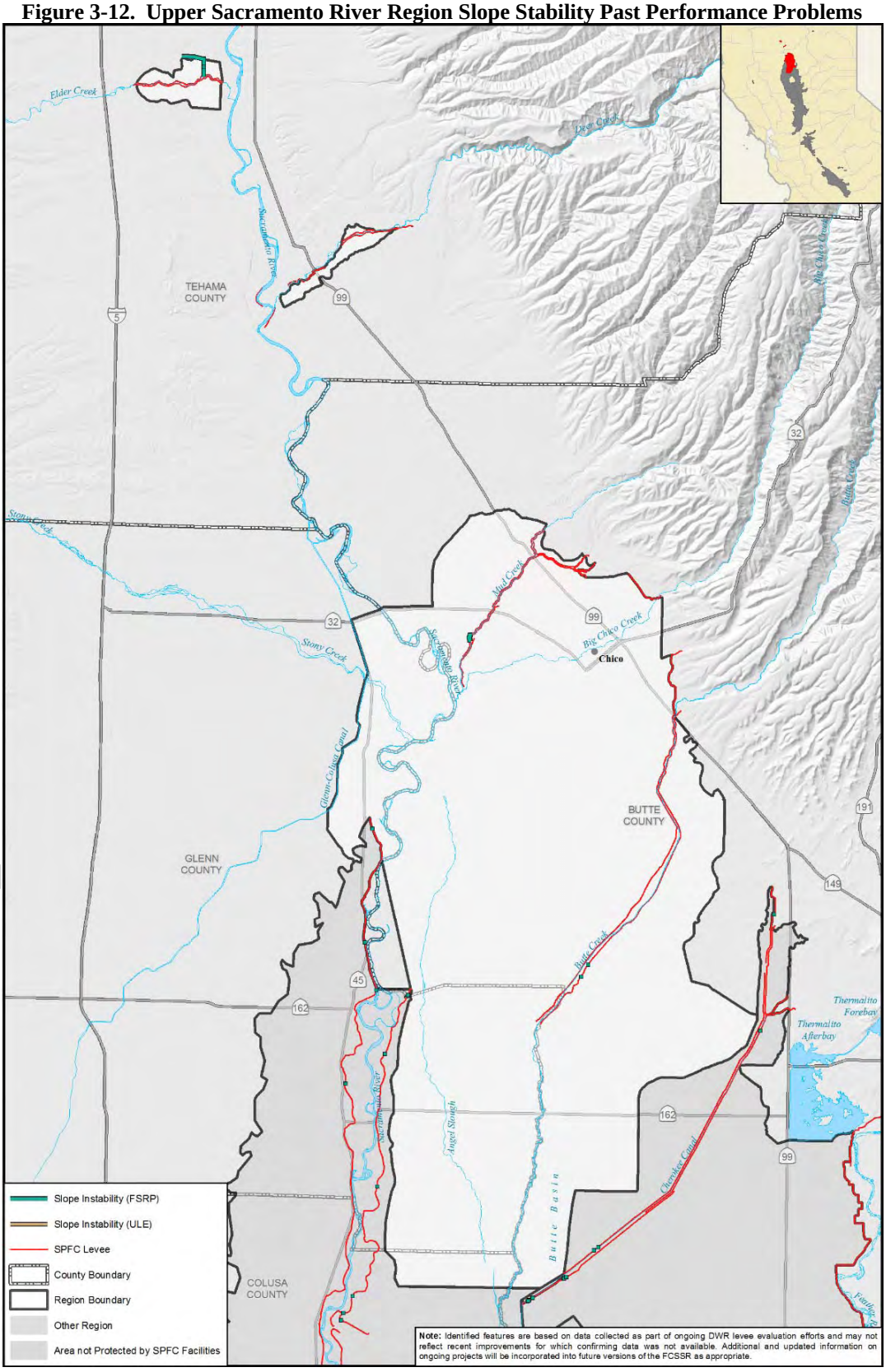


Figure 3-13. Mid Sacramento River Region Slope Stability Past Performance Problems

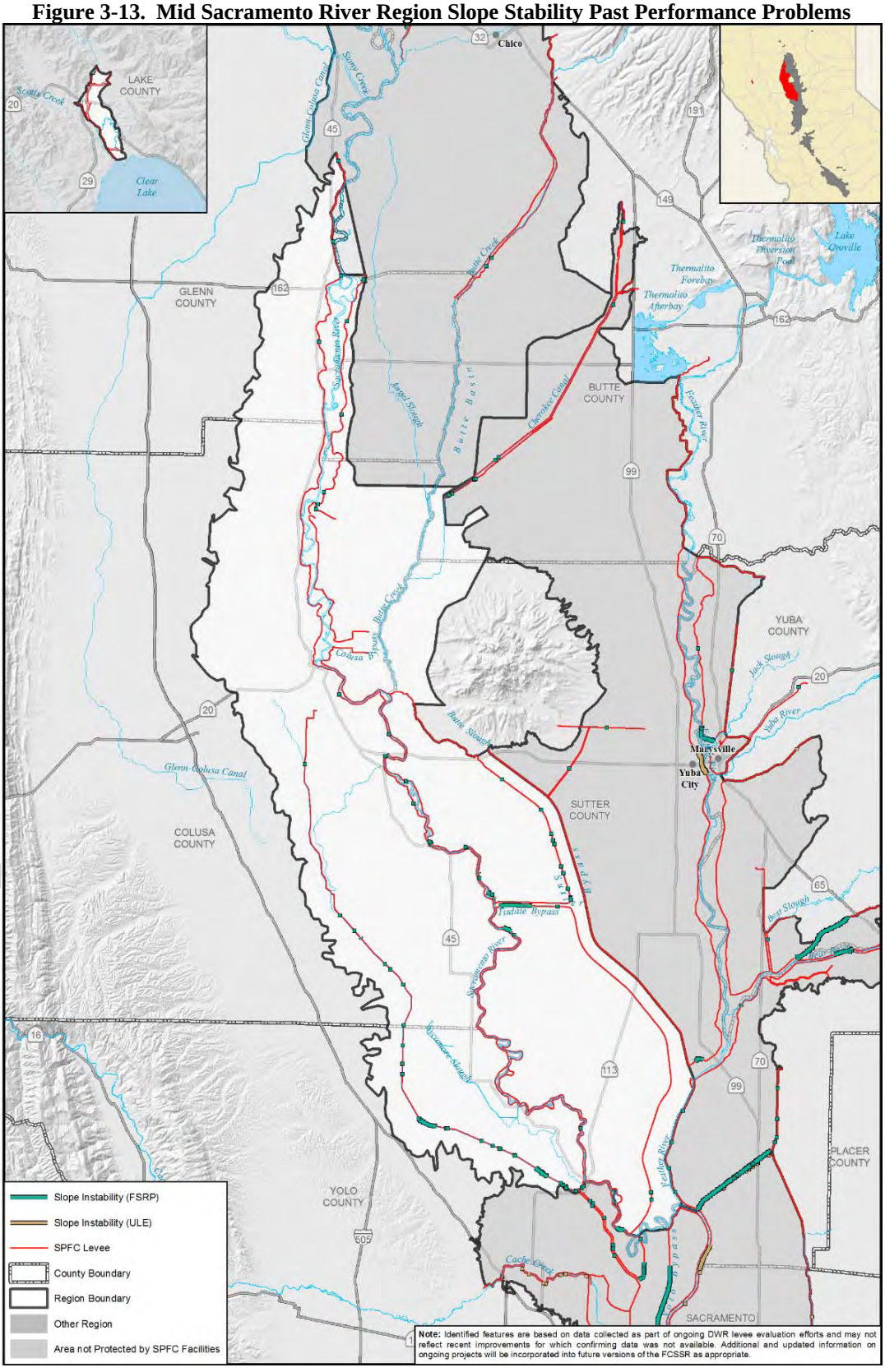


Figure 3-14. Upper Sacramento River Region Erosion Past Performance Problems

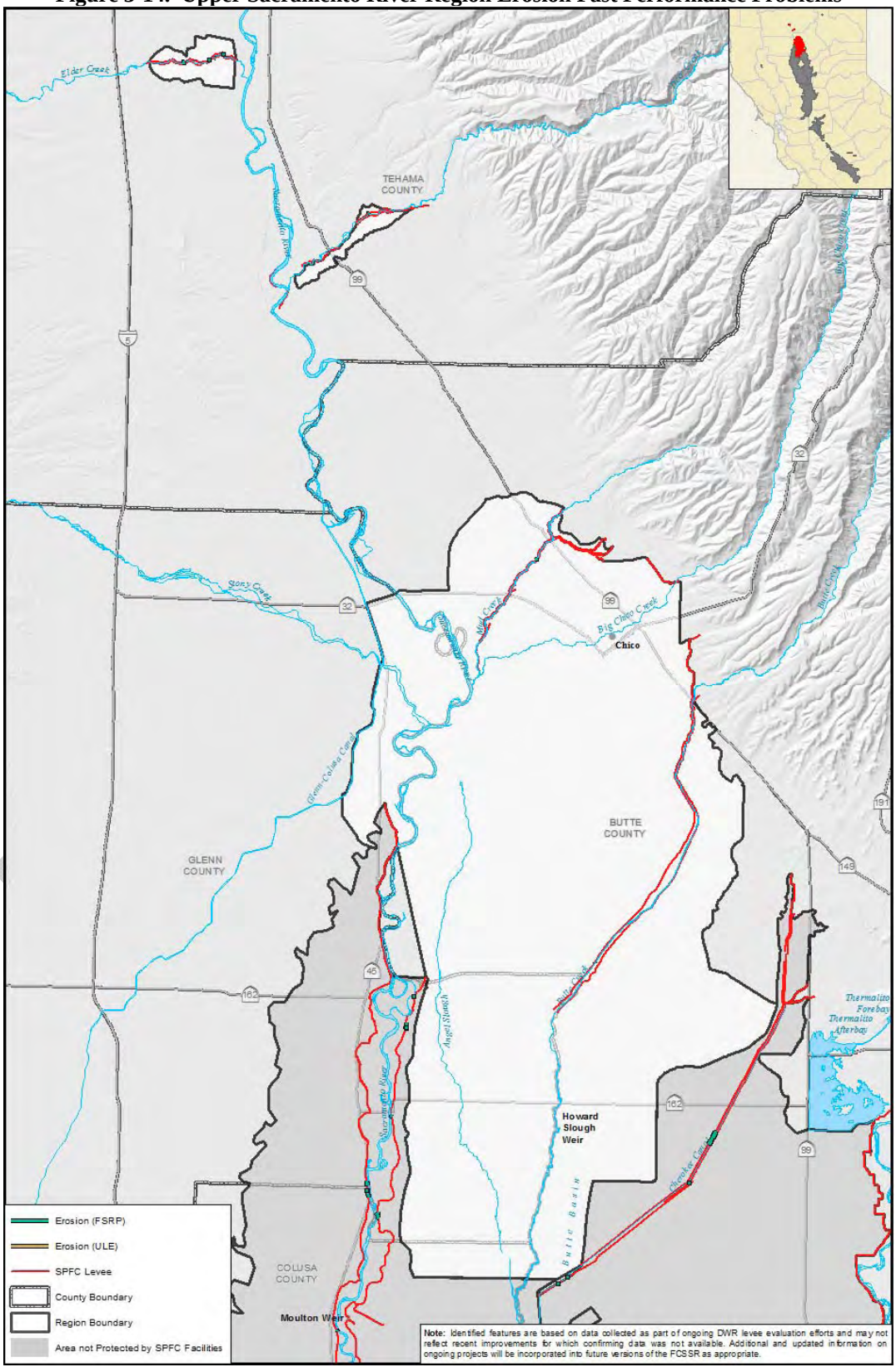
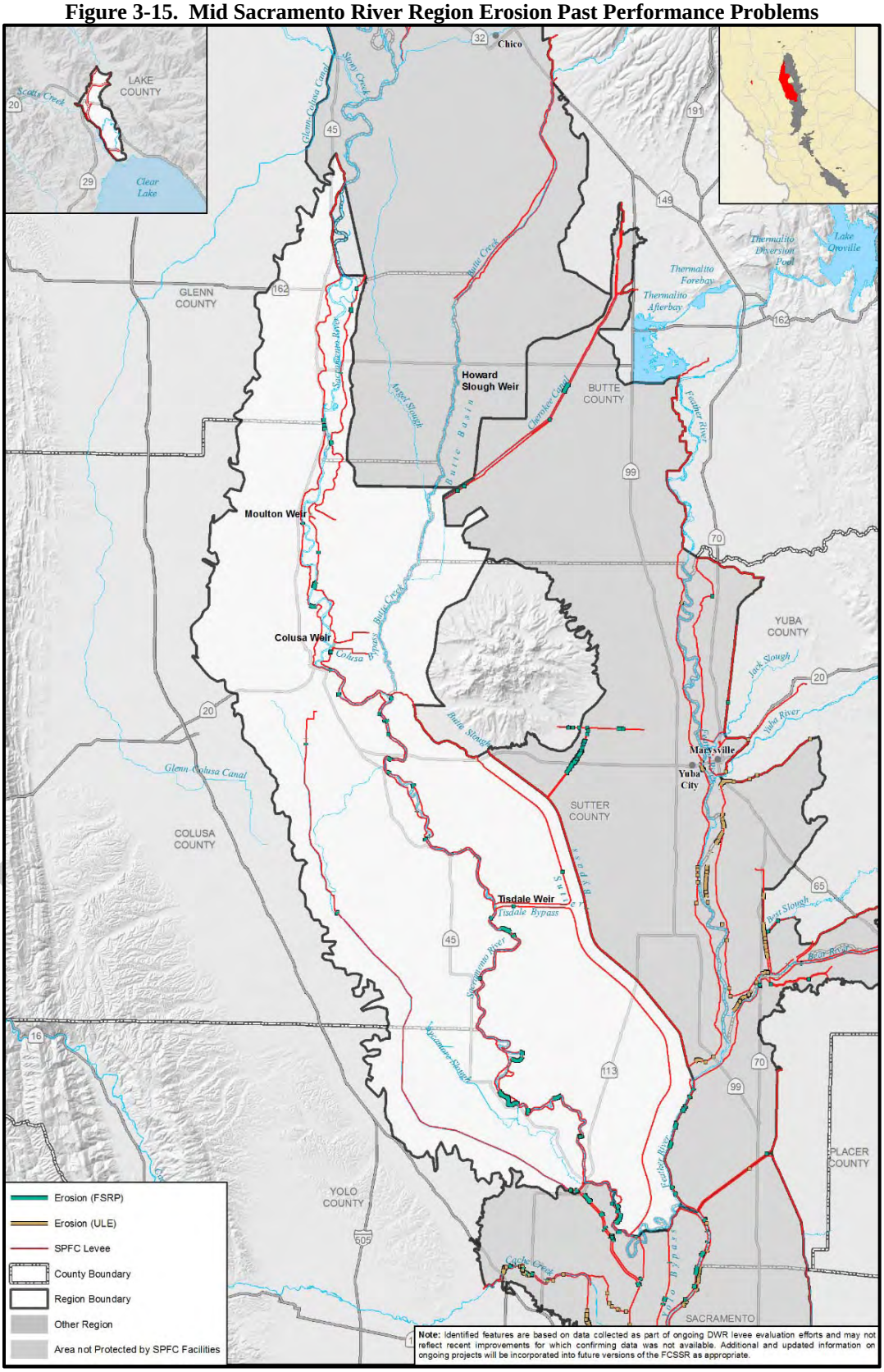


Figure 3-15. Mid Sacramento River Region Erosion Past Performance Problems



3.1.3. *Weirs*

As described in Chapter 2, floodwaters in the Sacramento River are reduced by diversion into flood bypasses via weirs and channels located in historic lowland overflow areas. These diversions are controlled principally by overflow weir structures and quasi-natural overflow areas, as described in the following section and shown in Figure 3-16.

Butte Basin Overflow Areas: M&T, 3B's, Goose Lake

The M&T, 3 B's and Goose Lake overflow areas and relief structures serve to divert a substantial portion of flood flows over the east bank of the Sacramento River into Butte Basin. DWR maintains all three of these flood relief structures (DWR, 2010). The existence and operation of these overflow areas is critical to downstream flood management as they relieve pressure off of the Sacramento River main channel levees. These overflow areas were not engineered to current USACE or DWR construction or performance standards, and are subject to erosion, which requires regular post-flood maintenance. For example, the 3-B's overflow structure is an unprotected weir comprised dominantly of silt-sized soil, which experiences scour and allows Sacramento River flows to bypass into the Butte Basin at lower stages than designed. The M&T and Goose Lake relief structures have required installation of localized rip-rap and concrete to help prevent scour and maintain structural integrity.

Moulton, Colusa, Tisdale, and Fremont Weirs

There are four primary flood relief weirs in the Regions, all of which consist of fixed elevation, lowered sections in the levee profile that serve to spill floodwaters when discharge in the Sacramento River is sufficient to flow over the crest of these weirs. These four hydraulic flood relief weirs, in order from upstream to downstream, are the Moulton Weir and Colusa Weirs that drain into the Butte Basin, the Tisdale Weir that drains into the Sutter Bypass, and the Fremont Weir, which is the upstream extent of the Yolo Bypass (and is located just outside the Regional boundaries).

Functioning properly and without obstructions or debris, the weirs limit the discharge and stress to levees in the main stem Sacramento River downstream of each respective weir. The flow dispersed into the Butte Basin and Sutter Bypass also serve to attenuate the flood hydrograph to downstream areas. These weirs function by gravity, spill when discharge of the river is sufficient to exceed crest height, and there are no gates or operable controls. Each of the weirs are concrete, have concrete stilling basins immediately downstream to dissipate energy, have channel stabilization features (rip-rap and/or erosion control blankets) further downstream of the stilling basin, and have training levees that define weir flow down the respective bypass, or relief channels (DWR, 2010).

A common operational and maintenance challenge is the removal of sediment deposits at the weir structures or in the channels downstream of the weirs. Sediment (gravel, sand and silt) deposition in the channel can have a significant negative impact on the hydraulic capacity of the channel and/or the weirs themselves (DWR, 2010a). Recognized as a specific and critical problem, a project in the Tisdale Bypass channel was conducted in 2007 to remove sediment, and this work was completed as a component of DWR's Early Implementation Program (DWR, 2007). Similar to sediment deposition is the potential for deposition of debris along the face of

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the weirs, which also has a negative impact on hydraulic capacity. Sediment and debris removal will continue to be ongoing maintenance issues.

Because they are a large source of flow into the Butte and Sutter Basins during floods, these weirs essentially serve as the "headwaters" during flood prone winter seasons. Because up-migrating salmon and steelhead in the basins may be queued toward this flow, fish passage and fish stranding is a concern. Currently, Fremont Weir has a small fish ladder at the center of the weir that operates during flood or overtopping flows (DWR, 2010a). The other weirs do not allow passage of fish during higher flows. Additionally, the fixed elevation nature of these structures do not allow for variation in flow depth/discharge during variable flow rates in the Sacramento River.

3.1.4. *Reservoirs*

There are two reservoirs with flood management capacities that discharge into the plan region, Shasta Reservoir and Dam of the Sacramento River near Redding, and Black Butte Reservoir and Dam on Stony Creek. Shasta Reservoir, the 1949 federally-built and operated facility by the United States Bureau of Reclamation (USBR) is substantially larger than the also federally built and operated (USACE) Black Butte facility. Shasta Reservoir provides significant water supply benefits, but also is a critical component of the SPFC. Despite not being part of the State Plan of Flood Control (SPFC), the operation of the facility is coordinated with State operations to best manage discharges and reduce flood risk and meet other regulatory demands (DWR, 2010b).

The primary concern amongst local stakeholders regarding reservoirs is the lack thereof, and the recent extreme drought conditions have spotlighted the need for the creation of new reservoirs to bolster California's existing water supply. While the primary benefit of these facilities would be water supply reliability, the development of new reservoirs would also include secondary benefits to flood control.

An increase to the storage capacity of Shasta Reservoir is currently proposed by the USBR and is currently in the Feasibility Analysis stage of project development. A draft feasibility report was released in February 2012, which recommended an 18.5 foot increase to the dam as the feasibility analysis shows this to have the greatest net economic benefits. The USBR released the project Environmental Impact Statement (EIS) in July 2013 (USBR, 2013). The 14% (634,000 acre-feet) increase in storage capacity has primary objectives of anadromous fish survival and water supply reliability, with reduced flood damage being a secondary objective. The construction cost is estimated at $1.07 billion (USBR, 2013).

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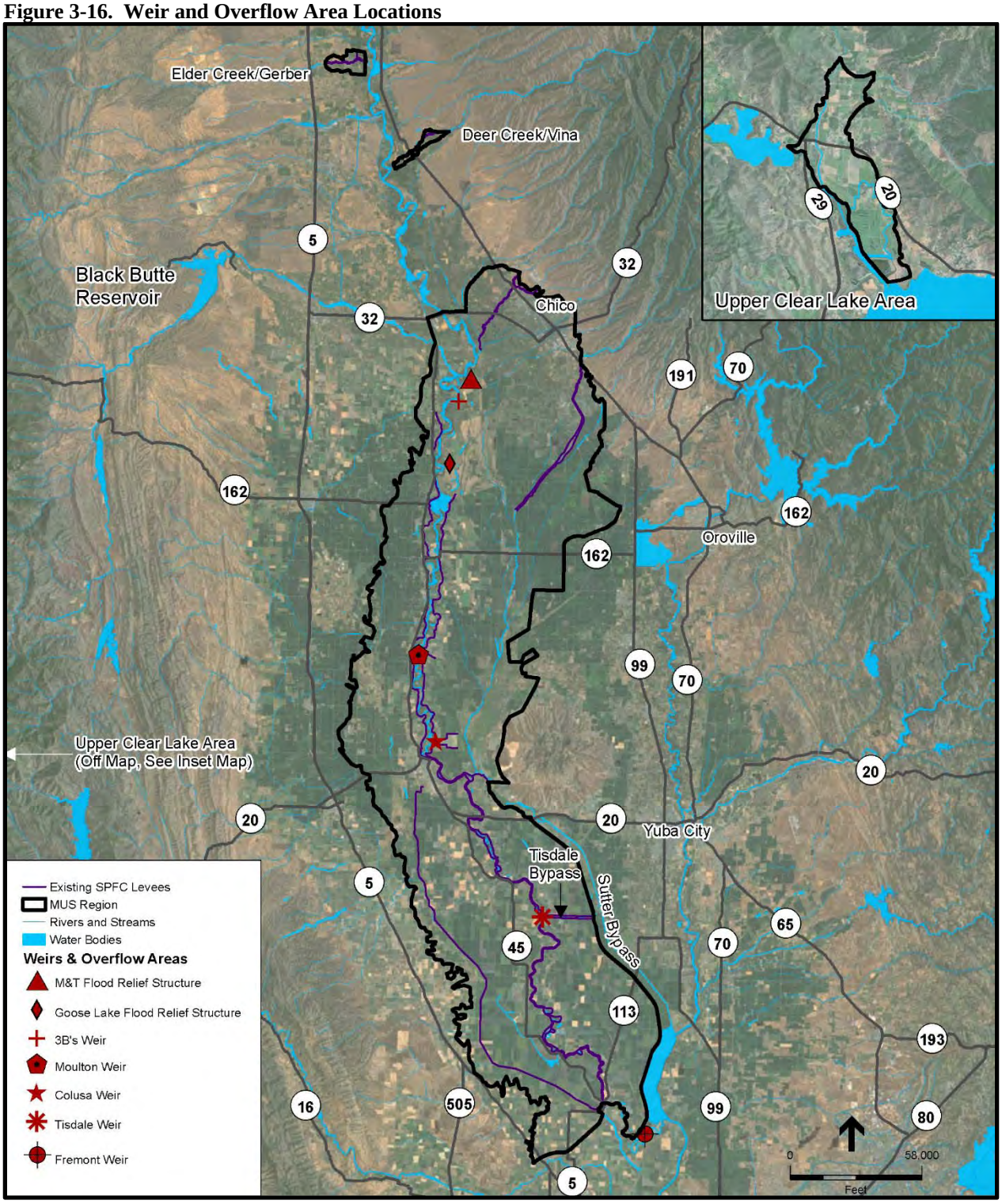
Figure 3-16. Weir and Overflow Area Locations



3.2. Risks Associated with Identified Flood Control System Deficiencies

The different types of flooding most prevalent within the Regions include stormwater, slow rise, and flash flooding and flooding associated with structure failure. Floods within the MUSR Region originate principally from heavy rainfall, with most events occurring in December and January as a result of multiple storms and saturated soil conditions. However, heavy flows also occur in October and November or during the late winter or early spring months with rainfall occurring on top of snow (DWR, 2013).

Risk can be defined as the possibility of loss, injury, or other adverse condition. Risk can be evaluated numerous ways, but with respect to flooding potential, risk is generally understood as the combination of the relative probability that an event will occur and the consequences of the event occurring, which includes the value of assets involved and how vulnerable the impacts are to other facets of the region (FEMA, 2006).

3.2.1. *Floodplain Delineation: Currently Mapped FEMA and DWR Floodplains*

Knowing where potential floodwaters may physically extend on the landscape serves a vital role in planning for and assessing flood risk. This delineation of where flood water will occur is commonly referred to as a "floodplain". The extents of floodplains are determined using mathematical hydraulic computer models, which use topographical and hydrologic inputs. Over time, these hydraulic models have become more sophisticated and provide users with more options to best simulate actual conditions. However, the accuracy of these models is inherently limited due to the dynamic physical properties of natural channels and limited accuracy of input data. Hydrologic inflows are traditionally based on exceedence probability, or the number of years a flow will be met or exceeded, based on historical knowledge and data. Flood frequencies typically used are the 100-year, 200-year, and 500-year based exceedence probabilities.

Floodplains have been delineated by multiple agencies for the Sacramento River and associated tributary channels. These different agency floodplain delineations have unique purposes to illustrate a specific risk. These agencies that have floodplain delineation include the Federal Emergency Management Agency (FEMA), State Central Valley Flood Protection Board, and Department of Water Resources.

The more commonly known floodplain delineation is those provided by FEMA. FEMA manages the National Flood Insurance Program (NFIP), which is a federal program that communities can participate in as an insurance mechanism that requires a premium to be paid for financial protection against flood losses. FEMA has jurisdiction to regulate lands and activities within the FEMA floodplains and labels these flood plains as 'flood zones'. Flood zones are geographic areas that FEMA has defined according to varying levels of flood risk and type of flooding. These zones are depicted on published Flood Insurance Rate Maps (FIRMs) or Flood Hazard Boundary Maps (FHBMs). Flood zones designated as "special hazard" flood zones are those with 100-year recurrence intervals. Some areas have rather recent and more accurate

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floodplain delineations than other areas, depending on the age and methodology of analysis (FEMA).

Figure 3-17. Overview of 100-year and 200-year Floodplains

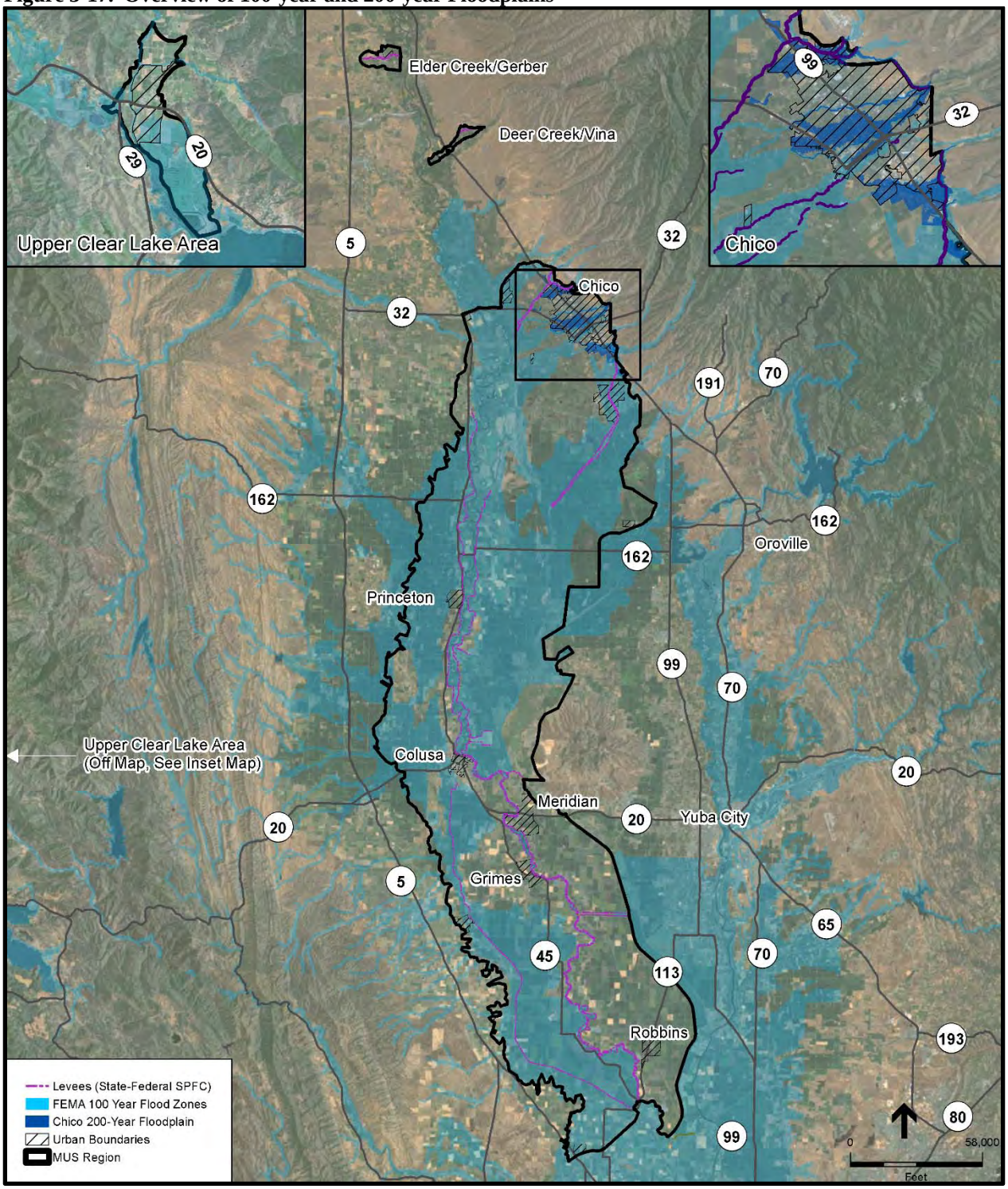


Figure 3-18. Upper Sacramento River Region Special Flood Hazard Areas

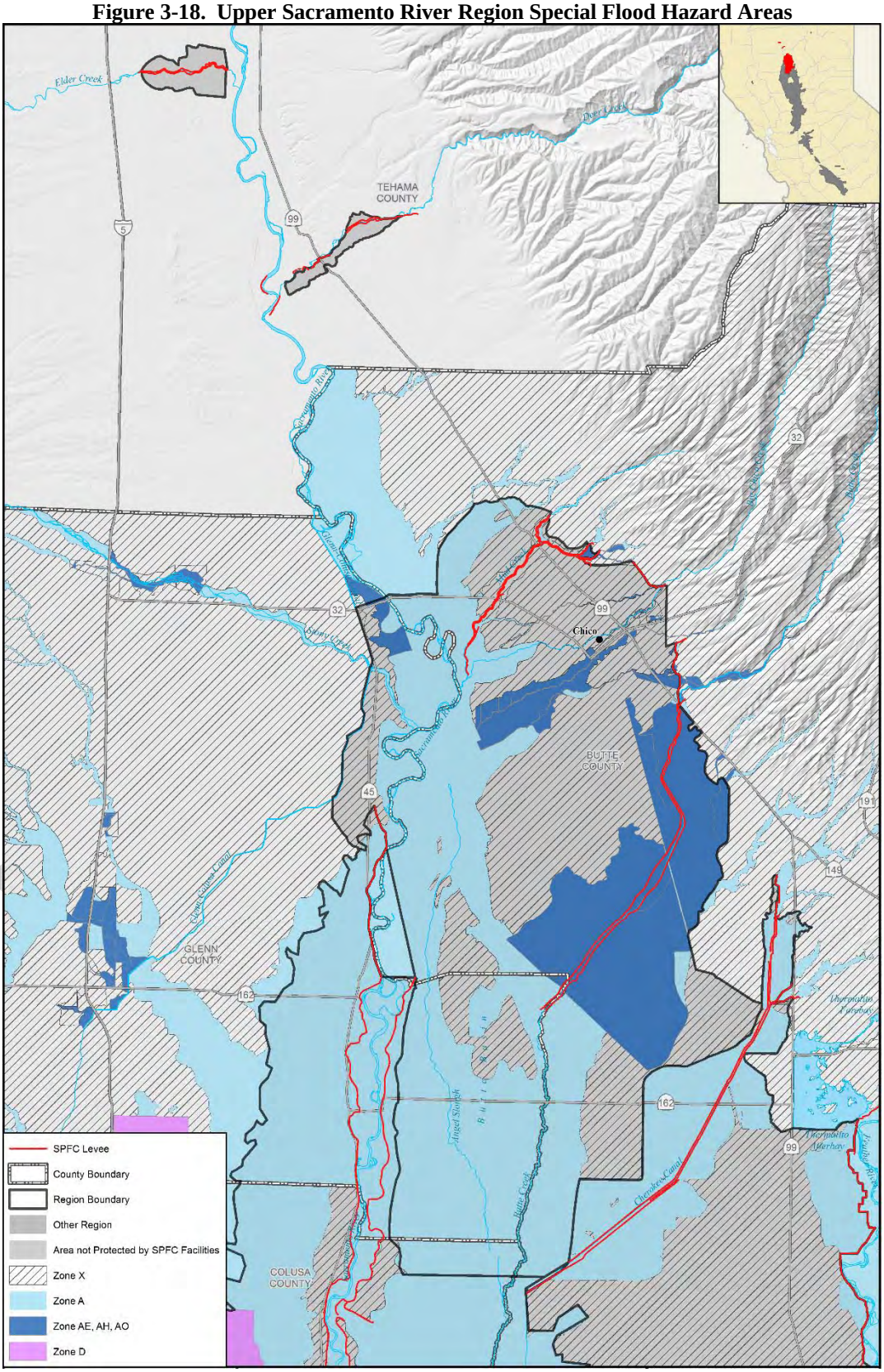
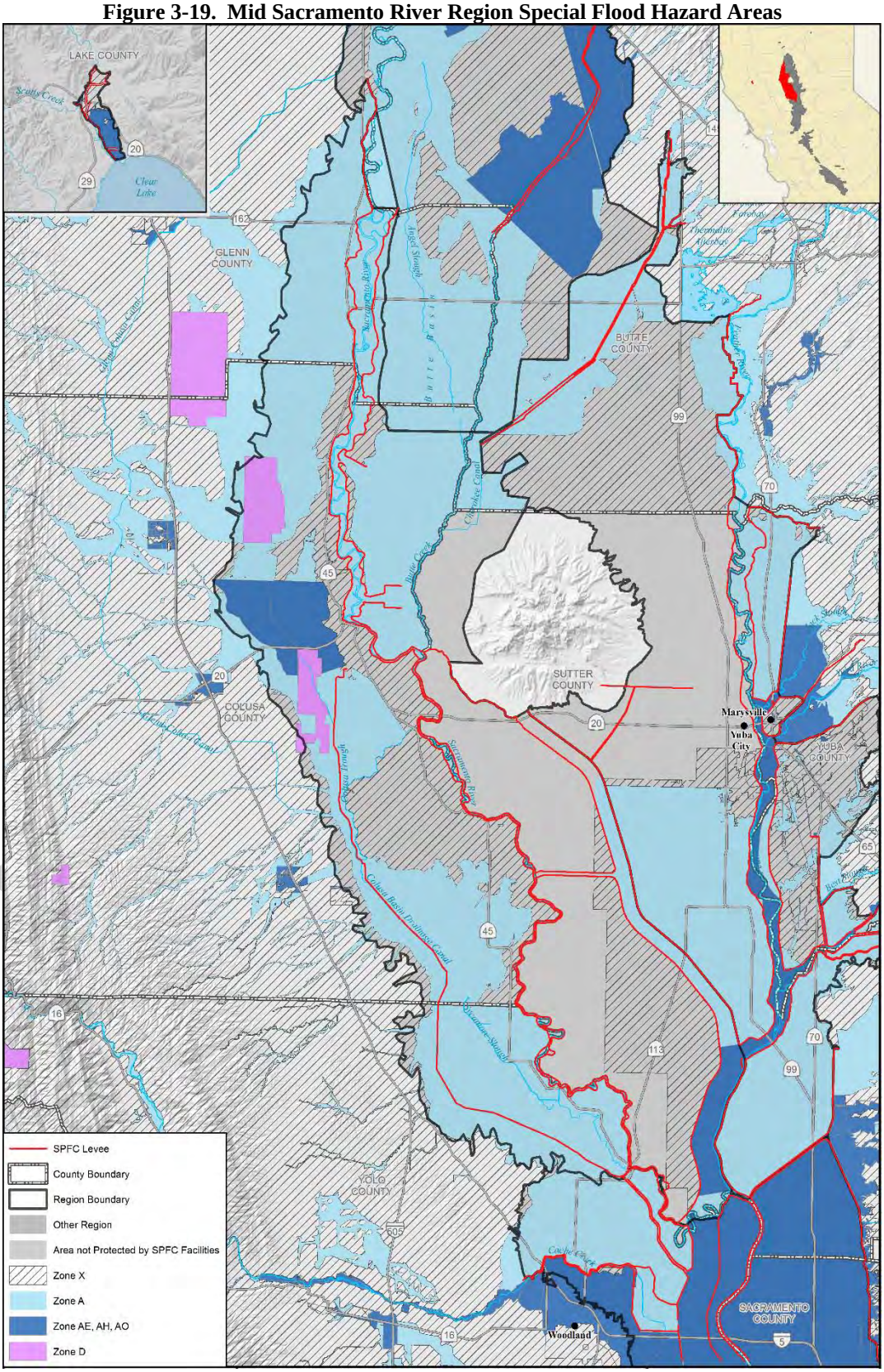


Figure 3-19. Mid Sacramento River Region Special Flood Hazard Areas



The Central Valley Flood Protection Board manages designated floodways within the central valley, including the Sacramento River and tributary channels within the reach. These designated floodways are not part of the SPFC as they do not contain assurances to, or participation from the federal government. These designations began in 1968 to control encroachments and preserve flow capacity of floodways based on CWC Section 8609 (DWR, 2010).

The California Department of Water Resources (DWR) have delineated floodplains in an effort to help inform landowners, decision makers and facilitate land use planning. DWR prepared Levee Flood Protection Zone (LFPZ) Maps, which represent floodplain areas protected by Central Valley State-Federal Project Levees, and identify the areas where flood levels would be more than three feet deep if a project levee were to fail. These maps were developed based on the best available information as required by Assembly Bill 156.

As part of SB 5, DWR prepared Central Valley Floodplain Evaluation and Delineation (CVFED) Maps and represent 100- and 200-year floodplains for urban and urbanizing areas within the Sacramento-San Joaquin Valley watersheds. These maps were developed in 2013 and distributed to the City of Chico, which is the only urbanized area in the region for which these delineations apply. These delineations serve to improve the quality and accuracy of flood hazard data and mapping available to urbanized areas within the SPFC.

3.2.2. *Population and Assets at Risk*

Broadly stated, the levees that were originally constructed to protect largely agricultural areas are inadequate to protect developing areas. Although the regional flood management system has prevented millions of dollars in flood damages since its construction, a better understanding of the risk assessment and engineering standards has made it clear that some of the regional levee segments face an unacceptably high chance of failure. This, combined with growth in the Regions has increased the estimated level of flood risk. While the chance and frequency of flooding has decreased since construction of the Regions' levees and multipurpose reservoirs, the damages that would occur if a levee were to fail in one of these areas are much greater, resulting in a net long- term increase in cumulative damages if no further action is taken to improve the flood management system.

The Mid and Upper Sacramento River Regions land use is predominantly agricultural and rural. However, several communities along with a substantial number of rural dwellings are at risk of flooding due to either their proximity to waterways, or due to their relatively low lying elevation. Within the boundary of the Regions, the City of Chico and surrounding area is both the most dense and highest populated area subject to flooding. Many small communities and rural areas are also heavily impacted. Table 3-4 below presents population and asset values for the counties in the Regions. These values are from DWR's 2013 *Flood Future Report* and illustrate the rural nature and potential flood risk of the Regions.

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Table 3-4. Population and Asset Summary

County	County Wide[1]					Within 100-year Floodplain								
								Structures and Contents			Crop			
	Population	Area (AC)	Structure and Contents Valuation[2]	Crop Area (AC)	Crop Valuation[2]	Area (AC)	% Total	#	Valuation[2]	% Total	Area (AC)	% Total	Valuation[2]	% Total
Butte	220,000	1,100,000	$16,800	223,900	$340.7	198,800	18%	5,300	$1,100.0	7%	119,000	53%	$146.9	43%
Glenn	28,100	849,100	$1,700	244,700	$324.9	123,300	15%	1,800	$246.0	14%	80,900	33%	$86.5	27%
Tehama	63,500	1,900,000	$4,100	112,400	$166.9	86,800	5%	3,800	$625.0	15%	24,300	22%	$62.3	37%
Colusa	21,400	740,400	$1,300	293,200	$335.6	175,300	24%	2,300	$334.0	26%	12,100	4%	$78.1	23%
Sutter	94,700	389,300	$7,300	282,500	$394.2	195,000	50%	2,100	$405.7	6%	164,300	58%	$218.8	56%
Lake	64,700	850,800	$5,600	28,500	$84.1	69,700	8%	6,400	$919.3	16%	7,200	25%	$22.0	26%
Yolo	201,300	653,500	$15,500	348,000	$631.8	240	0%	19,500	$5,800.0	37%	180,500	52%	$330.7	52%

Notes:
1. The values in this table are from DWR's 2013 Flood Future Report, which is based on the entire county, not the MUSR RFPM Planning Area
2. Valuations are in millions of dollars. Valuations are based on DWR's Flood Future Report, which used county assessor parcel records to identify structures and valuations based on reconstruction and subsequent depreciation. Content value was estimated implicitly as a function of structure value (DWR, 2013).

Assets can generally be defined as those fixed facilities that have an assessed or known monetary value. There may also be assets that have an intrinsic or sentimental value, however, these are difficult to quantify. As discussed previously, agricultural land use dominates most of the Sacramento Valley within the MUSR Regions. These lands contain a variety of different types of structures that range from storage garages to rural homes to high dollar agricultural processing facilities. The density of these structures also varies throughout the Regions, where some areas consist of smaller (10- or 20-acre) farmsteads with homes, and other areas consist of large tracts of land used primarily for larger industrial agricultural operations. Figure 3-20 helps illustrate the relative spatial density of structure assets within the region.

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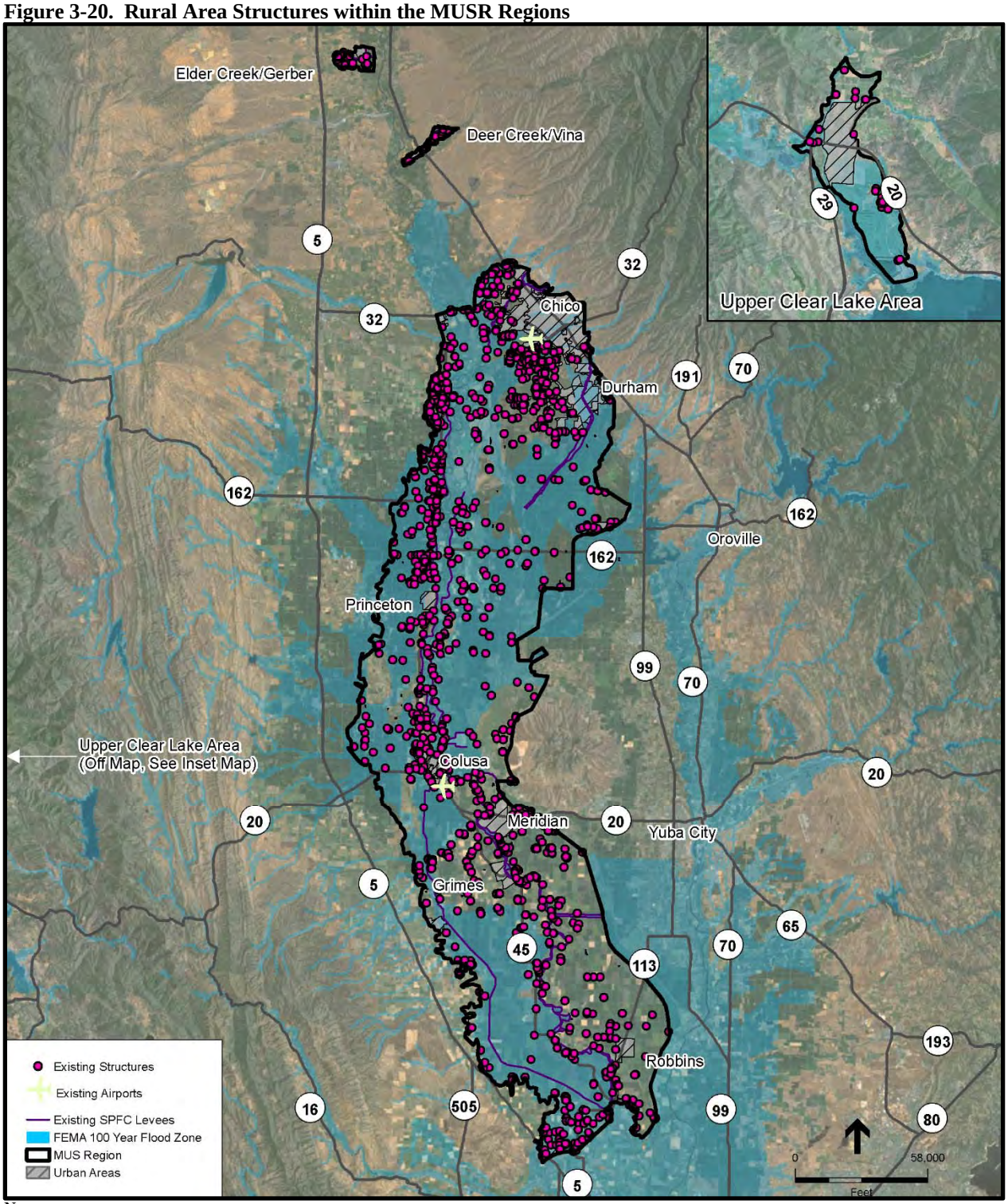
Figure 3-20. Rural Area Structures within the MUSR Regions



Notes:
Existing structure locations were determined from aerial imagery provided by ESRI.
Existing structures are not shown in Urban Areas. Urban Areas include all areas that contain a relative high density of structures.

3.2.3. *Critical Infrastructure*

Transportation plays an essential role in the economy and the overall functioning of society. Providing mobility enables individuals to participate in the labor force and facilitates the movement of goods and services. During times of catastrophic events, such as flooding, having a reliable and robust transportation network is critical to prompt emergency response.

The Mid and Upper Sacramento River Region has several major transportation roadways and bridges threatened by flooding that connect communities within the Regions and connect the Regions to outside areas. Table 3-5 identifies the most critical flood prone routes which play a vital role the interconnectivity of the Regions.

Table 3-5. Major Regional Roadways threatened by Flooding

Roadway Name	Connectivity	Flood Threat Sources
I-5	Major north-south route.	Western Foothill Streams
Hwy 99	Major north-south route. Alternate route to I-5.	Elder Creek, Deer Creek, and Rock Creek/Keefer Slough
Hwy 36	Major East-West route into Sierra Nevada Foothills	Battle Creek
San Benito Ave	Only one of two exits for Gerber.	Elder Creek
South Ave	Connects Corning and I-5 to 99. Alternate Route to I-5 and is primary route for heavy traffic	Sacramento River
Hwy 32	River crossing near Hamilton City; Connects Chico to I-5	Sacramento River
Ord Ferry Road	River crossing near Ord Bend	Sacramento River; Routinely floods from overflows into the Butte Sink
Hwy 162	River crossing near Butte City	Sacramento River; Routinely floods from overflows into the Butte Sink
River Road (Colusa)	River crossing near Colusa; Connects Colusa to lower Butte Sink	Sacramento River
Hwy 20 (Colusa - Sutter)	Major east-west route.	Sacramento River, Colusa Drain, and Sutter Bypass
Hwy 45	Major north-south route.	Sacramento River
Hwy 113	Major north-south route.	Sacramento River and Sutter Bypass
Hwy 20 (Lake County)	Major Regional east-west roadway.	Middle Creek
Nice-Lucerne Cutoff Rd.	Major east-west roadway; Alternate route to Hwy 20.	Middle Creek

Utilities are the various external services that are provided to a community, building or facility to provide a certain level of functionality. Utilities can be segregated between 'wet' and 'dry', with wet utilities being water supply and wastewater or sanitary sewer facilities, and dry utilities being gas distribution and transmission, electrical distribution and transmission, and phone and cable communication lines. Utilities that cross river or channel crossings are of a more critical concern due to the potential for exposure or disruption from channel scour. In addition, there are

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major distribution gas and petroleum facilities, major communication facilities, and other utilities that play a vital role in the inter-connectivity of the State.

Other critical facilities include hospitals, schools, communication facilities, and other emergency service facilities such as fire and police stations. These facilities are typically given special consideration as they provide for the safety and health of citizens during a time of emergency. The following figure provides an overview of critical facilities known to exist within flood prone areas of the Region. These critical utilities and facilities are further discussed in Chapter 5 of this RFMP.

3.2.4. *Water Quality*

There are several important connections between flood management and water quality. Most importantly, floods are capable of mobilizing large sediment loads and any included contaminants, carrying them downstream, and then sorting and re-depositing them. Also, when levees fail, the inundation of homes, farms, businesses, and industries often results in the release and dispersion of known toxic chemicals or oils and fuels from a flooded chemical storage facility, which can have far reaching health and economic effects. For example, when levee overtopping occurred on Middle Creek in 1995, it inundated a local junkyard and distributed many oils and toxins into the environment. Also, due to the rural agricultural setting of the Region, there are numerous fertilizer, herbicide and pesticide processing and storage facilities at risk.

These types of water quality concerns will continue to affect flood management programs by requiring that contaminants and toxics be addressed in the planning, design, construction, and maintenance phases of flood management projects, most likely intensifying in the future.

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Figure 3-21. Upper Sacramento River Region Emergency Response Facilities

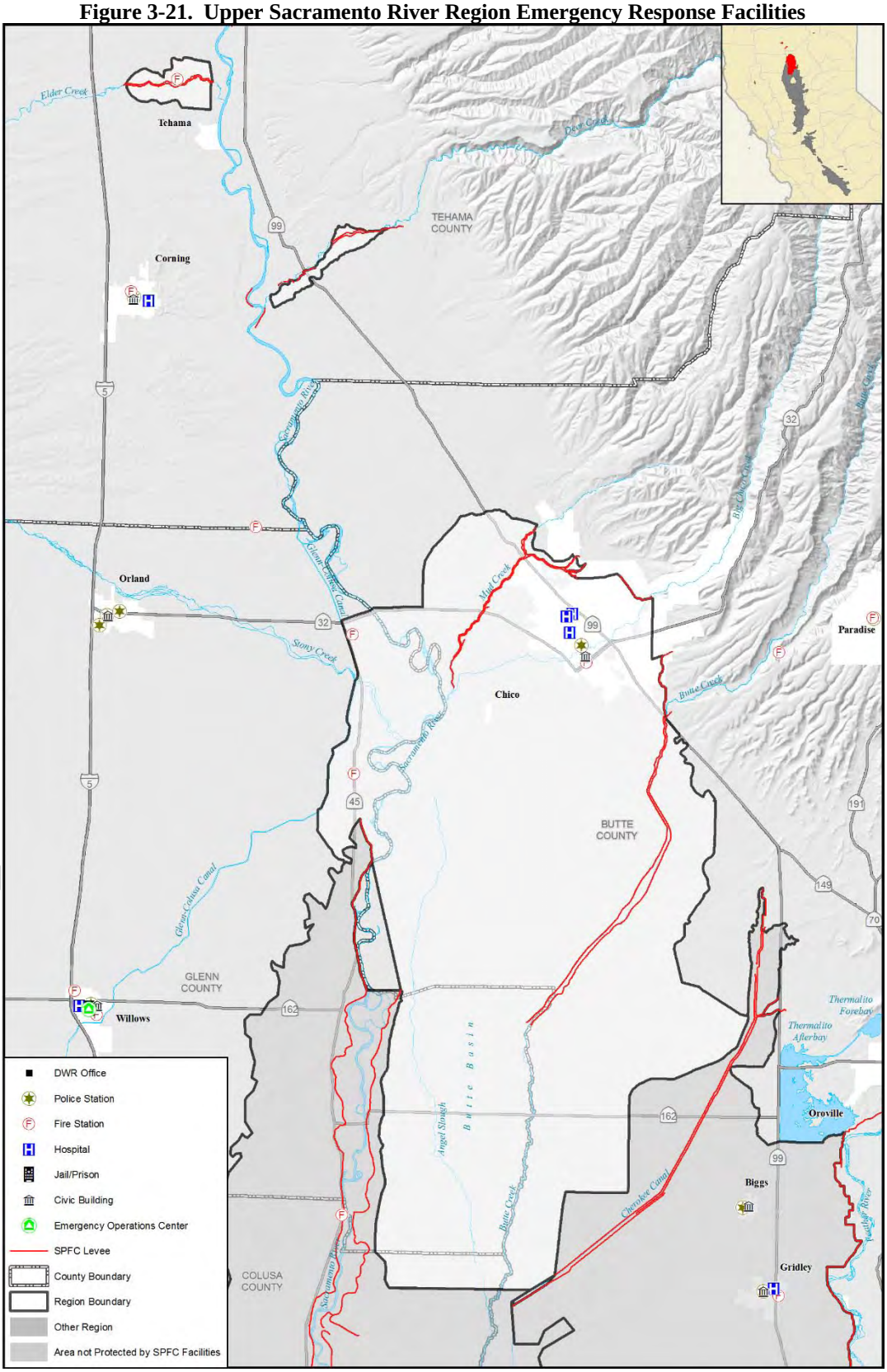
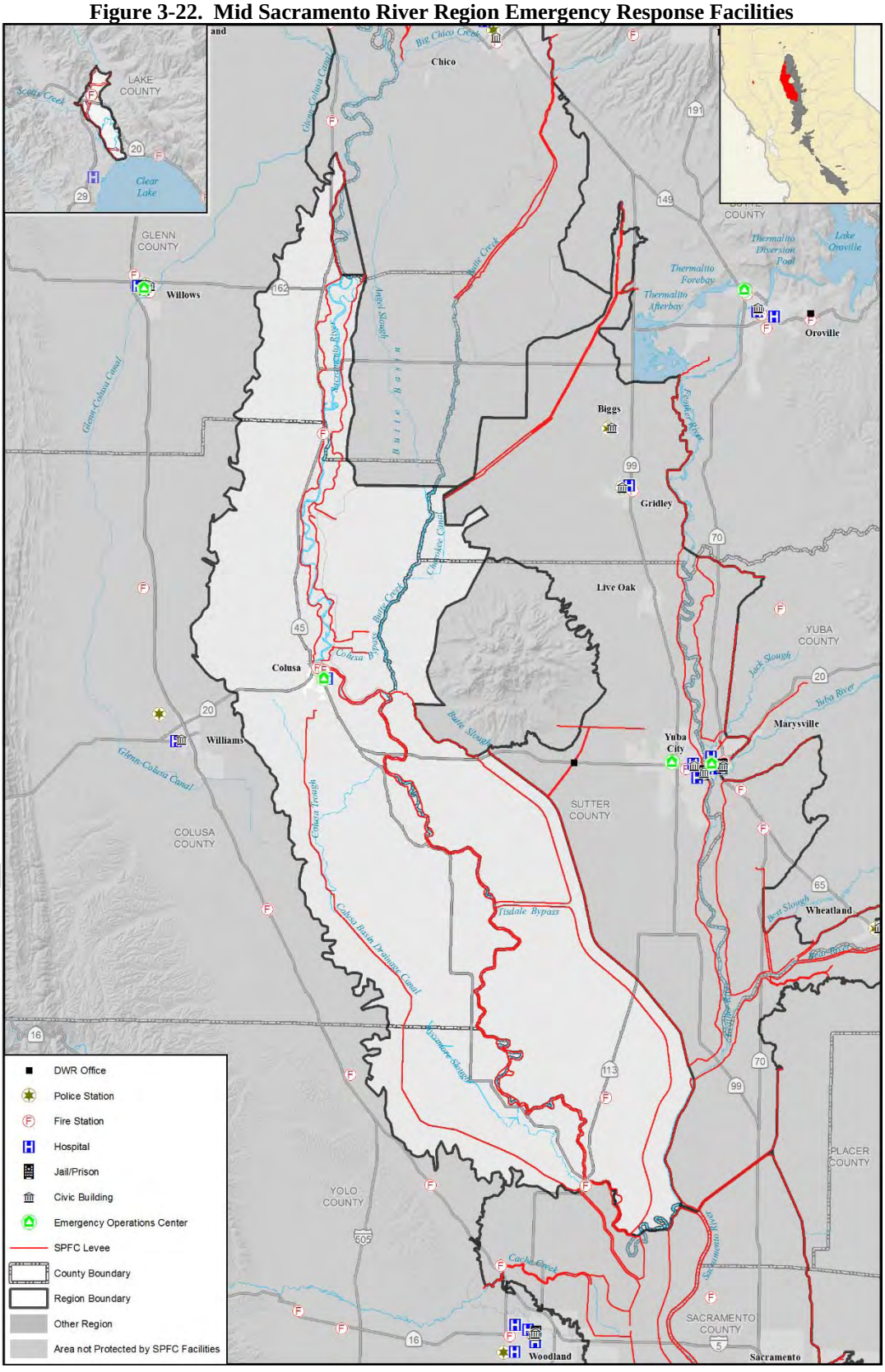


Figure 3-22. Mid Sacramento River Region Emergency Response Facilities



3.3. Flood Management Challenges

3.3.1. *Project Implementation*

To address the deficiencies and reduce the risks discussed above, flood system improvement projects within the Regions will need to be undertaken. However the development and ultimate implementation of flood system improvement projects is a difficult process. Developing a project and guiding it to construction involves a substantial commitment on behalf of the project sponsor. The project development process includes feasibility and preliminary studies; securing funding; performing detailed technical studies, completing biological surveys, and environmental permitting; obtaining other flood and land use permits; performing public outreach; administering contracts; final design development; and ultimately construction of the project. For the most part, local levee maintaining agencies were established and structured to provide basic operation and maintenance (O&M) activities and they are simply not adequately funded or staffed to implement large flood control capital improvement projects. The same is true for the towns, cities, and counties which now feel compelled to become involved in upgrading and providing flood control infrastructure due to regulatory pressures from State and federal agencies to improve flood protection.

The project development and implementation process typically takes several years to accomplish, with both recent and current projects providing some insight into the various challenges and obstacles that can cause significant delay or potential project termination. Some of the more typical project development components that have proved difficult include securing a robust funding source; the cost and time required to complete technical environmental studies and, in particular the review and resolution and granting of environmental permits; changes in regulatory baselines; and the cost variability and duration of acquiring property access.

For small communities and rural areas, acquiring a secure funding source that is sufficient to fund all project components is universally rare, oftentimes despite a substantial level of support for a project. The Hamilton City "J-Levee" is a particularly good example of a widely accepted and supported project being delayed because of a lack of funding. That project has been authorized for nearly 10 years (USACE, 2004), and has been awaiting a federal funding appropriation since being approved in 2007. As illustration of the challenges of current projects, Table 3-6, which includes a summary of existing and currently-contemplated large-scale flood projects in the regions, also demonstrates timelines and challenges faced by these projects, even with all of these projects generally well-supported.

In addition to funding challenges, the lengthy and costly environmental review and permitting process is problematic. Flood improvement projects inherently involve aquatic and riparian areas and, in California, these areas typically include a relatively-higher concentration of sensitive species, some that are listed as threatened or endangered by the state and/or federal governments. Consequently, projects with relatively small footprints and/or low construction cost may still require substantial environmental review and permitting as compared to larger projects. Staff reductions at regulatory agencies further complicate and add delays to the

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1 situation as those individuals must still comply with established laws and regulations despite
2 inappropriate workloads.

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Table 3-6. Summary of Select Major Projects within the MUSR Regions

Project	Description	Year Issue Emerged	Project Initiated	Status/ Duration					
				Funding Status	Technical Solution Developed	Environmental Permitting	Regulatory Compliance (CEQA/NEPA)	CVFPB and/or Section 408[1] Approval	Project Approval (Congress)
Lower Deer Creek Levee Improvements and Habitat Restoration (five phases)	Floodway Improvement, Ecological Habitat Restoration, and Levee Improvements (including Levee Setbacks)	1980s or earlier	2011	DWR considered direct funding Phase 1 and a portion of Phase 2 by the Flood Corridor Program in 2013, awaiting competitive selection.	Feasibility Study Completed, 2011	Not Started	Not Started	Not Started	Not Started
Hamilton City J-Levee	Levee setback	No Specific Year- ongoing flooding history	2000	Federal FY14 funding approved	Engineering and Design Completed, 2009	None. Categorically exempted or impacts avoided	Done, 2004	No Section 408 required. CVFPB permit not required.	Authorized in WRDA 2007
Kopta Slough	Flood Damage Reduction and Habitat Restoration Project	1980s	USACE initiated, 1998 DWR continuing feasibility study, 2007	Planning currently funded by DWR. Need construction funds	In Process, Draft feasibility study completed in 2014	In Progress	NOP likely out in Spring 2014	In Progress. Working with USACE and CVFPB Staff	Likely will not require Congressional approval
Riparian Sanctuary Restoration and Pumping Plant/Fish Screen Facility Protection Project	Rock removal, bank stabilization (rock placement) and habitat restoration	2001	2002	Need	Completed, 2012	Applications Done 2013 (preparing to submit)	Done, 2013	Preparing to submit	N/A. Can be approved at the Corps District level

1. Rivers and Harbors Act of 1899, Title 33 United States Code, Section 408

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3.3.2. *Habitat Mitigation Requirements*

Habitat mitigation is required to mitigate the impacts of a development or infrastructure construction or repair/replacement project. Habitat mitigation is comprises enhancement or rehabilitation of habitat in specific ways, for the betterment of the impacted species. These actions may include planting of vegetation, grading and contouring of the land surface and/or adjusting the hydrologic regime of the area through irrigation or management of drainage. This may at times involve the conversion of agricultural lands back to habitat. These mitigation areas are frequently located away from the project's site of impact, and the land use changes associated with the habitat mitigation have an influence on the properties adjacent to the mitigation site. The time and cost requirements associated with the mitigation process are a challenge for many local agencies whom are already struggling with other fiscal and staffing constraints.

3.3.3. *Evolving and Conflicting Levee Standards*

The methods used by USACE and DWR to estimate flood risk have become more conservative. Since 1995, USACE has been developing and implementing its risk and uncertainty methods, as well as upgrading its structural design criteria, with the net result that many existing facilities, which were previously rated as substantially adequate to meet project design criteria, have subsequently been downgraded. For example, the Natomas levee system, thought to provide 200-year to 400-year protection when upgraded in 1998, was downgraded to a 30-year rating ten years later.

In addition, standards for the design, construction, and management of levees have evolved over time, often in response to structural failures during floods. SPFC levees have been constructed through the individual and combined efforts of local, State, and federal agencies. The facilities were constructed with materials at hand over many decades, to meet evolving design standards and construction techniques. As a result, these facilities provide varying levels of protection, depending on when and how they were constructed and upgraded (DWR, 2012).

The flood risk evaluation and designation process has been very dynamic, with frequently changing standards for all aspects of levee system management being developed. This liquid regulatory dynamic poses unique challenges for responsible agencies who work to upgrade their levees to keep pace with these standards. A brief summary of some of the recent changes in State and federal levee standards is provided below.

USACE Standards:

In 2005, Hurricane Katrina caused widespread flooding and devastation along the Gulf Coast, most notably the flooding of much of New Orleans. As a result, USACE launched a multi-pronged effort to improve levee management nationwide, including the creation of a national levee database, risk notification procedures, and more stringent enforcement of its levee standards. Among the key changes in the USACE approach to national levee standards was the promulgation of levee vegetation management standards, which have had the effect of requiring

the removal of most woody vegetation from levee slopes and adjacent ground. From the State perspective, the removal of woody vegetation does not rank high in terms of levee safety risks. Accordingly, the CVFPP recommends a life cycle approach to vegetation management, in which woody vegetation is monitored and managed to assure that it does not pose localized threats to levee integrity. USACE has also stepped up enforcement of other standards for various aspects of levee integrity, including encroachments, penetrations, erosion protection, patrol roads, and structural cross sections.

Levees that are deemed noncompliant with current USACE standards risk being classified as inactive in the federal Rehabilitation and Inspection Program (RIP), which would make the levees ineligible for PL 84-99 rehabilitation assistance in the event of damage or failure during a flood. In addition, in many cases FEMA has based its National Flood Insurance Rate Maps (FIRM) hazard classification upon USACE determinations or certifications of levee integrity and channel capacity. When USACE downgrades levee structural ratings within its evolving standards, re-mapping by FEMA is a likely outcome.

State Urban Levee Standards:

Prior to 2008, the State primarily relied on USACE levee design, construction, operation, and management standards. Its historic role in the region included cost sharing in the construction of Project levees, providing Lands, Easements, Real Estate, Relocations (LERRDs), borrow materials, and disposal sites, and certifying that that the State, through the CVFPB, would take responsibility for Operation, Maintenance, Repair, and Rehabilitation (OMRR).

With the enactment of the 2007 California Flood Legislation however, the State's role in establishing levee standards was expanded. DWR led the development of the new levee standards for urban areas called the Urban Levee Design Criteria (ULDC, May 2012), which describes the levee and floodwall design criteria that flood control facilities protecting urban levees must now meet.

The ULDC provides engineering criteria and guidance for the design, evaluation, operation and maintenance of levees and floodwalls that provide an urban level of flood protection, as well as determining design water surface elevations along leveed and unleveed streams. Other topics are presented to provide reasonable assurance that once a levee or floodwall is found to provide an urban level of flood protection, it will continue to do so. The ULDC is very comprehensive and more stringent than current practice for levee design and accreditation

Rural Levee Repair Guidelines:

Most of the levees in the MUSR Regions were constructed to a geometry standard with the intent to pass design flows with adequate freeboard, and although they were improved and incorporated into the Sacramento River Flood Control Project, they do not meet current levee engineering performance standards because of inadequate cross sections, geotechnical weaknesses, erosion, encroachments, penetrations, or other concerns. It is unlikely that the combined resources of regional LMAs and the communities they protect can fund improvements to achieve a FEMA 100-year level of flood protection or better, even if State and federal funds are leveraged to the extent feasible. Nevertheless, it is important to improve flood protection for rural-agricultural areas, in accordance with the priorities set by the communities in the region.

In preparing and adopting the CVFPP, both DWR and CVFPB made strong commitments to work with LMAs in the Central Valley to develop local and regional flood management plans for repairs and improvements to rural-agricultural levee systems, including the development of rural-agricultural levee repair criteria.

The purpose of developing a set of common, consistent rural-agricultural levee repair criteria is to achieve the most cost effective reductions in flood risk feasible for these areas. This will likely require a strategy of making numerous repairs and improvements to multiple sites with known deficiencies. Available funds can be stretched further if repair criteria are less stringent than those required for urban areas or small communities.

Consistent with the State commitments, the Rural Levee Repair Criteria (RLRC) are currently under development by DWR, in coordination with the CVFPB, for levee repairs in the Central Valley's rural-agricultural areas. DWR has formed a work group of interested stakeholders to help develop criteria to be used to guide repair of documented rural levee performance problems. In addition to DWR staff, work group members will include representatives of the local maintaining agencies, CVFPB Board member(s) and staff, USACE representatives, and other interested parties.

3.3.4. *Levee Decertification and Floodplain Re-mapping*

When FEMA's National Flood Insurance Program (NFIP) was first established in 1968, areas protected by USACE levees were presumed to meet 100-year criteria. As a result, most of the floodplains in the MUSR Regions protected by the levees of the State Plan of Flood Control were mapped with 100-year ratings on FEMA's Flood Insurance Rate Maps (FIRMs). In 2005, FEMA issued Procedure Memorandum 34 (PM 34), which fundamentally reversed the historic presumption regarding USACE levee systems by requiring the agencies responsible for levees to demonstrate and document the integrity of their levee systems.

Recognizing that in many cases responsible agencies would need to conduct extensive field work, hydraulic and hydrologic studies, and geotechnical and engineering analyses in order to demonstrate that their levees met FEMA's certification criteria, FEMA issued PM 43 in 2007. PM 43 permits FEMA to issue preliminary and effective FIRMS with Provisionally Accredited Levees (PALs) if the responsible agencies believe that their systems meet 100-year criteria, but cannot provide adequate supporting documentation. The PAL designation provides the responsible agencies 24 months to gather and provide the necessary documentation.

FEMA embarked upon a map modernization process in the mid 2000's which resulted in updated FEMA maps (known as DFIRMs) being issued to most cities and counties within the MUSR area. A summary of the FEMA Remapping efforts for the counties within the MUSR Regions is show in Table 3-7

Table 3-7. Summary of FEMA DFIRM Re-Mapping Status

County	FEMA DFIRM Re-Mapping Status	Notes Regarding FEMA DFIRM Status	Current FIRM Effective Date
Tehama	Complete	-	09/29/11
Glenn	Complete	-	08/05/10
Butte	Complete	An accreditation package for select urban reaches of the Sycamore-Mud Creek levee system was submitted by the City of Chico/Butte County in January of 2011 and approved by FEMA in May of 2011. The City and County are currently working on an accreditation package for select non-urban reaches of the Sycamore-Mud Creek levee system.	01/06/11
Lake	In-Progress	Revision of the countywide DFIRM to address expired PALs, address a vertical datum shift, correct existing floodway/channel errors and correct an incorrect profile for Adobe Creek. Revised prelims will update mapping for Adobe and Highland Creeks while remainder of County is on hold.	09/30/05
Colusa	In-Progress	FEMA has initiated a project for public outreach and planning activities to support a planned future Colusa County, CA countywide DFIRM project. This project will include levee assessment and issuance of PAL agreements and a Discovery meeting.	05/15/03
Sutter	On-Hold	A countywide DFIRM project that will incorporate several existing data studies as well as utilize flood hazard data from the effective Sutter County and contiguous county DFIRMs.	12/02/08
Yolo	Complete	FEMA incorporated the Cache Creek South Levee Floodplain study into a revised Flood Insurance Study (FIS) Report, Flood Insurance Rate Map (FIRM), and Digital FIRM (DFIRM) database. The revised Physical Map Revision (PMR) is effective as of May 16, 2012. The final FIS Report and map products for this project can be obtained from the Product Catalog on the Federal Emergency Management Agency's (FEMA's) Map Service Center web site.	05/16/12

FEMA's remapping will result in much of the MUSR Regions being placed within FEMA's 100-year floodplain. As a result, development in these areas will be more expensive, difficult to insure, and subject to flood-proofing or elevation requirements.

In July 2012, the U. S. Congress passed the Biggert-Waters Flood Insurance Reform Act of 2012 (BW-12), which calls on the FEMA and other agencies to make a number of changes to the way the NFIP is administered. Some of these changes already have occurred and others will be implemented over time. Key provisions of the legislation will require the NFIP to raise rates to reflect true flood risk, make the program more financially stable, and change how FIRM updates impact policyholders. Over time, the changes will mean the premium rate increases. Further challenges associated with NFIP rate increases are described later in this plan.

In addition to FEMA floodplain mapping, the State of California put in place new floodplain regulatory requirement for the Central Valley. The 2007 California Flood Legislation mandated

that new development within urban and urbanizing areas have an urban (200-Year) level of flood protection. The 2007 California Flood Legislation defines an “urban area" as a developed area in which there are 10,000 residents or more, and an "urbanizing area" as a developed area or an area outside a developed area that is planned or anticipated to have 10,000 residents or more within the next 10 years.

3.3.5. *PL84-99 Eligibility*

Public Law 84-99 (PL84-99) provides for federal rehabilitation assistance for levees following a flood emergency. For a levee system to be eligible for PL 84-99 rehabilitation assistance, the levee system must have “active status” in the USACE’s Rehabilitation and Inspection Program (RIP). Levee systems are inspected through the USACE RIP. Systems that receive unacceptable ratings through either routine or periodic inspections are placed on inactive status in the RIP, which affects the amount and type of federal funding assistance for which a non-federal sponsor may be eligible following a flood event.

A system status of inactive in the RIP results in a loss of PL 84-99 rehabilitation assistance following a flood event. It does not necessarily result in a loss of FEMA NFIP certification or accreditation nor does it result in a loss of federal assistance for emergency flood fighting. A system status of active in the RIP does not guarantee rehabilitation assistance will be provided, only that it is eligible. Rural LMAs may have difficulty meeting the benefit cost ratio requirements in order to receive the rehabilitation assistance.

Flood control works that are eligible for USACE's RIP program, either Active or Inactive, are ineligible for assistance from FEMA for emergency repairs and permanent restoration. Although, FEMA may provide assistance for the placement and removal of flood fighting measures (e.g., sandbags, buttresses) on flood control works that are eligible for USACE's RIP program if such activity is necessary to eliminate an immediate threat to life, public health and safety, or improved property.

Loss of eligibility in the PL 84-99 RIP would mean that the LMAs and the State of California would have to fully fund rehabilitation following a high water event. Neither the State nor the rural LMAs have sufficient budgets to fund the increased rehabilitation costs.

The State now requires a local partnership agreement for many new projects including those funded under Propositions 1E and 84. Clauses in this agreement, also referred to as a “local O&M agreement”, include a requirement for the LMA “to continue to participate in and comply with the policies and procedures of the USACE Rehabilitation and Inspection Program” as well as Section 208.10. It is unclear how this requirement and the inability to meet this requirement affect rural LMAs.

System-Wide Improvement Frameworks (SWIFs) provide one avenue to maintain eligibility in the RIP and thus receive rehabilitation assistance while addressing long-term maintenance or repair deficiencies. Several LMAs in the Regions wish to pursue SWIFs but questions remain as

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to how their development and implementation will be funded. LMAs that have indicated their willingness to pursue SWIFs in order to regain PL84-99 eligibility include:

- Sacramento River West Bank Levee System comprising of RD 787, RD 108, LD 1, LD 2, Sacramento River West Side Levee District, and DWR.
- Sutter Basin South Levee System comprising of RD 1500 and DWR
- Sutter Basin North Levee System comprising of RD 70, RD 1660 and DWR
- Elder Creek North and South Levee Systems comprising of Tehama County FCWCD

Development of SWIFs as part of the regional planning process is ineligible under the current guidelines, however, DWR may wish to reconsider the fact that this loss of PL84-99 eligibility may have cost implications for the State. Also, the development and implementation of SWIFs can help optimize system performance, resiliency and robustness, which are key aspects of the 2012 CVFPP and the SSIA. In addition, regions may consider appropriate vegetation standards in their region and recommend that a regional variance be developed per those standards; the State may consider a cost-share funding program to assist rural LMAs in evaluating, repairing, and/or removing encroachments; there may be opportunities for regional projects to develop regional mitigation and or restoration areas to offset impacts of local repairs; or there may be opportunities for funding programs to obtain additional O&M easements in areas that have historically had less so that rural LMAs are able to adequately maintain the inspected areas in the future and thus maintain eligibility in the RIP.

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Figure 3-23. Sacramento River West Bank Levee System SWIF Area

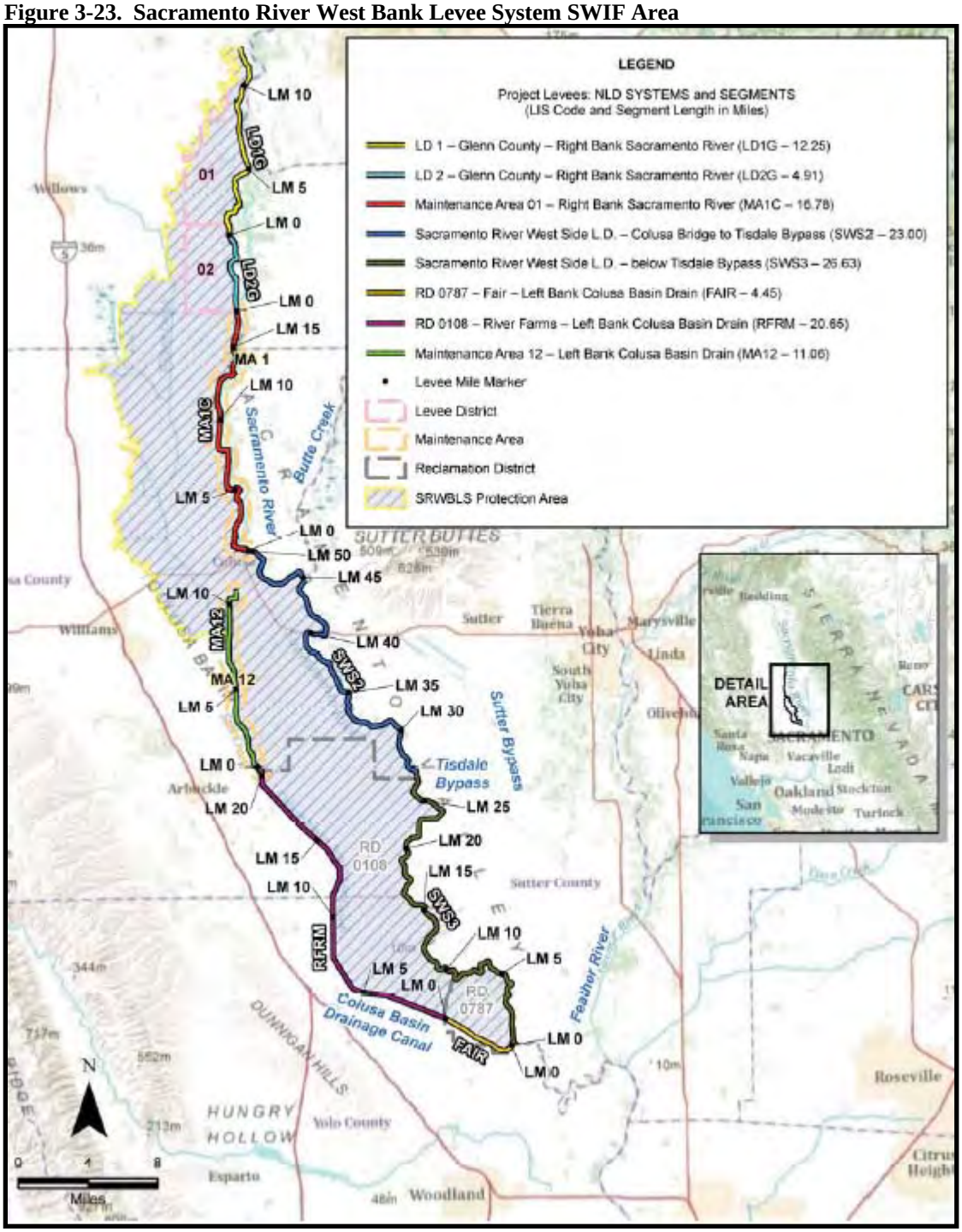


Figure 3-24. Sutter Basin South Levee System SWIF Area

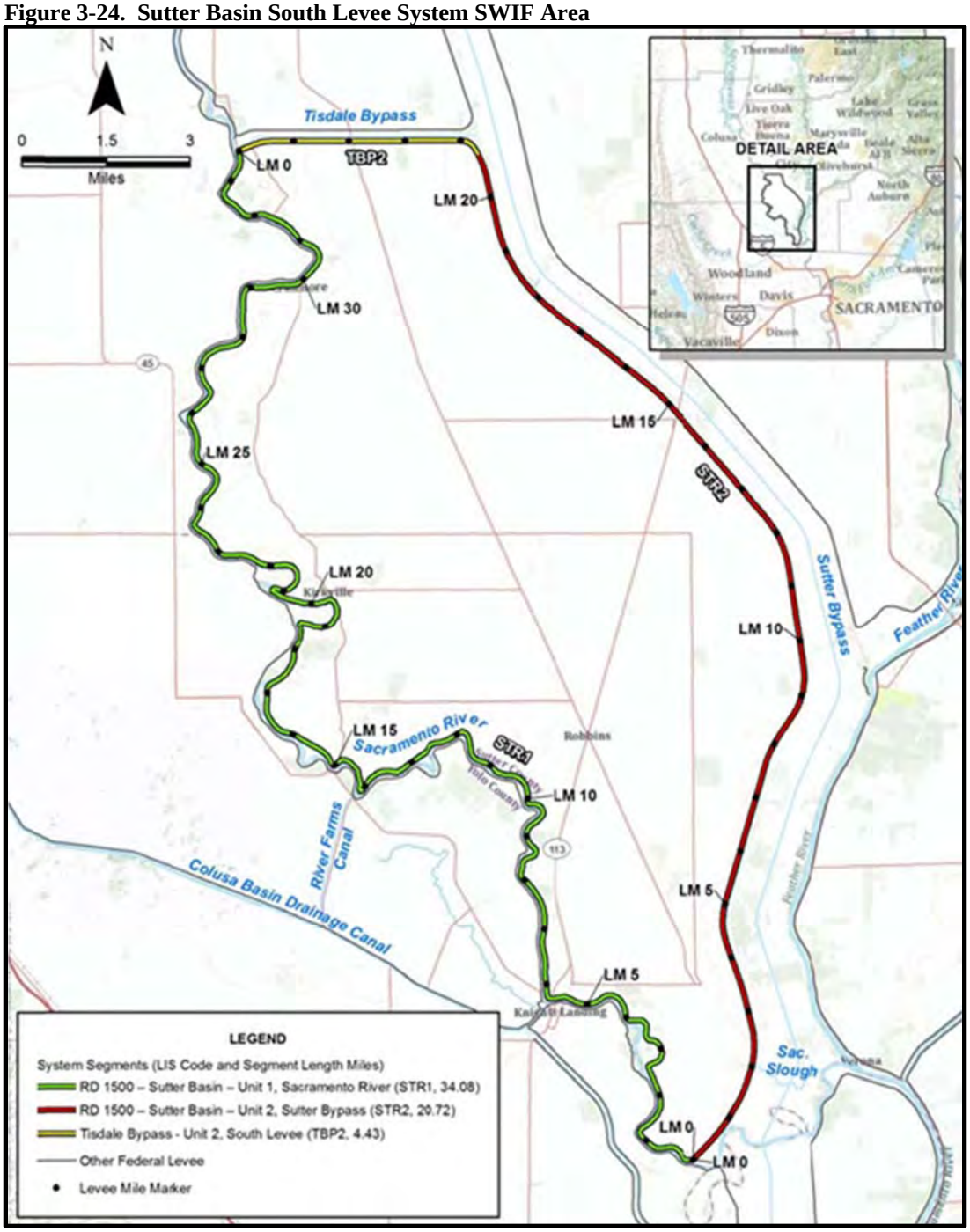
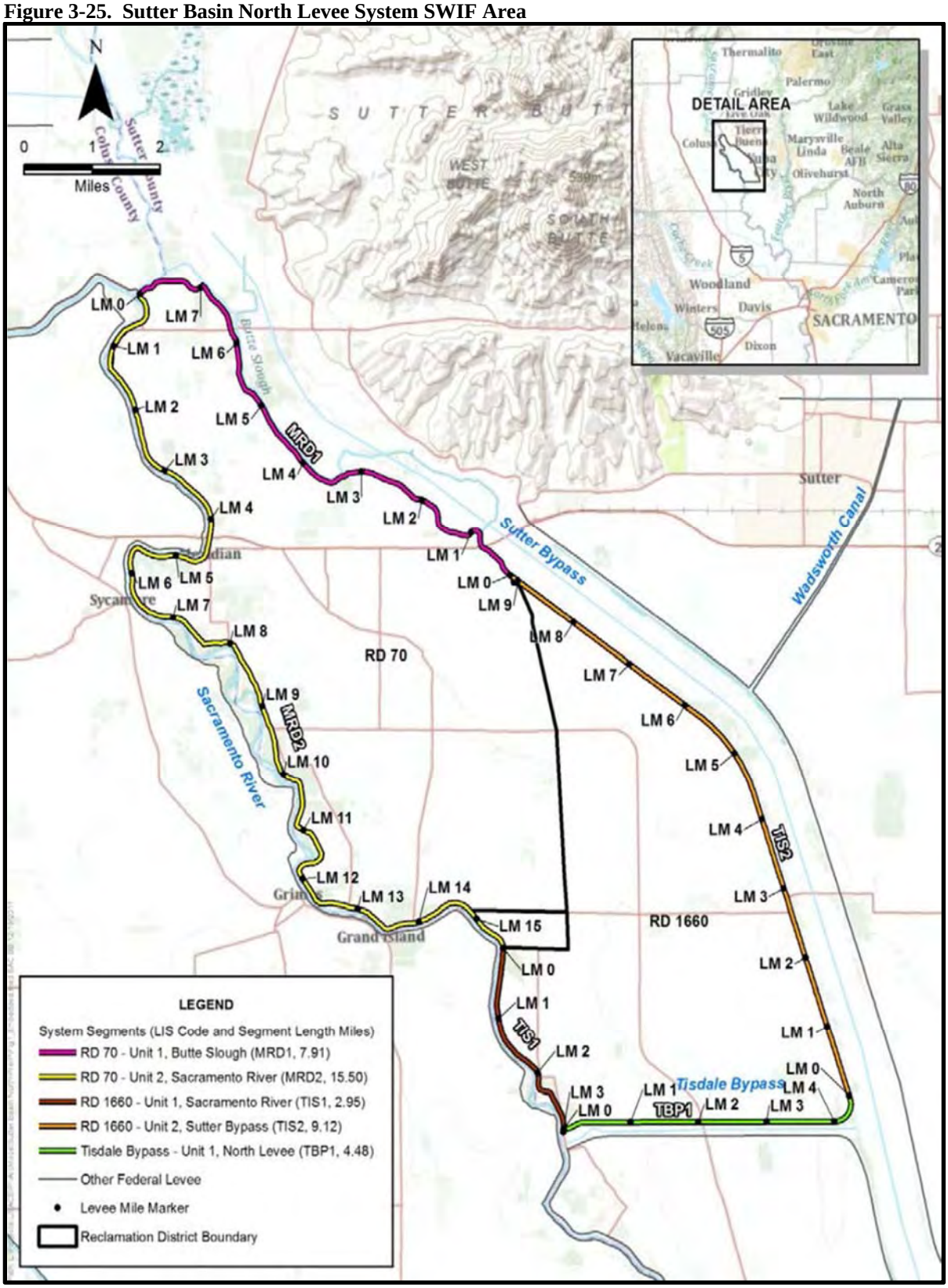


Figure 3-25. Sutter Basin North Levee System SWIF Area



3.3.6. *Compliance with Federal Flood Management Policies and Standards*

The levees comprising the Sacramento River Flood Control Project (SRFCP) are referred to as "Federal Project" levees as they are part of a congressionally authorized project. While the State of California is the non-federal sponsor of the SRFCP, the project remains subject to federal regulations as agreed to in cost-share agreements; Operation, Maintenance, Repair, Replacement, or Rehabilitation (OMRR&R) agreements; or other binding documents.

The primary benefits of being part of the federal program (i.e., a congressionally authorized project) are the cost-sharing of planning studies and construction of projects, and non-cost-shared rehabilitation assistance during and after declared emergency events. Participation in a planning and potential construction of a Federal project can be difficult for rural LMAs as the cost of levee upgrades are expensive and the benefits (i.e., damages) often do not outweigh the high costs.

As a result, obtaining "Federal Interest" is difficult and subsequent funding recommendation from the Office of Management and Budget is even more difficult as it typically requires a benefit to cost ratio of greater than 3.0. Cost-shared assistance during and after declared emergencies is available to both project and non-project levees if the LMA has requested and received eligibility in the PL 84-99 Rehabilitation and Inspection Program (RIP). The RIP also requires a minimum 1.0 benefit to cost ratio, but because repairs are generally smaller as compared to major levee system upgrade projects, history indicates that this requirement can be met.

Secondary benefits have in the past included the Corps' certification of projects to support local communities in obtaining FEMA accreditation for the 100 year event. However, based on review of new guidelines (EC 1110-2-6067) published by the Corps it is unlikely that this benefit will be realized as was in the past.

In accordance with commitments made in applicable cost-sharing agreements, the non-federal sponsor's primary responsibility following construction of the project is Operation and Maintenance (O&M) of the project under 33 CFR 208.10 through compliance with the O&M Manual provided by the USACE at the time of project completion. The USACE can adapt and/or revise existing regulations, create new regulations, or modify O&M Manuals as tools, technology, and science improve over time. Generally, the guiding document remains the O&M Manual, although recent updates of regulations by the USACE will likely require a modification to O&M manuals and thus O&M practices.

The USACE enforcement position and regulation concerning vegetation on levees has changed and the USACE has issued new guidelines reiterating the removal of most vegetation on levees except in cases where it can be demonstrated that the vegetation is not a threat to levee integrity. The USACE's guidelines, which are in conflict with the O&M manual for the SRFCP and LSJR&T Project, have acted as a catalyst for discussions on eligibility in the PL 84-99 RIP and the viability of remaining a Federal project as it would be extremely difficult to obtain the necessary environmental permits and the necessary funding to comply with the removal requirements. In other cases, it is no longer realistic (financially cost advantageous) for the

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LMAs to maintain the levees to current USACE standards. For example, some federal levees provide a relatively low degree of protection and the cost of diverting limited financial resources to maintain them to current USACE standards, such as those for pipe inspections, may not provide the same level of benefit when compared to using those resources to directly repair the levee deficiencies or to reserve the money for flood fighting. In other cases, particularly in the LSJR&T project, federal levees are no longer needed to provide protection against major floods as new bypass systems have been constructed.

Removal of projects from the federal program would almost certainly require a congressional act. USACE has authority to conduct deauthorization studies, which are submitted to Congress, but funding and processing of these studies would be uncertain. USACE deauthorizations are uncommon. Independent from the USACE deauthorization project, non-federal sponsors, or others, could pursue their own congressional legislation to remove the project from the federal program.

If a project levee was deauthorized and removed from the RIP, it could be eligible for assistance for both flood fighting and rehabilitation through the Federal Emergency Management Agency (FEMA) or National Resources Conservation Service (NRCS) programs if Congress indicated so. Flood control works that are eligible for USACE's RIP program, either Active or Inactive, are ineligible for assistance from FEMA for emergency repairs and permanent repairs.

If a project were no longer in the federal program, permitting requirements under 33 USC 408 would be eliminated except in cases where an alteration could have an effect on an adjacent, or neighboring, Federal project. Permitting under other federal and State authorities would likely be required.

In summary, continued participation in the federal program, and adherence to federal polices and standards provides benefits for planning and implementation of major repair and/or improvement projects as well as benefits during and following emergency events. However, deauthorization, or removal from the federal program through other means, may provide its own benefits. A weighing of advantages and disadvantages should take place to determine if deauthorization should be pursued and if so how and where (i.e., large or small systems, rural or urban systems, etc.).

As part of this RFMP, stakeholders have identified the need for a feasibility level analysis to identify levees that while providing critical flood protection, may benefit from being removed from the federal program, while remaining in the State Plan of Flood Control. In this study, consideration should be given to the ability of LMAs and the State to meet standards that would provide emergency and rehabilitation assistance, the ability to fund levee improvement projects without federal cost-share dollars, and liability for damages in the event of failures. Further consideration should be given for evaluating where levees may not be necessary and could altogether be removed from the federal program.

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3.3.7. *Water Surface Profile Deficiencies*

As flood flows are conveyed downstream, water elevations rise to accommodate the increased flows, and the water either spreads out over adjoining flood plains or rises against confining levees. The relationship between stage and flow at any given location (typically at a gaging location) is called a rating curve.

The relationship between stage and flow can be extended along the length of a stream channel to provide a water surface profile, and can be computed or measured for storms of various magnitudes. The water surface profile depends on many factors, including the magnitude and duration of the flood wave and channel roughness, shape, and capacity.

Detailed mathematical modeling is typically undertaken for feasibility-level studies, to subsequent design and construction. Over the past several decades the Sacramento Valley flood management system has been modeled with increasing levels of accuracy and sophistication. A complete system hydrologic analysis was completed as part of the Sacramento-San Joaquin Comprehensive Study (2002). DWR has recently worked closely with USACE to update and refine the hydrologic and hydraulic modeling system for the Sacramento Valley under two inter-related programs.

The Central Valley Hydrology Study (CVHS) is providing updated unregulated flow-frequency curves for streams throughout the valley at key locations, simulating the effects of reservoir regulation on those streamflows, and evaluating the effects of climate change on the system in the future.

The Central Valley Floodplain Evaluation and Delineation Program (CVFED) is providing updated mathematical models for evaluating flood risks and alternatives for reducing those risks, improved topographic mapping and floodplain delineation, and improved flood risk information for use by local, State, and federal agencies involved in land use planning and flood risk evaluation.

A significant challenge for the MUSR Regions is that there are no current, reliable 100-year or 200-year profiles available for the Colusa Basin Drain, the Sacramento River upstream of the Fremont weir, or the Butte Basin. The CVFED team has indicated that models for these areas will be delivered sometime in the future (final release date is still undetermined), however, the models will not include 100-year, 200-year, or 500-year water surface profile information. Therefore, there is an immediate need to fund this effort before any significant planning steps can made in regard to regional levee improvements. The Sacramento River flood control system downstream of Chico is very much interconnected and the numerous weirs, bypasses, and natural detention basins, along with the heavy presence of backwater, must be analyzed while looking at the complete system in order to produce accurate and reliable results. This lack of existing information and the need for regional coordination presents additional hurdles for local stakeholders interested in only specific reaches of flood system, such as the City of Colusa.

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3.3.8. *Accommodating Climate Change*

While the exact conditions of future climate remain to be seen, there is considerable certainty about past conditions. Analysis of paleoclimatic data (such as tree-ring reconstructions of streamflow and precipitation) indicates a history of naturally and widely varying hydrologic conditions in California and the western United States, including a pattern of recurring and extended droughts (DWR 2008). This natural variability is inherent in the climate of the west; however, there are several trends that are more recent, which may be linked to a changing climate, and are potential cause for concern.

The average early spring snowpack in the Sierra Nevada decreased by about 10 percent during the last century, a loss of 1.5 million acre-feet of snowpack storage (California Natural Resources Agency, 2009). During the same period, sea level rose seven inches along California's coast. California's temperature has risen 10 F, mostly at night and during the winter, with higher elevations experiencing the highest increase (DWR, 2008). A disturbing pattern has also emerged in flood patterns; peak natural flows have increased on many of the State's rivers during the last 50 years (DWR, 2008). At the other extreme, many Southern California cities have experienced their lowest recorded annual precipitation twice within the past decade. In addition, during the formation of this report, 2013 ended up as the driest year in California recorded history [CITE]. Increased seasonal temperatures and altered runoff patterns would also affect both agriculture and the health of the region's remaining ecosystems and habitats.

The quantity of mountain snowpack is critical for water supply and environmental needs, but so is the timing of snowmelt runoff into rivers and streams. Rising snowlines caused by climate change will allow more high-elevation watersheds to contribute to peak storm runoff. High frequency flood events (e.g., 10-year floods) in particular are likely to increase with a changing climate. Along with reductions in the amount of the snowpack and accelerated snowmelt, scientists project greater storm intensity, resulting in more direct runoff and flooding. Changes in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As streamflows and velocities change, erosion patterns will also change, altering channel shapes and depths, possibly increasing sedimentation behind dams, and affecting habitat and water quality. With potential increases in the frequency and intensity of wildland fires due to climate change, there is a potential for more floods following fire, which increase sediment loads and water quality impacts (DWR, 2008).

California has invested in, and now depends upon, a system that relied on historical hydrology as a guide to the future for water supply and flood protection. However, with the uncertainty in climate change, the hydrology of the past is no longer a reliable guide to the future. For the purposes of federal flood insurance, the Federal Emergency Management Agency (FEMA) has traditionally used the 100-year flood event, which refers to the level of flood flows that has a one-percent chance of being exceeded in any single year. As California's hydrology changes, what is currently considered a 100-year flood may strike more often, leaving many communities at greater risk. Moreover, as peak flows and precipitation change over time, climate change calls into question the validity of key assumptions typically used in flood-related statistical hydrologic

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analyses, such as the "100-year flood" (DWR, 2010). This climate uncertainty requires flexibility in flood management planning.

The State has acknowledged the importance of climate change, as demonstrated by the passage of Assembly Bill (AB) 32 – the California Global Warming Solutions Act, which states, "Global warming poses a serious threat to the economic well-being, public health, natural resources, and the environment of California." Additionally, as stipulated by CWC Section 9614, the Central Valley Flood Protection Plan among other items, shall include a description of the probable impacts of projected climate change, projected land-use patterns, and other potential flood management challenges on the ability of the system to provide adequate levels of flood protection.

In summary, the uncertainty in climate change may have a profound impact on our hydrologic patterns, and those hydrologic patterns may stress the existing flood management system in ways which were never previously expected. As California's climate changes, floodplain risk assessments and development constraints will likely be adjusted accordingly. For example, the 100-year and 200- year (1% and 0.5% annual chance) flood events, calculated based on historical flood events may become larger for the Sacramento River, with long-term effects on National Flood Insurance Program map ratings, flood insurance costs, floodplain development, and the economic viability of the region. In addition, if the moderating effects of snowpack on runoff decrease, there will be a need for more water supply storage, putting greater pressure on the multipurpose reservoirs protecting the region.

3.3.9. *Funding*

Major capital improvement and routine maintenance of the flood management system are primarily dependent on public funding generated by local, State, and federal sources. Flood risk management programs must compete with numerous other pressing funding needs such as education, transportation, health, and welfare. Major infusions of funding for flood risk management have historically followed major floods, when public attention is focused on the catastrophic damages they cause. For example, Propositions 1E and 84, with a combined bond funding capability of $4.9 billion, were approved by California voters a little more than a year after Hurricane Katrina flooded and destroyed much of New Orleans, killing over 1,200 people. However, flood risk reduction programs and infrastructure need steady, long-term funding to achieve and sustain the requisite level of protection. Governments at all levels struggling with heavy debt burdens, recession-damped revenue projections, and rising construction costs all add uncertainty for fully funding the flood risk management programs and projects described in this report.

Current trends suggest that future federal funding for flood risk reduction projects will be diminishing over time, as the federal government struggles to achieve a balanced budget while facing enormous pressure from nationwide entitlement programs, infrastructure needs, and defense needs.

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State bond funds, which are authorized until June 20, 2016, will need to be supplemented by subsequent bond measures or other sources to maintain current levels of State leadership in Central Valley flood risk reduction.

<< Note to Reviewer: The final draft of the MUSR RFPM will include a Financial Plan that will discuss in more detail the challenges associated with funding flood system improvements.>>

3.3.10. *Land Use Challenges*

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

Impacts of modifications to facilities and environmental restoration on adjacent properties must also be carefully considered and mitigated, where feasible. For example, where wildlife habitat is proposed in proximity to existing agricultural lands, the impacts of plowing, spraying, and harvesting of agricultural lands on nearby wildlife habitat and, conversely, the impacts of protected species on agricultural lands, must both be carefully addressed to successfully implement flood risk reduction projects with environmental enhancement components. A major goal of the RFMP will be to help identify the methods that provide mutual benefits to agriculture and ecosystem functions.

Flood protection structures can be adversely impacted by land use decisions ("land-use activities") that do not fully consider how the activity is integrated into a region's flood protection requirements and systems. These adverse impacts can be minor, requiring recurring, unbudgeted maintenance effort; significant, creating a need for major levee repair projects; or even catastrophic, causing failure of the levee during a high-water event, leading to a major flood event. In addition, un-integrated land-use activities can be cited by flood protection authorities as reason for decertification of a flood protection structure and/or removal of flood protection systems from aid programs such as PL84-99. To ensure LMAs have an opportunity to review and comment on land-use activities which could impact their systems, improved communication and interaction between LMAs and land-use authorities is needed. Creation of "Flood Structure Protection Areas" directly adjacent to levees and other flood control structures would provide LMAs an opportunity for input on land-use decisions occurring in the vicinity of their facilities. These areas would be identified in county and city floodplain management ordinances and/or general plans as zones in which input is required from LMAs before land-use decisions are finalized.

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4. Operations and Maintenance

4.1. Introduction

Operations and Maintenance (O&M) is the physical operation of the flood control system, as well as the ongoing maintenance of the associated infrastructure. This includes but is not limited to: erosion repair and prevention, crack control resulting from settlement, through seepage and under-seepage, animal burrow control and repair, maintenance, removal and repair of penetrations through the levee, managing encroachments and vegetation, and providing security of the levee system against vandalism and terrorism. O&M must be performed on a regular basis in accordance with the manuals and procedures provided and updated to meet requirements as prescribed by inspection criteria of the various agencies and programs and that have jurisdiction.

During development of the MUSR RFMP one of the most deliberated issues was the growing challenges local levee maintaining agencies (LMAs) must deal with to effective operate and maintain the current flood control system to provide the flood control benefit it was originally designed to provide. The current flood system of levees, weirs, and bypasses was largely developed as a 'single purpose' system with the goal to reduce flooding and flood damages. Since development of the system new laws such as the Endangered Species Act, and changes in societal aspirations for the preservation of the natural environment, have created challenges and conflicts in managing, and operating the flood control system. This has particularly become an issue for rural levee maintaining agencies as they are not sufficiently funded to manage these emerging challenges.

4.2. Background

The California Central Valley Flood Control Association (Association) was established in 1926 to promote the common interests of its members in maintaining effective flood control and protection in the California Central Valley. The Association has been and continues to be actively involved in advancing and advocating for effective flood management in both rural and urban areas. To support the regional flood management planning effort underway throughout the Central Valley, the Association established the Rural LMA Work Group (Workgroup) in late 2012 with the purpose of identifying and describing problems faced by rural areas and proposing solutions/actions for inclusion in the Regional Flood Management Plans (RFMP). This effort was based on the Workgroup's belief that sustainable, system-wide flood management must consider the role of rural communities and agricultural areas, which provide the opportunity to realize multiple objectives identified in the 2012 Central Valley Flood Protection Plan. While the initial focus was on rural LMA issues, it became clear that urban LMAs are facing many of the same challenges, and the issues discussed here are not exclusively rural issues.

The Workgroup identified a number of O&M related issues including:

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Channel, Bank, and Bypass Maintenance – Insufficient maintenance of channels and banks of the Sacramento flood control system is adversely impacting its carrying capacity and performance and is compromising the ability of LMAs to maintain PL84-99 eligibility for their levee systems. Barriers to performing adequate maintenance include environmental and regulatory restrictions, insufficient funding and resources, and competing maintenance priorities, and completing interests of federal and state regulatory and resource agencies, and flood system maintenance agencies.

Permitting and Maintenance Activities – Most maintenance activities are exempt from NEPA and CEQA but require compliance with other laws such as State and federal endangered species laws and California's streambed alteration law. Compliance with such laws is usually achieved through a permitting process that is often burdensome, lengthy, and expensive. As such, LMAs typically avoid the permitting process altogether to meet obligations for levee safety, or choose to not undertake certain maintenance activities.

Maintenance of Mitigation and Habitat Enhancement Projects – The increasing number of mitigation planting and habitat enhancement projects within the channels, bypasses, and other floodways of the Sacramento and San Joaquin River flood systems together with existing 'legacy' mitigation projects is compounding the already challenging regulatory environment faced by levee maintainers. Failure to properly plan, maintain and manage mitigation and habitat enhancement projects is resulting in adverse impacts to hydraulic capacity, conveyance, and ability to inspect, monitor, and flood fight. Further, plantings are migrating beyond their original project limits and the lack of "safe harbor" agreements is creating financial and operational constraints for the LMAs.

Rodent and Burrowing Animal Control – The presence of rodents on levees is a historic and ongoing problem that poses a threat to levee integrity due to increased seepage penetration into the levee and interior and exterior erosion causing voids and levee stability issues via the burrows the rodents create.

Pipe Maintenance and Inspection – LMAs lack the enforcement authorities for inspection and maintenance of private and certain public pipe penetrations in their levees. The Central Valley Flood Protection Board (CVFPB), as the authorizing agency, has issued the encroachment permits for these facilities and holds the enforcement authority through the encroachment permits. In light of reluctance for pipe owners to properly inspect and maintain their pipes, there is a need to develop clear enforcement action and also develop other cost effective methodologies for performing the inspections that do not solely rely on video and sonar.

Encroachments – Undocumented encroachments and non-compliant encroachments present safety and legal challenges for LMAs.

Eligibility in the PL84-99 RIP – Inactive status in the Rehabilitation and Inspection Program (RIP) results in a loss of eligibility for Federal PL 84-99 rehabilitation assistance (i.e., funding) following an emergency event and Sponsors and LMAs would therefore be faced with rehabilitating damaged levees using all non-federal funds. It is difficult for Rural LMAs to design, implement, and fund rehabilitation of levees following an emergency event without federal assistance. If LMAs are unable to fund or otherwise implement repairs, it is unclear who

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would make the repairs and if this responsibility would fall on the State as the non-federal sponsor.

Flood Structure Protection Area – Flood protection structures can be adversely impacted by land use decisions which do not fully consider how the activity is integrated into a region's flood protection requirements and systems. Creation of a consistent process is needed to allow LMAs the ability to review land-use activities in the vicinity of flood protection structures so that the activities do not conflict with the design, construction, maintenance, operation of the LMA's facilities, and do not compromise or impair the system's integrity.

Funding - Some LMAs are responsible for maintenance of system-wide improvements but receive no funding assistance from the system-wide beneficiaries. The burden of maintaining and operating the system falls on a relatively small number or local landowners. Funding programs need to developed and implemented that include all beneficiaries.

Following below is a more detailed discussion of the identified O&M issues and potential solutions which should be considered.

4.3. Issues & Solutions

4.3.1. *Channel Bank and Bypass Maintenance*

Insufficient maintenance of channels, banks, and bypasses of the flood control system is adversely impacting its carrying capacity and performance and is compromising the ability of LMAs to maintain PL84-99 eligibility for their levee systems. Barriers to performing adequate maintenance include environmental and regulatory restrictions, insufficient funding and resources, competing maintenance priorities, and the competing interests of federal and state regulatory and resource agencies and flood system maintenance agencies.

Water Code section 8361 indicates that the California Department of Water Resources must maintain specific enumerated project features, including the "channels and overflow channels" of the Sacramento River and tributaries, while the local maintaining agencies are responsible for other features, including levees. However, the DWR's Channel Evaluation and Rehabilitation program for the Sacramento system has been hindered at times by budget and environmental constraints. This has resulted in banks that have eroded into levees, channels that have become overgrown with vegetation, and overflow channels that have aggradated resulting in decreased carrying capacities of the system and as a result are negatively affecting levee inspection ratings.

As part of assuming maintenance responsibility for the Sacramento River Flood Control System, the State agreed to comply with the regulations of the United States Army Corps of Engineers (USACE) as defined in the Standard Operation and Maintenance Manuals for the Projects1. In the manual, Section VI, Channels, describes "The channels of the project constitute that part of

[1] Standard Operation and Maintenance Manual for the Sacramento River Flood Control Project, prepared by the Sacramento District, Corps of Engineers, US Army, Sacramento, California dated May 1955

the waterway which lies between the levees of the Sacramento River…and all tributary and distributary streams." The manuals go on to describe the maintenance requirements of the channels and floodways in Section 6-02, paragraph a.1, which includes "(i) The channel or floodway is clear of debris, weeds, and wild growth;" as well as "(iv) Banks are not being damaged by rain or wave wash, and that no sloughing of banks has occurred." Finally, paragraph b of the same section requires that "(1) Weeds and other vegetal growth in the channel shall be cut in advance of the flood season and, together with all debris, removed from the channel; and… (4) Dumped rock or other suitable types of protection should be placed at locations found by experience to be critical trouble points, with a view to stabilizing the channel alignment and preserving the general uniformity of the bank lines."

The above requirements of the O&M manuals for the Sacramento River system have not consistently been met. This may be the result of State funding constraints, difficulty in meeting regulatory requirements for sensitive resources, or simply a lack of prioritization. As a result, LMAs are encountering issues with overgrown channel vegetation encroaching onto levees resulting in decreased channel capacity and non-compliance with levee vegetation standards; bank erosion that has encroached into the levee section and resulting in compromised levee stability; and an increase in unacceptable levee inspections resulting from these State responsibilities that may impact the ability of the State to receive federal assistance following a flood event.

Potential solutions which should be considered include:

- That the State recognize and accept the definition of channels as clearly described in Section VI of the Standard Operation and Maintenance manual as "The channels of the project constitute that part of the waterway which lies between the levees of the Sacramento River … and all tributary and distributary streams.".
- That the State should work with the USACE to update the standard Operation and Maintenance manuals for both the Sacramento River System to establish appropriate channel maintenance measures that both preserve the design capacity with consideration for the ecosystem function of the river channels and floodways. Current O&M standards are outdated and no longer feasible.
- That the State and LMAs should work with Regulatory Agencies on long-term maintenance plans to avoid the need for mitigation. These plans could limit the areas for sediment removal, vegetation thinning or removal, or slope protection in areas where the channel is encroaching within 35 feet of the levee. Maintenance measures and standards would include best management practices and be covered in maintenance agreements to avoid lengthy and costly environmental consultation.
- That the State develop a dedicated and reliable Statewide funding mechanism to provide a minimum annual revenue stream to support channel and bank maintenance. This program could include end user fees for the State Water Project and other water delivery systems.

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4.3.2. *Permitting and Maintenance Activities*

Most maintenance activities are exempt from NEPA and CEQA but require compliance with other laws such as State and Federal endangered species laws and California's streambed alteration law. Compliance with such laws is usually achieved through a permitting process that is often burdensome, lengthy, and expensive. As such, LMAs sometimes avoid the permitting process altogether to meet obligations for levee safety, or choose to not conduct certain maintenance activities.

Compliance with the State and Federal endangered species acts (ESA) presents a difficult challenge primarily because mitigation requirements for activities impacting listed species are changing and the process to obtain permits is burdensome and lengthy often times delaying maintenance or forcing LMAs to conduct their maintenance without consultation or risk eligibility in federal rehabilitation programs. This dilemma is particularly concerning for rural LMAs because they lack the financial resources to rehabilitate the levees following any event without federal assistance. Further, LMAs lack the resources to implement costly mitigation measures.

In addition to ESA issues, notification to California Department of Fish and Wildlife (DFW) for a streambed alteration permit is required for any activity that will substantially divert or obstruct the natural flow of the river; substantially change or use any material from the bed, channel, or bank of a river; or deposit or dispose of debris, waste or other material where it may pass into a river. DFW contends that Section 1600 applies to areas from the waterside levee crown to and the water and wetted channel. While there is disagreement between the LMAs and DFW on what actions constitute substantial, both parties have been relatively successful in moving forward with streambed alteration agreements enabling maintenance activities to proceed.

Levee maintenance requirements were prescribed by USACE decades prior to ESA laws upon turnover of the Sacramento River flood control system. LMAs have adjusted their maintenance methodologies to accommodate these laws and the listings of species but common maintenance practices that in the past were not considered to affect listed species now are making it difficult to meet obligations for levee maintenance. Potential solutions which should be considered include:

- A regional programmatic agreement or framework for permits with the resource agencies could provide an effective avenue for permitting that enables the LMAs to conduct their maintenance activities while considering the interests of listed species and resources. Agreements could be tailored for the species, timelines, etc.
- Incentives for using certain maintenance methodologies (e.g., type of management activity such as cutting versus burning versus spraying or grouting versus, etc.), which if used, would alleviate mitigation requirements.
- Setting aside designated mitigation areas or providing pre-mitigation (advance mitigation).
- Reaching agreement on timing and/or phasing of maintenance activities at a regional level to avoid "adverse impact" finding by resources agencies.

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4.3.3. *Maintenance of Mitigation and Habitat Enhancement Projects*

The increasing number of mitigation planting and habitat enhancement projects within the channels, bypasses, and other floodways of the Sacramento River flood system together with existing 'legacy' mitigation projects is compounding the already challenging regulatory environment faced by levee maintainers. Failure on the part of some 'habitat implementers' to properly plan, maintain and manage mitigation and habitat enhancement projects is resulting in adverse impacts to hydraulic capacity, conveyance, and ability to inspect, monitor, and flood fight. These impacts combine to reduce the flood system's resilience and robustness. Further, plantings are migrating beyond their original project limits and the lack of "safe harbor" agreements is creating financial and operational constraints for the LMAs.

Rural LMAs recognize that when trying to accomplish specific goals, such as species recovery for example, there is value in implementing mitigation and enhancement projects within the flood control system. However, LMAs are being adversely affected both financially and operationally as they cannot perform proper levee maintenance due to increased costs, permitting, or inability to access, inspect and perform repairs within those sites. This in turn can impact the status of the levee system in the PL 84-99 Rehabilitation and Inspection Program. Potential solutions which should be considered include:

- Identity which types or habitat/mitigation creation are the most problematic for flood control system operations;
- Examine in a comprehensive regional manner, the goals, objectives and necessity for mitigation planting and habitat enhancement within the flood control system;
- Identify and securing sustainable funding for long term maintenance;
- Define maintenance roles and responsibilities;
- Obtain long-term (programmatic) regulatory permissions to perform levee maintenance without the need for additional mitigation;
- CVFPB more actively monitor and enforce permits issued for habitat/mitigation; and
- Provide safeguards to neighboring landowners and levee maintaining agencies when the projects migrate beyond their original project limits.

4.3.4. *Eligibility in the PL84-99 Rehabilitation and Inspection Program*

Inactive status in the Rehabilitation and Inspection Program (RIP) results in a loss of eligibility for Federal PL 84-99 rehabilitation assistance (i.e., funding) following an emergency event and Sponsors and LMAs would therefore be faced with rehabilitating damaged levees using all non-federal funds. It is difficult for Rural LMAs to design, implement, and fund rehabilitation of levees following an emergency event without federal assistance. If LMAs are unable to fund or otherwise implement repairs, it is unclear who would make the repairs and if this responsibility would fall on the State as the non-federal sponsor.

Levee systems are inspected through the USACE RIP. Systems that receive unacceptable ratings through either routine or periodic continuing eligibility inspections are placed on inactive status

in the RIP, which affects the amount and type of federal funding assistance for which a non-federal sponsor may be eligible following a flood event.

A system status of inactive in the RIP results in a loss of PL 84-99 rehabilitation assistance following a flood event. It does not necessarily result in a loss of FEMA NFIP certification or accreditation nor does it result in a loss of federal assistance for emergency flood fighting. A system status of active in the RIP does not guarantee rehabilitation assistance will be provided, only that it is eligible. Rural LMAs may have difficulty meeting the benefit cost ratio requirements in order to receive the rehabilitation assistance.

Flood control works that are eligible for USACE's RIP program, either Active or Inactive, are ineligible for assistance from FEMA for emergency repairs and permanent restoration. Although, FEMA may provide assistance for the placement and removal of flood fighting measures (e.g., sandbags, buttresses) on flood control works that are eligible for USACE's RIP program if such activity is necessary to eliminate an immediate threat to life, public health and safety, or improved property.

Loss of eligibility in the PL 84-99 RIP would mean that the LMAs and the State of California would have to fully fund rehabilitation following a high water event. Neither the State nor the Rural LMAs have sufficient budgets to fund the increased rehabilitation costs.

The State now requires a local partnership agreement for many new projects including those funded under Propositions 1E and 84. Clauses in this agreement, also referred to as a “local O&M agreement”, include a requirement for the LMA “to continue to participate in and comply with the policies and procedures of the USACE Rehabilitation and Inspection Program” as well as Section 208.10. It is unclear how this requirement and the inability to meet this requirement affect rural LMAs.

System-Wide Improvement Frameworks (SWIFs) provide one avenue to maintain eligibility in the RIP and thus receive rehabilitation assistance while addressing long-term maintenance or repair deficiencies. Several LMAs in the Regions wish to pursue SWIFs but questions remain as to how their development and implementation will be funded. Development of SWIFs as part of the regional planning process is ineligible under the current guidelines, but DWR wish to reconsider this as loss of PL84-99 eligibility may have cost implication for the State. Also development and implementation of SWIFs can help optimize system performance, resiliency and robustness, which are key aspects of the 2012 CVFPP and the SSIA.

4.3.5. *Rodent and Burrowing Animal Control*

The presence of rodents on levees is a historic and ongoing problem that poses a threat to levee integrity due to increased seepage penetration into the levee and interior and exterior erosion causing voids and levee stability issues via the burrows the rodents create.

It is imperative that every LMA has an aggressive rodent abatement and damage repair program. Diligent efforts to eradicate burrowing animals are a necessity, and eliminating them from an

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infested levee is extremely difficult. Control of these animals must be pursued frequently and persistently to ensure safety of the levee during both normal conditions and high water events.

Adequate rodent control is a two-part maintenance process of eradicating the rodents and properly filling their burrows. The more rodents in an area and the longer they have been there, the greater the threat due to greater loss of levee material and further increase in populations. Voids within the levees cannot be easily detected, and therefore, pose a significant risk to levee integrity and stability. Interpretation of environmental laws and regulations by various resource agencies can limit the periods during which poison bait can be utilized and other methods can be employed to control rodents. The implementation of these regulations may be in conflict with the approved and allowed proper use of the compounds being applied and often conflict with the optimal timing for successful control. Complete eradication of rodents is difficult. However, a well-managed eradication program vigorously applied throughout the year can keep populations and concentrations of rodents under reasonable control.

Coupled with aggressive rodent abatement, thorough repair of levees damaged by burrowing rodents is essential to minimize risks posed to levee integrity. Damage repair can be achieved by excavation and re-compaction of burrows, filling holes with grout slurry, and other comparable methods. Regardless of the method of rodent burrow damage repair, voids must be filled to minimize risk to levees. Past practices of simply dragging over the rodent holes to cover them is inadequate, and does not fill the voids left by rodent infestation. Potential endangered species act (both CESA and ESA) impacts during rodent burrow repair activities have been expressed as a concern by resource agencies. Potential solutions which should be considered include:

- Facilitation through environmental regulatory processes and relief from some limitations of how and when eradication actions can be performed.
- Funding to assist in the purchase and use of specialized equipment and services such as grouting machines, hiring licensed trappers and performing biological assessments to determine potential impacts to other desirable species as well as provide options for more effective control programs.
- Establish guidelines for habitat projects that could become a source of rodents. An example of this might be the development of habitat that could create a breeding area for beaver and muskrats that will migrate and take up residence in a levee.
- Establish procedures and guidelines for removal of rodent habitat and food sources.
- Establish funding and programs to work with local property owners, the farming community, and agricultural commissioners to coordinate rodent abatement activities on properties near the flood protection system, to minimize threats to levee integrity.

4.3.6. *Pipe Maintenance and Inspection*

LMAs lack the enforcement authorities for inspection and maintenance of private and certain public pipe penetrations in their levees. The Central Valley Flood Protection Board (CVFPB), as the authorizing agency, has issued the encroachment permits for these facilities and holds the enforcement authority through the encroachment permits. In light of reluctance for pipe owners to properly inspect and maintain their pipes, there is a need to develop clear enforcement action

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and also develop other cost effective methodologies for performing the inspections that do not solely rely on video and sonar.

Gravity or pressurized pipes that penetrate the levee are required to be inspected and maintained pursuant to the Code of Federal Regulations (CFR) Section 208.10 and the Standard Operations and Maintenance Manual. Those documents only provide general requirements. Current USACE guidance documents require inspection utilizing video or sonar inspection every five (5) years. Maintenance is performed as appropriate to repair or replace pipe penetrations in order to bring them into compliance with the USACE and CVFPB standards. Permitted repairs and installations must also be compliant with current California Code of Regulations, Title 23. Waters, Division 1. Central Valley Flood Protection Board.

The intent of the USACE's video inspection program is to monitor the interior of pipes through the levee every five (5) years so that pipes can be rehabilitated or replaced before damage occurs that could threaten the integrity of the levee. The inspection also provides a record of the previous condition of each pipe for comparison over time, allows an inspector to examine parts of the pipe that cannot be inspected visually from the pipe exterior or levee surface, and allows the pipe owner, DWR and /or the LMA to determine whether the condition of a pipe requires action to protect the levee. Additionally, by identifying pipes that need attention prior to failure, the repairs can be scheduled to occur outside of the typical flood season, and at a time when the pipe owner could find them more cost-effective than an emergency repair.

Video inspections are costly, and some pipe owners are resisting or refusing to perform them. This is problematic for LMAs as failure to perform and report the inspection results could result in unacceptable ratings by USACE and/or CVFPB. Other effective methods of inspection, such as pressure testing, may provide an acceptable level of analysis and be more cost effective and practical, and might allow for a higher level of compliance. Also, most pipes are steel, and video inspection may be limited in identifying problems as most of the corrosion occurs from the exterior of the pipe. Access to the video equipment is limited and use generally requires cutting access entrances for insertion of the devices. These access entrances can cause additional sites for corrosion to start and can be difficult and expensive to install properly. These pipes present a very minor threat for flooding, when they cross above the floodplain or have positive closure structures on the waterside of the levee since these measures generally prevent or limit conveyance of flood waters.

While there is little or no disagreement for the inspection requirements on pipes that are located below the design water surface elevation, there are instances, where pipes are installed on the levee slope surfaces and only penetrate the levee just below the crown above the design water surface elevation. Additionally, once the pipe inspections have been performed, and maintenance/rehabilitation actions are identified, there exist various issues regarding the necessity and expense associated with obtaining permits and the permit requirements for maintenance/rehabilitation. Many routine maintenance actions should not require costly permit application processes or expensive upgrades to the existing facility. There are also instances where a "one size fits all" regulation may not provide the most cost effective or best practice for a given situation. An example of this is positive closure devices on pipes that are located above the design water surface elevation.

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In addition to the issues listed above, a majority of pipes are permitted encroachments in the flood control systems. The encroachment permits are issued through the CVFPB and only require an endorsement by the LMA. Although the existing permits themselves do not typically include requirements for video inspections, they do include a standard condition that would require the encroachment owner to remove, alter, or relocate the encroachment at their sole expense for any reasons upon written notice from the CVFPB. Because the CVFPB is the permitting agency, they hold the enforcement authority. However, they have rarely used their authority and have only recently been given legal authority to develop an enforcement process to bring encroachments into compliance with current standards.

The primary issue for LMA's is that they do not own or operate many of the pipes that penetrate their levees, and therefore lack the ability to access those pipes for inspection and maintenance. Furthermore, the LMAs cannot afford to be held financially responsible for those inspections or the maintenance of the pipelines. Enforcement of the inspection and maintenance requirements is difficult and costly for the LMAs and is the responsibility of the CVFPB.

Potential solutions which should be considered include:

- CVFPB adopt a standard noticing procedure to remind pipe owners that they must maintain their pipes in accordance with the permit terms and current standards, including video inspections of pipes crossing under or through levees;
- Require pipe owners provide annual records of maintenance, inspection, repair, and replacement demonstrating compliance with permit terms and current standards to the LMA;
- Where pipes were installed as part of the system and the LMA is responsible for maintenance of that facility, the State should consider a funding program to assist LMAs with bringing the system facilities into compliance;
- Streamlined permitting for simple repairs and rehabilitation of pipelines;
- Outreach and education of utility owners to help them understand why compliance with the standards is important so they become willing and proactive participants; and
- Add flexibility to the regulations to avoid "one size fits all" policies for construction, repair and inspection so that more cost effective solutions can be implemented that retain the overall protection desired.

4.3.7. *Encroachments*

Undocumented encroachments, permitted or not, and documented, non-compliant encroachments present safety and legal challenges for LMAs. If an LMA or the State cannot produce documentation of an encroachment, that encroachment is flagged during inspections as an unpermitted encroachment and therefore unacceptable. If an encroachment is not in compliance with its permit, it is also flagged as unacceptable. Depending on the type of encroachment, either can cause an entire levee system to lose eligibility under PL 84-99. Of particular concern are encroachments representing a risk to levee integrity.

Encroachment scenarios currently presenting challenges include:

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- Non-permitted encroachments;
- Legacy encroachments lacking documentation (i.e., not specifically or thoroughly documented in as-builts)
- Encroachments permitted by CVFPB, no concurrence from USACE;
- Encroachments permitted by CVFPB with concurrence from USACE, but now not in compliance with permit terms;
- Encroachments permitted by CVFPB with concurrence from USACE, in compliance with permit terms but compliance is not documented; and
- Encroachments not permitted, but constructed by the USACE as documented in the as-builts and/or O&M manual.

In addition to typical encroachments owned by an individual or company, there are some encroachments that exist as a result of the levee system itself. These encroachments, primarily interior drainage ditches adjacent to the landside levee toe, retaining walls, rip-rap, and pipes, present a unique set of problems as they often pre-date permits, and documentation can be inconclusive. Some of these encroachments may be found in as-builts, but others are not seen in as-builts or the as-builts cannot be found. These encroachments are typically maintained by the LMA, but many have either exceeded their lifespan and/or need improvements to meet current standards.

- Establish a process, agreed to by the CVFPB and USACE, for retroactive permitting of encroachments determined not to impair or threaten system integrity;
- USACE and CVFPB research historical and current files to build a database of encroachments and provide LMAs with access the database.
- Provide funding to remove unnecessary facilities;
- CVFPB adopt a standard noticing procedure to remind encroachment owners that they must maintain their encroachments in accordance with the permit terms and current standards.
- Require encroachment owners provide annual records of maintenance, inspection, repair, and replacement demonstrating compliance with permit terms and current standards to the LMA.
- Develop a funding program to address required upgrades, improvements, and/or documentation of the facilities included in the original project and are still necessary for the functioning of the system (i.e., landside drainage ditches, erosion protection, or other facilities).

4.3.8. *Flood Structure Protection Areas*

Flood protection structures can be adversely impacted by land use decisions ("land-use activities") which do not fully consider how the activity is integrated into a region's flood protection requirements and systems. These adverse impacts can be minor, requiring recurring, unbudgeted maintenance effort; significant, creating a need for major levee repair projects; or

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even catastrophic, causing failure of the levee during a high-water event, leading to a major flood event. In addition, un-integrated land-use activities can be cited by flood protection authorities as reason for decertification of a flood protection structure and/or removal of flood protection systems from aid programs such as PL84-99.

"Land-use activity" could mean any ministerial, discretionary, or other regulatory permit approvals that are likely to lead to a change to improved or unimproved land, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials. These approvals include, but are not necessarily limited to:

- General Plan amendments;
- Specific Plans & amendments;
- Zoning Map changes;
- Zoning Text amendments;
- Conditional Use Permits;
- Planned Development Permits;
- Design Review Permits;
- Subdivision Maps and Parcel Maps;
- Parcel Mergers and Lot Line Adjustments;
- Building Permits;
- Sign Permits;
- Grading Permits;
- Encroachment Permits;
- On-site Development Permits;
- Public & Private Utilities;
- Underground Pipelines.

To ensure LMAs have an opportunity to review and comment on land-use activities which could impact their systems, improved communication and interaction between LMAs and land-use authorities is needed. Creation of “Flood Structure Protection Areas” directly adjacent to levees and other flood control structures would provide LMAs an opportunity for input on land-use decisions occurring in the vicinity of their facilities. These areas would be identified in county and city floodplain management ordinances and/or general plans as zones in which input is required from LMAs before land-use decisions are finalized.

The RFMP process could be used to identify areas within the region of applicability of Flood Structure Protection Areas. The RFMP process could also help develop model floodplain ordinances and general plan amendments for adoption by local land-use authorities detailing how Flood Structure Protection Areas should be developed, implemented, and administered.

4.3.9. *Levee Vegetation Management*

The 2012 CVFPP describes the State’s approach to levee vegetation management in light of USACE’s Engineering Technical Letter 1110-2-571, which emphasizes the need to establish a

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vegetation-free zone on and adjacent to project levees. The 2012 CVFPP Levee Vegetation Management Strategy is intended to reflect a flexible and adaptive management strategy that meets public safety goals, and protects and enhances sensitive habitats. Based on the current understanding of levee failure mechanisms, properly trimmed and spaced levee vegetation poses a low threat to levee integrity as compared to many indisputable risk factors, such as under-seepage, through-seepage, slope instability, erosion, and rodents. Under the State's Levee Vegetation Management strategy,

- New levees will be constructed and managed in consistency with the guidelines in U.S. Army Corps of Engineers Engineering Technical Letter 1110-2-571 with a vegetation-free zone.
- Levees with "legacy" trees will be managed to allow the existing large trees and woody vegetation to live out their normal life cycles unless they pose an unacceptable threat, while maintaining visibility for inspection and access for maintenance and flood-fight. This strategy allows for the retention of lower waterside vegetation below the "Vegetation Management Zone."

The Vegetation Management Zone is the area on and near a levee in which vegetation is managed for visibility and accessibility using a life-cycle management strategy. For typical sized levees the Vegetation Management Zone would include the entire landside levee slope plus 15 feet beyond the landside toe (or less if the existing easement is less than 15 feet), the levee crown, and the top 20 feet (slope length) of the waterside levee slope.

The Life Cycle Management approach achieves "visibility and accessibility" criteria while progressing gradually (over many decades) toward the USACE vegetation policy goal of eventually eliminating woody vegetation from the Vegetation Management Zone on the landside slope, crown, and upper waterside slope of levees. Existing trees and brush larger than 4" should be allowed to remain on the levee slope to live out their normal life cycles. Trees (alive or dead) will be removed if they posed an unacceptable threat to levee integrity. Removal would be accomplished in consultation with appropriate resource agencies.

This approach would protect waterside vegetation, which acts to stabilize the bank and provide erosion protection, while also providing habitat for sensitive species. In order to sustain this critical habitat, the CVFPP levee management strategy retains waterside vegetation (below the Vegetation Management Zone).

Under the State's strategy, vegetation that was introduced, allowed, required as mitigation, or endorsed by a previous USACE action to comply with environmental requirements, or was present when the levee system was transferred from the USACE to a non-federal sponsor, would not be removed.

LMA's within the Region should evaluate their systems to determine if the 2012 CVFPP Levee Vegetation Management Strategy is a workable strategy for them. This or other vegetation management strategies could be implement through the SWIF process many of the LMAs are about to embark upon.

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4.3.10. *Funding*

The Sacramento River flood control system provides system-wide benefits but its operation and maintenance is subdivided and delegated to individual entities, and is not funded, executed or coordinated in a system-wide manner. Some LMAs are responsible for maintenance of system-wide improvements but receive no funding assistance from the system-wide beneficiaries. The burden of maintaining and operating the system falls on a relatively small number or local landowners. As one of the near-term actions identified in the State System-wide Investment Approach (SSIA), DWR has developed the Flood System Repair Program (FSRP) to help LMAs repair documented critical problems with flood control facilities of the SPFC in non-urban areas To address longer-term systemic maintenance issues, DWR should expand the FSRP to develop and implement a maintenance subventions cost share program that provides technical and financial assistance to LMAs for long-term system maintenance and rehabilitation.

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5. Emergency Response

5.1. Introduction

This Chapter of the Mid and Upper Sacramento River RFMP describes the current status of flood emergency response in the Mid and Upper Sacramento River Regions. The nature of residual risk in the region and the current response structure is described in some detail. This chapter also provides an overall assessment of regional flood response readiness. Out of this assessment some key response issues have been identified and described. Information for these assessments was acquired during field trips and meetings conducted in March and November 2013 and through independent outreach and research. Finally, this chapter includes some recommended projects for improving the level of flood response readiness. These are presented to serve as a basis for discussion by stakeholders. All information in this draft Chapter is preliminary and subject to review, correction and modification, and final approval by local stakeholders.

5.2. 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). A key locally-based State agency in the Mid and Upper Sacramento River Regions with an important local flood response function is the Department of Water Resources which uniquely in the Central Valley directly maintains significant stretches of project levees through State "maintenance areas". Local entities and locally-based State agencies provide emergency response within their legal "jurisdiction". This "jurisdiction" is defined by either geography or specific mandated response function(s), or by a combination of both. As a result of this legal "jurisdiction" local entities and relevant locally-based State agencies retain primary command and control ("incident command") for subsequent emergency response and recovery activities occurring within their jurisdiction.

Local and State public agencies are required to use the National Incident Management System (NIMS) and the California Standardized Emergency Management System (SEMS) to organize and conduct their disaster response activities. These emergency management systems require agencies to use the Incident Command System (ICS) to organize response in the "field", where the direct impacts of the disaster are being handled. Higher levels of county, city, and State response management occur within "emergency operations centers (EOC)" or "departmental operating centers (DOC)" where special, but often somewhat different, adaptations of the ICS is used to organize activities. Where a disaster event extends across multiple different jurisdictions, by geography or function, the ICS recommends that a "Unified Command" be established in the field among all involved agencies with primary jurisdictional responsibilities.

Counties and many cities also maintain a specialized "emergency management" function within their organization in addition to agencies/departments with specific emergency response functions (e.g., Sheriff, fire department),. This emergency management function is responsible

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for coordinating the activities of the different departments of the jurisdiction during an event, assisting those internal departments with pre-disaster readiness activities, and facilitating executive management control of the overall response. The emergency management organizations performing this function generally prepare and maintain a jurisdictional Emergency Operations Plan (EOP) which describes how this overall disaster management function will be performed as well as specific plans/procedures of departments of the jurisdiction where they exist.

Counties are also mandated by State law to create and manage an "operational area" organization. This is a special organization composed of all local public jurisdictions within the county for the purpose of facilitating joint management of response resources and information to achieve the most efficient response possible. This special purpose operational area organization serves as a key communications and coordination link between different local jurisdictions and between those local jurisdictions and the State and federal governments.

Except for those locally-based State agencies that have initial emergency response responsibilities, and therefore a local incident command role in the field, State agencies primarily provide resources and support to responsible local agencies at their request. These resources are acquired under protocols laid out in the mutual aid and other systems described in the California Standardized Emergency Management System (SEMS). The California Office of Emergency Services (Cal OES) is responsible for the coordination of this State response in support of impacted local agencies. Cal OES staff do not typically serve as part of the disaster command structure actually managing the response in the field. The Federal Emergency Management Agency (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 are responsible for maintaining a readiness to meet their responsibilities in a disaster. Such readiness may take the form of developing a pre-planned SEMS response organization, preparing written plans or protocols, conducting training and exercise programs, and acquiring specialized equipment, supplies, and facilities. Whether any such actions taken are "adequate" or otherwise of an acceptable nature is a subjective evaluation. Statutes provide readiness mandates of a general nature and federal and State guidance provide general preparedness guidance and implementation methodologies but neither provide an unambiguous methodology for determining whether any particular response activity can be performed "adequately" 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.

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5.3. Flood Response Roles

5.3.1. *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 reducing the extent, depth, or duration of flood waters if a levee does fail. Such activities include levee patrol and basic remedial actions involving the placement of sandbags or rolls of plastic. Importantly, it also often includes the acquisition of private contractors and/or bulk materials for more substantive remedial actions such as the placement of rock blankets or the creation of a relief cut. General public safety operations, on the other hand, include those traditional public safety activities of public warning, evacuation, rescue, fire suppression, and recovery normally conducted by local law, fire and other agencies.

Levees are often maintained by a "special district" (or State "maintenance area") created for that sole specific function. Where such a special district (e.g., reclamation district, levee district, flood control district) has been established, it has primary jurisdiction for performing flood fight operations on its levee as a concomitant of its day-to-day levee maintenance responsibility. Within "maintenance areas" the Department of Water Resources has these responsibilities. In regard to public safety operations, fire suppression and rescue are generally provided in the Mid and Upper Sacramento River Regions by "fire districts", except in the case of two incorporated cities which have internal fire departments. Local law agencies generally provide traffic control and security functions. Public warning and evacuation activities seem to be a shared responsibility among multiple local agencies but specific local procedures identifying how this responsibility would be managed were not identified.

The Mid and Upper Sacramento River Regions include eleven reclamation districts, levee districts, or State maintenance areas that maintain project levees in the area. There are additional reclamation districts present in the region but they perform their functions through other means than levees. In addition, there are three important levee systems either maintained by a county or city directly or currently without a clearly identified maintaining agency. Table 5-1 shows the approximate size, status, land uses, and assets of each of the levee maintaining districts along with the local agencies responsible for performing the public safety operations component within the area protected by that district's levee.

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Table 5-1. Mid and Upper Sacramento River Regions Levee Maintaining Agencies

RDs	Size of District (acres)	Distance of Levees (miles)	Primary Land Use	Critical Public Assets	Status of LMA	Public Safety Agencies*
RD70	20,315	23.6	Agriculture	School, Highway 45, PG&E Gas Pipeline	Active	Sutter Co Sheriff; Sutter Basin Fire Protection District
RD108	48,000 (58,000)	20.6	Agriculture	School, Highway 45	Active	Colusa Co Sheriff; Sacramento River Fire Protection District; Colusa Fire Department
RD787	9,493	4.4	Agriculture	School, Fire Station, Highway 45, Highway 113	Active	Yolo County Sheriff; Knights Landing Fire Protection District
RD1500	64,000	33.58 (Sacramento) 20.77 (Sutter)	Agriculture	School, Highway 20, PG&E Gas Pipeline	Active	Sutter County Sheriff; Sutter Basin Fire Protection District
RD1660	14,807	3 (Sacramento) 9.14 (Sutter)	Agriculture	School, Highway 45, Highway 162, PG&E Gas Pipeline	Active	Sutter County Sheriff; Meridian Fire Protection District
LD1	11,700	12.45	Agriculture	School, Highway 45, Highway 162, PG&E Gas Pipeline	Active	Glenn County Sheriff; Glenn Cordora Fire Protection District
LD2	9,000	4.89	Agriculture	Highway 45, Highway 162, PG&E Gas Pipeline	Active	Glenn County Sheriff; Glenn Cordora Fire Protection District
LD3	4,000	12.24	Agriculture	Schools (5), Hospital, Fire Station, Highway 45, PG&E Gas Pipeline	Active	Glenn County Sheriff; Glenn Cordora Fire Protection District
MA1	10,000	17.12	Agriculture	Highway 99, Railroads (3) , PG&E Gas Pipeline	Active	Colusa County Sheriff; Princeton Volunteer Fire Department; Colusa Fire Department
MA5	45,000	15.29 (No.1 Butte) 16.53 (No.2 Butte) 1.5 (No.3 Little Chico Creek)	Agriculture	Airport	Active	Colusa County Sheriff; Sacramento River Fire Protection District
MA12	7,500	11.31	Agriculture	School, Highway 32, Highway 45,	Active	Butte County Sheriff; Butte County Fire Department
Hamilton City J-Levee	200	6.8	Agriculture	School, Highway 5, Highway 99	Inactive special district	Glenn County Sheriff; Hamilton City Fire Protection District
Tehama County Gerber Levee	590	1.62	Agriculture	Schools (12), Airport, Hospitals, Fire Stations, Police Stations, Railroads (Amtrak), PG&E Gas Pipeline, Highway 32, Highway 99	Active	Tehama County Sheriff; CalFire Tehama Glenn Unit
Big Chico Creek System Levees	22,000	18.5	Urban	School, Highway 45, PG&E Gas Pipeline	Active	Chico Police Department; Chico Fire Department

5.3.2. *Coordination of Multi-Agency Response*

Within the Mid and Upper Sacramento River Regions planning area, the six county Offices of Emergency Services (OES) are responsible for the day-to-day administration of disaster preparedness, mitigation, response, and recovery programs within their jurisdictions. These OES

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offices also provide administrative support to their respective Operational Area Councils and County Disaster Councils. In a disaster, these offices are responsible for coordinating the response of their county departments within the unincorporated area. They are also responsible as the lead "operational area" organization for coordinating information and resource sharing among the separate jurisdictions (e.g., cities, districts) within their political boundary. The county OES offices maintain emergency operations center (EOC) facilities to support the performance of these coordination activities.

The areas protected by project levees within the Mid and Upper Sacramento River Regions are unincorporated except for the Cities of Colusa and Chico. The City of Colusa is within the area protected by levees maintained by State Maintenance Area 1 and Reclamation District 108. The City of Chico maintains the flood control system for Big Chico Creek, which runs through its jurisdiction. Aside from those two cities, flood response in this planning area is, therefore, primarily a matter of coordinating the activities of county public safety agencies (primarily the sheriff's department and public works) and special districts (e.g., fire and reclamation/levee district/maintenance areas) having response functions in the area of concern.

This coordination of agencies and special districts conducting public safety operations in the field is usually accomplished through 1) an established Unified Incident Command with related field command post, and 2) at the operational area by the local county OES. No written pre-planned Unified Command structures, command post locations, or field multi-agency coordination processes for specific and distinct areas were identified during the research for this chapter. At this point, it would appear that these relationships would be developed on some formal basis at the time of the emergency. The presence of personnel with past flood experience would, therefore, be necessary to take advantage of past response experience in attempts to establish an effective incident command in a future event.

5.3.3. *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 in a disaster. The requesting jurisdiction does have a responsibility for providing for the maintenance of these outside resources during the period that they provide this assistance. The Master Mutual Aid Agreement is based on the fundamental concept that resources shared are held in common among jurisdictions (e.g., fire trucks, police officers) so that potential reciprocity applies. There are no provisions, requirements, or protocols in the Master Mutual Aid Agreement for the direct expenditure of funds by one jurisdiction on the behalf of another jurisdiction to help meet the requesting jurisdiction's responsibilities. In fact, FEMA public agency disaster assistance regulations discourage such cross-jurisdictional expenditures.

Each county within the Mid and Upper Sacramento River Regions, and their internal 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 agreements exist within the Mid and Upper Sacramento River Regions to supplement the provisions of that Agreement.

Therefore, no county or city jurisdiction is required by law or agreement to assist a levee maintaining special district (and, therefore, separate jurisdiction) with direct expenditures to help prevent a levee failure, or physically contain a flood. While examples of such assistance through the provision of resources (e.g., sandbags) or funds were identified, no explicit or written policies guiding the provision of such assistance to a levee maintaining agency were identified making such help in the future ad hoc and dependent on bureaucratic dynamics operable at the that time.

5.3.4. *U.S. Army Corps of Engineers and PL84-99 Programs*

The U.S. Army Corps of Engineers 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 State Plan of Flood Control were constructed through federal flood control programs. The U.S. Army Corps of Engineers 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 operation and maintenance (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.

5.3.5. *O&M Manual Flood Fight Components*

USACE Operation and Maintenance 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 so 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 PL84-99 authorities will continue despite federal action to remove LMAs from PL84-99 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.

5.3.6. *PL84-99 Levee Rehabilitation*

A long standing role of USACE in flood emergency response was rehabilitation of damaged levees after a flood under PL84-99 authority. Historically there has been a strong dependence on the federal funding under this program to perform expensive re-construction of levee breaches

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and other levee rehabilitation actions. The current effort of USACE to remove LMAs from PL84-99 eligibility for such assistance has wide-ranging consequences for the future of flood control in California. If sustained, it will require a paradigm shift in how levee maintenance is funded and structured. A paradigm shift that is at yet undefined, much less implemented.

It is clear that the ability of the Mid and Upper Sacramento River Region LMAs, with a couple of possible exceptions, to repair levee breaches, or perform extensive repairs to levees damaged by impounded flood waters, is questionable. 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. Therefore, absent this critical historic USACE assistance, the rehabilitation of the flood control system after a flood becomes a question mark without immediate answers.

Answers to this issue may only be forthcoming after the next flood if the issue is not addressed by policy makers at all levels of government in the meantime. 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 control 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 the Department of Water Resources, 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.

Given this situation, the question of what are the implications of losing PL84-99 levee rehabilitation assistance becomes essentially a rhetorical one. No extensive research is needed to know that no ready source of funds at the LMA, local or State level is in place to replace this historic federal assistance. No funds are in place because there is no clear policy as to how this change in federal policy will be addressed.

Clearly, there are only two options available. New joint discussions to define a new structure for rehabilitating levee systems must be carried out by local and State agencies. This will involve either strengthening LMA 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

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emergency. The role of such an emergency fund to provide cash flow for response and rehabilitation of the system for all areas of the SPFC after a flood could be added to the discussions concerning implementation of a new local/State structure for meeting this essential flood control activity.

5.4. Emergency Response Readiness

5.4.1. *Analysis of Residual Risk*

Project levees were constructed in the Mid and Upper Sacramento River Regions 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, as noted, to control floods of a specified magnitude there is also a "residual risk" to the protected area that a flood exceeding that 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 does fail, 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 is partially dependent on the relative difficulty of performing the appropriate protective actions. In this regard, the project levees in the Mid and Upper Sacramento River Regions 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 evacuating people and property from an area subject to flooding in this area is less than for many areas of the Central Valley due to its mostly rural nature. Highly urbanized areas subject to flooding are limited in number although these areas, of course, present a more complex response issue. Rural areas do make some protective action issues of more critical interest, such as evacuation of hazardous materials and debris removal after a flood.

5.4.2. *Flood Fight Readiness*

Determining whether an existing response capacity is adequate is highly subjective. For a short-term study some simple indicators must be used to provide a general impression of the degree of attention that jurisdictions are applying to flood preparedness. From such an impression one then must make a subjective judgment based on experience on the degree to which a jurisdiction will perform adequately when the time comes.

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Simple indicators in regard to flood fight capacity can be the existence of 1) written levee flood fight plans or flood-specific plans maintained by supporting agencies, 2) evidence that personnel receive training to perform levee patrol and basic remedial actions (e.g., sandbagging), 3) clear and unambiguous protocols for establishing flood fight command and control, and 4) the presence of stockpiles of materials or funds clearly identified and available for use in emergency response. Simple indicators of the capacity of the other jurisdictions in an operational area to rapidly and effectively support LMA flood fight operations would be the existence of 1) flood fight stockpiles maintained by these other jurisdictions which can be accessed by the reclamation or levee district, 2) flood specific mutual aid procedures, 3) clear and unambiguous policies for the provision of personnel and funds to assist with levee flood fight, and 4) regular joint exercises with levee maintaining agencies. While certainly not comprehensive, these indicators would provide a general impression of the ability of the two flood response components described above to perform effectively and to effectively coordinate and/or support the other.

Table 5-2. Indicators of Flood Fight Readiness

Agency	Written Flood Fight Plan or Procedures	Clear Flood Fight Command Protocols	LMA On-Hand Resources: Materials, Trained Crews, Emergency Fund (EF)	County, City or Fire District Mutual Aid/Coordination Capability	Exercises: Internal/Multi-agency
Reclamation District 70	No	No	Stockpile - Yes Crews – Yes but no ICS/SEMS/NIMS training EF - Yes	Stockpile - None Crews – None EF –None No clear LMA Mutual Aid procedures	No
Reclamation District 108	Yes; additional elements needed	No	Stockpile – Yes Crews – Yes EF - Yes	Stockpile - None Crews – None EF – None No clear LMA Mutual Aid procedures	No
Sacramento River West Side Levee District	Yes; additional elements needed	No	Stockpile – Yes Crews – Yes EF - No	Stockpile - None Crews – None EF –None No clear LMA Mutual Aid procedures	No
Reclamation District 787	Yes; additional elements needed	No	Stockpiles – Yes Crews – Yes EF – No	Stockpile - None Crews – None EF –None No clear LMA Mutual Aid procedures	No
Reclamation District 1500	Yes	Yes	Stockpile - Yes Crews – Yes EF -Yes	Stockpile - No Crews – CCC EF – No Agreement with CCC	Yes
Reclamation District 1660	No	No	Stockpile – Yes Crews – Yes but no ICS/SEMS/NIMS training ER – Yes	Stockpile - None Crews – None EF –None No clear LMA Mutual Aid procedures	No
Levee District 1 (Glenn)	No	No	Stockpile – No Crews – No EF – No	Stockpile - No Crews – No EF –No No clear LMA Mutual Aid procedures	No

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Agency	Written Flood Fight Plan or Procedures	Clear Flood Fight Command Protocols	LMA On-Hand Resources: Materials, Trained Crews, Emergency Fund (EF)	County, City or Fire District Mutual Aid/Coordination Capability	Exercises: Internal/Multi-agency
Levee District 2 (Glenn)	No	No	Stockpile – No Crews – No EF – No	Stockpile - No Crews – No EF –No No clear LMA Mutual Aid procedures	No
Levee District 3	No	No	Stockpile – No Crews – No EF – No	Stockpile - No Crews – No EF –No No clear Mutual Aid procedures	No
Maintenance Area 1 (DWR)	Yes	Yes	Stockpile – Yes Crews – Yes EF – Yes	Stockpile - Crews – EF – No clear Mutual Aid policy in regard to State MAs	No
Maintenance Area 5 (DWR)	Yes	Yes	Stockpile – Yes Crews – Yes EF – Yes	Stockpile – No Crews – No EF –No No clear Mutual Aid policy in regard to State MAs	No
Maintenance Area 12 (DWR)	Yes	Yes	Stockpile – Yes Crews – Yes EF – Yes	Stockpile - No Crews – No EF –No No clear Mutual Aid policy in regard to State MAs	No
Hamilton City J Levee	No	No	Stockpile – No Crews – No EF – No	Stockpile - None Crews – None EF –None No clear LMA mutual aid procedures	No
Tehama County Gerber Levee	No	No	Stockpile – No Crews – No EF – No	Stockpile - Crews – EF – Field Cmd -	No
City of Chico Big Chico Creek System	No	Yes	Stockpile – No Crews – No EF – No	Stockpile - Crews – EF – Field Cmd -	No

5.4.3. *General Assessment of the Readiness to Conduct Flood Fight Operations*

A review of the capacity indicators above indicates that the readiness of the Mid and Upper Sacramento River Regions levee maintaining agencies ranges widely.

Overall, a judgment can be made based on best practices that the readiness of the LMAs as a group to conduct effective flood fight operations is below optimal. Even among the State maintenance areas, where a high level of readiness is evident, there are indications that coordination or the potential for mutual aid with local governments is informal, lacks written policies, and could be further clarified, in particular, as to how State staff operating in their

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maintenance area could access assistance from other jurisdictions as opposed to other levels of the Department of Water Resources.

LMAs either have no written plans for conducting flood fight operations or have plans that do not share a common format or content with the plans of other LMAs. There appears to be clear leadership within LMAs for organizing and conducting flood fight operations but few personnel who were identified as potential managers of such operations have formal ICS/SEMS/NIMS training. Levee flood fight leadership would, therefore, be competent but would lack an optimal ability to apply ICS/SEMS/NIMS concepts to inter-agency coordination and mutual aid.

Local governments, other than levee maintaining entities, do not maintain stockpiles of flood fight materials to support potential flood fight operations on the levees and do not have clear policies in regard to providing such support to the LMAs. This leads to a lack of formal flood fight training of local government staff that could quickly assist with common flood fight activities such as levee patrol if needed. In some cases, such as in Glenn County, local fire district personnel assist in LMA activities but it is unclear whether they are acting as fire district employees or in a dual capacity as members of the LMA.

In regard to the provision of funds for more complex remedial actions to prevent levee failure, there does not seem to be clear and written policies within local governments identifying their level of willingness or capability for assisting with funding for direct acquisition of contractors or expensive bulk material. Local governments also do not have clear and pre-determined field command protocols for inter-agency coordination in the field except in a few cases.

Finally, levee maintaining agencies and public safety jurisdictions that would be operating in the same area do not conduct regular exercises to identify gaps in the development of an optimal response capability. These factors, the existence of a considerable level of residual risk, and a review of best practices available in the Central Valley would justify the evaluation that the Mid and Upper Sacramento Regions planning area's capacity to address residual risk through flood fight operations is below optimal.

5.4.4. *Public Safety Operations Readiness*

Turning to public safety operations for areas protected by project levees, some simple indicators of response capacity would be the existence of 1) general response plans, 2) flood specific response plans and/or training programs, 3) general Incident Command System/SEMS/NIMS training programs, and 4) written protocols for establishing multi-agency command and control in the floodplain. Indicators of the capacity of the counties, cities, and fire districts in the region 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.

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Table 5-3. Level of Public Safety Operations Readiness

Agency	Written Emergency Response Plan (General and/or Flood Specific)	Training and Frequency (ICS/SEMS/NIMS; Flood Fight Specific)	Command and Control Protocols specifically for Flood Operations	Resources/Equipment Available/Suitable for Floodplain Warning, Evacuation, Rescue, etc.	Clear Mutual Aid Procedures for Law, Fire, EMS
Yolo County; KLFPD	Standard EOP only No flood specific response plan	ICS/SEMS/NIMS – Yes FF specific – No	No	Yes	Yes
Colusa County; City of Colusa; PVFD; SRFPD	Standard EOP only No flood specific response plans	ICS/SEMS/NIMS – Yes, within Fire/Law FF specific – No	No	Yes	Yes
Glenn County; HCFPD; GCFPD; OFPD	Standard EOP only No flood specific response plan	ICS/SEMS/NIMS – Fire and Law FF Specific – No	No	Yes	Yes
Tehama County; CFTGU	Standard EOP only No flood specific response plans	ICS/SEMS/NIMS – Fire and Law FF Specific – No	No	Yes	Yes
Butte County; City of Chico	Standard EOP only No flood specific response plans	ICS/SEMS/NIMS – Fire and Law FF Specific – No	No	Yes	Yes
Sutter County; MFPD; SBFPD	Standard EOP only; No flood specific response plans	ICS/SEMS/NIMS – Yes FF Specific – No	No	Yes	Yes

* Agency Abbreviations

CFTGU – CalFire Tehama Glenn Unit
GCFPD – Glenn Codora Fire Protection District
HCFPD – Hamilton City Fire Protection District
KLFPD – Knights Landing Fire Protection District
MFPD – Meridian Fire Protection District
OFPD – Ord Fire Protection District
PVFD – Princeton Volunteer Fire Department
SRFPD – Sacramento River Fire Protection District
SBFPD – Sutter Basin Fire Protection District

5.4.5. *General Assessment of Readiness to Conduct Public Safety Operations*

A review of the capacity indicators above indicate that the readiness of the public safety agencies in the Mid and Upper Sacramento River Regions to conduct effective public safety operations in the floodplain are adequate but below optimal based on best practices in the Central Valley. Jurisdictions maintain normal general emergency operations plans and conduct more or less routine general ICS/SEMS/NIMS training. There are the normal established fire, law, and EMS mutual aid systems and most counties have specialized equipment for supporting field command and control activities available. However, specific and comprehensive plans for response to flood events do not exist and no flood fight specific training provided to county, city, and fire district responders was identified. Several jurisdictions work closely with one or more LMAs during a flood but this operational relationship is not documented so exact roles and relationships remain vague. The participation of residents in both the local fire district and the levee maintaining agency also tends to blur inter-agency relationships since it seems to be unclear under which agency's auspices these dual role personnel are responding.

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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 for areas where they would be appropriate. 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/SEMS/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 and Upper Sacramento Regions planning area's flood response capacity for public safety operations is less optimal than it could be.

5.4.6. *Gaps and Overlaps*

Written emergency plans that do exist in the Mid and Upper Sacramento River Regions are general in nature and prepared by each jurisdiction to describe how they will conduct their own operations within their own jurisdictional boundaries. Although Operational Area Councils are in existence it appears that participation by levee maintaining agencies is limited during routine coordination meetings and activities. Department of Water Resources staff assigned to State levee maintenance areas also do not seem to participate in these local coordination processes on a routine basis. 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 indicates that five key general gaps exist in the Mid and Upper Sacramento River Regions planning area's capacity to address all flood response issues in an optimal manner.

Lack of region wide consistent LMA written levee flood fight plans and floodplain-specific procedures within county and city emergency operations plans.

Ambiguity in relationships of local public agencies to LMAs in how they will coordinate field operations. In those cases where LMA command is identified, there is a lack of ICS/SEMS/NIMS training among the LMAs to facilitate coordination processes

Lack of clear and unambiguous policies by operational area jurisdictions in regard to providing mutual aid of personnel, resources/materials, and funds to LMAs to support levee flood fight operations.

Lack of joint exercises to identify response gaps and improvement opportunities.

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Lack of effective mechanisms to ensure that routine coordination and planning activities between LMAs and other public agencies occur to promote and maintain solutions to the other identified response issues.

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

5.5. Funding and Commitment

There are five reclamation districts that indicated they had a standing emergency fund to support flood fight efforts. Most of those indicated that the level of this funding was considered inadequate. State officials indicated that emergency funds were available to staff of DWR maintenance areas but the presence of an overarching State bureaucracy in this case makes the nature of such potential emergency funding significantly different from independent LMAs. In general, the limited financial situation of reclamation and levee districts and the resulting general difficulty in maintaining an adequate emergency fund makes their ability to respond to financial demands of flood emergencies questionable.

No other jurisdictions in the Mid and Upper Sacramento River regions were identified that maintain a designated and budgeted emergency fund for responding to emergencies. County and city jurisdictions would clearly be dependent on their internal general fund reserves or any general budgeted contingency funds 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 LMAs with levee flood fight operations is not required by existing mutual aid agreements or any statute. Such expenditure of county or city tax dollars in another jurisdiction has legal barriers as well as issues with FEMA disaster assistance regulations, both of which would best be addressed with a written flood-specific mutual aid protocol. Such a protocol does not exist in the Mid and Upper Sacramento River Regions. Examination of the general funds of local county or city jurisdictions would not be productive given the absence of a clear commitment or protocol for providing direct expenditure support on behalf of LMA special districts.

Without a clear commitment to provide financial assistance, and without a designated budgeted emergency fund, it is impossible to evaluate the capacity of the non-LMA jurisdictions to assist with flood fight operations.

5.6. Response Issues

Jurisdictions within the Mid and Upper Sacramento River regions have, without exception, worked hard over the past years to improve response capability and institutionalize SEMS and NIMS response doctrine. However, the relatively small size of jurisdictions in this region creates significant challenges to improving overall response. Levee maintaining agencies, in particular, struggle to maintain optimum plans due to small staffs and limited resources. Active cooperation

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among LMAs to pool resources for maintenance of plans and stockpiles has been limited and no formal mechanism for such cooperation has been formed. The existence of large stretches of levees maintained by State employees of the Department of Water Resources in defined "maintenance areas" further complicates the creation of SEMS consistent joint planning, mutual aid and coordination processes.

5.6.1. *General Issues*

A meeting of regional jurisdictions conducted in March 2013 identified several general areas of improvement that should be addressed in the regional flood management plan. These jurisdictions also agreed that better integration of their individual response systems was a key to significant preparedness progress.

General Issue #1: Need for higher quality, more user-friendly local, tactical, flood safety plans
Many levee maintaining agencies lack adequate written plans for flood fighting their levees. Plans that do exist are not uniform in format or content. Historical knowledge, knowledge of local topography, and awareness of potential containment actions in the event of a breach are often known by LMA officials but not documented. Many of the LMAs must comply with Water Code Section 9650 (AB156) flood safety plan requirements and all LMAs must comply with the State priority of developing local flood response plans if they are to receive DWR grant funding. This situation makes the issue of developing a standard, state-of-the-art, template for a local, tactical, flood safety plan for consistent implementation throughout the regions a critical issue.

As an added point to this issue, research for this chapter indicates that specific information on the probable behavior of flood waters flowing from foreseeable breach scenarios has not been developed. The lack of this information hinders the ability of local jurisdictions to develop detailed action plans before a breach occurs. Improving this situation as part of the development of local flood safety plans should be a high priority.

General Issue #2: Need to reduce failures of communication in the field between multiple, separate, jurisdictions operating in the same area with different functions
Field tours of the region revealed a common problem that has also been recognized in other regions of the Central Valley. This is the failure of different jurisdictions operating in the field with different response functions to effectively communicate in many instances. Stories of public safety officers who don't allow reclamation district levee patrols through, LMA staff who don't know how to contact public safety field command staff, and unilateral actions by one agency that affects the ability of others to perform their functions were common in the field interviews. While the complexity of disaster operations makes some of these failures inevitable, reducing failures to communicate in the field, particularly across political lines, is a high priority for the region.

General Issue #3: Need for a more integrated and sophisticated regional flood fight resource stockpile system
Current practice is for individual LMA's to stockpile flood fight resources for their own needs within their own jurisdiction. Stockpiles that do exist contain standard general resources (e.g.,

sandbags) but not necessarily specific materials or resources that would be needed to respond to specific foreseeable breach scenarios. DWR stockpiles large quantities of flood fight materials but the State interest is that these materials be available for crisis situations and to back up local stockpiles and not for initial needs.

The situation tends to be worse in regard to specialized evacuation supplies such as signs, low-power radio transmitters, and barricades. Barricades and other general supplies might be stockpiled by jurisdictions but rarely with the implementation of a specific evacuation tactical plan in mind. If a breach-scenario analysis is completed as part of the creation of higher quality local flood emergency action plans then this could promote the preparation of more detailed evacuation/rescue plans and the subsequent acquisition of specific supplies needed to carry them out.

General Issue #4: Need for better tools for creating a regional common operating picture
Regional jurisdictions feel that additional means for sharing real-time critical information should be created for the region. Essential elements of information were identified that would best help create a common sense of the regional threat if effectively shared. This common operating picture would facilitate inter-agency and inter-jurisdictional coordination and sharing of resources. These essential elements of information are; 1) levee patrol reports in order to reduce rumors and create an accurate sense of the status of all levees, 2) real-time locations of resources deemed critically limited to enhance the ability of mutual aid systems to deploy these resources as effectively as possible, 3) location, contact, and status information of activated unified flood fight and public safety field commands, and 4) contents of local flood emergency action plans for download in an easily printed and used map format.

5.6.2. *Specific Response Issues*

The following specific issues fall under the general issues identified above and were identified during a follow up interview process in November 2013.

- **Interaction with Levee Maintaining Agencies.** Operational areas in the regions have a mixed relationship with the levee maintaining agencies within their jurisdiction. Many interact with the LMAs extensively in a flood event but the manner of interaction in the field is not formally defined. LMA mutual aid processes are often not defined through any written protocols. Day to day interaction for purposes of joint planning, training, and exercises seems to be very limited throughout the regions.

- **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 once flood waters originating within their jurisdiction leaves their jurisdiction. General experience is that LMAs do assist with removing impounded flood waters to some extent within their financial resources. However, they do not cross jurisdictional boundaries to flood fight flood waters leaving their jurisdiction. Any concurrent responsibility of impacted cities

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or counties or of the State of California to assist in dewatering is poorly defined making dewatering operations, in particular, ad hoc activities.

- **Evacuation Planning.** Written evacuation plans for specific 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 were identified. These adjuncts to a comprehensive local, tactical, flood safety plan should be addressed.

  The rural nature of the Mid and Upper Sacramento River Regions simplifies the problems of warning, evacuation, and rescue for people but elevates the importance of other evacuation and recovery issues unique to agricultural areas. Evacuation planning for the two regional cities and the numerous smaller but significant communities (e.g., Hamilton City) in the region also remains a key issue.

- **Flood Fight Materials and Mutual Aid.** No jurisdiction outside of reclamation districts and DWR was identified that maintains stockpiles of materials specifically for supporting levee flood fight operations. Specific processes for levee maintaining agencies to request mutual aid were lacking. This lack of specific written processes is even more critical in these regions since the existence of State maintenance areas within local operational areas could potentially lead to SEMS inconsistent mutual aid activities.

- **Flood Fight Operations Training.** No non-LMA jurisdiction was identified that conducts regular flood-specific training or DWR flood fight classes to its employees. This decreases the potential for meaningful, local, mutual aid processes for flood fight operations.

- **Debris Removal.** FEMA will allow counties to assist with removal of debris from private property that did not originate from the property owner's possessions or land. Counties 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. No such plan was identified within the regions. Such assistance could be critical for expediting the return of agricultural and economic productivity after a flood.

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

- **Mechanisms for ongoing planning and coordination**. Improved mechanisms need to be created to ensure that there is ongoing planning and coordination between neighboring LMAs and between LMAs and other public agencies responding in their areas. A more effective process would maintain essential personal relationships and ensure that solutions to other identified gaps are maintained into the future.

5.7. Opportunities

Despite the issues identified for emergency response planning in the Mid and Upper Sacramento River Regions, many opportunities are appearing to assist with efforts to improve the situation.

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5.7.1. *Standard Local Flood Safety Plan Template*

The issuance of two grants by DWR for local flood emergency response projects has stimulated discussion on the need for adequate local tactical flood response plans that meet some consistent standard, format and content. DWR grant guidance indicates that completion of such local plans is a prerequisite to obtaining funds for other response items such as supplies or communications and the recent addition of Water Code Section 9650 (AB156) to State law, which also requires such efforts. These mandates highlight the need for a standard and high quality template for such plans before uncoordinated and independent efforts result in a mixed bag of plans in the region with different formats and quality.

There is an existing opportunity to develop such a common, high quality, approach to meeting State mandates. As part of the project definition process for the regional flood management plan, a Flood Safety Plan guide was developed defining and elaborating a standard, high quality, flood safety plan based on best practices in the Central Valley. This guide, which is included as Appendix C, takes advantage of this opportunity to provide local agencies with a consistent approach to local flood planning before extensive work begins.

5.7.2. *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. Mid and Upper Sacramento Regions jurisdictions were eligible for applying for the statewide grant and submitted a joint, regional, application in April 2013. DWR awarded $1.2 million to this application for preparation of local tactical flood safety plans and training in October 2013. A second round of statewide grants is anticipated in the next year or so.

This current funding opportunity and the potential second funding opportunity should be integrated into the final RFMP. Projects approved in the current grant will be identified as RFMP improvement projects and more detailed project descriptions created to guide grant implementation. Stakeholders can identify additional ER enhancement projects not funded in the current grant for inclusion in the second anticipated funding opportunity in 2014 or 2015.

5.7.3. *New Joint Planning and Maintenance Mechanisms*

The Mid and Upper Sacramento River Regions 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.

Regional operational areas could form flood response working groups within their operational area and disaster council organizations to provide a better focus and incentive for pre-event flood

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planning. These working groups should be composed of the reclamation districts and those public safety agencies with primary response jurisdiction within the flood plain. Working groups could be created through a written agreement or protocol that defines meeting frequency, objectives, and specific review items. The creation of such groups could ensure that flood response products developed in past preparedness projects are maintained and would help ensure that new officials have an efficient means of being properly briefed on current preparedness plans and their status.

5.8. Additional Findings

The Mid and Upper Sacramento River Regions 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 available. 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 and Upper Sacramento River Regions should include a mechanism for ensuring proper maintenance of resulting improved plans and training programs created as a result of project implementation.

5.9. Specific Recommended Projects

Based on the findings made above, the following four specific projects are recommended to improve flood emergency response preparedness in the Mid and Upper Sacramento River Regions.

5.9.1. *Overall Preparedness Goal and Summary of Recommended Projects*

The Mid and Upper Sacramento River Region jurisdictions have identified specific projects based on the review of the current status of preparedness of the region and in light of the State priorities of 1) improving local flood emergency plans and incorporating them into multi-hazard emergency response plans and 2) improving regional and interagency coordination. All specific projects would be implemented in accordance with the Federal Integrated Planning System (IPS) and Federal Emergency Management Agency (FEMA) Comprehensive Preparedness Guide (CPG) 101 as well as applicable standards of the California Standardized Emergency Management System (SEMS). All levels of government would be involved in project implementation, both vertically and horizontally, in accordance with National Response Framework doctrine.

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Overall Regional Flood Preparedness Goal:
Create a sustainable, regional, integrated response structure and partnership, the foundation of which is high quality, thorough, and user friendly local flood emergency action plans to guide field response to an incipient flood problem or threat.

Project #1: Develop a set of GIS-based local flood safety plans for the region with a common standard and mapping format.

Project #2: Create a region-wide unified command structure and enhanced multi-agency communication and coordination system.

Project #3: Develop and implement a regional flood response training and exercise program.

Project #4: Implement a regional stockpile system using breach scenario analysis to supplement criteria for standard resource inventory.

Implementation of these projects will improve flood preparedness and reduce flood risks in the Mid and Upper Sacramento River Valley by addressing identified gaps in current response capabilities. They will create high quality first response to incipient flood threats by improving multi-agency coordination, decision making in the event of a levee breach, and agency response capabilities. Collection of critical information and pre-event identification of containment options to foreseeable breach scenarios in the flood safety plan implementation process will facilitate rapid and effective decision making to reduce flood damage. Enhanced regional multi-agency coordination systems will also improve the region's ability to develop a common operating picture and share resources during a flood event. Finally, resources needed for initial response to threats to levee integrity, for initial public protection actions, and for prompt action to contain floodwaters would be acquired and placed in an integrated and more sophisticated regional stockpile system.

5.9.2. *Local Flood Safety Plans*

In regard to flood fight operations, reclamation districts 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. Reclamation districts, levee districts, or State maintenance areas, as the local jurisdiction responsible for maintaining the flood control system, 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 are not under the direct maintenance responsibility of a LMA or other agency but could serve to contain or limit flood extent.

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. In addition, areas whose improvement would support more efficient flood fight response should also be identified.

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These structural improvements related specifically to flood emergency response can then become a part of the LMA levee improvement plan.

A standard template for development of such flood safety plans mandated by AB156 (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 reclamation district emergency operations plan. A project definition manual based on this template is part of the Mid and Upper Sacramento River RFMP.

The limited financial resources and staffing of reclamation districts makes development and maintenance of detailed and adequate levee flood fight plans difficult. LMAs also often lack formal training in developing emergency plans. LMAs could form an agreement with cities and counties to help develop plans.

5.9.3. *Unified Command Structure*

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 flood safety plan. In addition, LMAs should adopt a formal mechanism for clearly designating a flood fight incident commander as part of their flood safety plans.

The Incident Command System (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 control 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.

5.9.4. *Regional Training and Exercise Program*

State and federal governments require that public agencies institutionalize the SEMS and 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 LMAs should be developed as part of the planning process to provide familiarization with SEMS and NIMS procedures and flood fight protocols. This should include abbreviated courses that could be

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presented upon flood warning to volunteers and LMA staff that have not had the opportunity to take formal courses.

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.

5.9.5. *Regional Stockpile System*

Design regional stockpile system including location of long-term storage sites and pre-identified deployment sites (staging areas) with specific site inventories. Completion of high quality flood fight-based local flood safety plans will provide the information needed for design of a more sophisticated regional stockpile system.

Resource needs for implementing identified containment options for foreseeable breach scenarios will now be identified and integrated into inventories for specific stockpile locations.

Develop agreements for use of specific long term and staging area storage sites and work with site owners to implement plan. Establish procedures for accessing regional stockpiles consistent with mutual aid and SEMS processes but ensuring rapid access to resources by field responders dealing with levee problems. Acquire materials and resources for regional stockpile system and place in long-term storage areas in accordance with the system plan. Specialized containers for rapid movement of materials to staging areas will be acquired as needed.

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6. Land Use and Environmental

6.1. The Value and Importance of Preserving Agriculture

The Mid and Upper Sacramento River Regions have rich alluvial soils and relatively-secure and abundant water supplies that, when combined with efficient farming practices, contributes greatly to the Regions' ability to generate a significant portion of the nation's food production. This robust agricultural industry contributes a large portion of the economic base for the regions in the form of employment and local taxes.

As discussed previously in Chapter 2, the agricultural industry accounts for more than $3.3 billion of the economies within the MUSR Regions. This value does not account for the indirect impacts from local "business-to-business" transactions necessary to support the agricultural industry (i.e., the local purchase of farm machinery, pesticides etc.), nor does it account for the induced impacts generated by the direct and indirect economic activity (i.e., when agricultural laborers or farm proprietors use earnings to purchase food, clothing, automobiles, real estate, education, and health and social services), which are vital to the Regions' economy.

The Regions also have a rich cultural heritage of farming, which for some farms spans multiple generations. Managing flooding and preserving the agricultural landscape are intertwined and inseparable. They are integral parts of the cultural heritage of the Regions. Working and living in this rural setting creates a strong sense of identity with the land and the agricultural lifestyle. Sustaining this agricultural heritage and social fabric is a very important view to many living in the Regions. During development of the MUSR RFPM, regional stakeholders have made it clear that they expect that any proposed changes to the flood control system within the Regions must fully evaluate and consider the potential impacts and consequences for the agricultural landscape.

6.2. The Value and Importance of the Natural Environment

This section describes the values and importance of the natural environment in the Regions with a focus on riparian corridors. This includes context related to flood system impairments and existing and future goals for natural environment rehabilitation.

6.2.1. Habitat Mitigation and Restoration

The current flood system of levees, weirs and bypasses was largely developed as a 'single purpose' system with the goal to reduce flooding and flood damages. Since development of the system, new laws such as the Endangered Species Act, and changes in societal aspirations for preservation of the natural environment, have created challenges and conflicts in managing, operating and improving the flood control system. In recent history, some projects have been

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undertaken that physically alter the landscape, oftentimes converting agricultural lands back to native vegetation and changed hydrologic regimes, to enhance or create habitat for native species.

Mitigation projects are developed to address adverse effects on listed species and/or their habitats from project impacts, as required by State and federal law. Mitigation is generally comprises the enhancement or rehabilitation of habitat in specific ways, to offset an impact caused by a project or action. Mitigation may include planting of vegetation, grading and contouring of the land surface and/or adjusting the hydrologic regime of the area through irrigation or management of drainage. This may at times involve the conversion of agricultural lands to habitat area. In all such instances, this is for the purpose of mitigating the impacts of a development or infrastructure construction or repair/replacement project. These mitigation areas are frequently located away from the project's site of impact, and the land use changes associated with the habitat mitigation have an influence on the properties adjacent to the mitigation site.

Many projects within the river and its adjacent riparian corridor have potential to impact listed species and/or their habitats, either through the construction process or because a component of the project will influence a species and/or habitat. Mitigation for any identified impacts could be completed on site or off site, depending on the specific site attributes and design considerations. Importantly, mitigation also can be integrated into a project itself, with the result of project activities resulting in a net improvement for the species in question. For example, a levee setback or rock revetment removal project may create sufficient new habitat such that any adverse impacts are mitigated by the project actions themselves. Integrating mitigation into a project can reduce the overall cost of the project (e.g., no added mitigation costs).

Similar, but importantly different, are habitat restoration projects, planned and implemented by a variety of organizations and government agencies with the goal of restoring the habitat for species recovery and human recreation and enjoyment. While the actual changes to the landscape stemming from mitigation and restoration projects are essentially the same, the difference between mitigation and restoration are largely a legal construct. There are legal requirements for mitigation whereas restoration projects are largely completed based on the aspirational goals of various agencies and organizations, which were set based on societal value of these natural resources.

Confusion between these two project types can and does occur. This is largely because the visible changes to the landscape are so similar; however, the "driver" (mitigation or restoration) is essentially an invisible land management directive. Regardless of the project type, concerns for landowners adjacent to habitat projects include potential for depredation of crops; the potential incidental take of an endangered species that may now be located closer to their property; increased potential for fire; and a host of other concerns related to the management of these habitat areas. Agencies responsible for operation, maintenance, and management of the flood control system also are concerned that these changes to the landscape hinder the original purpose of the flood control system, and diminish the flood risk reduction benefits for which the system was initially designed to provide.

6.2.2. Existing Habitats and Threatened and Endangered Species

Rangeland and cultivated agriculture dominates the existing landscape within the Regions and helps support threatened and endangered plants and animals. There are also many natural habitat areas that support threatened and endangered plants and animals. Primarily, these areas exist along the Sacramento River corridor where valley foothill riparian occurs adjacent to the river channel throughout parts of the planning area. In addition, freshwater emergent marsh exists in the Regions immediately west and north of the Sutter Buttes, and a matrix of annual grassland is found throughout (Table 6-1).

Table 6-1. Existing Habitats in the Regions

Habitat Type	Acres	%
Cropland	479,815	79.4%
Fresh Emergent Wetland	54,680	9.0%
Valley Foothill Riparian	22,770	3.8%
Annual Grassland	21,624	3.6%
Urban	14,115	2.3%
Open Water	8,486	1.4%
Barren	1,673	0.3%
Blue Oak Woodland, Blue Oak-Foothill Pine	940	0.2%
Scrub	132	<0.1%
Eucalyptus, Urban	85	<0.1%
Alkaline Desert Scrub, Saline Emergent Wetland	27	<0.1%
TOTAL	**604,352**	**100.0%**

Source: Regional Flood Atlas Database, DWR 2013.

Notes: Vernal Pool/Swale habitat type occurs within the Regions, though it was not mapped in this data set. "Coastal scrub" was changed to "scrub" vegetation for accuracy purposes. Habitat layer includes data gaps in an area that appears to be primarily dominated by agriculture/cropland immediately south of Chico.

Compared to other regions within the Central Valley, the MUSR Regions includes substantial habitat areas (see Table 6-2). Within the MUSR Regions, over 80 State and federally listed species are known to occur. While these species primarily depend on natural aquatic habitats, there are also three listed bird species that use agricultural areas (croplands) including Swainson's hawk, Townsend's big-eared bat, and the greater sandhill crane.

Table 6-2. Existing Habitat in MUSR Region compared to other Central Valley Regions

Habitat Type	Acres	%
Valley Foothill Riparian	<<xxx>>	<<x%>>
Fresh Emergent Wetland	<<xxx>>	<<x%>>
<<Under Development>>		
TOTAL	**<<XXX>>**	**100.0%**

Source:

Within the region, there are over 84,000 acres that are designated as conservation lands. These conservation lands include areas designated and managed as wildlife refuges or ecological areas that are owned by California Department of Fish and Wildlife (CDFW) or the United States Fish and Wildlife Service (USFWS), as well private conservation lands held by organizations such as The Nature Conservancy, Westervelt Ecological Services, Wildlands, and River Partners. It also includes privately held lands that are under a conservation easement. USFWS lands include the Colusa National Wildlife Refuge, Delevan National Wildlife Refuge, Sacramento River National Wildlife Refuge, and Sutter National Wildlife Refuge. CDFW wildlife-oriented properties include Collins Eddy Wildlife Area, Colusa Bypass Wildlife Area, Gray Lodge Wildlife Area, Sacramento River Wildlife Area, Sutter Bypass Wildlife Area, and Upper Butte Basin Wildlife Area.

6.2.3. The Value of Incorporating Riparian and Floodplain Habitat

The primary purpose of the MUSR RFMP is to develop strategies for improving flood management within the Regions. An important component of the MUSR RFMP will be development of a list of projects that will help achieve flood management improvement. This planning process provides an opportunity to develop and include in that project list *multi-benefit* projects that reduce flood risk while also enhancing and restoring habitat for threatened and endangered species. Some multi-benefit projects take advantage of natural processes enabled by changes in floodway constriction, enabling a sustainable ecological system with appropriate habitat structure and river process. Such projects may be viable for funding from sources unrelated to flood management (i.e., funding sources dedicated to ecosystem projects), thus tapping into alternative funding sources that hereto were not viable funding mechanisms for flood projects. These projects also provide for the recovery of threatened and endangered species, which supports delisting of species and an appurtenant reduction in regulation to landowners. These sorts of projects may also be used to (self) mitigate for any impacts of the flood project itself, for other flood projects in the region, or for projects or conservation/mitigation goals outside the region. Overall, including appropriately planned, implemented and managed riparian and floodplain habitat into the Regions' landscape matrix ultimately contributes to a resilient and sustainable ecosystem on a long term time scale and may provide opportunities at the landowner and regional levels for opportunistic financing. More information on multi-benefit projects, including examples, potential restoration opportunities, land stewardship opportunities, and potential landowner participation incentives are described in Section 6.4.

6.2.4. Conservation Goals

There are several agencies and non-governmental organizations that are known to undertake conservation planning in the Regions, and some also own and manage lands as well as implement environmental enhancement projects within the Regions. These include USFWS,

CDFW, DWR, TNC, River Partners, American Rivers, Westervelt Ecological Services, and Wildlands. Other landowners and cooperating agencies/organizations may also have goals and objectives relevant to the ecosystem and land management. In addition, three Natural Community Conservation Plans/Habitat Conservation Plans (NCCPs/HCPs) are underway in the Regions and they each include goals and objectives relevant to the RFMP (more details on these HCPs are included in Section 6.2.6). During development of the MUSR RFMP, these and other organizations provided the following input, as related to their goals and objectives for the conservation within in the Regions:

- Let the river move. Restore natural river process by removing revetment where possible (without impacts to infrastructure), especially in areas where the levees are set back and rock is on the bank, not the levee.
- Pursue ways to provide adequate water in the streams and rivers at the appropriate times of year (for foodweb production, as habitat for aquatic species, and for natural river process to refresh banks, cottonwood regeneration, etc.)
- Develop landowner incentives to restore native vegetation and allow erosion of river bank through easements or other cooperative programs.
- Increase inundation of floodplains at appropriate times, longer duration, and increased frequency by lowering or reconnecting floodplains.
- Retain existing and increase amount of shaded riverine aquatic (SRA) habitat, especially SRA that includes natural bank, not planted rock whenever possible.
- Promote increased complexity and diversity of vegetation seral stages. Having all mature "riparian jungle" is not desirable or sustainable. Many species need different age classes of riparian and grasslands, oak woodlands, etc. This will also enhance public use where compatible and may create buffers to keep native wildlife in protected areas to reduce their impact on private lands.
- Continue CDFW's surveying of the Sacramento River deer population with the hope that a special hunt program may be developed to manage that population and decrease depredation impacts to private landowners.
- Complete property line surveys and sign posting on private lands to assist CDFW enforcement staff in helping to keep the public off of private lands adjacent to CDFW owned or managed lands.
- Promote an upland connection for wildlife to provide refuge during flood events.
- Encourage and participate efforts to improve, restore, and create new habitat for species (listed and native) in the area, including salmonids, green sturgeon, bank swallow, western yellow-billed cuckoo, Swainson's hawk, deer, bats, native fish, birds, mammals and rare plants.
- Encourage projects that incorporate ecosystem restoration of tributary streams to the Sacramento River (such as Colusa Canal, Sycamore Slough, Cache Creek, and other canals for water transport).

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- Support establishment of native vegetation buffers between existing agriculture and tributary streams to provide corridors for wildlife, improve water quality, and decrease costs and conflicts associated with channel maintenance.
- Address fish stranding at the weirs that feed the bypasses (i.e., Fremont, Tisdale, etc.) and the screening of all unscreened diversions on the Sacramento River and its tributaries. Incorporate these actions into the plan and encourage collaboration to correct these issues.

6.2.5. Environmental goals of the CVFPP and Enabling Legislation

The preparation of the CVFPP is legally mandated based on Senate Bill 5 (Chapter 364, filed with the Secretary of State on October 10, 2007, codified at Water Code Section 9600 et seq.). It specifies that the CVFPP shall include descriptions of both structural and nonstructural means for improving the performance and eliminating deficiencies of levees, weirs, bypasses, and facilities (including those of the State Plan of Flood Control). It also states that these activities should strive to meet multiple objectives, including (but not limited to):

- Promote natural dynamic hydrologic and geomorphic processes;
- Increase and improve the quantity, diversity, and connectivity of riparian, wetland, flood plain, and shaded riverine aquatic habitats, including the agricultural and ecological values of these lands;
- Minimize flood management system operation and maintenance requirements; and
- Promote the recovery and stability of native species populations and overall biotic community diversity.

DWR's FESSRO has been charged with supporting the Central Valley Flood System Conservation Strategy, a mechanism by which mitigation for repairs and improvements to the SPFC can be (pre-) mitigated and the charge of SB 5 met. Details of the conservation strategy, including numerical habitat targets, are forthcoming, likely for release in late spring 2014. The USFWS and NOAA have species recovery plans for federally threatened or endangered species and habitats in the Regions, supporting and informing decision making, but are not legally binding. These species and habitats include the Chinook salmon, valley elderberry longhorn beetle, and the vernal pools.

6.2.6. Existing Natural Community Conservation Plans/Habitat Conservation Plans (HCPs/NCCPs), RAMP and other Plans

HCPs are planning documents prepared by non-federal parties as part of an application for an incidental take permit for listed species, when take of such species may occur from projects or other activities (i.e., maintenance). An HCP assesses the impacts of a proposed action on species, proposes measures to monitor, minimize, and mitigate these impacts, and analyzes action alternatives. On approval of an HCP, the USFWS and NOAA issue an incidental take permit, which allows the non-federal party to legally proceed with an activity that otherwise may

result in unlawful take of a protected species. An NCCP essentially is the California state equivalent of a federal HCP for species listed under the California Endangered Species Act (CESA).

These HCP/NCCP efforts take a broad-based ecosystem approach to planning for the protection and perpetuation of biological diversity. Therefore, an HCP/NCCP can identify and provide for the regional protection of plants, animals, and their habitats, while allowing compatible and appropriate economic activity.

There are three Natural Community Conservation Plans/Habitat Conservation Plans (NCCP/HCP) that have planning areas which overlap with the MUSR RFMP boundary. These plans include the Butte Regional Conservation Plan (BRCP), Yuba-Sutter Regional Conservation Plan (YSRCP), and Yolo Natural Heritage Program (YNHP). All three plans are both federal HCPs and state NCCPs. The BRCP, YSRCP, and YNHP will help to streamline the environmental permitting process to reduce permitting costs, improve certainty regarding regulatory requirements, provide local control through consolidation and streamlining of the permitting process, improve habitat, and protect property rights (BRCP 2014; YSRCP 2014; YNHP 2014). The most direct influence of these plans on the MUSR RFMP would be for any activities recommended by this plan to be covered as a part of the HCPs/NCCPs. An incidental impact, and one harder to assess, is the potential for these plans to preclude the MUSR RFMP from taking advantage of certain mitigation opportunities that the HCPs/NCCPs might otherwise develop beforehand

The BRCP is being coordinated by the Butte County Association of Governments on behalf of the cities of Chico, Oroville, Biggs, and Gridley, Butte County, Caltrans District 3, the Western Canal Water District, the Richvale Irrigation District, the Biggs west-Gridley Water District, the Butte Water District, California Department of Fish and Wildlife (CDFW), and the U.S. Fish and Wildlife Service (USFWS). The draft BRCP and Environmental Impact Statement/ Environmental Impact Report (EIS/EIR) are scheduled to be released in early to mid-2014. According to the draft BRCP, the plan does not include coverage for maintenance of levees or other flood control facilities that may be maintained by DWR as DWR is not a permit applicant and its activities are not covered under the BRCP. The draft BRCP does include coverage for these activities for County Service Areas (Butte), but not other LMAs.

The YSRCP is being prepared through a partnership between Sutter and Yuba counties, Yuba City, Wheatland, Live Oak, Caltrans, CDFW, and USFWS. Initial concepts for the NCCP/HCP have been developed and further preparation of the plan as well as an EIS/EIR is expected to begin in 2014. According to the draft YSRCP, the plan does not include coverage for maintenance or construction related to flood control projects and other stream-related facilities. LMAs are not participating in the plan and currently these activities are not recommended for coverage for the participating counties' activities.

The YNHP is run by the Yolo County NCCP/HCP Joint Powers Agency (JPA), which includes representatives from Yolo County; the cities of Davis, Woodland, West Sacramento, and Winters; and UC Davis. The first administrative draft NCCP/HCP, called the Yolo County Natural Heritage Program Plan, was posted on the program website on July 1, 2013. Actions

covered in the plan include residential industrial, institutional, and commercial development; transportation projects; utility projects; recreational facilities; solar energy development projects; flood control and water conservation improvements; and aggregate mining, including O&M activities associated with each of these types of projects. The draft YNHP includes the following as covered activities:

- Installing geomorphic controls (such as vanes, weirs, walls, step pools, or other features) in conveyance channels to control grade, velocity, or channel migration; such controls would be designed, to the extent allowable by site constraints and functionality, to mimic features of natural channels.
- Installing gates, checks, culverts, road crossings, or other flow control features in channels.
- Establishing flood flow corridors to train out-of-bank flows into low impact areas that are designed, to the extent feasible, to sustain shallow water depths and slow velocities.
- Installation of ponds, retention basins, or micro-reservoirs that provide operational flexibility (i.e., capacity to adjust timing or amount of delivered water) or flood risk reduction.
- The draft YNHP also states that flood pathways may be implemented to improve flood conveyance and minimize periodic damage to infrastructure and agricultural lands.

The 2012 CVFPP includes Attachment 9A, Regional Advance Mitigation Planning (RAMP). RAMP is an effort to provide a method to achieve faster, less expensive, and better mitigation for unavoidable impacts associated with infrastructure projects proposed within the State. RAMP can be integrated with and add benefits to conservation planning efforts such as HCPs/NCCPs, which are also attempting to address impacts in advance. The RAMP Work Group formed in 2008 and includes DWR and Caltrans—the main potential users of the RAMP in terms of mitigation of potential impacts—as well as the United States Environmental Protection Agency (USEPA), 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.

Within the greater Sacramento River Valley and Sacramento and San Joaquin River Delta, multiple demands for water use, and oftentimes other competing interests, influence water management—with significant social, economic and environmental implications. To help guide future management decisions, several relatively recent water management plans and studies have been completed or are in progress. Some of these plans encompass a more integrated approach to cover a wide variety of water needs from viability of supply, quality, ecosystem enhancement and flood control. Most of these more current plans recognize the value in working across jurisdictional boundaries to better align spatially with natural water systems. There are inherently similar goals with each of these planning efforts, such as the recognition of the importance of agricultural production, water quality and environmental improvements.

As discussed earlier, the Northern Sacramento Valley Integrated Regional Water Management (NSVIRWM) area covers a similar area to this planning region and includes six counties of

Shasta, Tehama, Butte, Glen, Sutter, and Colusa. The NSVIRWM aims to collaboratively identify the water-related needs and develop goals and recommend projects and programs to include in a planning document. The NSVIRWM released a Revised Final Draft in February 2014 which provides the foundation and rationale for the recommended projects and an implementation strategy.

A multi-agency effort composed of the California Natural Resources Agency, California Department of Food and Agriculture (CDFA), and California Environmental Protection Agency (CAL/EPA) at the direction of the Governor, released a Public Review Draft of the California Water Action Plan on January 27, 2014. This plan identifies ten general actions to be taken in the next one to five years aimed at improving the vitality of water supply and restore and preserve critical habitat.

6.3. Challenges

Challenges for ongoing land and conservation management in the Regions (and specifically, along waterways and in riparian areas) may be broken into two categories:

- Physical considerations—these are generally related to the conflict between species needs and human activities that influence these species and their habitats.

- Socio-economic considerations— these considerations revolve around the local cultural heritage of farming and the strong sense of identity with the land and the agricultural lifestyle, which may be in conflict with some conservation stewardship approaches pursued by resource agencies and other organizations within the Regions.

The following sections explore the various challenges and considerations facing land and environmental management in the Regions.

6.3.1. Physical Considerations

Revetment and Limited Channel Migration

Natural alluvial rivers of the size and slope that characterize the Sacramento River have channels that migrate across their floodplains over the course of time. This channel movement may occur through the relatively-slow process of channel meander, wherein during floods the outside bank on a river bend erodes, the inner bank has sediment deposition, and through time the channel meanders across the landscape. Also, during a flood the bends of the river may become too sharp, and the river avulses, jumping to a new channel location and potentially cutting a new channel path or reoccupying an old location. In either event, the channel migration process of alluvial rivers on their floodplains is an important component in creating and maintaining the habitat components that native species evolved with and require for continued survival. When human infrastructure and business enterprises are at risk from channel migration processes, land use and ecosystem management conflicts may arise when bank revetment is placed to limit channel movement.

Apart from the obvious considerations noted above, there are also several challenges related to restoring river process. The first is that there are miles of near-channel levees and bank revetment which exist along the Sacramento River within the Regions (See Figure 6-1).

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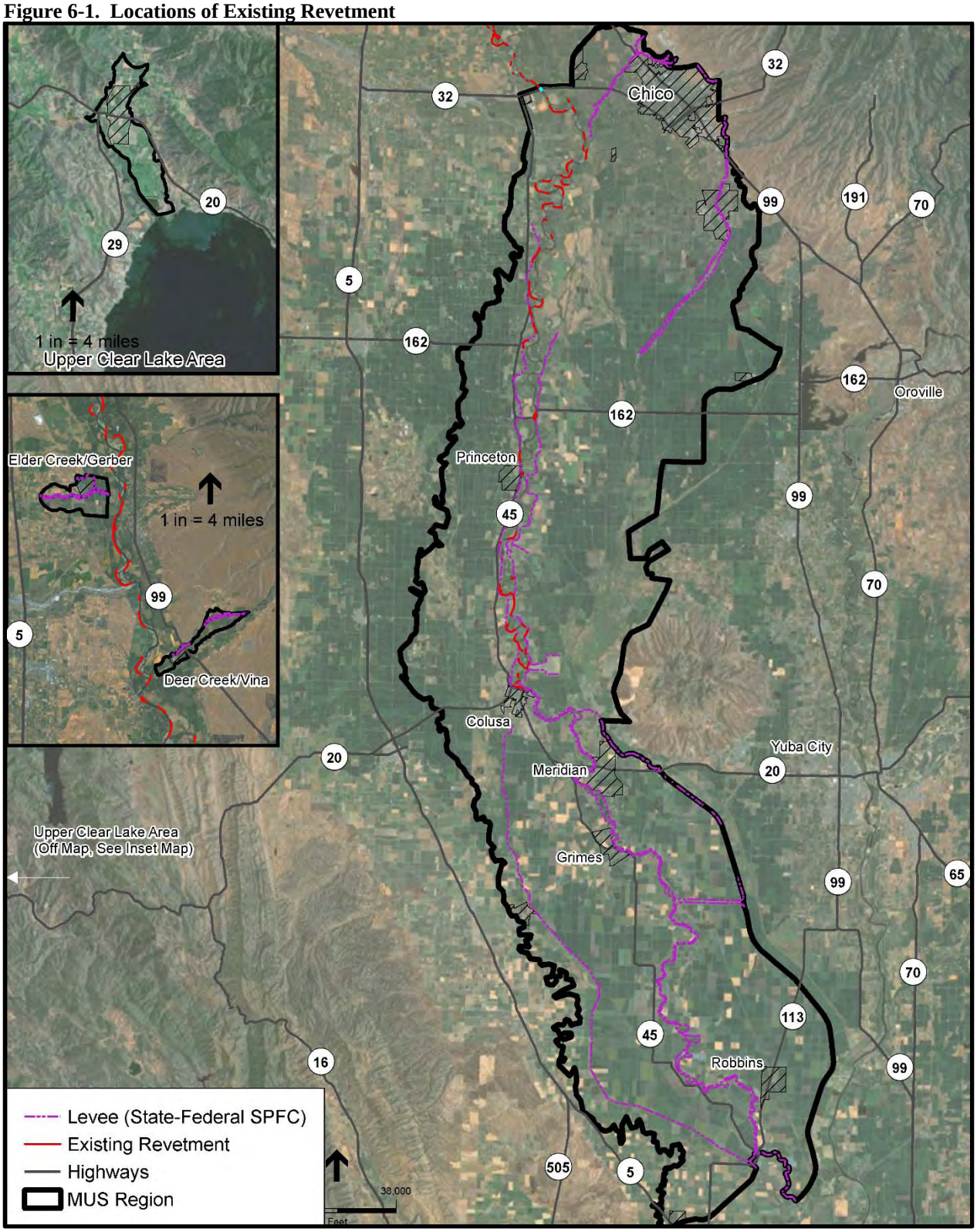
Figure 6-1. Locations of Existing Revetment



These structures control the width, depth, gradient and velocities of flows and prevent channel migration and the secondary benefits of channel migration as described above. The flood control levees and revetment are also within state or federal jurisdiction (Project Levees and Sacramento Bank Protection Project [Sac Bank], respectively) and the majority of the lands within the Regions are protected by State Plan of Flood Control levees. This may restrict the possibility for channel migration because agencies are mandated to maintain these structures, and removal or modification of a federal project requires approvals at a Congressional level.

Topographic, Hydrologic, Hydraulic, and Infrastructure Limitations

Physical conditions exist within the Regions that limit the ability to implement habitat and flood projects. Challenges range from the altered natural hydrograph and geomorphic conditions, to the requirement to maintain specific levels of flood flow conveyance, to the need to protect critical infrastructure. For example, because reservoir operations have reduced the magnitude and altered the timing and duration of spring flows, floodplain inundation and related ecological processes are limited. Because residences and infrastructure are located adjacent to flood control levees, options for new flood footprints are constrained. Such limitations challenge both flood projects (trying to keep flows inside the managed floodway) and ecosystem projects (trying to inundate floodplains and invigorate river processes within the floodway). Indeed, the two may be at odds with the ecological process of floodplain inundation exactly the opposite of the desires of many adjacent landowners and flood managers, which is to convey flood flows at the lowest stage possible.

Channel & Bypass Conveyance

As mentioned earlier, the current flood system of levees, weirs and bypasses was largely developed as a 'single purpose' system with the goal to reduce flooding and flood damages, and did not account for future habitat restoration. Furthermore, recent flood events and system technical reevaluations have shown that in many areas, the original system design did not properly account for levee safety issues such as levee underseepage and erosion. Without careful and proper planning, implementation and management, mitigation and restoration efforts have the potential to further exacerbate these levee safety concerns.

6.3.2. Socio-economic Considerations

Land Use Stewardship Philosophies

A common interest of reducing flood risk and generally improving the overall health of the river system is shared among most parties with a vested interest in the river corridor. However, differences reside in how to prioritize management of lands in and adjacent to the river, specifically regarding the creation of habitat exclusively for targeted species or ecosystem function, versus agricultural purposes. Also, differences exist regarding land management within flood bypasses, which were designed to address the flood conveyance limitation of the natural river system. Both management strategies have valid goals and objectives, with impassioned voices stating them in the past and during the development of this plan. Prevailing differences frequently overshadow the common interest of flood risk reduction and improving the overall health of the river corridor, goals that when met benefit nearly all stakeholders. Examples of

projects that found ways to find these mutually–beneficial opportunities are included in Section 6.4.

Timeframe and Costs associated with Regulatory Compliance and Permitting

There are a variety of permits and approvals that must be attained in order to complete many types of projects and flood system maintenance that influence river habitats and associated species. These requirements remain in affect whether the purpose of the project is to restore the ecosystem, to build a shopping mall, or to upgrade a levee with slurry wall. Further, while the project may have a relatively-small footprint and/or be of relatively-low cost, it still must adhere to the same governing laws and regulations. Many stakeholders believe that these conditions are difficult because they require significant timelines and there are considerable costs, to complete them. Approaches for accelerating and streamlining some of these processes are included in Section 6.4.

Increased environmental regulations

There is a concern amongst some stakeholders that increased public ownership of land and increased areas of privately- and publicly-owned wildlife habitat may result in increased regulation of other neighboring properties in the Subreach by state and federal agencies. These concerns primarily relate to regulations that pertain to special status species, water and air pollution standards, pesticides and herbicides. Section 6.4 outlines potential landowner incentives to address some of these concerns.

6.4. Potential Enhancements

The following sections outline potential enhancements for the Regions. These enhancements take the form of potential management actions, specific projects, programs, best management practices, approaches to improve the permitting and regulatory compliance process for the Regions, and funding options.

6.4.1. Strategies to Support River Process

This section provides an overview of potential concepts and management actions that can support restoration of riverine processes that create and maintain the habitat of listed species that may require mitigation from impacts related to flood projects contemplated in this plan. The following sections outline concepts and management actions that can be completed on their own as mitigation or restoration projects—or can be integrated with flood management objectives (see Chapter 9) to potentially generate multi-benefit projects.

While specific multi-benefit projects and related opportunities are discussed in more detail later in this chapter, the 2012 CVFPP identifies several areas along the Sacramento River with "meander potential" which could be appropriate places to create river migration corridors and increase flood conveyance. These areas were identified by defining a natural and existing meander zone, with the difference between the two zones representing the area of meander potential that "have been lost because of engineered, permanent features, such as levees, bank

revetments, structures and roads" (DWR, 2012). However, there are local concerns that without careful and proper planning, implementation and management, these efforts have the potential to further exacerbate levee safety concerns. There are also concerns as to how the scope and scale of this concept could impact the Regions' agricultural economy and character.

Over a decade ago, the Sacramento River Conservation Area Forum (SRCAF), identified potential locations with meander potential as an "inner river zone" (Sacramento River Advisory Council 2003). The historical 100-year meander belt, combined with projected erosion locations 50 years in the future, defines the potential meander locations in the "inner river zone." All areas considered as opportunities for any multi-benefit projects to increase habitat values and reduce flood risk must be done with consideration to existing infrastructure and land uses, and with respect for private property rights.

Opportunities to enable channel migration upstream and downstream of revetment areas must consider compromising the integrity of these structures and the planform and channel profile ramifications of "releasing" the channel when other parts of the river have evolved while the revetment has been in place. In addition, a study of existing geology within the Regions indicates that there are several areas with erosion resistant Pleistocene alluvial geologic formations (Singer and Dunne, 2001), that have shown resistance to lateral migration of the Sacramento River Channel. This resistance to lateral migration is illustrated in Figure 6-2 as the outer boundary of the historical meander belt.

<u>Revetment removal</u>

Certain existing revetment within the plan region may provide minimal flood management function and yet may be both required to be maintained (i.e., part of a federal project) and also cost prohibitive to maintain. Also the original need for the revetment may no longer exist due to changes in land use (e.g., an area which was converted from agriculture to a habitat area after the revetment was installed). Removal of these revetments allows for potentially significant enhancement to geomorphic processes and habitat creation. Revetment removal should only be considered where there are willing landowners whom are supportive of the concept, and where there are probable positive or at least neutral outcomes on both flood risk and ecosystem function.

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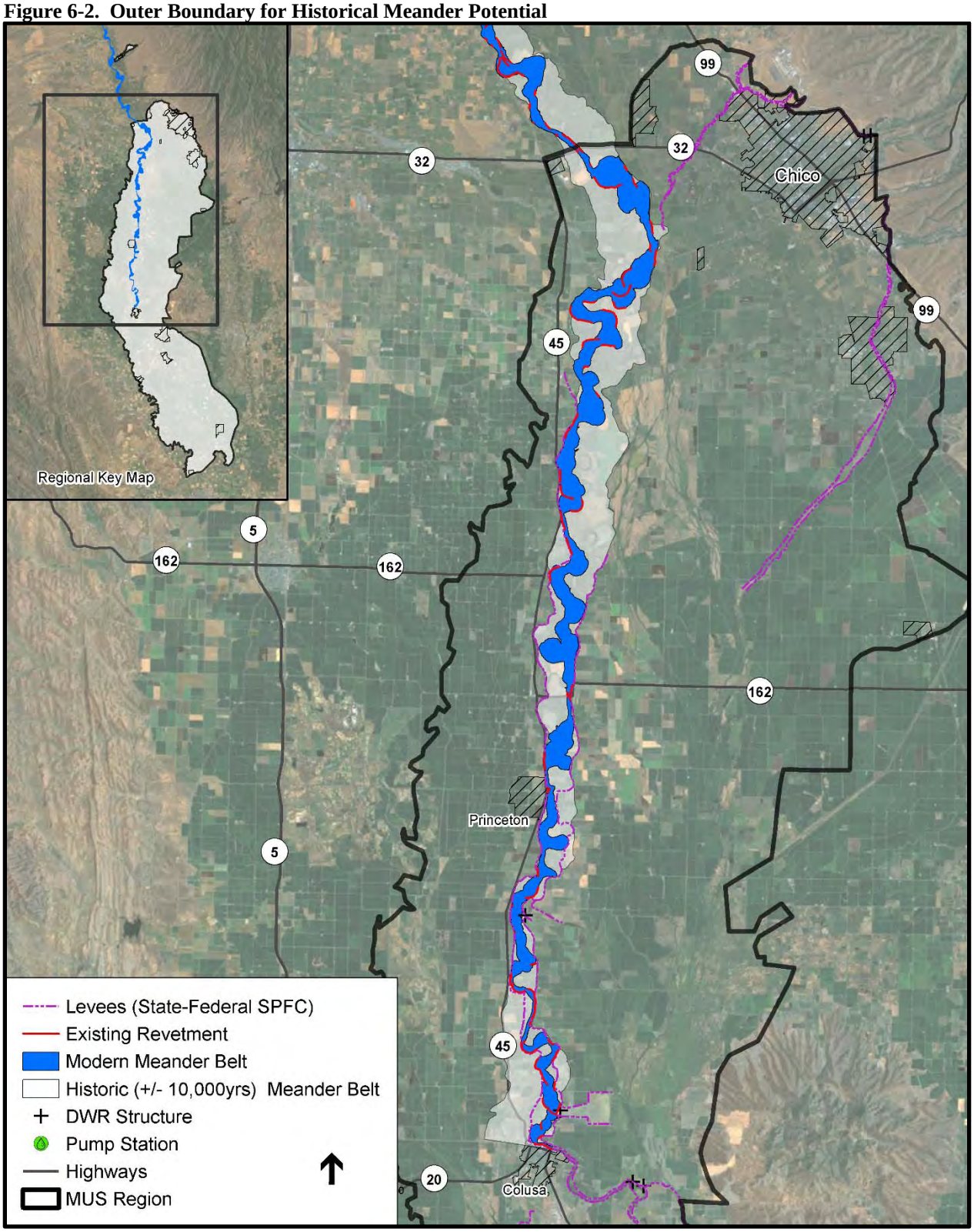
Figure 6-2. Outer Boundary for Historical Meander Potential



Floodplain lowering

Floodplain-lowering generally refers to the lowering in elevation or modification of floodplains to facilitate longer durations of inundation and increase channel flow area. This strategy benefits flow conveyance with larger flow areas and can also benefit riparian and marsh habitat. In the context of this discussion, connection of swales and low points to increase inundation duration could also be considered floodplain lowering.

Levee Relocation

This potential action involves relocation of a levee to enhance system flood conveyance and/or resolve a levee safety issue such as under seepage, erosion, etc. In reaches where levees closely follow sinuous river channels, relocating levees provide opportunities for significantly reducing overall levee length, which may reduce overall maintenance costs. This can also generate opportunities for improving ecosystem function and increasing habitat extent, quality, and connectivity. The expanded floodway creates space for river meandering, sediment erosion and deposition, natural ecosystem disturbance processes, and a healthy diversity of riverine habitat. Relocating levees is typically applicable in opportunistic conditions where the repair of an existing levee reach may be cost prohibitive, and adjacent and neighboring landowners are in support.

Vegetative flow and erosion management

In select conditions, the use of vegetation can reduce bank erosion, reduce flow velocities of flood flows at applicable locations, and reduce sediment depositions in agricultural lands. The use of vegetation has a long history of use and success in the Sacramento Valley at specific locations (DWR, 2012) and serves as a potential multi-benefit flood management strategy.

Flowage Easements

Purchasing easements can be valuable for a variety of purposes, including reducing the risk of future major flood consequences by retaining rural land uses, maintaining viable agricultural productivity, and creating important habitat. To be most useful for environmental purposes (not just floodway conveyance), these easements, where applicable, would allow for the following:

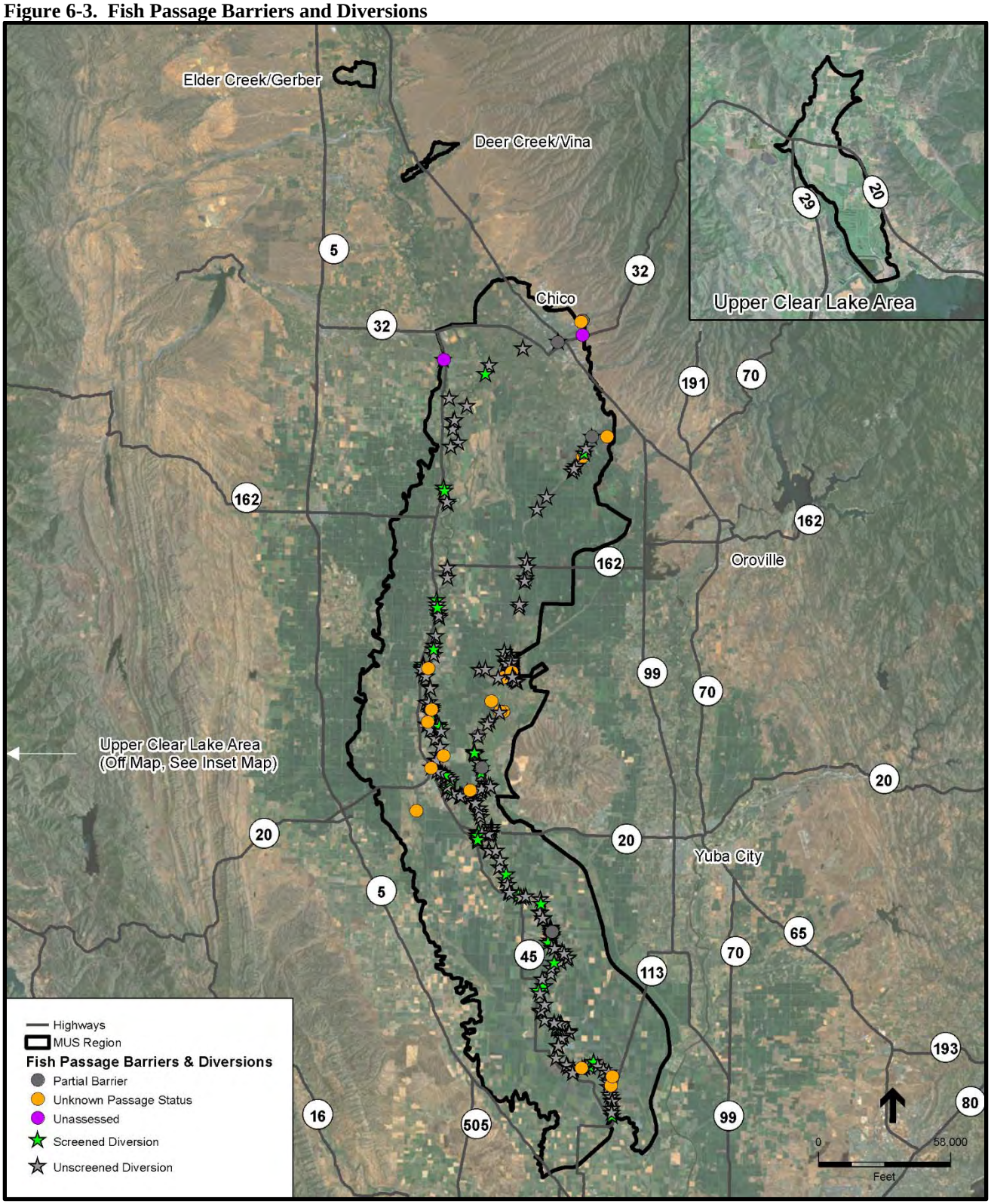
- Periodic inundation and soil saturation important for the ecological functioning of floodplains (i.e., increasing aquatic ecosystem productivity, allowing sediment deposition on floodplains, and supplying large woody materials to aquatic ecosystems).
- Allowing natural riverine processes to occur thereby allowing more natural flows, and erosion and deposition of sediment.

Flowage Easements are explored further in Chapter 10.

Fish Passage and Fish Screens

Removal of fish passage barriers at diversions may afford migratory fish access to habitat that can potentially be used for spawning and rearing of juvenile fish. Figure 6-3 illustrates known fish passage barriers and helps identify potential diversions that may benefit from installation of fish screens.

Figure 6-3. Fish Passage Barriers and Diversions



Multi-Benefit Projects

Multiple benefit, or multi-benefit, projects are a key part of the 2012 Central Valley Flood Protection Plan (CVFPP) as well as the planning efforts that are currently underway that will support the preparation of the 2017 CVFPP. The primary goal of the CVFPP is to improve flood risk management. One of the four supporting goals of the CVFPP is to promote multi-benefit projects along with improving operations and maintenance, promoting ecosystem functions, and improving institutional support. The guiding strategy for reducing flood risk in the 2012 CVFPP is based on the State Systemwide Investment Approach (SSIA), a multi-benefit and integrated flood management approach. CVFPP Section 4.7.1.indicates that the State, in funding for the SSIA, will place a priority on funding projects that provide multiple benefits and goes on to cite California Water Code Section 12585.7, which indicates that the State "will pay up to 20 percent more" for multiple-benefit projects. In addition to funding, a key value of a multi-benefit project is that it can be self-mitigating; speeding up the project process because mitigation is not required and the cost and potentially-lengthy time to develop and implement that habitat project are unnecessary.

A formal definition of multi-benefit projects has not been established. However, generally, multi-benefit projects are those that reduce flood risk along with one or more other benefits such as improving water supply reliability; water quality; aquatic and/or terrestrial habitat; operations and maintenance; public access; recreation; and/or transportation. Well-developed multi-benefit projects have the advantage of being able to access different types of funding sources. Multi-benefit programs are similar to multi-benefit projects in that they focus on providing benefits to more than one area of water, flood, and resource management.

An example multi-benefit project exists at the Princeton-Codora-Glenn & Provident Irrigation Districts (PCGID-PID) Pumping Plan/Fish Screen Facility and the Llano Seco Riparian Sanctuary Unit of the Sacramento River National Wildlife Refuge. Prior to acquisition by the USFWS, rock revetment was placed on the north end of the Llano Seco Riparian Sanctuary Unit by DWR in 1985 and 1986. The rock was placed in order to hold the planform alignment of the Sacramento River in place, ensuring that flood flows would continue to be diverted from the Sacramento River through the Goose Lake overflow structure and into the Butte Basin. Since the placement of rock revetment in 1986, the natural riverbank that is south of the revetment eroded approximately 600 feet. The erosion on refuge property is directly across from the PCGID-PID pumping plant and fish screening facility. In 1999, the PCGID-PID consolidated three pumping plants into one new facility equipped with state-of-the-art fish screens. The fish-screening efficiency of the new PCGID-PID pumping plant is now endangered by the bank erosion on the refuge property and the migration of the Sacramento River. Although the rock revetment on the north edge of refuge property is decades old and eroding, it plays a key role in protecting the PCGID-PID pumping plant. As the bank erodes, the angle of flow and velocity of the water passing the screens will change, trapping fish against the screen rather than sweeping them past. Without some type of protection, it is likely the bank will continue to erode and the pumping plant facility will fail to meet NOAA guidelines for operation of the pumping-plant fish screens.

The preferred alternative includes installation of approximately 1,990 feet of traditional riprap along the Sacramento River bank on the northwest bank of the Riparian Sanctuary, including a low berm along the gravel bar and a toe trench just off the gravel bar; removal of upstream rock; and site-specific plantings on the Riparian Sanctuary. An estimated 10,781 cubic yards of rock along 2,220 feet of the upstream bank would be removed to an elevation of about 80 feet (just below the summer mean water surface). A Federal Record of Decision for the project was issues in December, 2013. This relocation and repurposing of rock illustrates a project where adaptation of existing methods for changing conditions is resulting in infrastructure protection and habitat restoration.

6.4.2. Multi-Benefit Flood Control Projects

There are several existing opportunities for multi-benefit flood control projects in or near the MUSR Regions. These projects are in various stages of development with different funding sources and needs. The projects include the Middle Creek Flood Damage Reduction and Ecosystem Restoration Project, the Hamilton City Flood Damage Reduction and Ecosystem Restoration Project (Hamilton City Project), Kopta Slough Flood Damage Reduction and Habitat Restoration Project (Kopta Slough Project), Lower Deer Creek Restoration and Flood Management Project (Lower Deer Creek Project), and Riparian Sanctuary Project. Each of these is introduced below.

<u>Middle Creek Flood Damage Reduction and Ecosystem Restoration Project</u>
The U.S. Army Corps of Engineers and Lake County, the non-federal sponsor, propose to restore the Middle Creek flood plain to a natural wetland ecosystem and provide flood damage reduction to the study area, which is located between Highway 20 and Middle Creek immediately northwest of Clear Lake. The project involves the de-authorization and breaching of federal levees in order to restore approximately 1,650 acres into natural floodplain. A final FR/EIS/EIR has been developed that describes the environmental resources in the Clear Lake area; evaluates the direct, indirect, and cumulative environmental effects of the recommended plan and three alternative plans; and recommends avoidance, minimization, and mitigation measures. Most potential adverse effects would either be short term and insignificant, or would be avoided or reduced to less-than significance using best management practices.

<u>Hamilton City Flood Damage Reduction and Ecosystem Restoration Project</u>
In the late 1990s, the Hamilton City Project was developed to address the flood risk in Hamilton City and improve aquatic and riparian habitat. The objectives of the project include flood risk reduction, the reduction of flood damages, the improvement of the quality and quantity of habitat within the project area, the restoration of river function, and the formation of a successful partnership between the community of Hamilton City, agriculture, and the environment. The recommended plan includes levee improvements that would result in up to a 90% chance of passing a 75-year flood event and restoration of 1,361 acres of native habitat and reestablishment of river/floodplain connectivity (Partnership, 2012).

Kopta Slough Flood Damage Reduction and Habitat Restoration Project

The Kopta Slough Project is located in Tehama County between the City of Corning and the Town of Vina. Five project goals have been established, including: 1) provide flood damage reduction benefits through reduced bank erosion to protect public resources; 2) provide advance mitigation credits for projects on State-maintained Central Valley Flood Control facilities (DWR Flood Control Projects) for riparian habitat, including habitat for valley elderberry long horn beetle (VELB); 3) provide ecosystem benefits through the restoration of natural fluvial and floodplain processes and mitigate for the loss of shaded riverine aquatic (SRA) habitat from DWR Flood Control Projects; 4) establish long term public ownership of the 708-acre Kopta Slough property to protect public trust resources; and 5) expand recreational opportunities for the people of the State of California on a portion of the project area, including camping, hiking, picnicking, and equestrian use. Project partners and stakeholders include Tehama County, California State Parks, The Nature Conservancy, the Sacramento River Conservation Area Forum, and the United States Army Corps of Engineers (USACE) (TNC, 2012).

Lower Deer Creek Restoration and Flood Management Project

The Lower Deer Creek Project site is also located in Tehama County and near the Town of Vina. The goal of the project is to improve habitat while developing feasible solutions to flood hazards on lower Deer Creek. The project has been in the planning stage for several years (DCWC, 2001).

Riparian Sanctuary Project

A 950-acre portion of the Riparian Sanctuary Unit, which is part of the Sacramento River National Wildlife Refuge (SRNWR) Llano Seco Unit, will be restored under the Riparian Sanctuary Project. The project is in the second phase of planning, and will be implemented after a third planning phase. In addition to providing riparian habitat, the project will minimize ecosystem impacts from a pumping plant, include anadromous fish screen protection measures, and provide data to aid in making sound floodplain management decisions on future sites (River Partners, 2014).

Butte Slough Outfall Gates Replacement Project

DWR is beginning the environmental process for replacement of the Butte Slough outfall gates, located at the historical tributary/distributary confluence of Butte Creek with the river. The description of the project is to rehabilitate the outfall gates by repairing known structural deficiencies (including holes found at the structure's wing wall), replacing worn out appurtenances, constructing a trash barrier system to protect the gates and ease debris collection, and upgrading the electrical and communication system to include backup capability to meet current USACE O&M standards.

6.4.3. Restoration Opportunities

This section briefly summarizes some of the potential restoration opportunities which have been identified during development of this RFMP.

Attachment 9F, Floodplain Restoration Opportunity Analysis, of the 2012 CVFPP includes a list of the general restoration opportunities that have been identified along the Sacramento River and other Central Valley rivers. Floodplain restoration opportunities are most extensive along the Sacramento River from Woodson Bridge to Colusa. The restoration opportunities identified in the FROA that are located in the MUSR planning area include areas along the Sacramento River from Woodson Bridge to Chico Landing, Chico Landing to Colusa, and Colusa to Verona (DWR, 2012). Additional analysis and conservation targets will be provided by FESSRO as a part of the Central Valley Flood System Conservation Strategy, expected for release in spring 2014.

Salmon Rearing in Inundated Rice Fields

California Trout (CalTrout) is undertaking floodplain agricultural habitat experiments, a collaborative effort between farmers and researchers to help restore salmon populations by reintroducing young salmon during winter to inundated floodplains that are farmed with rice during the summer. These "surrogate wetlands" mimic the floodplain rearing habitat formerly used by young salmon, which has been largely eliminated by the development of the Central Valley. The lands used in this strategy are maintained in productive agriculture, and such properties can also be managed to provide habitat to ducks, geese, raptors, shorebirds and songbirds. These experiments documented the fastest growth of juvenile salmon ever recorded in the Central Valley. Prior work was limited to experimental sites of 5 to 20 acres; present work is seeking to expand the program and demonstrate that success can ultimately be achieved on larger landscape level scales of approximately 2,500 acres. Ongoing work is focusing on how to design fields to decrease predation and increase fish survival, and mesh this strategy with agriculture throughout the Region.

Fish Passage Improvements

Cal Trout is working with various agricultural interests to reduce fish passage barriers and stranding of up-migrating adult fishes. Present work emphasizes spring and winter run Chinook salmon and is focused in the Colusa Basin.

M&T Ranch Pumping Plant Improvements

- M&T pumps short-term project: Gravel dredge and toe rock. This is being done to keep the M&T operable until a long-term solution is identified.
- M&T pumps long-term project: Public scoping will begin early 2014. Begin EIR/EIS process for identifying a long term solution to the gravel migration problem at the site.

Other:

- The Davis Home Ranch Corridor project.
- Acquisition and restoration of a 49-acre parcel called "Thousand Acres."

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6.4.4. Strategies for Preserving Agriculture and Enhancing Habitat and for Reducing Flood System Maintenance

The following sections provide an overview of potential strategies to preserve agriculture production while enhancing habitat and to reduce conflicts with flood and conservation management. Strategies to reduce flood system maintenance, which could be formulated to include some agricultural maintenance practices, are also presented.

Agricultural Lands Stewardship

Agricultural Land Stewardship planning and strategy is an integrated and collaborative approach for addressing impacts created by the conversion of farmland to open space uses. In October 2013 the DWR Agricultural Lands Stewardship Workgroup released a draft discussion paper https://agriculturallandstewardship.water.ca.gov/, which presents a framework with various potential strategies focused on maintaining agricultural and economic viability which may be considered by decision makers regarding mitigation measures. The framework was developed for the Sacramento-San Joaquin Delta (Delta) and in some instances is specifically tailored to address unique aspects related to management in the Delta; however, the vast majority of the framework may be applied to the Regions. The document and framework are structured around four main groups of potential strategies. An overview of these strategy sets are provided in the following sections. Additional information and detail are included in the draft discussion paper.

1. Strategies to help maintain farming

This set of strategies discusses a number of approaches for technical and financial assistance for agriculture, including for flood protection, control of terrestrial weeds, water management, water quality improvements, sediment removal, and water supply reliability. It also includes a discussion of a "good neighbor" policy, the use of conservation easements on agricultural land; the Williamson Act and options for an *in lieu* tax revenue. One example of a technical approach is Stormwater Attenuation / Runoff and Discharge Management (Section 0), as described below.

2. Strategies that provide incentives for conservation on farmland

These strategies offer ways to enhance environmental quality on farmland, including wildlife-friendly agriculture, management of farmland for habitat purposes, and establishment of habitat features by farmers that can be offered for sale as credits in a market based conservation program.

3. Strategies to manage land for purposes other than conventional crop production

These strategies offer ways for landowners and lessees to earn income from growing crops other than food and fiber, mainly floodplain plants. There could be a direct payment for such floodplain habitat services and/or flowage easements provided for these types of strategies. Growing crops other than food or fiber could provide an economic return for its role in sequestering carbon and mitigating greenhouse gas emissions or helping meet environmental permitting requirements.

Working Landscapes

Another strategy first developed in the Delta is the Delta Working Landscapes Program (Working Landscapes). The purpose of Working Landscapes is to encourage farmers to invest in

habitat on farmland in a manner that is mutually beneficial to production agriculture and the ecosystem. Working Landscapes is a group of projects which demonstrate how farmers can integrate habitat restoration into farming practices. The objectives are to improve the environmental quality of existing landscapes; coordinate programs with local farmers; understand the social, economic, environmental and governmental policy hurdles and/or incentives to perform conservation practices; and communicate to farmers the advantages of implementing wildlife friendly agricultural practices. Project types for the program in the Delta included planting of native grasses and hedgerow along ditch banks and levees to provide habitat, improve quality of agricultural drainage water, provide levee stability, and retard levee erosion; and establishment of permanent and seasonal wetlands to provide waterfowl habitat for brooding and serve as a food source. Sponsored by a grant, the Working Landscapes program produced a document that may serve as a reference for establishing public/private partnerships for such programs in the Regions.

Stormwater Attenuation / Runoff and Discharge Management

Storage of floodwater, whether in foothill reservoirs or in floodplains and historic overflow basins throughout the Regions, is a valuable tools for managing flood risk. This strategy may also generate opportunities to integrate and benefit water supply (including groundwater recharge and conjunctive use), water quality, ecosystem conservation and restoration, agricultural conservation, and recreation. These strategies reduce peak run-off by land use/ vegetative modifications, increased infiltration/ detention and integrated watershed and water planning.

Related in practice and in some installations, but separate in terms of management focus, are means for managing runoff and discharge, particularly from agricultural operations. A variety of best management practices are available to assist, including hedgerows of native vegetation along and in canals of various sizes and along property boundaries. Benefits include:

- Reduces cost for herbicides.
- Eliminates need to reshape canal, which is generally needed every 2 to 5 years in unvegetated canals, depending on bank slope.
- Provides bank stabilization and reduced erosion.
- Provides habitat for beneficial insects: pollinators and predators of agricultural pests, birds, and other wildlife.
- Reduces long-term O&M costs. The initial investment may be covered through grant funding and other sources.

Agricultural and Habitat Conservation Easements

Another agricultural preservation tool is the agricultural conservation easement, a voluntary program that places deed restrictions on specific properties restricting land use to only agriculture, for the life of the property. Such easements permit continuation of agricultural use, commonly subject to the provision that the land not be developed for more intensive use with a lower habitat value. This strategy is a part of DWR's Agricultural Lands Stewardship Workgroup's draft discussion paper and also is a part of the Conservation Framework of the

CVFPP (DWR, 2010). Habitat conservation easements essentially restrict land use to only certain types of habitat, for the life of the property.

Conservation easements involve the transfer of certain, specified property rights. The landowner retains fee title ownership of the property and all the property rights that are not sold as part of the transaction. The provisions of conservation easements can vary depending on the objectives of the transaction parties. Generally, conservation easements commit the landowner to maintain the agricultural uses (or habitat values, for that type of easement) of the subject property. For example, a property that is in riparian habitat would typically be kept in that habitat under a conservation easement. All transferred rights, which become permanent binding limitations on the fee title ownership, are specified in the easement deed. The holder of the easement is normally given the right to access the property and verify that the easement provisions are being met.

Issues identified with conservation easements during the MUSR RFMP process include a lack of flexibility to allow farming methods to adapt to changing conditions. Therefore, agricultural conservation areas should be defined as rural areas negotiated and mutually agreed to as permanently suitable and designated private property(ies), which have been identified with concurrence of the property owner(s) as utilized only for agricultural and/or farming purposes in exchange for fair value and forgoing development rights on the specified property.

The creation of agricultural conservation areas is a concept that has embraced the idea of the "sale of development rights." These areas may not necessarily be pre-determined to flood in a large flood event and may include areas protected by a lower standard-of-performance levee system. Embracing this concept would help ensure that areas susceptible to high flood risk remain rural and in agricultural production. The benefits could be valued and paid-for in exchange for the designation similar to the Williamson Act, but which would be applied to eligible areas protected by the State Plan of Flood Control. Landowners eligible for this type of program could engage in long-term (or permanent) agreements for the sale of their development rights in exchange for yearly payments. These payments would encourage the current landowners to stay in business versus the one-time payment that could cause the landowner to stop farming and sell the land.

<u>Landowner Incentive Programs</u>

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

Three programs (CDFW's Voluntary Local Program and Safe Harbor Agreement Program and the USFWS Safe Harbor Agreement Program) encourage landowners to enhance habitat for

threatened and endangered wildlife, while maintaining viable agricultural operations. These programs allow landowners to remove the habitat enhancements with no penalties. These programs provide flexibility for landowners and flood managers but do not provide assurances of long-term habitat conservation.

Safe Harbor Agreements

A Safe Harbor Agreement is a voluntary agreement between any non-federal property owner(s) and the USFWS or the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (collectively, the Services) whereby performing actions that contribute to the recovery of listed species and fulfilling the conditions of the Safe Harbor Agreement, the property owner(s) will receive formal assurances from the Services that they will not require any additional or different management activities by the parties without their consent. A Safe Harbor Agreement allows neighboring landowners to join, establish a baseline and enjoy endangered species protections. Thus if a restoration project or any other occurrence results in an increase of listed species on a property, the landowner will not be subject to regulatory limitations. Additionally, at the end of the agreement period, participating property owners may return the subject property to the previous condition that existed at the beginning of the Safe Harbor Agreement. This may be an attractive opportunity for property owners where operations are in potential conflict with a listed species.

Re-Investment in the Williamson Act

The Williamson Act is a voluntary program that provides reduced property taxes on qualifying agricultural lands in exchange for abstaining from commercial and residential land development. A large portion of the agricultural lands within the state and particularly in this Regions are covered under the Williamson Act and the act has been a valuable incentive in preserving agricultural lands. However, during State budget cuts in 2009, subvention payments (monies provided to local government agencies to compensate for lost property tax revenues) have been significantly reduced, leaving participating local agencies fiscally challenged or potentially unable to continue the program. Without this incentive, the agricultural community will be more prone to develop their lands, and some may be in flood prone areas. Reinstatement of subvention payments is needed to re-incentivize local agencies to continue this agriculture preservation resource.

Good Neighbor Policy

The Sacramento River Conservation Area Forum (SRCAF) adopted its Good Neighbor Policy on March 15, 2007. The Policy was adopted after a multi-year process involving many different interests. It focused on an effective communication process, monitored by the SRCAF, where neighboring landowners are expected to work cooperatively to identify concerns and resolve problems. This SRCAF Good Neighbor Policy (GNP) was set forth to outline an approach that all landowners (new, existing, and absentee) should follow in order to comply with the intent and spirit of the SRCAF Handbook. The goal of the GNP is to avoid negative impacts, address and resolve unavoidable impacts, and foster good communication and relationships among neighbors and communities. The GNP is intended to apply to land management activities within or affecting the Sacramento River Conservation Area, including changes in land use where habitat is actively developed, develops naturally, or is converted to agricultural or other uses. The GNP

is not intended to apply to those cultural practices normally used in farming or habitat conservation operations or to the normal maintenance practices required of public entities for public safety, as long as those practices are undertaken within the law, and with reasonable consideration to prevent impacts to others. The existence of the GNP and adherence to it can provide a sound foundation to managing flood and conservation/land use issues in the Regions.

6.4.5. Strategies for Streamlining Flood Projects and Maintenance

As discussed previously, the concept of streamlining regulations is a key element that cuts across development of all project types: residential or commercial development, flood, and even restoration projects. The Sacramento River corridor is a rich but fragile ecosystem that is affected by numerous regulations designed to protect air quality, water quality, public health and wildlife. These standards are administered by many different agencies; and meeting these various regulations can be complex, time consuming and expensive. Compliance with these standards influences agriculture, flood control, water supply, and recreation and conservation restoration. A number of regulatory consistency/streamlining strategies are available to address: permitting application and mitigation requirements; interagency consistency; and mitigation banking.

Corridor Management Strategy

The Corridor Management Strategy (CMS) approach is a developing concept for improving flood management and ecological conditions at scales that are both manageable and flexible to meet multiple needs. The CMS process involves developing a vision, strategy, and plan (CMP) for managing a corridor that integrates flood risk management, improved ecosystem function and integrated water management over a long-term (greater than 30 years) planning horizon. A CMP includes a strategy for managing flood protection facilities, conveyance channels, floodplains, and associated uplands; a maintenance plan; a restoration plan; and identifies policies for compatible land uses such as agriculture and recreation within the corridor. In addition to addressing habitat restoration and flood facility maintenance, CMPs are a foundation for securing programmatic regulatory agency approvals for ongoing maintenance activities and habitat restoration. CMPs rely on coordination, collaboration, and cooperative working relationships with interested parties and stakeholders, including State, federal, and local agencies, NGOs, maintenance districts, agricultural interests, and landowners.

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

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

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

CMP strategies are means of restructuring existing flood management practices and policies implemented within a given management area to benefit and enhance the environment without compromising actions required by practices and policies. CMPs effectively support the objectives of the CVFPP in establishing an integrated management plan to reduce flood risk, improve ecosystem function, and create a more sustainable flood management system that allows for ongoing O&M of flood management facilities. DWR has initiated development of a CMP on a 20-mile long reach of the lower Feather River (from Yuba City to the Sutter Bypass). A CMP for DWR and/or LMAs in the region may be a strategy that could serve as a foundation for other aspects of regulatory compliance streamlining.

Advanced Regional Mitigation Banks

Advanced mitigation of flood management improvements provides a means of making flood maintenance less expensive and timelier. A mitigation bank is a specific aquatic habitat or terrestrial habitat resource that has been restored, established to a certain condition for the purpose of providing compensation for unavoidable impacts to similar resources. Based on the spatial extent and other factors, each bank receives a certain amount or number of credits for use (or sale) to provide mitigation credits for projects that disturb similar resources as those covered by the bank. Traditionally, mitigation banks are used on a project by project basis with purchase of compensatory mitigation credits from the bank by a project sponsor that has need for these credits because a project will impact a resource. Mitigation banks may be third-party in nature, where the owner is responsible for developing and crediting the habitat with the regulatory agencies, as well as maintaining the mitigation lands in perpetuity. Banks may also be developed by partnerships of agencies and municipalities, with agreements in place for use of the credits and costs and management associated with development and maintenance of the bank. If project types and locations—as well as the types and approximate levels of impact—are reasonably foreseeable, then developing advance mitigation and/or using a bank is a good strategy for accelerating the project toward implementation. Section 6.2 describes DWR and Caltrans's Regional Advance Mitigation Planning (RAMP) approach to advanced mitigation, and RAMP is an example of a flood and infrastructure-focused effort to provide a method to

achieve faster, less expensive, and better mitigation for unavoidable impacts associated with projects.

Regional Permitting

Traditional project-by-project environmental permitting has resulted in several shortcomings, both for project proponents and conservation interests. These shortcomings can include time-consuming negotiations for each project to identify, where required, suitable offsite mitigation areas as compensation for habitat losses, project delays, establishment of small, isolated restoration areas that are difficult to manage, and temporary losses in habitat while compensation sites are restored. Several new regional permitting methods have been developed in the past 20 years to solve these permitting and conservation challenges, and local governments in California have been using these approaches to both permit land development and maintain healthy ecosystems. These methods include regional programmatic ESA Section 7 consultations, Regional General Permits for Clean Water Act (CWA) section 404 and River and Harbors Act (RHA) section 10; and NCCPs/HCPs. New methods to support these regional permitting approaches include CMS (Section 0) and RAMP (Section 6.2.6). Attachment 9G (Regional Permitting Options) to the CVFPP provides more detailed information about the types of flood management activities that could potentially be covered under regional permits; describes and evaluates several options for developing regional permits for the flood management system; and summarizes important environmental regulations that apply to flood management projects.

Regional General Permits (RGPs)

A Regional General Permit (RGP) is issued by a USACE district or division and authorizes a class of activities within a geographic region that are similar in nature and have minimal individual and cumulative environmental effects. RGPs may be used to collectively meet permitting needs for multiple projects, over longer planning horizons, while also consolidating mitigation and conservation efforts into larger, more viable conservation areas. Overall RGPs streamline the USACE permitting process by avoiding the need to obtain separate permits on a project-by-project basis. To qualify for authorization under an RGP permit, applicants must meet the general and special conditions established for that RGP. Once an RGP is issued, applicants can use the permit, if the stated conditions are met.

Section 404 of the Clean Water Act (CWA) prohibits the discharge of dredged or fill materials into waters of the United States without USACE authorization. Section 10 of the Rivers and Harbors Act of 1899 (RHA) requires USACE authorization for the construction of any structure or work in or over any traditional navigable waters of the United States. The USACE can develop an RGP under the authority of CWA section 404 (33 U.S. Code [USC] section 1344) and RHA section 10 (33 USC section 403), in accordance with provisions of *Regulatory Programs of the Corps of Engineers*, 33 Code of Federal Regulations (CFR) section 323.2(h) for activities that are substantially similar in nature and cause only minimal individual and cumulative environmental impacts. Additionally, the USACE must be in compliance with federal regulations, including those identified below, and documentation by USACE is required before issuance of the RGP:

- ESA

- National Environmental Policy Act (NEPA)
- Section 106 of the National Historic Preservation Act (NHPA)
- Section 401 of the CWA (certification could be provided on a project-by-project basis if the RWQCB does not certify an RGP)
- Bald and Golden Eagle Protection Act (BGEPA)
- Fish and Wildlife Coordination Act (FWCA)
- Magnuson-Stevens Fishery Conservation and Management Act (MSA) for Essential Fish Habitat;
- Marine Mammal Protection Act (MMPA)
- Migratory Bird Treaty Act (MBTA)

Activity-Specific Programmatic Permitting

In scenarios where a similar activity will be implemented multiple times, developing some type of program level permitting can be an effective streamlining approach compared to repeating permitting processes each time the activity is undertaken. DWR is testing this approach with the Small Erosion Repair Program (SERP). The SERP is intended to provide a streamlined process for DWR to identify, obtain regulatory authorization for, and construct small levee repairs on levees maintained by DWR within the Sacramento River Flood Control Project (SRFCP) area. Several flood risk reduction features within the RFMP area are included in the SERP project area. (see http://www.water.ca.gov/floodmgmt/fmo/msb/smallerosionrepairs.cfm#dpeir) The SERP uses programmatic authorizations, issued by federal and state agencies that typically have regulatory authority over levee erosion repair projects, to streamline the process for implementing small erosion repairs in accordance with conservation-based design and monitoring standards established in the SERP Manual. Projects that qualify under the SERP are eligible to receive authorization within a shortened time frame because they are designed to minimize effects on fish and wildlife resources, including listed species, and to protect and enhance the existing aquatic and riparian habitats comprising the riverine corridor.

Authorizations streamlined under the SERP consist of Clean Water Act permits from USACE, ESA compliance with USFWS and NMFS, streambed alteration agreements from CDFW, and water quality certification with the RWQCB. For activities in the RFMP that are repeated numerous times, such as operations and maintenance or similar new infrastructure elements that are constructed in multiple locations, a programmatic permitting regime similar to the SERP could be beneficial. An LMA could use the SERP program as a model to coordinate with regulatory agencies to develop a process for streamlined approval for qualifying projects or activities.

Master or Programmatic Streambed Alteration Agreement

If the MUSR RFMP includes similar repeated activities that require a Streambed Alteration Agreement (SAA) from CDFW (Fish & Game Code section 1600), and obtaining a SAA is not included in a program similar to the SERP, there are options for obtaining an SAA that would prevent the need to repeatedly apply for an obtain separate agreements for individual projects or activities.

A Master SAA (Master Agreement) may be obtained to cover a large, multi-phased project consisting of smaller specific projects for which detailed project plans are not available at the time the SAA is applied for. The SAA process would then be streamlined as each smaller future project is implemented. Master SAAs can have durations longer than the 5-years typical of Standard Agreements. There are also Programmatic SAAs (Programmatic Agreement) that are similar to Master Agreements but may cover a larger geographic area or potentially a broader suite of activities. Work consistent with the terms of the agreement can be conducted in and adjacent to streams without the need to repeat the application and approval process.

Program EIR

Section 15168 of the State CEQA Guidelines describes the uses of a program EIR. A program EIR is typically considered when a series of actions that can be characterized as one large project are related either:

- Geographically
- As logical parts in the chain of contemplated actions
- In connection with issuance of rules, regulations, plans, or other general criteria to govern the conduct of a continuing program
- As individual activities carried out under the same authorizing statutory or regulatory authority and having generally similar environmental effects, which can be mitigated in similar ways

In addition, when information on future elements of the larger project is not sufficiently developed to support a project level EIR analysis, the future activities may be evaluated at a more general programmatic level using a program EIR.

When subsequent activities considered in the program EIR are ready for implementation, a checklist may be used to determine whether the environmental effects of the activity were covered in the program EIR. If it is found that the subsequent activity has no new effects not already identified in the program EIR, and no new mitigation would be required, the subsequent activity can be approved as being within the scope of the project covered by the program EIR, and no new CEQA document would be required. If there are new effects or new mitigation measures are needed, a CEQA document addressing the subsequent activity may focus solely on the new effects or mitigation that had not been considered before.

NCCPs/HCPs

As described in Section 6.2.6, NCCPs/HCPs are planning documents prepared by non-federal parties as part of an application for an incidental take permit for listed species, when take of such species may occur from projects or other activities (i.e., maintenance). An HCP assesses the impacts of a proposed action on species, proposes measures to monitor, minimize, and mitigate these impacts, and analyzes action alternatives. On approval of an HCP, the USFWS and NOAA issue an incidental take permit, which allows the non-federal party to legally proceed with an activity that otherwise may result in unlawful take of a protected species. An NCCP essentially is the California state equivalent of a federal HCP for species listed under the California Endangered Species Act (CESA).

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While there are three NCCPs/HCPs that have planning areas that overlap with the MUSR RFMP boundary, these plans are limited in their ability to cover flood- and habitat-project related activities. Furthermore, there is no HCP that covers Tehama County. When projects are being developed for the Regions, use of an NCCP/HCP may be merited if there is sufficient project need and agreement and coordination between project sponsors can be attained.

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7. Rural Areas and Small Communities

7.1. Rural Areas and Small Communities within the Region

For rural-agricultural areas, the 2012 CVFPP describes improving flood protection consistent with the preservation of rural-agricultural activities and viable local economies, encouragement of land uses compatible with periodic flooding, and integration of actions to improve ecosystem services and functions.

Guidance presented in the 2012 CVFPP also identified the goal of providing 100-year protection to small communities, where feasible. The 2012CVFPP defines small communities as developed areas with fewer than 10,000 residents. Because small communities do not fall in the category of urban or urbanizing areas (10,000 or more residents, currently or within the next 10 years), they are not required to meet State-mandated 200-year level of protection requirements for urban areas. However, recent legislative changes imposed upon FEMA, via the Biggert-Waters Flood Insurance Reform Act of 2012, will increase the rates of flood insurance for property owners that do not meet the Federal Emergency Management Agency (FEMA) standard 100-year level (1 percent Annual Exceedence Probability (AEP)) of protection for properties located within the flood hazard zone. These increases in rates will prompt small communities to reassess their costs and benefits for achieving or maintaining a 100-year level of protection.

Small communities were identified in the CVFPP using the following data sources:

- California Department of Finance
- Census-Designated Places (CDP)
- California List of Places (U.S. Geological Survey Topographic Quadrangle Maps)

The 2012 CVFPP characterized the flood threats to small communities using attributes related to flood frequency, potential flood depth, and proximity to the nearest river. These characterizations were then used to prioritize the small communities into four categories:

- Group A (High Hazard) – Communities subject to high flooding frequency (greater than 1 percent per year) and also subject to deep flooding conditions (potential flood depths exceeding 3 feet on average).
- Group B (Moderate to High Hazard) – Communities subject to high flooding frequency (greater than 1 percent per year), subject to sheet flooding conditions (potential flood depths of less than 3 feet on average), and less than two miles from a major flooding source.
- Group C (Low to Moderate) – Communities subject to high flooding frequency (greater than 1 percent per year), subject to sheet flooding conditions (potential flood depths of less than 3 feet on average), and more than two miles from a major flooding source.
- Group D (Low Hazard) – Communities that are not subject to high flooding frequency (less than 1 percent per year). Improving protection facilities is one option to mitigate flood threats to small communities. This can be accomplished by strengthening

(reconstruction-in-place) existing levees, raising existing levees, and/or constructing new levees.

During the development of this plan, the MUSR RFMP team was asked to re-examine the definition of 'small community', and then re-assess which areas are to be included in this list for purposes of this RFMP. Stakeholders in the Regions express initial thoughts that some of the small communities listed in the 2012 CVFPP should fall more under the category of 'rural areas'. Therefore, the following definition was developed for purposes of this RFMP planning effort:

> <u>*Small Community:*</u> *A well-defined and easily distinguishable group of structures, containing 75 or more people, within a rural area.*

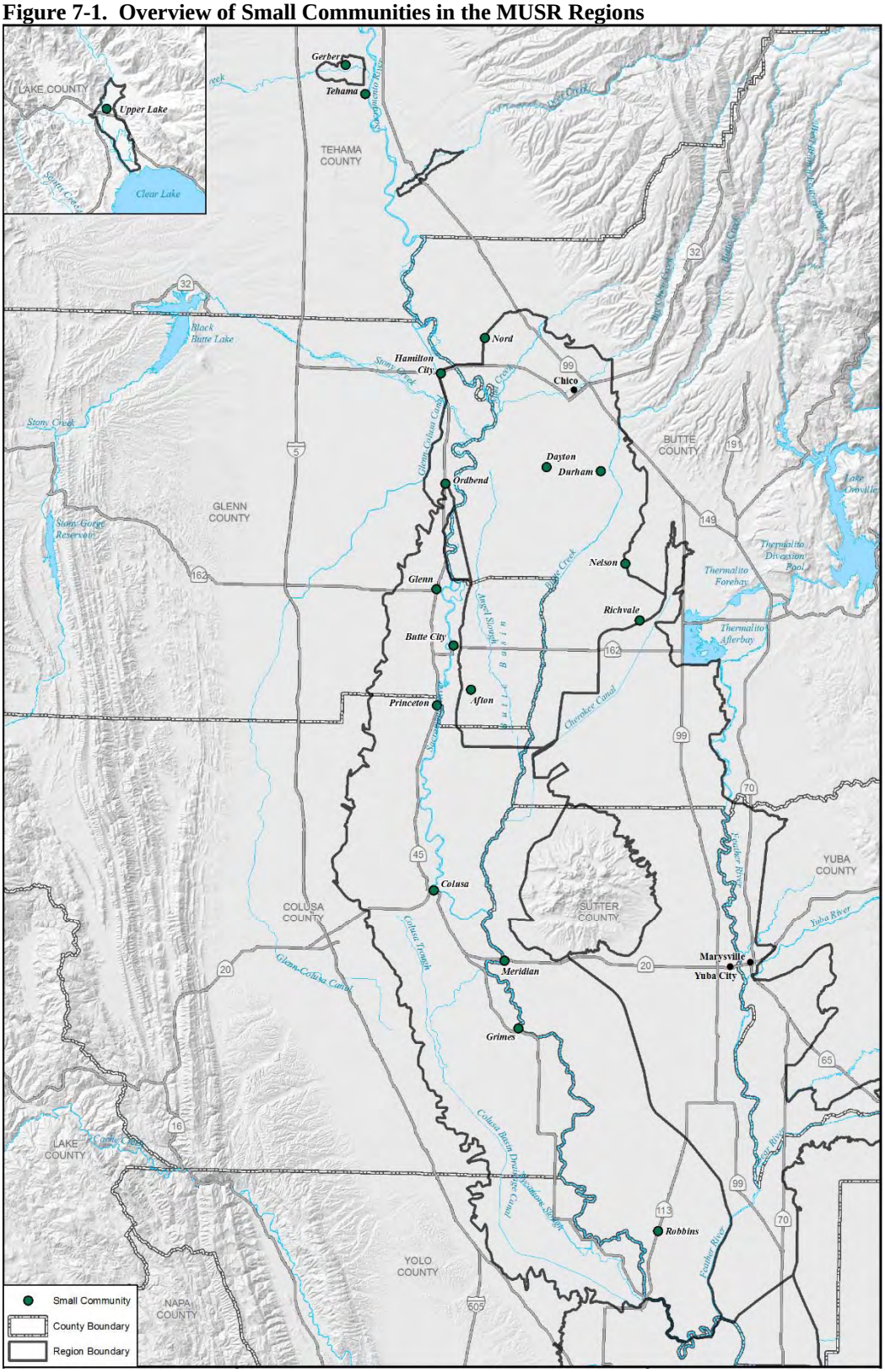
Using this definition and applying it to the small community populations outlined in Chapter 2, Ord Bend, Afton, and Glenn have all been reclassified as rural areas for this RFMP. Table 7-1 and Figure 7-1 shows an overview of the rural areas and small communities included in the Mid and Upper Sacramento River Regions.

Table 7-1. Summary of Small Communities and Rural Areas included in the MUSR Regions.

Name	Population*	Flood Hazard Level assigned in 2012 CVFPP	MUSR RFMP Categorization
Gerber	1,060	B	Small Community
Hamilton City	1,759	B	Small Community
Butte City	107	B	Small Community
Upper Lake	1,052	C	Small Community
Nord	320	Not Available	Small Community
Durham	2,569	B	Small Community
Nelson	88	Not Available	Small Community
Richvale	244	Not Available	Small Community
Colusa	7,380	B	Small Community
Princeton	303	B	Small Community
Grimes	391	B	Small Community
Meridian	358	A	Small Community
Robbins	323	A	Small Community
Ord Bend	72	Not Available	Rural Area
Glenn	42	B	Rural Area
Afton	18	Not Available	Rural Area

**Based upon 2010 U.S. Census Data*

Figure 7-1. Overview of Small Communities in the MUSR Regions



7.2. Challenges

7.2.1. *FEMA Floodplain Mapping and Rate Issues*

In the MUSR Regions, a significant portion of the rural-agricultural areas and small communities are mapped as FEMA Special Flood Hazard Areas (SFHA). Recent legislative changes imposed upon FEMA, via the Biggert-Waters Flood Insurance Reform Act of 2012, do not provide the flexibility needed to sustain agriculture including the ability for reinvestment in infrastructure without unreasonable or cost-prohibitive measures. In addition, landowners cannot afford the level of protection required to meet 100-year level-of-protection standards.

The Biggert-Waters Act, which was signed by the President on July 6, 2012, attempts to shore up the National Flood Insurance Program (NFIP) by moving it towards risk-based pricing. It eliminates premium subsidies for repetitive loss properties, property owners who do not take steps to mitigate, secondary homes and certain properties that have been protected from risk-based rates by grandfathering.

The NFIP collects more than $3.5 billion in annual premium revenue, and FEMA estimates that an additional $1.5 billion annually is needed from subsidized policyholders for it to get financially even.

FEMA estimates that about 20 percent of its 5.5 million policyholders — about 1.1 million — receive subsidies. Under Biggert-Waters, about 250,000 of them will see immediate increases: business owners, those owning second homes and people with frequently flooded properties. Below is a summary of what's changing:

- Rates for most properties will increase
- Subsidized rates for non-primary residences are being phased out
- Other subsidized rates will be eliminated over time
- When a community adopts a new flood map, discounts like grandfathering will be phased out – meaning premiums will increase over time

Table 7-2, released in January of 2013, shows an example of the proposed new FEMA rates. Although, these rates are currently a topic of discussion in Congress at this time, it is apparent that the rate increases have the potential to be substantial. To further complicate matters, homes designated in FEMA floodplains that have high potential flood depths also carry tough restrictions which make it almost impossible to rebuild (in the event of a disaster) or remodel, as these improvements be built at or above the base flood elevations (BFE). Specifically, in order to meet the FEMA regulatory requirements, structures must be wet flood proofed, dry flood proofed, or elevated. These requirements are often infeasible or cost prohibitive, especially in areas protected by levees with the potential for deep flooding. In addition, all federally backed mortgages for properties in SFHAs require federally mandated flood insurance, which further complicates matters for property owners looking to sell their home or business.

Table 7-2. Potential New Flood Insurance Rates (Released January 31, 2013)

Single Family One Story,	Post FIRM AE Zone	
	$250,000 Building Coverage	
Lowest Floor Elevation Difference	Building Coverage Only	With $100,000 Contents Coverage
	Flood Insurance Premium	
3 feet above	$376	$561
2 feet above	$448	$633
1 foot above	$660	$845
At Base Flood	$1,359	$1,724
1 foot below	$4,527	$5,255
2 feet below	$5,924	$8,308
3 feet below	$7,204	$10,554
4 feet below	$9,551	$14,370
6 feet below	$18,830	$28,535

<< Note to Reviewer: Legislation which would temporarily lessen the impacts Biggert-Waters Act was recently approved by the U.S. Congress, and is awaiting signature by the President. The changes to the Biggert-Waters Act brought forth by this legislation will be discussed in the next version for the MUSR RFMP.>>

Homes and businesses located in the rural areas and small communities provide the necessary support and foundation which allows the adjacent agricultural industry to thrive. Without these communities, agriculture and the local and state economy will suffer; these are the communities where people working in agriculture gather to worship, shop, socialize, educate their children, and conduct business. The NFIP does not currently take into consideration the unique interdependency and tenuous economic balance that exists between the agriculture industry and adjacent small communities as compared to urbanized economies. Without recognizing the unique characteristics of agricultural and small communities in the NFIP structure, and by instead applying an urban-focused flood insurance standard that imposes high cost flood insurance and strict building restrictions, the existing agriculture enterprises and their dependent small communities will continue to degrade and ultimately fade away.

7.2.2. *Project Funding*

In general, rural areas and small communities alone cannot afford the necessary capital improvements that are needed to achieve a 100-year level of flood protection. The initial costs presented in the 2012 CVFPP for implementing structural levee improvements to bring individual small communities up to a 100-year level of protection range from roughly $6 to $75 million, well above the level that could be funded locally.

Many rural areas and small communities are categorized as economically disadvantaged communities. ‘Economically Disadvantaged’ is defined as a community with an annual median household income that is less than 80 percent of the Statewide annual median household income. Out of the 16 identified small communities within the Regions, half of them are classified as economically disadvantaged.

7.2.3. *Project Implementation*

As described in Section 3, project implementation is very difficult for rural areas and small communities to achieve on their own. In most cases, there is no existing city council or local agency with legal authority to approve and administer contracts on behalf of the community. Responsibility thus falls onto the respective County or the rural LMA, which often lack access to the additional funding or staffing requirements needed to carry out such projects.

7.3. Potential Management Strategies

7.3.1. *Changes in Agricultural Floodplain Regulation*

As discussed in Chapter 2, the agricultural industry has a dramatic impact on the overall economy of the MUSR Regions. The Regions' economies rely in large part upon the viability and success of the agricultural industry and its production. In order for the MUSR Regions to continue to sustain a strong agricultural economy, it is apparent that changes are needed to the National Flood Insurance Program that will promote the long-term sustainability of agriculture.

To effect the needed changes to the NFIP, the Agricultural Flood Management Alliance (AFMA) was formed in 2012 as a national coalition of local agencies, organizations, and individuals interested in protecting the long-term viability of agricultural communities, industries, and operations located in the FEMA regulatory floodplain. AFMA is concerned that the current approach under the NFIP places a disproportionately impactful economic burden on agricultural communities in the mapping of Special Flood Hazard Areas (SFHAs) which imposes highly-restrictive flood protection regulations and establishes burdensome flood insurance rates. In particular, AFMA is seeking changes to the building limitations on structures needed to support agricultural production, storage, and processing. Further, AFMA is supporting an approach in which flood insurance is offered at a rate which is variable depending upon the risk, but which makes flood insurance a meaningful and affordable option for the property owner.

AFMA is pursuing the creation of a new agricultural flood hazard area under the NFIP. This new zone would apply to established agricultural areas that would otherwise be mapped into the 100-year floodplain and would help ensure that agriculture and the communities it supports continue to thrive. The new zone would include provisions for agricultural and small dependent communities that allow for practical and feasible replacement of and reinvestment in industrial and commercial structures, to ensure long term socio-economic sustainability. Stakeholders within the MUSR RFMP area strongly support AFMA's efforts.

7.3.2. *Grant Funding and Project Implementation Assistance for Small Community Flood Control Improvements*

Recent updates from DWR have indicated that future grant funding will be available for small community flood control improvements. Currently, draft guidelines for the funding requirements are scheduled to be released in late spring of 2014.

The RFMP widely supports the concept for allocating grant funding to small communities and rural areas. However, due to the previously mentioned challenges that these areas face with project implementation, it is very difficult for small communities to plan for, apply for, and administer the grant funding awards. It is also important, if not critical, that certain requirements associated with the grant funding agreements be minimized; such as the local cost share percentage, retention of funds, and timeframes for payment approval and release.

In addition, the funding of flood improvements for small communities and rural areas does not necessarily need to target a specified level of protection. Instead, it could focus on those identified and known deficiencies at specific areas based upon recent levee inspections or local knowledge. This may provide a more cost-effective approach to improving flood protection in rural areas and small communities.

7.3.3. *Critical Infrastructure Identification and Flood Contingency Planning*

Critical infrastructure identification and flood contingency planning is vital for the small communities and rural areas located within the MUSR Regions. These topics are covered in detail in Chapter 5 of this RFMP.

7.3.4. *Non-Structural Solutions*

Non-structural measures reduce flood risk without significantly altering the nature or extent of the flooding. This is achieved by changing the use made of the floodplains, or by adapting existing uses to the flood hazard. Nonstructural methods include options such as the construction of floodwalls, floodproofing, relocating structures or critical infrastructure, installing flood warning and preparedness systems, developing detailed emergency response contingency plans, implementing land use restrictions, and designating or acquiring flood prone areas.

In addition the following concepts could be explored to help mitigate the effects of the impending FEMA regulations on small communities and rural areas:

- Direct or support action by FEMA to develop and use insurance actuarial rates that reflect the actual flood risks within each levee-protected zone, based on best available hydrologic, hydraulic, and geotechnical analyses. This would lead to more efficient allocation of investment resources based on true economic risk, with regional and national economic benefits. It is important to keep in mind that levees provide protection, even if they are not certifiable. An actuarial rating system should be developed for unaccredited levee systems to avoid imposing undue burdens on agricultural communities.
- Regional agencies and communities may take advantage of federal and State risk mitigation actions, such as flood proofing and elevating residential and nonresidential structures. Where such flood risk reductions are not feasible, federal and State funds for relocating, selling, or demolishing at-risk structures may be available.

- Establish State and federal post-disaster recovery programs that recognize the national importance of sustainable agriculture, the consistency of agriculture with the wise use of floodplains, and that recovery from occasional flooding due to levee failures in SFHAs should be an integral part of such sustainable land use. Such post-disaster recovery programs could include low-interest loans, grants, technical assistance, and other tools, which could be developed in consultation with agricultural interests, in order to speed post-disaster recovery to the agricultural industry and the small communities that support it. They could include linkages to incorporating additional wildlife-friendly agricultural practices to attract more favorable loans and grants while accomplishing State and national environmental restoration goals.

Another avenue for communities to pursue might be qualification for the Federal Emergency Management Agency (FEMA) Zone D designation rather than Zone AE. The Zone D designation is used where there are possible but undetermined flood hazards, but no definitive analysis of flood hazards has been conducted. Areas that are designated Zone D are often undeveloped and sparsely populated. There are no federal restrictions on building new structures in Zone D and flood insurance is not required although it can be purchased through the NFIP (historically at high rates that reflect the uncertainty of the flood hazard.)

Although the State has recently collected some geotechnical data on the levee systems protecting small communities within the Regions, no definitive analysis of flood hazards has been conducted. For some communities, levees have generally performed reasonably well, having withstood the flood of record in 1986 and another large flood in 1997, and have not experienced a levee failure in the past 100 years. These levee systems are thought to meet NFIP freeboard requirements but may not meet the more rigorous levee embankment and foundation stability standards that have recently been applied in urban levee evaluations. This uncertainty supports the Zone D designation.

The argument for using Zone D in the Sacramento Valley for rural areas and small communities with suitable levee systems would be as follows: Use of this designation in combination with appropriately priced insurance rates and local controls on new development would promote rural economic sustainability without subjecting the Federal government or the nation's taxpayers to undue liability. Indeed, the affected areas would remain sparsely populated but highly productive agriculturally.

Given the State's overarching responsibility for managing the rural levee systems which may be eligible for the Zone D designation, it would make sense for the State perhaps through its Central Valley Flood Protection Board to play a formal role in the Zone D designation process. The State is a recognized NFIP community. In this instance, the State would seek recognition from FEMA of the rural areas within the State Plan of Flood Control that could qualify for Zone D designation. These areas would need to meet the following criteria:

- The levee system protecting the area meets FEMA 100-year freeboard requirements;
- The area has no history of substantial or repetitive flood loss claims; and
- The area is governed by a locally adopted floodplain management plan containing appropriate local land use controls, risk notification protocols, levee operation and

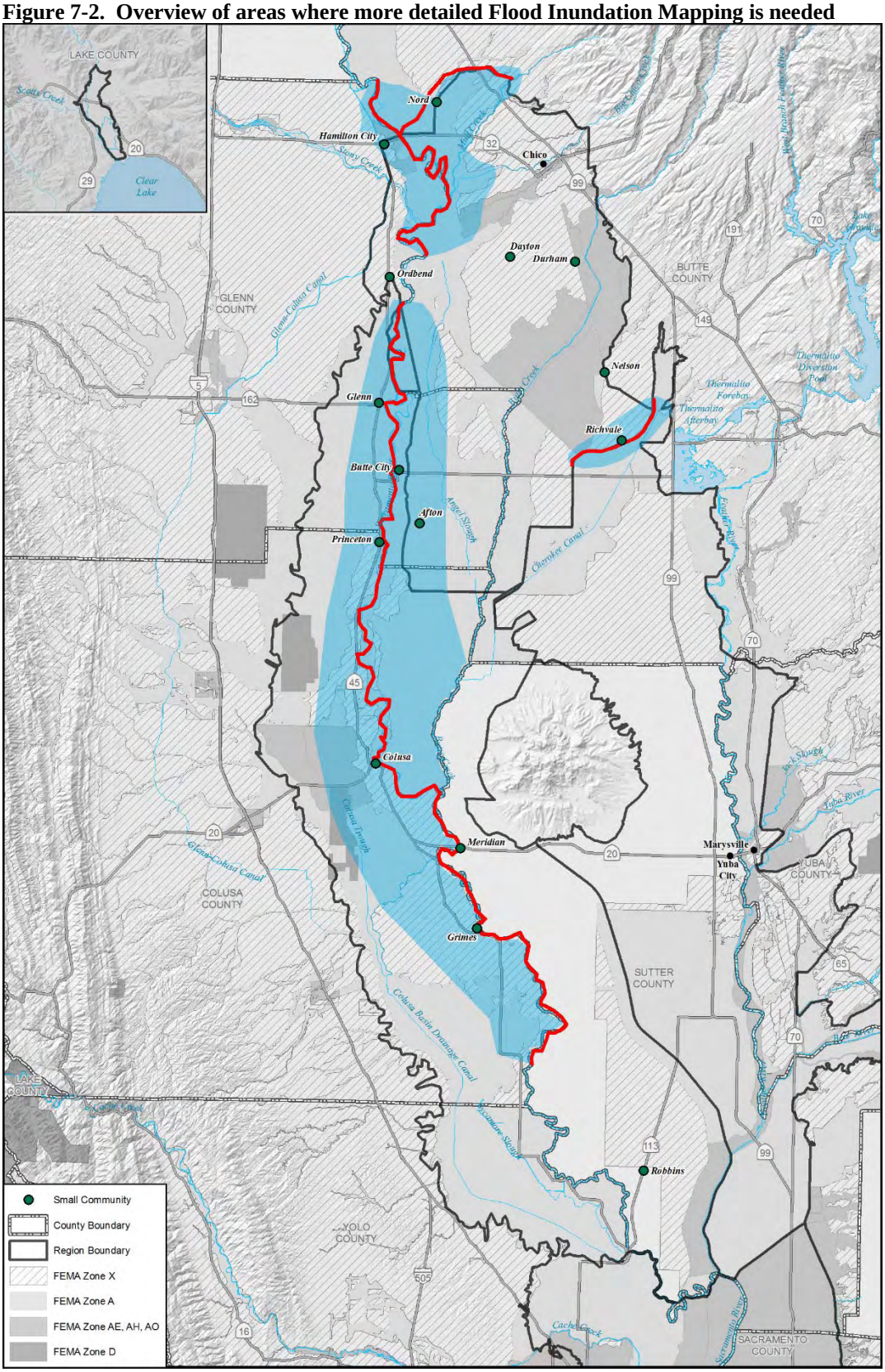
maintenance standards, and emergency response plans which have been reviewed and approved by the State.

Once the potentially eligible areas are mapped, local communities would be able to request the designation through the State to FEMA by providing the requisite documentation of a State approved floodplain management plan. Insurance in the rural areas which qualify for the Zone D designation would be available through a group insurance program administered by the State. Zone D designations would be renewable on a 10 year cycle.

7.3.5. *Improved Flood Depth Mapping*

Most of the rural areas within the Regions are classified as either Zone A or Zone X and no detailed hydraulic mapping exists for locals to use to determine what the potential flooding depths would be during a flood. It is recommend that future hydraulic modeling be completed to further analyze potential levee breach and flood scenarios in order to provide more detailed information to stakeholders in these areas. Figure 7-2 shows an overview of the areas within the Mid and Upper Sacramento River Planning Area where more detailed floodplain mapping is recommend. These areas were identified from local stakeholder input during development of this RFMP.

Figure 7-2. Overview of areas where more detailed Flood Inundation Mapping is needed



Note: Approximate areas where more detailed mapping is needed are shown in blue; related river reaches are shown in red.

Currently, DWR is in the process of defining work which will map residual floodplains for various potential breach scenarios within the Regions. It is recommended that this work be coordinated with the RFMP planning team so that local input regarding desired breach locations can be relayed. In addition, it is also recommended that the potential breach scenarios consider a variation of river channel n-values, so that uncertainty in future vegetation growth can be accounted for. For example, breach scenarios could be analyzed for existing river channel condition, ideal river channel conditions (lower channel roughness), and unmaintained river channel conditions (higher channel roughness) in order to determine the effects that these have on the overall residual floodplains.

7.4. Potential Small Community Solutions

This section provides an overview of the various small community solutions proposed in the 2012 MUSR Planning Area, and presents the identified conceptual solutions based upon local guidance and input received from local stakeholders for improving flood protection to the local community.

The 2012 CVFPP (Volume IV, Attachment 8J, Appendix C) looked at conceptual design and cost estimates for providing 100-year level of flood protection for small communities within the Systemwide Planning Area through physical modifications to the flood protection system (remediation of existing levees and/or construction of new levees). Engineering solutions adopted for each community implement physical modifications based on preliminary information from the Non-Urban Levee Evaluation Program and the most recent (undocumented) floodplain inundation modeling data available at that time. The engineering solutions were not generated through detailed alternative analysis that considers site-specific details, and the cost estimates presented in the 2012 CVFPP for providing 100-year level of protection do not consider interior drainage. The conceptual small community alternatives presented in Attachment 8J of the 2012 CVFPP were not adopted by the CVFPB as part of Resolution No. 2012-25.

In many cases the 2012 CVFPP proposes a ring levee as a first alternative to remedy flood inundation in the community. The cost of improving an adjacent system levee along with the required new levee to enclose the community will be very high relative to the population protected. Therefore, the ring levee is not typically the most economically feasible solution to the problem of flood inundation. In addition, the 2012 CVFPP conceptual solutions were generally not supported by the local stakeholders and jurisdictions as a preferred alternative. Other, more cost effective and direct ways to address local flood problems must be developed and brought forward into discussion.

<<Note to Reviewer: Conducting detailed hydrologic and hydraulic analyses to identify and analyze small community deficiencies is beyond the scope of this MUSR RFPM. However, the DWR Central Valley Floodplain Evaluation and Delineation (CVFED) program is developing new hydraulic models for many areas within the MUSR Regional boundary. As they become available, these hydraulic models will be used in conjunction with local stakeholder input to help formulate potential conceptual-level alternatives for the various small communities in the Regions.>>

7.4.1. *Colusa*

The City of Colusa is located along the right bank of the Sacramento River in Colusa County.

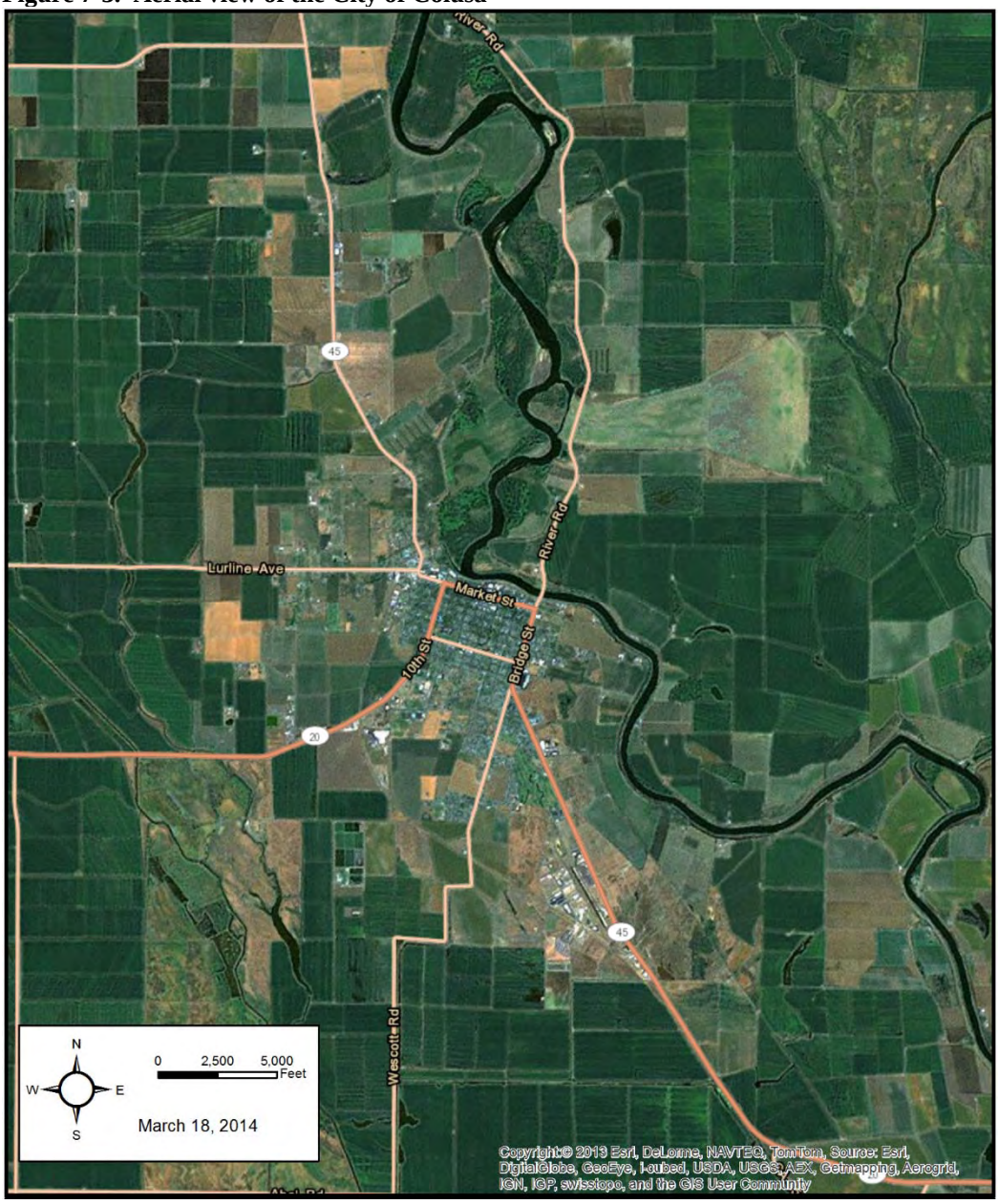
Conceptual Alternative Presented in the CVFPP

The 2012 CVFPP determined that reconstruction-in-place repairs along the right bank levee of the Sacramento River, in combination with construction of a training levee extending along the north and west of Colusa, would protect the community from a 1 percent AEP flood. The recommended repairs along the right bank of the Sacramento River include remediation for under-seepage, through-seepage, and freeboard and geometry for the first levee segment, and under-seepage, through-seepage, and erosion for the second segment.

RFMP Conceptual Alternatives:

<< To be developed upon receipt of CVFED data.>>

Figure 7-3. Aerial view of the City of Colusa



7.4.2. *Grimes*

Grimes is an unincorporated community located along the right bank of the Sacramento River in Colusa County.

Conceptual Alternative Presented in the CVFPP

The 2012 CVFPP determined that reconstruction-in-place repairs along the right bank levee of the Sacramento River, in combination with construction of a training levee south of Grimes, would protect the community from a 1 percent AEP flood. Recommended repairs along the right bank of the Sacramento River include remediation for under-seepage, through-seepage, nonseepage- related stability, erosion, and freeboard.

RFMP Conceptual Alternatives

<< To be developed upon receipt of CVFED data.>>

Figure 7-4. Aerial view of Grimes

7.4.3. *Gerber*

The small community of Gerber is located along the right bank of the Sacramento River in Tehama County.

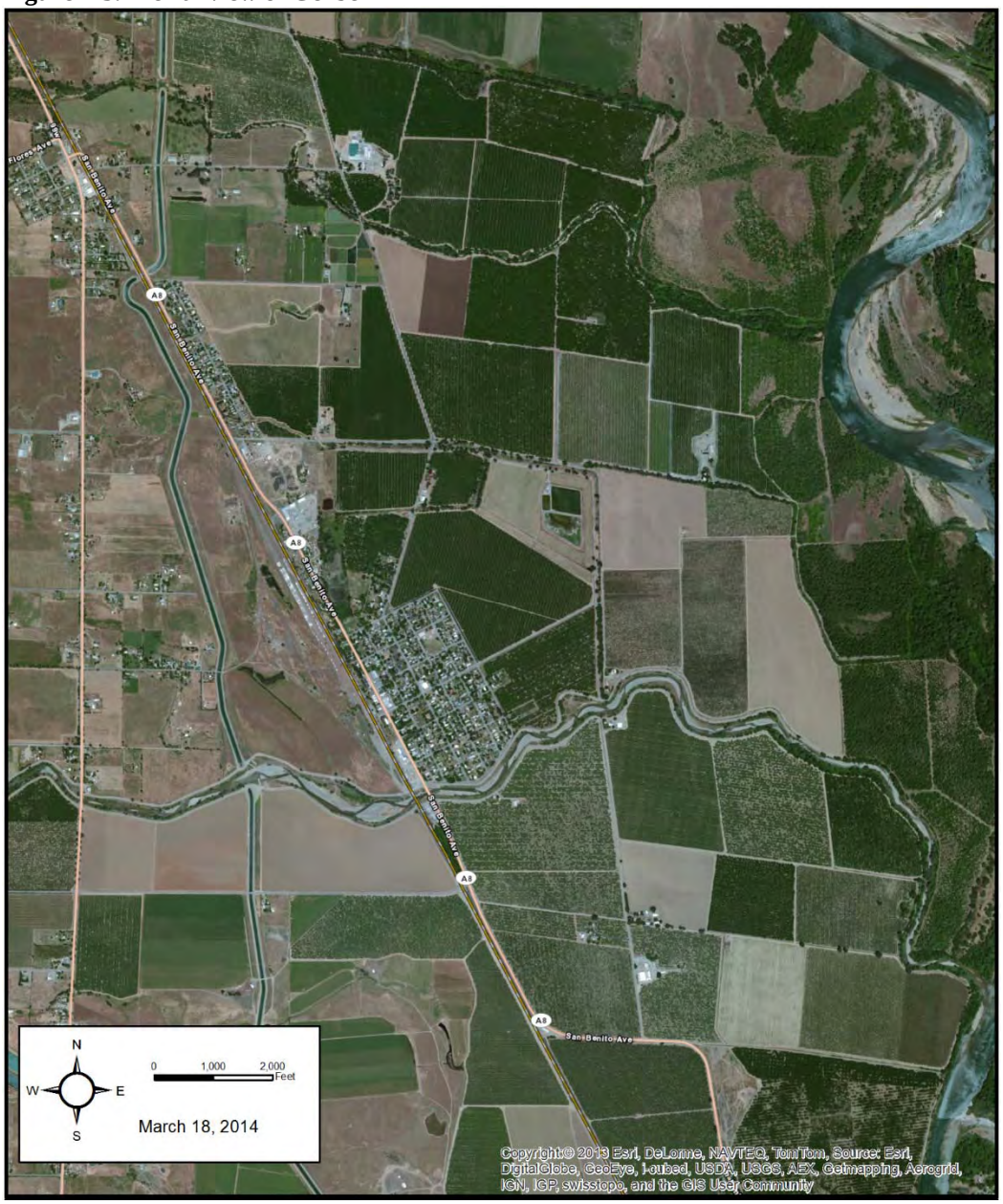
Conceptual Alternative Presented in the CVFPP

Not Assessed in the CVFPP.

RFMP Conceptual Alternatives

<< To be developed upon receipt of CVFED data.>>

Figure 7-5. Aerial view of Gerber



7.4.4. *Hamilton City*

Hamilton City is a census-designated place in Glenn County, located along the right bank of the Sacramento River.

Conceptual Alternative Presented in the CVFPP

Not assessed in the CVFPP.

RFMP Conceptual Alternatives

<< Under Development.>>

Figure 7-6. Aerial view of Hamilton City

7.4.5. *Butte City*

Butte City is an unincorporated community located along the left bank of the Sacramento River in Glenn County.

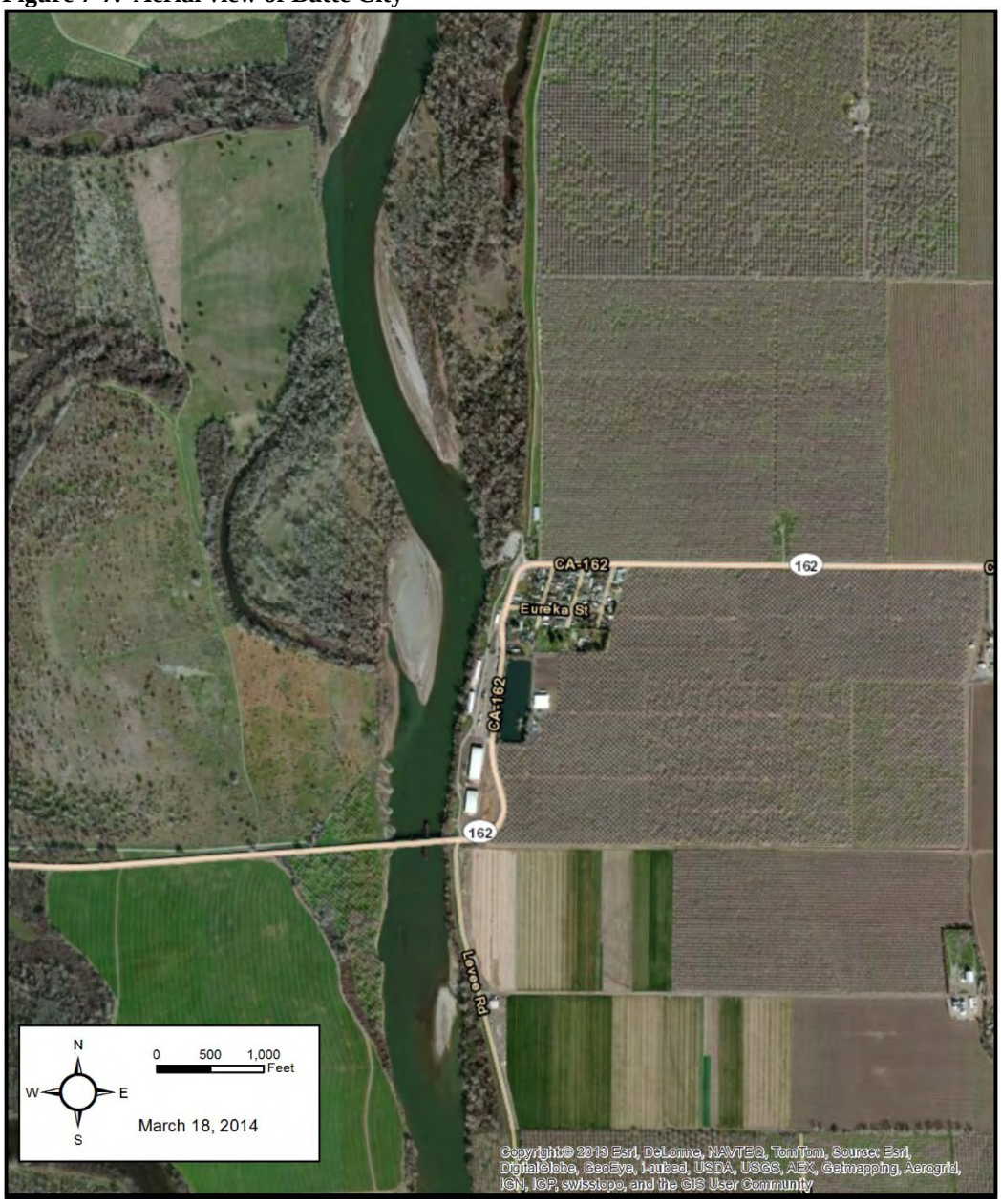
Conceptual Alternative Presented in the CVFPP

The 2012 CVFPP determined that reconstruction-in- place repairs along the left bank levee of the Sacramento River, in combination with the construction of a ring levee around Butte City, would protect the community from a 1 percent AEP flood. Recommended repairs along the left bank of the Sacramento River include remediation for under-seepage, through-seepage, seepage-related stability, erosion, and freeboard.

RFMP Conceptual Alternatives

<< To be developed upon receipt of CVFED data.>>

Figure 7-7. Aerial view of Butte City



7.4.6. *Upper Lake*

Upper Lake is an unincorporated community situated between the left bank of Middle Creek and the left bank of Alley Creek in Lake County.

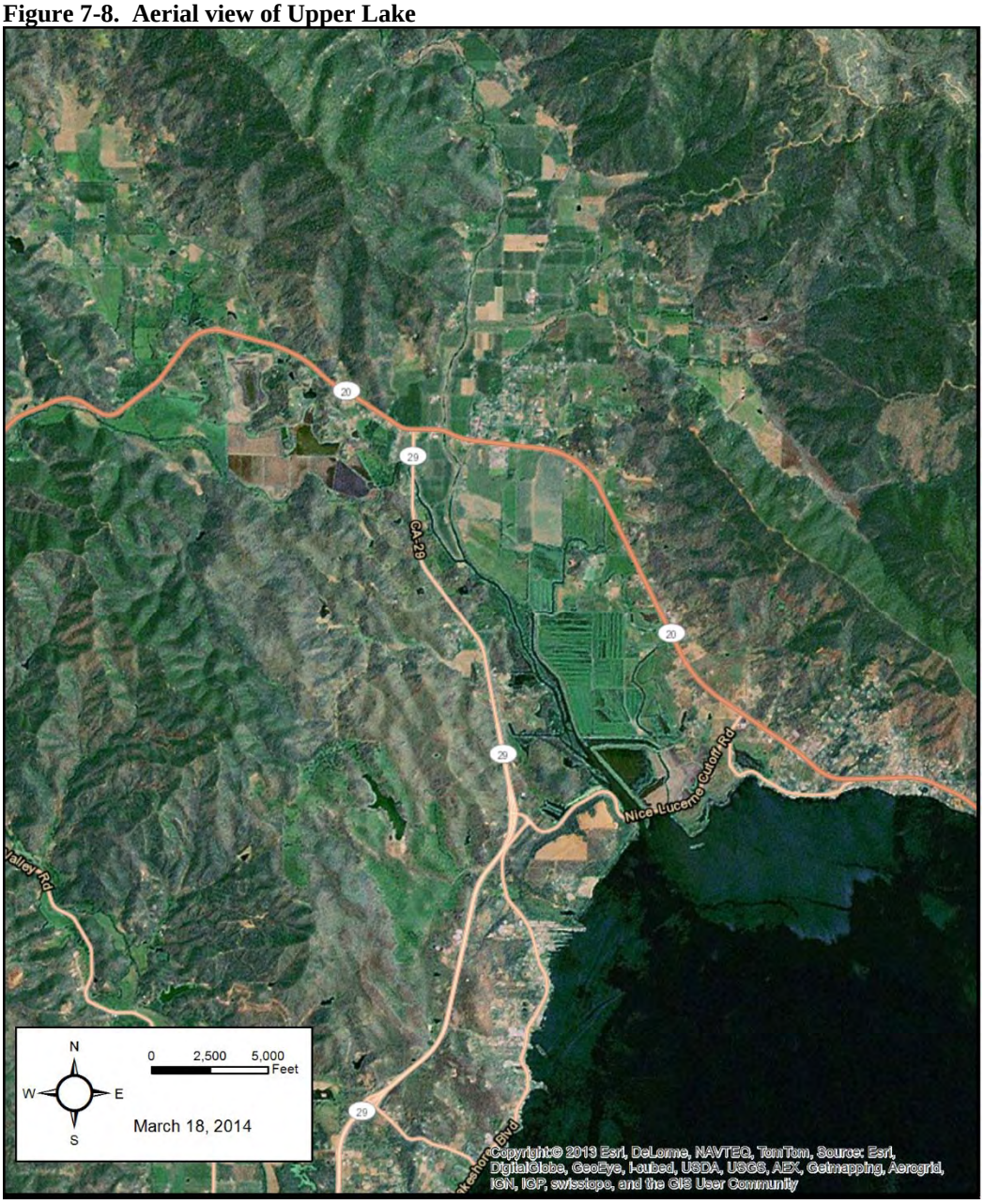
Conceptual Alternative Presented in the CVFPP

The 2012 CVFPP determined that reconstruction-in-place repairs along the entire lengths of the left bank levee of Middle Creek and the left bank levee of Alley Creek adjacent to Upper Lake would address flooding potential until more data becomes available. The recommended repairs along the left bank of Middle Creek and the left bank of Alley Creek include only remediation for freeboard and geometry.

RFMP Conceptual Alternatives

<< To be developed upon receipt of CVFED data.>>

Figure 7-8. Aerial view of Upper Lake



7.4.7. *Nord*

Nord is a census-designated place in Butte County, located along the left bank of the Sacramento River.

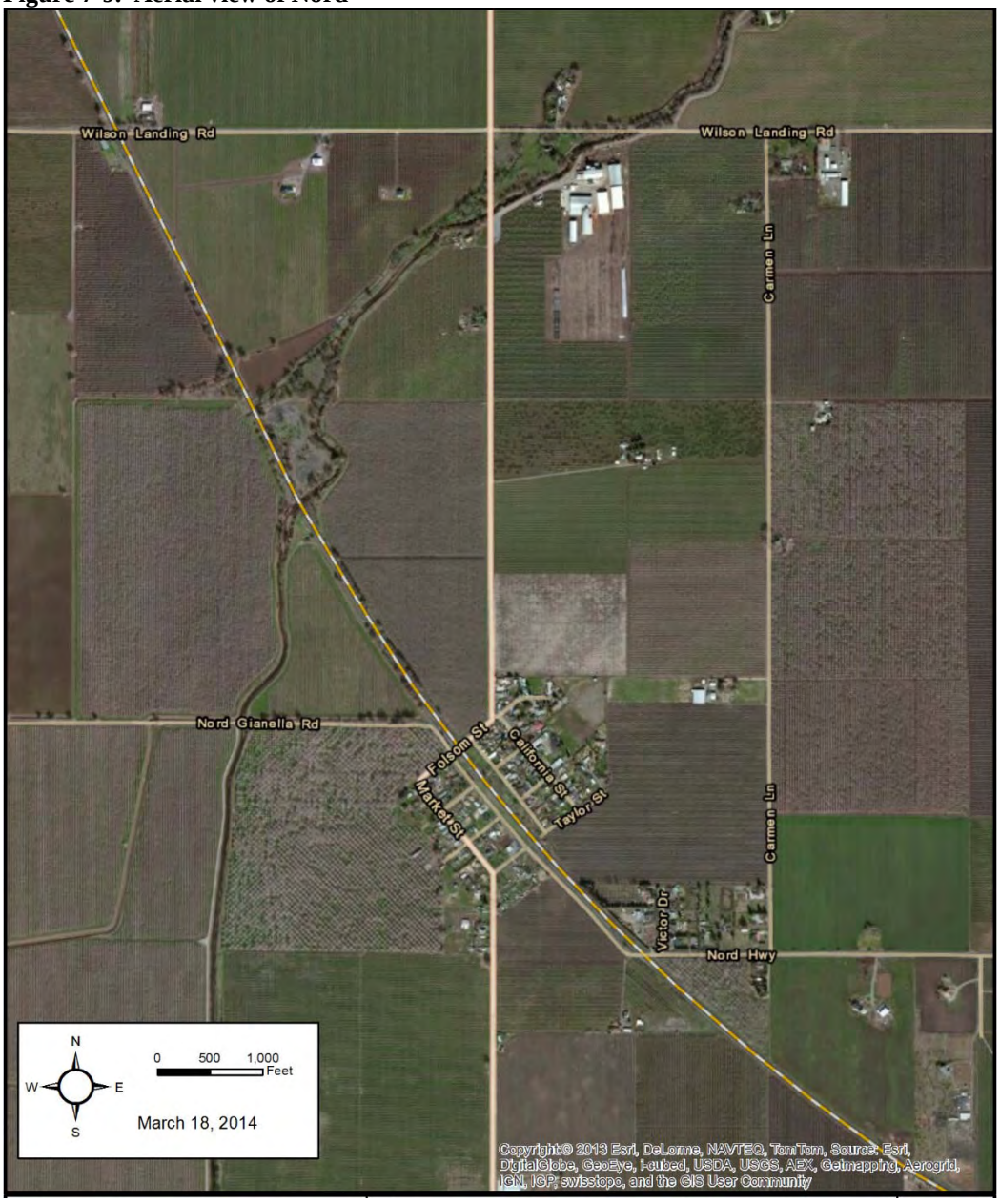
Conceptual Alternative Presented in the CVFPP

Not assessed in the CVFPP.

RFMP Conceptual Alternatives

<< To be developed upon receipt of CVFED data.>>

Figure 7-9. Aerial view of Nord



7.4.8. *Durham*

Durham is a Census-Designated Place (CDP) in Butte County about five miles southeast from Chico and about one mile west from Butte Creek.

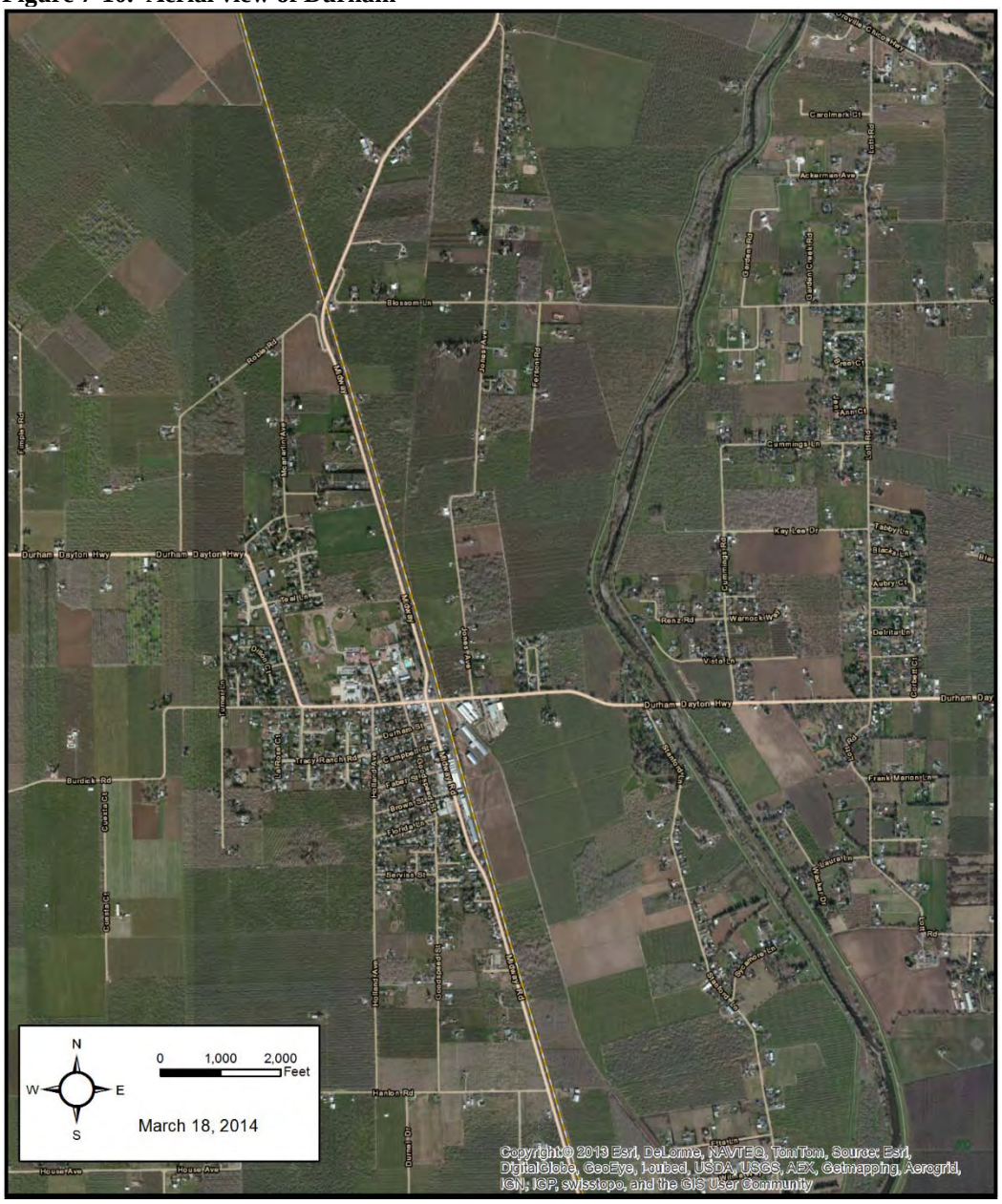
Conceptual Alternative Presented in the CVFPP

The 2012 CVFPP conceptual design is a reconstruction-in-place alternative repairing both the left banks and right banks of the Butte Creek upstream and downstream of Durham. This option would provide protection to an area beyond the community.

RFMP Conceptual Alternatives

<< To be developed upon receipt of CVFED data.>>

Figure 7-10. Aerial view of Durham



7.4.9. *Nelson*

Nelson is an unincorporated community in Butte County, located along the left bank of Butte Creek about 6.5 miles southeast of Durham.

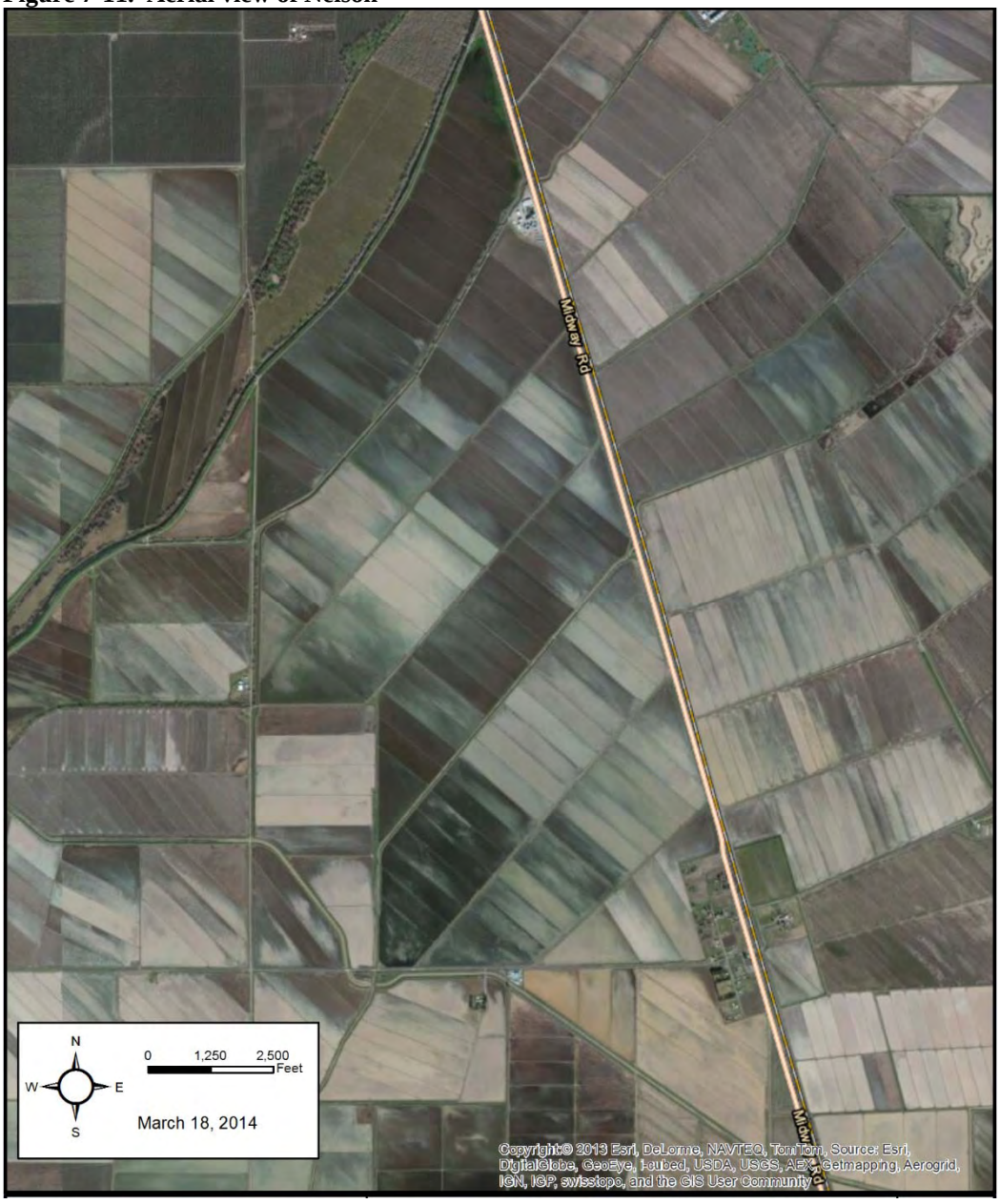
Conceptual Alternative Presented in the CVFPP

Not assessed in the CVFPP.

RFMP Conceptual Alternatives

<< To be developed upon receipt of CVFED data.>>

Figure 7-11. Aerial view of Nelson



7.4.10. *Richvale*

Richvale is a census-designated place in Butte County, located along the right bank of Cherokee Canal.

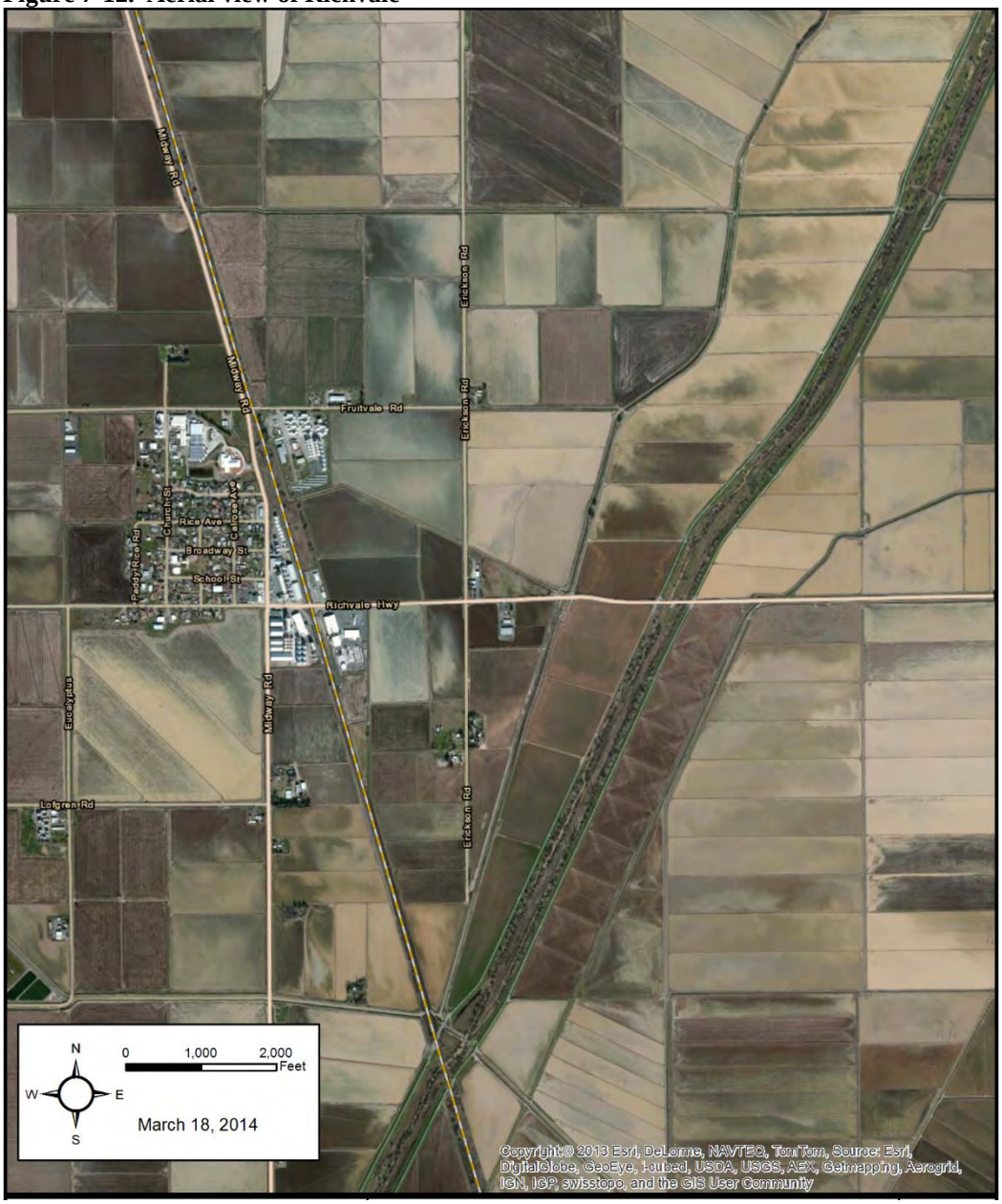
Conceptual Alternative Presented in the CVFPP

Not assessed in the CVFPP.

RFMP Conceptual Alternatives

<< To be developed upon receipt of CVFED data.>>

Figure 7-12. Aerial view of Richvale



7.4.11. *Princeton*

Princeton is a census-designated place in Colusa County, located along the right bank of the Sacramento River.

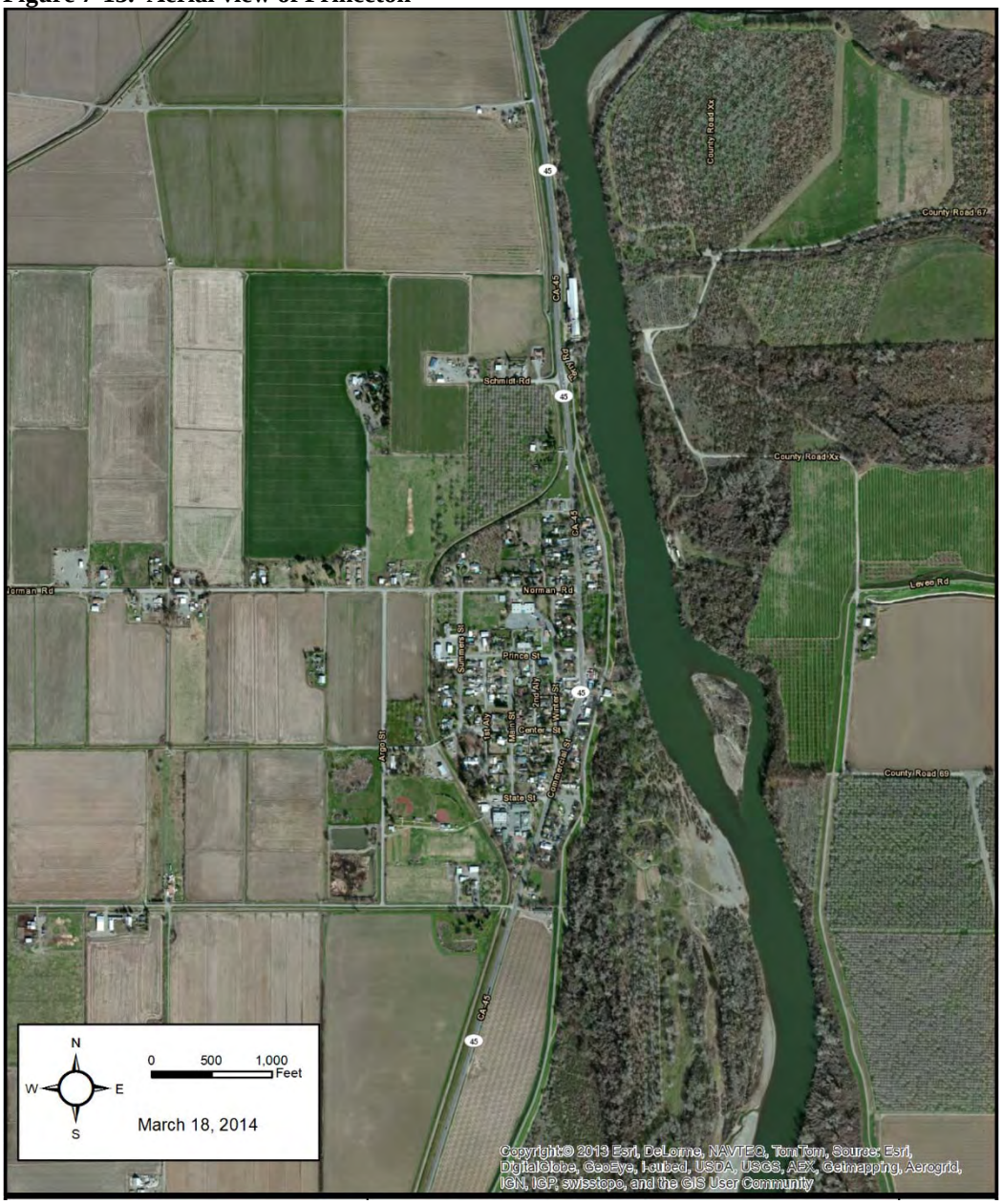
Conceptual Alternative Presented in the CVFPP

Not assessed in the CVFPP.

RFMP Conceptual Alternatives

<< To be developed upon receipt of CVFED data.>>

Figure 7-13. Aerial view of Princeton



7.4.12. *Meridian*

Meridian is an unincorporated community located along the left bank of the Sacramento River in Sutter County.

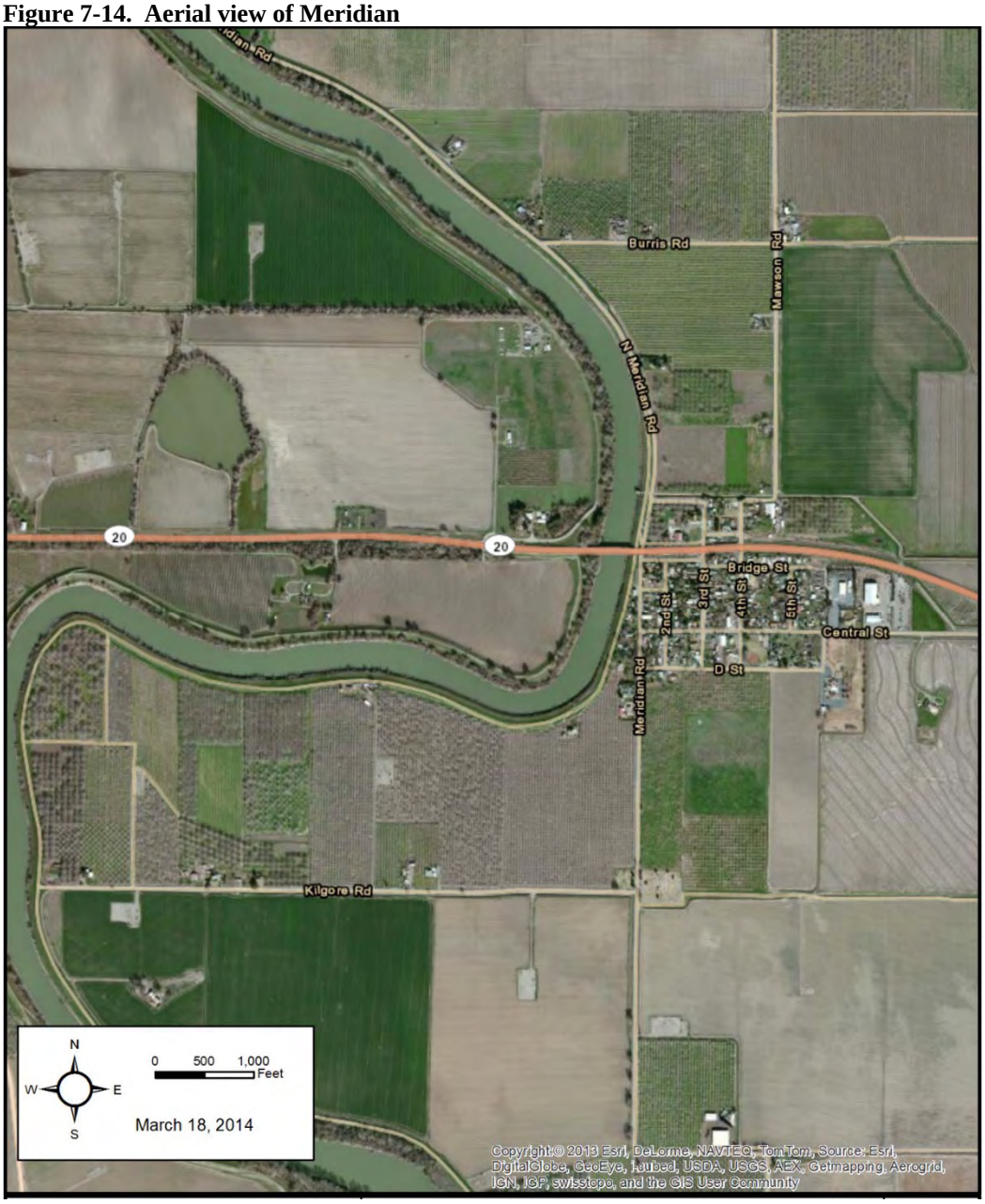
Conceptual Alternative Presented in the CVFPP

The 2012 CVFPP determined that reconstruction-in-place repairs along the left bank levee of the Sacramento River, in combination with construction of a ring levee around Meridian, would protect the community from a 1 percent AEP flood. The recommended repairs along the left bank of the Sacramento River include remediation for under-seepage, through-seepage, and nonseepage- related stability.

RFMP Conceptual Alternatives

<< To be developed upon receipt of CVFED data.>>

Figure 7-14. Aerial view of Meridian



7.4.13. *Robbins*

Robbins is an unincorporated town in Sutter County situated about 1.5 to two miles from the left bank of the Sacramento River to the west and about 2.5 to three miles from the right bank of the Sutter Bypass to the east.

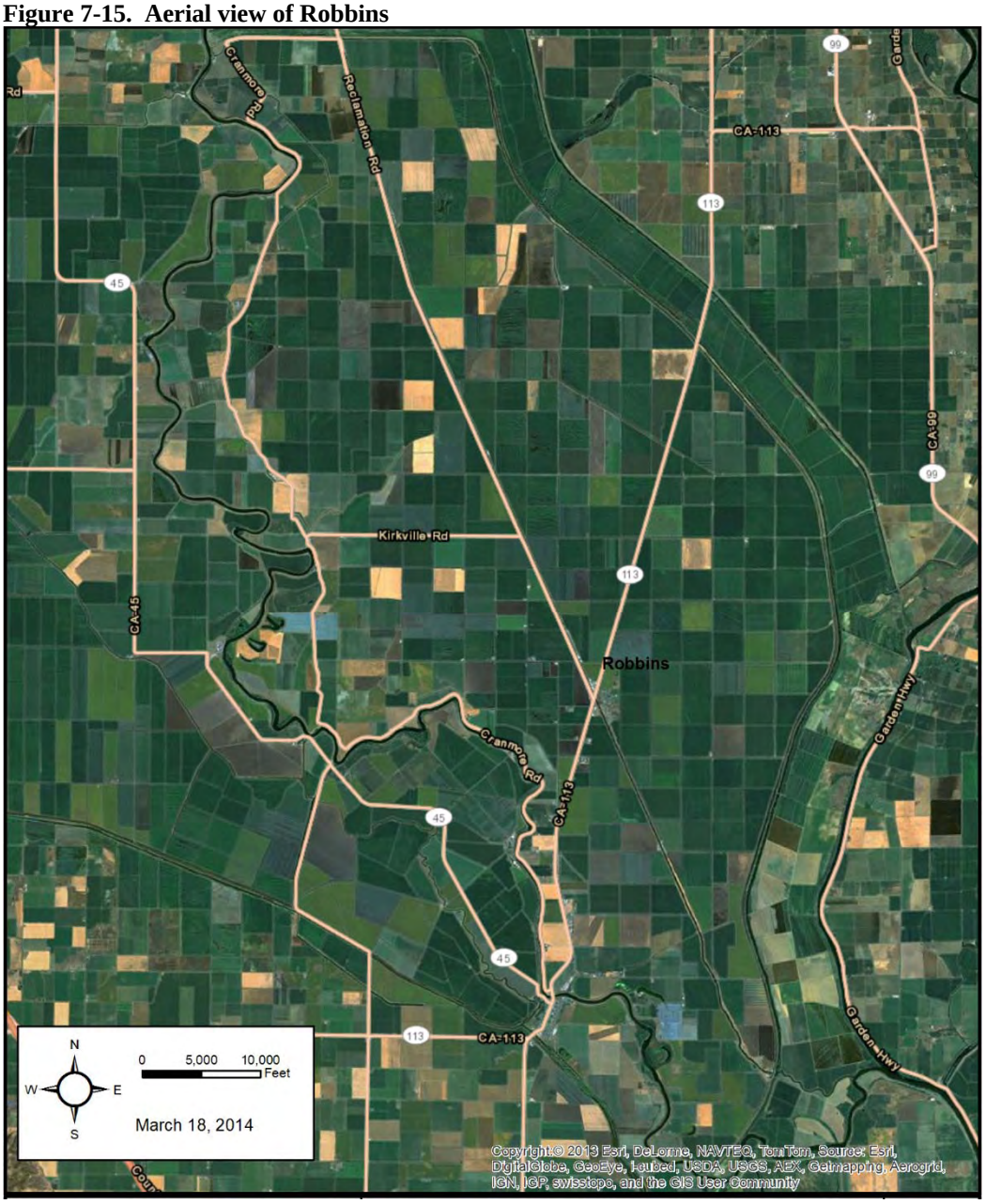
Conceptual Alternative Presented in the CVFPP

In the 2012 CVFPP, constructing a ring levee around the town was chosen as the most practical approach to protect Robbins from a 1 percent AEP flood. A conceptual ring levee has been conservatively designed with an average height of 13.91 feet. The length of levee needed to encircle Robbins was approximated at 2.25 miles.

RFMP Conceptual Alternatives

<< To be developed upon receipt of CVFED data.>>

Figure 7-15. Aerial view of Robbins



7.4.14. *Glenn*

Glenn is an unincorporated community in Glenn County located about one mile west of the Sacramento River, at the intersection of State Route 45 and State Route 162, about 10 miles east of Interstate 5 (I-5).

Conceptual Alternative Presented in the CVFPP

The 2012 CVFPP conceptual design for Glenn included a ring levee system. It would involve constructing a new levee on the north, west, and south and replacing a portion of an existing levee along the Sacramento River east of the community with a new levee. The new levees would have a 12-foot crown, with an average height of 4.5 feet, spanning about 1.9 miles in total.

RFMP Conceptual Alternatives

<< To be developed upon receipt of CVFED data.>>

Figure 7-16. Aerial view of Glenn

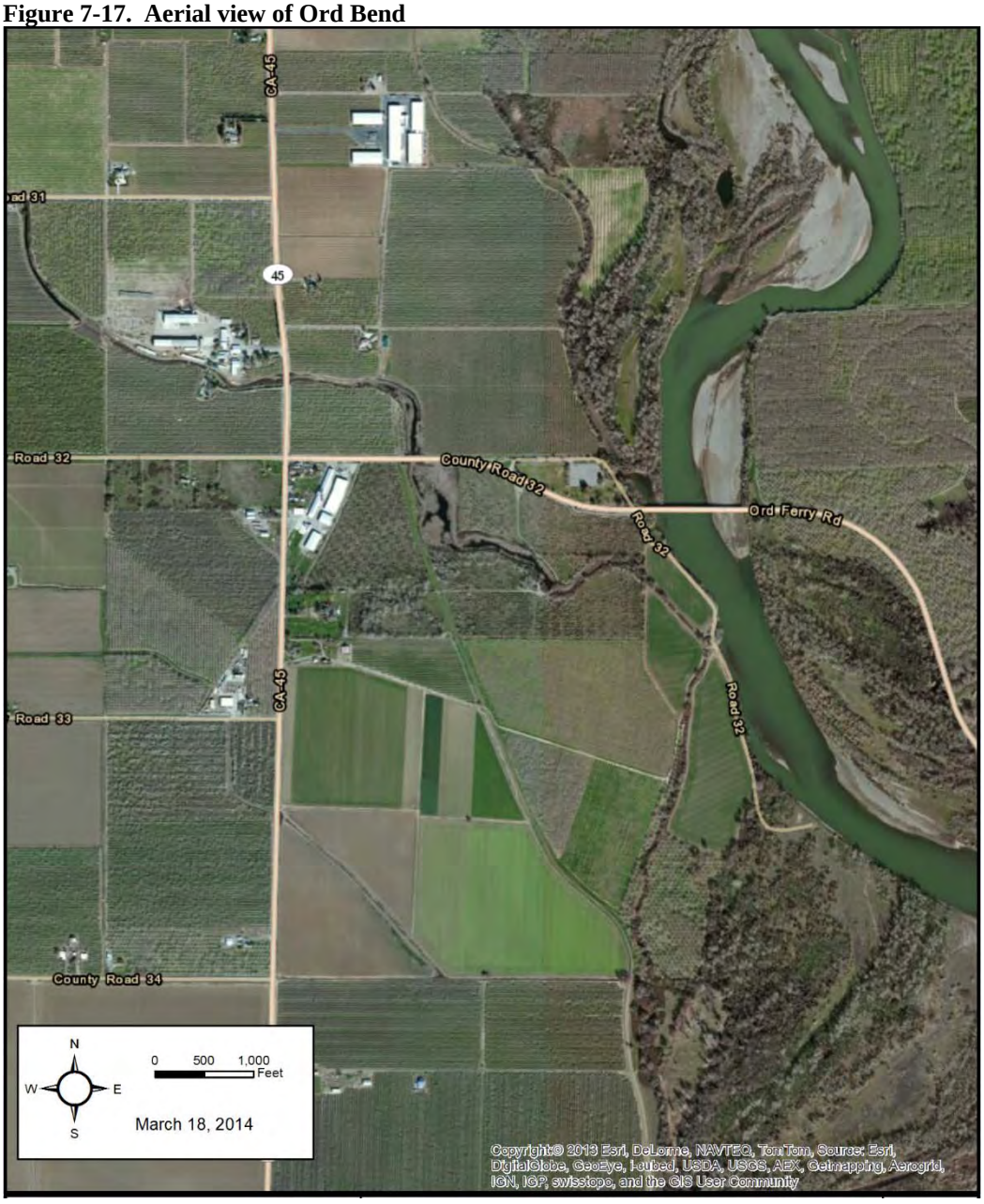
7.4.15. *Ord Bend*

Ord Bend is a small unincorporated community about 121 feet above mean sea level in Glenn County, California. Ord Bend is along State Route 45 between Glenn and Hamilton City (about eight miles south of Hamilton City).

Conceptual Alternative Presented in the CVFPP
Not assessed in the CVFPP.

RFMP Conceptual Alternatives
<< To be developed upon receipt of CVFED data.>>

Figure 7-17. Aerial view of Ord Bend



8. Urban Areas

8.1. Overview

An “urban area" is defined as a developed area in which there are 10,000 residents or more, and an "urbanizing area" is defined as a developed area or an area outside of a developed area that is planned or anticipated to have 10,000 residents or more within the next 10 years. The City of Chico is the only area within the Mid and Upper Sacramento RFMP regions that is characterized as ‘urban’ or ‘urbanizing’. Therefore, this Chapter focuses on the identification of flood related problems and solutions for the City of Chico.

8.2. Legislative Background

California voters passed the Disaster Preparedness and Flood Prevention Bond Act (Proposition 1E) and the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act (Proposition 84) in November 2006, authorizing the sale of nearly $5 billion in State bonds for flood management improvements throughout the state with $4.275 billion of this amount specifically earmarked for the repair and improvements to State and federal flood projects within the Central Valley.

In the latter part of 2007, the California Legislature passed and the Governor signed five interrelated bills (2007 California Flood Legislation) aimed at addressing the problems of flood protection and liability and helping direct use of the Proposition 1E bond funds. These included Senate Bills (SB) 5 and 17, and Assembly Bills (AB) 5, 70, and 156. A sixth bill passed in 2007, AB 162, required additional consideration of flood risk in local land use planning throughout California.

These bills, effective January 1, 2008, collectively added or amended sections in the California Government Code, Health and Safety Code, Public Resources Code, and Water Code. Together, these bills outline a comprehensive approach to improving flood management at the State and local levels, with elements to address both the chance of flooding (e.g., improvements to reduce the probability that floods will occur) and the consequences when flooding does occur.

Of the six bills in the 2007 California Flood Legislation, SB 5 contains the provisions most relevant to urban areas within the Central Valley. It mandates that new development within urban and urbanizing areas have an “urban level of flood protection” which is defined as the “level of protection that is necessary to withstand flooding that has a 1-in-200 chance of occurring in any given year using criteria consistent with, or developed by, the California Department of Water Resources.” SB 5 requires all cities and counties within the Sacramento-San Joaquin Valley to make ‘findings’ related to an urban level of flood protection before making a variety of land use decisions.

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Since 2007, there have been several legislative amendments to SB 5 regarding urban level of flood protection. SB 1278 (2012) and AB 1965 (2012) are the most recent amendments. These amendments extended the original compliance schedule for cities and counties to amend their General Plans and Zoning Ordinances, which in turn starts the timeline for implementing the urban level of flood protection provisions. General Plans must be amended by no later than July 2, 2015, and Zoning Ordinances must be amended within 12 months after completion of the General Plans amendments. The urban level of flood protection requirements apply once the General Plan and Zoning Ordinance amendments become effective, but no later than July 2, 2016.

8.3. Chico Urban Area

8.3.1. *Boundary*

Senate Bill 5 mandated that new development within urban and urbanizing areas have an urban (200-Year) level of flood protection. As mentioned previously, SB 5 defines an “urban area" as a developed area in which there are 10,000 residents or more, and an "urbanizing area" as a developed area or an area outside a developed area that is planned or anticipated to have 10,000 residents or more within the next 10 years. The only area within the MUSR RFPM planning area that meets these definitions is the Chico area. SB5 allows some discretion to local land use agencies in determining the boundaries and extents of urban and urbanizing areas. For the purpose this report, the Chico Urban Area has been assumed to be the City of Chico sphere of influence together with directly adjacent developed unincorporated areas.

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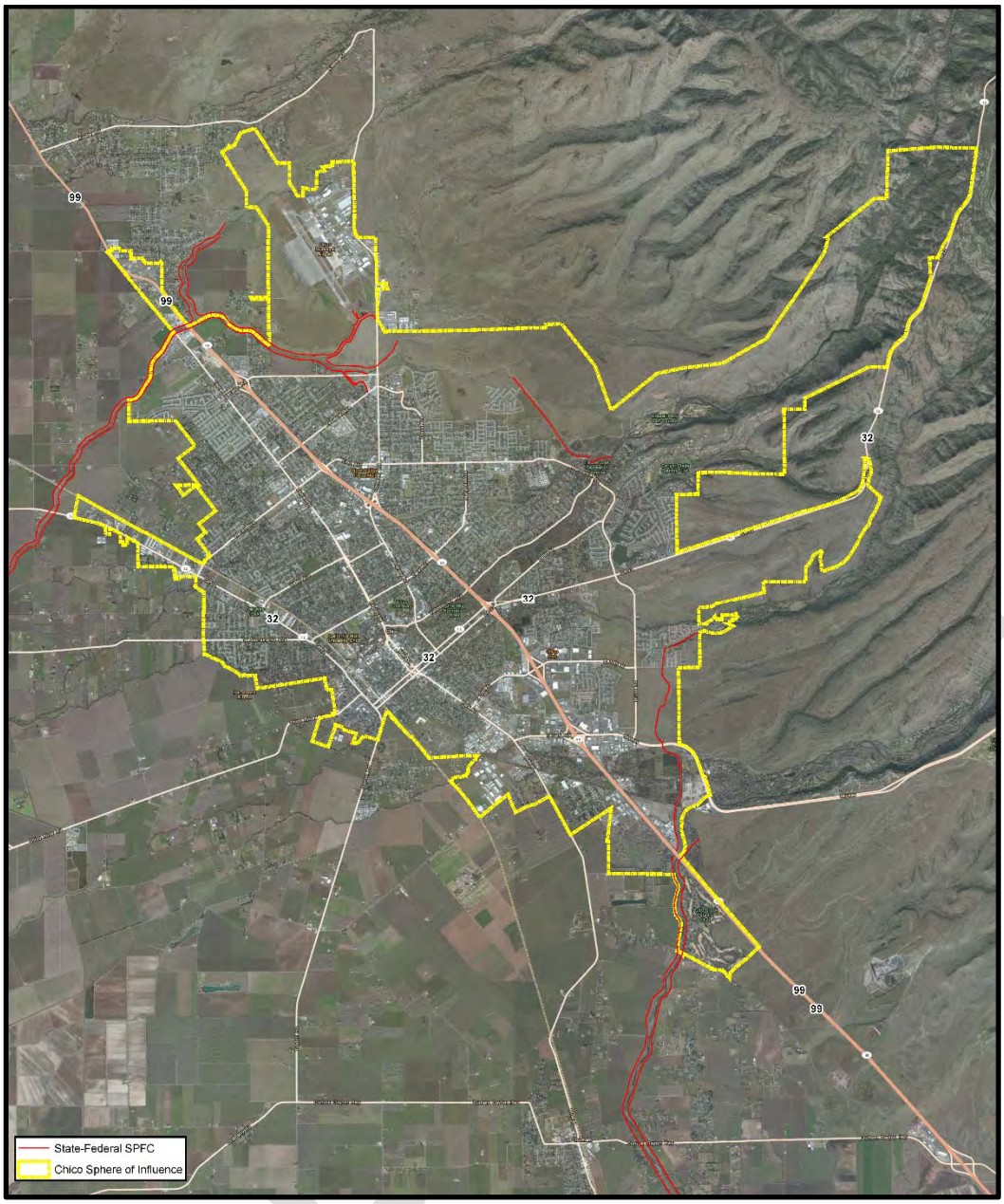
Figure 8-1. Chico Urban Area Boundary



8.3.2. *Levee System Description*

The Big Chico Diversion and the Sycamore and Mud Creek levee systems are located north of Chico, CA and were designed by the United States Army Corps of Engineers (USACE) in the 1960's to protect Chico from flooding during major storm events. The levees are maintained by the Butte County Department of Public Works, and the channels and diversion structures are maintained by DWR.

Big Chico Creek originates in the foothills and flows through the City of Chico. The Big Chico Creek diversion structure is located just upstream of the City and diverts high water flows from

Big Chico Creek through a Diversion Channel and into the Sycamore-Mud Creek leveed system. This Sycamore-Mud Creek levee system routes flood flows around the City to the north and east. Lindo Channel and Mud Creek. Failure of these structures could flood portions of the City of Chico.

Floodwaters from Little Chico Creek to the south are also diverted away from the City of Chico into Butte Creek by a diversion structure. While these streams rise rapidly and generally flow high for a limited duration, a prolonged storm event could potentially create an extended flow situation which would greatly increase the flood threat on this system. Figure 8-2 shows an overview of the Big Chico Creek system, and Figure 8-3 shows an overview of the Little Chico Creek System.

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Figure 8-2. Overview of the Big Chico Creek Levee System

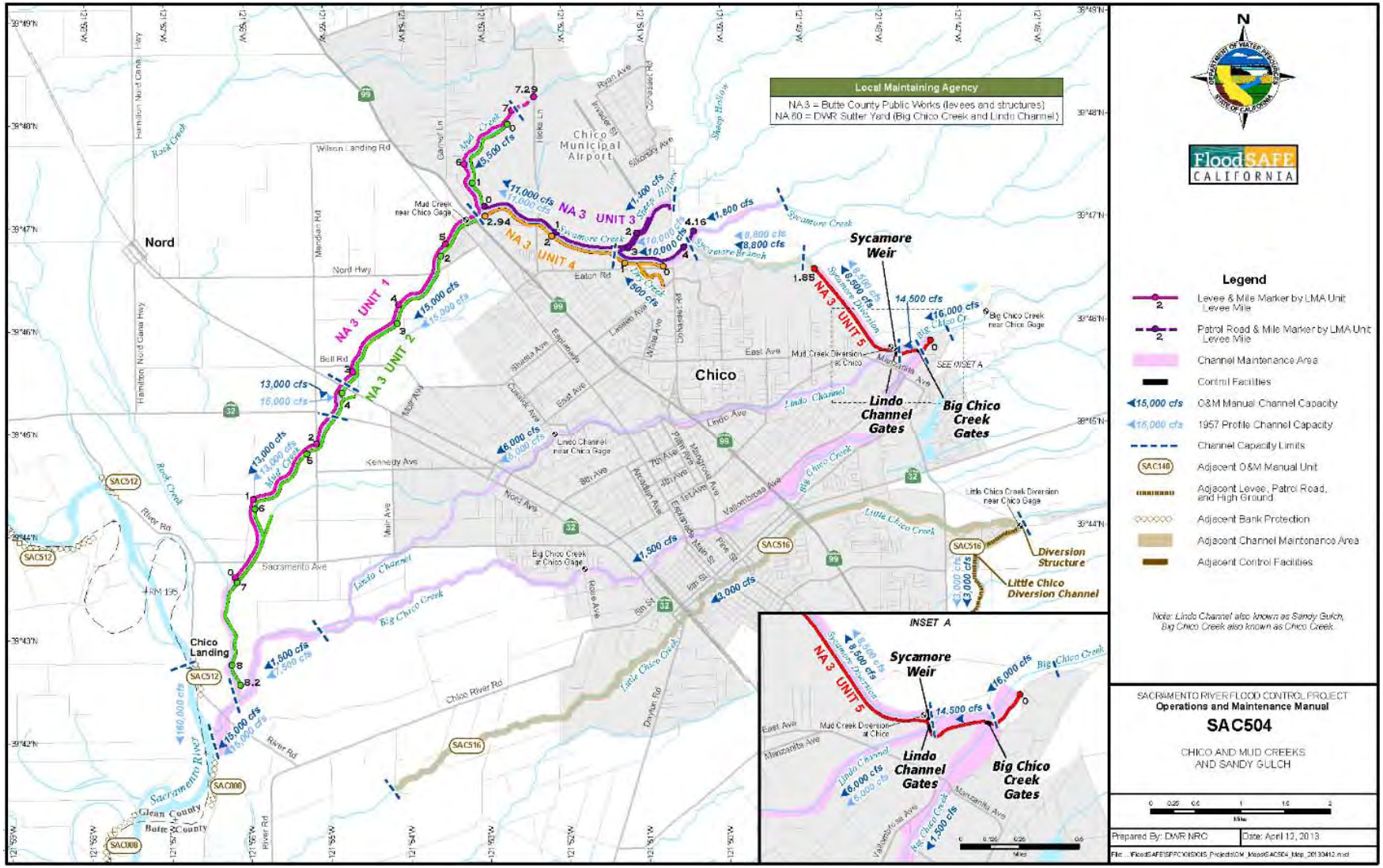
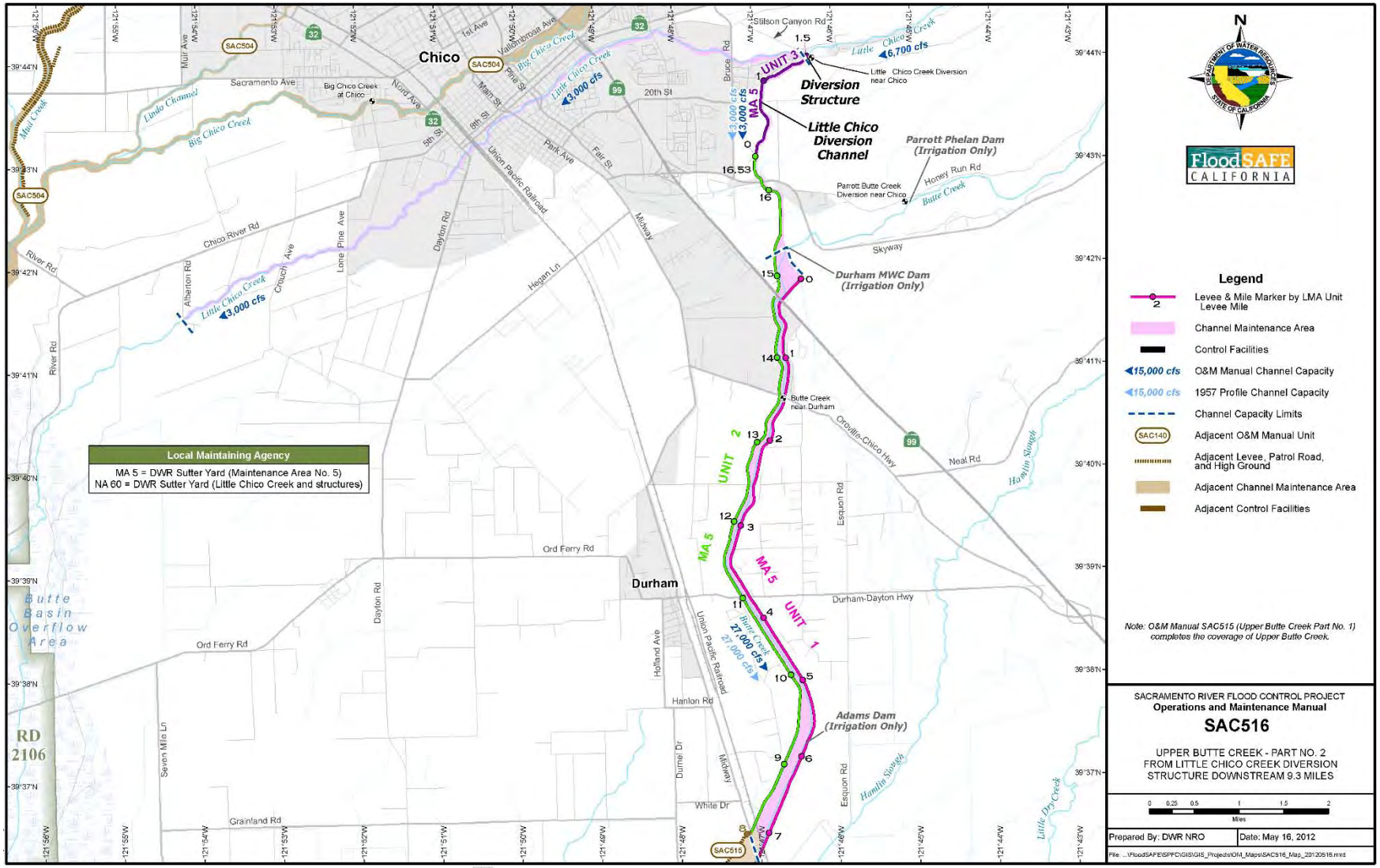


Figure 8-3. Overview of the Little Chico Creek Levee System



8.4. Levee Standards, Urban Criteria, and Ongoing Evaluations

Standards for the design, construction, and management of levees have evolved over time, often in response to structural failures during floods. SPFC levees have been constructed through the individual and combined efforts of local, State, and federal agencies. The facilities were constructed with materials at hand over many decades, to meet evolving design standards and using construction techniques. As a result, these facilities provide varying levels of protection, depending on when and how they were constructed and upgraded.

8.4.1. *USACE Levee Standards*

In 2005, Hurricane Katrina caused widespread flooding and devastation along the Gulf Coast, most notably the flooding of much of New Orleans. As a result, USACE launched a multi-pronged effort to improve levee management nationwide, including the creation of a national levee database, risk notification procedures, and more stringent enforcement of its levee standards. USACE has also stepped up enforcement of other standards for various aspects of levee integrity, including encroachments, penetrations, erosion protection, patrol roads, and structural cross sections.

Levees that are deemed noncompliant with current USACE standards risk being classified as inactive in the federal Rehabilitation and Inspection Program (RIP), which would make the levees ineligible for PL 84-99 rehabilitation assistance in the event of damage or failure during a flood. In addition, in many cases FEMA has based its National Flood Insurance Rate Maps (FIRM) hazard classification upon USACE determinations or certifications of levee integrity and channel capacity. When USACE downgrades levee structural ratings within its evolving standards, re-mapping by FEMA is a likely outcome.

8.4.2. *FEMA Standards and Accreditation*

When FEMA's National Flood Insurance Program (NFIP) was first established in 1968, areas protected by USACE levees were presumed to meet 100-year criteria. As a result, most of the floodplains in the Chico Urban Area protected by the levees of the State Plan of Flood Control were mapped with 100-year ratings on FEMA's Flood Insurance Rate Maps (FIRMs). In 2005, FEMA issued Procedure Memorandum 34 (PM 34), which fundamentally reversed the historic presumption regarding USACE levee systems by requiring the agencies responsible for levees to demonstrate and document the integrity of their levee systems.

Recognizing that in many cases responsible agencies would need to conduct extensive field work, hydraulic and hydrologic studies, and geotechnical and engineering analyses in order to demonstrate that their levees met FEMA's certification criteria, FEMA issued PM 43 in 2007. Procedure Memorandum 43 permits FEMA to issue preliminary and effective FIRMS with Provisionally Accredited Levees (PALs) if the responsible agencies believe that their systems meet 100-year criteria, but cannot provide adequate supporting documentation. The PAL

designation provides the responsible agencies 24 months to gather and provide the necessary documentation.

The City of Chico and Butte County recently utilized the PAL process to recertify the following levees as meeting FEMA criteria. The FEMA accreditation package was submitted in January of 2011 and approved in May of 2011. The accredited levees include:

- Diversion Channel and Sycamore Creek east of Cohasset Road
- Sycamore Creek West of Cohasset Road to it confluence with Mud Creek
- Mud Creek from high ground downstream to State Highway 32

8.4.3. *State Levee Standards and Urban Levee Design Criteria*

Prior to 2008, the State primarily relied on USACE levee design, construction, operation, and management standards. Its historic role in the region included cost sharing in the construction of Project levees, providing Lands, Easements, Real Estate, Relocations (LERRDs), borrow materials, and disposal sites, and certifying that that the State, through the CVFPB, would take responsibility for Operation, Maintenance, Repair, and Rehabilitation (OMRR).

With the enactment of the 2007 California Flood Legislation however, the State's role in establishing levee standards was expanded. DWR led the developed of the new levee standards for urban areas called the Urban Levee Design Criteria (ULDC, May 2012), which describes the levee and floodwall design criteria which flood control facilities protecting urban levees must now meet.

The ULDC provides engineering criteria and guidance for the design, evaluation, operation and maintenance of levees and floodwalls that provide an urban level of flood protection, as well as determining design water surface elevations along leveed and unleveed streams. Other topics are presented to provide reasonable assurance that once a levee or floodwall is found to provide an urban level of flood protection, it will continue to do so. The ULDC is very comprehensive and more stringent than current practice for levee design and accreditation. Some of the key features are as follows:

- Periodic review by a civil engineer at least every 5 years of the urban level of flood protection
- For frequently loaded levees, more stringent requirement that include seepage control and crack-stopping features like those commonly included in earthen dams of similar height; and seismic stability sufficient to maintain the integrity of the levee and its internal structures without significant deformation.
- For intermittently loaded levees, post-earthquake remediation plan must address 200-year return period ground motions at a minimum. The plan most address the amount and extent of damage and the general magnitude of earth and other materials that would be required to restore flood protection against the 10-year flood within 8 weeks.
- Expanding the fee title/easement area beyond the levee landside toe from 10 to 20 feet.
- Additional right-of-way for a future needs area that has a width equal to four times the levee height or 50 feet, whichever is greater, on the landside of the 20-foot clear zone.

- Cities and counties should adopt aggressive setback criteria that keep permanent structures 70 to 400 feet beyond the future needs area, depending on the height of the levees, future plans for the levee system, and other site-specific conditions.
- Cities and counties should adopt restrictions on excavations within 400 feet of levees greater than 15 feet in height and within 200 feet for levees less than 15 feet in height.
- Civil engineer needs to assess existing encroachments and penetrations and render an opinion as to their impact on the reliable performance of the levee/floodwall.
- At minimum of 5-year intervals, the interiors of all pipe and culvert penetrations need to be visually inspected and/or pressure tested.
- An engineering inspection and evaluation shall be conducted to identify trees and other woody vegetation on the levee and within 15 feet of the levee toe.
- A security plan is required to protect urban and urbanizing area levee systems from acts of terrorism and other malicious or negligent acts.

The ULDC was developed through a collaborative stakeholder involvement process with representatives from cities, counties, flood agencies, and State and Federal agencies. The Chico Urban Area levee systems have not yet been evaluated to determine if they meet the ULDC.

8.4.4. *Urban Level of Protection Criteria*

As discussed earlier, cities and counties (local agencies) located within the Sacramento-San Joaquin Valley are subject to additional requirements as a result of the 2007 California Flood Legislation. In October 2013, DWR published criteria called the "Urban Level of Flood Protection Criteria" (ULOP), for cities and counties to follow when making findings regarding 200-Year level of flood protection for new development as required by the 2007 law. Specific sections of that law require local agencies to complete the following two planning actions:

Planning Action 1:
Amend the General Plan by July 1, 2015 to include data and analysis contained within the Central Valley Flood Protection Plan (CVFPP). The amendment should include the locations of facilities of the State Plan of Flood Control, and other flood management facilities, locations of real property protected by those facilities, and the locations of flood hazard zones.

Planning Action 2:
Amend the Zoning Ordinance by July 1, 2016 so that it is consistent with the General Plan, as amended.

Once these planning actions are taken, SB5 limits the authority of local agencies to grant the following three entitlements unless certain conditions are met:

Limit 1:
Cannot enter into a development agreement for any property; or

Limit 2:
Cannot approve any discretionary permit or other discretionary entitlement (for residential, commercial or industrial property) or any ministerial permit that would result in construction of a new residence; or

Limit 3:
Cannot approve any tentative map, or a parcel map for which a tentative map was not required, or any subdivision that is located within a flood hazard zone.

If the local agency wishes to take any of these three actions, it must first make, based on substantial evidence in the record, one of the following findings:

Finding 1:
The facilities of the State Plan of Flood Control or other flood management facilities protect the property, project, or subdivision to the ULOP 200-year flood protection; or

Finding 2:
The local agency has imposed conditions on the development agreement, permit or discretionary entitlement, or subdivision, whichever is applicable, that will provide protect the property, project, or subdivision with ULOP 200-year flood protection; or

Finding 3:
The local flood management/levee maintaining agency has made adequate progress on the construction of a flood protection system which will result in flood protection equal to or greater than the ULOP 200-year flood protection for property, project or subdivision located within a flood hazard zone, intended to be protected by the system. The ULOP 200-year flood protection shall be achieved by 2025.

Finding 1 requires that the area has already achieved ULOP 200-year flood protection. Finding 2 allows approvals, but not construction of structures; not a practical solution for most urban areas since development construction quickly follows land use approvals. Finding 3, which measures adequate progress toward construction and ultimate completion of ULOP 200-year flood protection, will therefore be relevant to most urban areas as few have 200-Year levels of protection already in place.

According to SB5, adequate progress means all of the following:

Progress 1:
The total project scope, schedule and cost of the completed flood protection system have been developed to meet the appropriate standard of protection, and

Progress 2A:
Revenues that are sufficient to fund each year of the project schedule developed in Progress 1 have been identified and, in any given year and consistent with that schedule, at least 90 percent of the revenues scheduled to have been received by that year have been appropriated and are currently expended, and

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Progress 2B:
Notwithstanding Progress 2A, for any year in which State funding is not appropriated consistent with an agreement between a state agency and a local flood management agency, the Central Valley Flood Protection Board may find that the local flood management agency is making adequate progress in working toward the completion of the flood protection system, and

Progress 3:
Critical features of the flood protection system are under construction, and each critical feature is progressing as indicated by the actual expenditure of the construction budget funds, and

Progress 4:
The local agency has not been responsible for a significant delay in the completion of the system, and

Progress 5:
The local flood management agency provides the Department of Water Resources and the Central Valley Flood Protection Board with the information specified in this subdivision sufficient to determine substantial completion of the required flood protection. The local flood management agency annually reports to the Central Valley Flood Protection Board on the efforts in working toward completion of the flood protection system.

8.4.5. *DWR's Urban Levee Evaluation Program*

As part of the Urban Levee Evaluation (ULE) program, DWR is conducting geotechnical exploration, testing, and analysis of state and federal levees that protect the highly populated urban areas. Technical specialists are also reviewing existing levee historical data; mapping near-surface geology; conducting field explorations; performing engineering, stability and seepage analyses; and preparing preliminary design and construction estimates for repairing and upgrading the levees, where needed.

For the Chico urban area, the ULE program is evaluating 5.5 miles of levees, which are directly adjacent to the City of Chico (the Diversion Canal, Mud, Sycamore and Dry Creeks). The ULE program will be releasing a draft Geotechnical Evaluation Report (GER) in 2014 that will present the results of the geotechnical analyses for existing conditions for freeboard, erosion, seepage, stability, rapid drawdown, and seismic vulnerability. The GER will also further evaluate the segments identified as not meeting Urban Levee Design Criteria. Two remedial alternatives will be selected and analyzed in order to better define the repairs and costs which are needed to bring the deficient segments in compliance ULDC criteria. Appendix B summarizes the ULE information that has been developed for levee segments protecting the Chico Urban area.

<<Note to Reviewer: Additional ULE information will be incorporated into future drafts as it becomes available in order to help develop potential system enhancements for the Chico system.>>

8.4.6. *DWR's 200-Year Floodplain Mapping*

In 2012, SB 1278 amended the 2007 California Flood Legislation to require DWR to provide urban areas with 200-Year floodplain maps. DWR provided what they termed "informational maps" in July 2013 for the City of Chico depicting the resultant 200-Year floodplain from failure of SPFC levees. The maps were developed using DWR hydraulic models developed as part of the Central Valley Floodplain Evaluation and Delineation Program (CVFED) and levee geotechnical information derived in part from the Urban Levee Evaluation program. The maps were 'clipped' to depict the extent of flooding within the sphere of influence only, and only account for sources of flooding associated with SPFC levees protecting the urban area.

The SB 1278 200-year maps do not:

- Provide all of the information needed for the Chico Urban Area to make ULOP findings.
- Represent the most likely floodplain
- Relate to FEMA NFIP regulatory maps or the FEMA levee accreditation process
- Account for other sources of flooding (non-SPFC levees or local/interior drainage)

Therefore, the maps may need to be substantially refined for use in making ULOP findings for the Chico Urban Area.

8.5. Issues

<<Note to Reviewer: Conducting detailed hydrologic and hydraulic analyses to identify and analyze system deficiencies is beyond the scope of the MUSR RFPM. However, DWR is currently performing analyses which are expected to help better understand the hydraulic limitations of the Big Chico Creek flood control system. DWR Northern Region Office is developing updated hydraulic models to be used to assess maintenance needs and priorities for the Chico system, including analyses for the 100-Year and 200-Year flood events using updated system hydrology and hydraulics. This information was not available for inclusion in this Working Draft version of the MUSR RFMP but will be incorporated into future drafts as it becomes available>>.

8.5.1. *Big Chico Creek Diversion Structure*

The Big Chico Creek Diversion Structure was originally constructed in 1965. Since construction, sedimentation and gravel deposits have consistently been an issue. Historically, these deposits were regularly removed after high water events through agreements with local contractors. However, these efforts have not occurred for quite some time and deposits have accumulated to the point where the diversion weir is no visible. The O&M Manual even makes reference to a 'notch in the weir', which is no longer visible.

Gravel and sediment deposits at the diversion pose a serious threat to the City of Chico. The deposits limit the volume of water which gets diverted into the diversion channel, which in turn forces more water through the Big Chico Creek gates and down through the heart of the City.

Downstream of the gates, Big Chico runs adjacent to residential neighborhoods, downtown, and the University.

8.5.2. *Capacity Deficiencies*

<< Under Development >>

8.5.3. *Lindo Channel*

<< Under Development >>

8.5.4. *Sycamore and Mud Creek*

Mud Creek suffers from both sediment and vegetation buildup. In recent years, significant erosion has occurred on the bed and bank on the lower reaches of Sycamore Creek, both directly at and just below its confluence with the Diversion Channel from Big Chico Creek. The channel, before the addition of floodwaters, was a relatively small stream with no significant scour holes or erosion in the underlying geologic structure. Scour and erosion is evident in an originally buried sewer pipe being exposed and scour at several bridges downstream of Cohasset Road. All such erosion is taking place in the areas of Mud Creek and its tributary Sycamore Creek. With the relatively narrow levees along Mud Creek, sediment carried by the stream has no place to go besides settle in the bottom of the flood control channel.

8.5.5. *Little Chico Creek*

The Little Chico Creek Diversion Channel was not designed to provide an urban level of protection. The channel primarily suffers from the buildup of unwanted (non-native) vegetation. It is believed that sedimentation is not a major issue.

8.6. Potential Enhancements

8.6.1. *ULOP 200-year Strategic Plan*

<< Under Development >>

8.6.2. *Sediment Removal at Big Chico Creek Diversion*

<< Under Development >>

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8.6.3. *Lindo Channel Improvements*

<< Under Development >>

8.6.4. *Enhanced Channel Maintenance Program*

<< Under Development >>

8.6.5. *Sycamore Creek Grade Control Structures*

<< Under Development >>

8.6.6. *Sheep Hollow Off-Stream Storage Area*

<< Under Development >>

8.6.7. *Dry Creek Detention Facility*

<< Under Development >>

8.6.8. *Mud Creek UPRR Bridge Crossing Improvements*

<< Under Development >>

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9. Levee Maintaining Agency Projects

<<Note to Reviewer: The data compiled in this chapter of the Working Draft is preliminary and is still under review by local LMAs. It is the intent of this Working Draft to solicit additional input and feedback on the identified deficiencies and to identify proposed solutions.>

9.1. Overview

This chapter summarizes the known deficiencies identified for each local levee maintaining agency (LMA) within the Regions. Note that although the focus of the 2012 CVFPP and DWR's BWFS is State Plan of Flood Control (SPFC) facilities, the non-SPFC facilities operated and maintained by Rock Creek Reclamation District, Reclamation District 2140, and the Colusa Basin Drainage District play an important role in the Regions' flood control system, and therefore their projects have also been included in this chapter. The potential projects to be described in this chapter will be assessed and prioritized in coordination with stakeholders as described later in this document.

The deficiencies included in the RFMP have been developed from existing information including:

- Locally provided information and studies;
- DWR and USACE Levee Inspection Reports;
- DWR Flood System Repair Project Information; and
- DWR NULE and ULE Information.

<< Note to Reviewer: Some of the deficiencies identified in this Working Draft may have already been corrected by the LMA after the DWR and USACE Levee Inspection Reports were first published. >>

This chapter contains a number of tables detailing known levee deficiencies. The acronyms and abbreviations contained in the tables are explained below:

Hazard Level A. When water reaches the assessment water surface elevation, 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 water surface elevation, 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 water surface elevation, there is a high likelihood of either levee failure or the need to flood-fight to prevent levee failure.

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A – Acceptable. All inspection items are rated as acceptable.

M – Minimally Acceptable. One or more inspection items are rated as Minimally Acceptable or one or more items are rated as Unacceptable and an engineering determination concludes that the Unacceptable inspection items would not prevent the segment/system from performing as intended during the next flood event.

U – Unacceptable. One or more inspection items are rated as Unacceptable and would prevent the segment/system from performing as intended, or a serious deficiency noted in past inspections (previous Unacceptable items in a Minimally Acceptable overall rating) has not been corrected within the established timeframe, not to exceed two years.

LD - Lacking Sufficient Data. The levee segment is currently lacking sufficient data about past performance or hazard indicators to be able to assign a hazard level, or there is poor correlation between past performance and hazard indicators. Category LD may be further divided into subcategories, like LD(A) or LD(B or C), to indicate how the segment could be assessed when additional data is gathered and analyzed.

NA - Not Assessed

Assessment Water Level - Water level used for freeboard and structural evaluation of levee segments. It is either the 1957 water surface profile or a level 3 feet below the existing crest if 1957 water surface profile is not defined for the segment.

Note that in addition to the geotechnical failure modes, freeboard and geometry deficiencies were also assessed as either meeting or not meeting applicable criteria, but no hazard level category was assigned.

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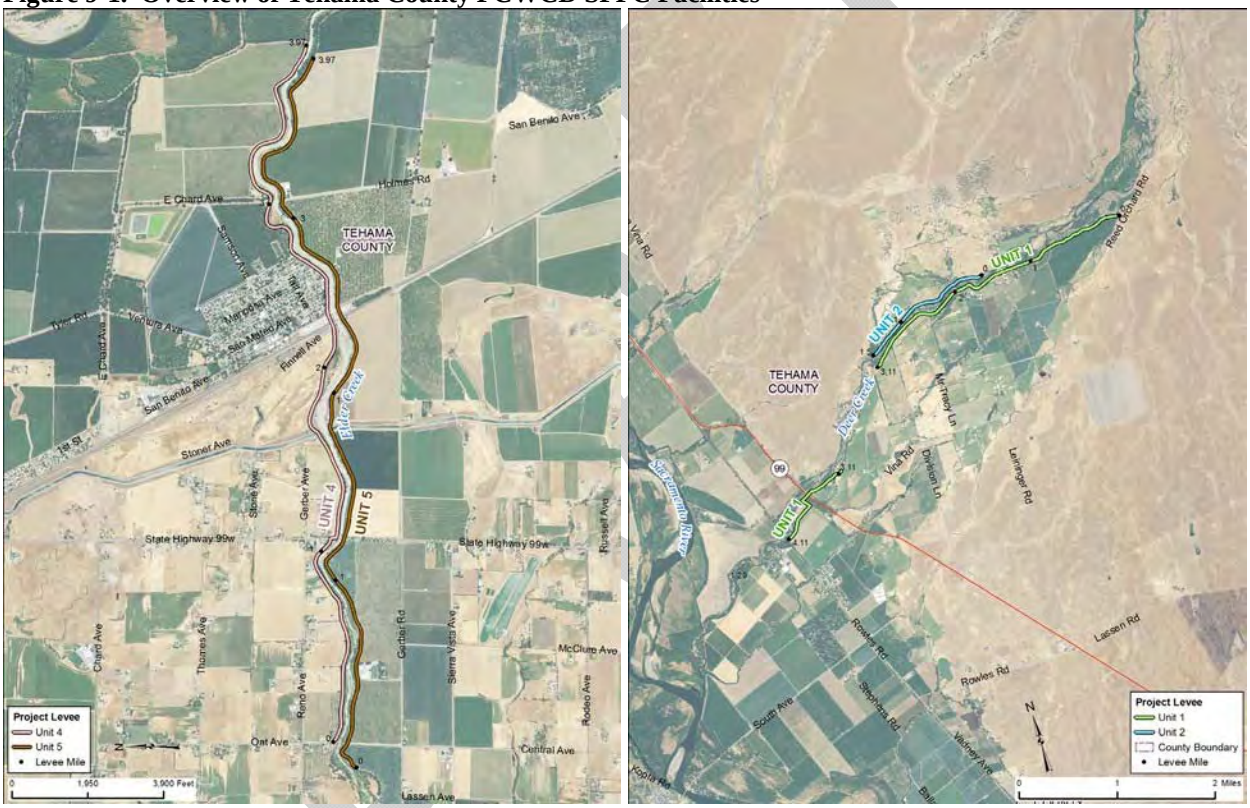
9.2. Tehama County Flood Control and Water Conservation District

Tehama County Flood Control & Water Conservation District (FCWCD) was originally established in 1957 by the Tehama County Flood Control and Water Conservation District Act. This Act defined the boundary and territory of the District as follows: "all that territory of the County of Tehama lying within the exterior boundaries thereof." In the context of this RFMP, Tehama County FCWCD is responsible for the maintenance of approximately 13.6 miles of SPFC levees along Deer Creek and Elder Creek. The Deer Creek levees primarily protect rural agricultural lands in addition to the rural area of Vina. Elder Creek levees protect the small community of Gerber in addition to rural agricultural areas.

Figure 9-1. Overview of Tehama County FCWCD SPFC Facilities



Based on an initial assessment of flood threats and local input, the high priority goals for the District include:

- Address identified deficiencies to achieve 'Active' status in the USACE RIP and regain PL84-99 compliance for Elder Creek levees.
- Remove excess vegetation that significantly impacts access, visibility and channel conveyance.

The following tables summarize the existing known levee deficiencies.

Table 9-1. DWR Overall Maintenance Area Rating

LMA Short Name	Area Name	Overall Rating						
		2007	2008	2009	2010	2011	2012	2013
NA0019	Tehama County Flood Control and Water Conservation District	U	M	M	A	M	M	M

Table 9-2. Summary of Tehama County FCWCD Levee Units

Unit	Bank	Length (Miles)
Unit No. 01	Deer Creek LB	4.11
Unit No. 02	Deer Creek RB	1.50
Unit No. 04	Elder Creek LB	4.07
Unit No. 05	Elder Creek RB	3.96

Table 9-3. DWR Levee Inspection Summary for Tehama County FCWCD

NA0019	Total LMA Miles	**13.64**											
	Fall 2012				**Fall 2013**				**Change**			
	Overall LMA Rating		**M**		Overall LMA Rating		**M**					
Rated Item	M	U	M+4U Miles	Thresh. %	M	U	M+4U Miles	Thresh. %	M	U	M+4U Miles	Thresh. %
Earthen Levee												
Vegetation	1.40		1.40	**10.26**	1.40		1.40	**10.26**				**0.00**
Encroachments	0.09		0.09	**0.66**	0.08		0.08	**0.59**	-0.01		-0.01	**-0.07**
Animal Control	0.03		0.03	**0.22**	0.07		0.07	**0.51**	0.04		0.04	**0.29**
Slope Stability	0.31		0.31	**2.27**	0.33		0.33	**2.42**	0.02		0.02	**0.15**
Erosion / Bank Caving	0.01		0.01	**0.07**	0.04		0.04	**0.29**	0.03		0.03	**0.22**
Supplemental												
USACE Erosion Survey	0.16		0.16	**1.17**	0.16		0.16	**1.17**				**0.00**
LMA Totals:	2.00	0.00	2.00	**14.66**	2.08	0.00	2.08	**15.25**	0.08	0.00	0.08	**0.59**

Table 9-4. DWR Channel Inspection Summary for Tehama County FCWCD

Channel Name	Overall Rating
McClure Creek	A
Salt Creek	A

Table 9-5. USACE 2012 Sacramento River Erosion Summary for Tehama County FCWCD

Site ID	River Mile	Levee Mile Start	Levee Mile End	Status	Rating
Unit No. 1 Deer Creek LB: DEC_2-4_L	0.00	2.98	3.00	eroding	M
Unit No. 2 Deer Creek RB: DEC_0-9_R	0.00	0.86	0.91	eroding	M
Unit No. 4 Elder Creek LB: ELC_1-4_L	0.00	1.44	1.51	eroding	M
Unit No. 5 Elder Creek RB: ELC_3-0_R	0.00	3.08	3.10	eroding	M

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Table 9-6. USACE Inspection Rating Summary

System Name	Length (Miles)	RIP Status	RIP Date	Rating
Deer Creek left bank, Unit 1 east - Tehama County	3.09	Active	N/A	N/A
Deer Creek left bank, Unit 1 west - Tehama County	1.14	Active	N/A	N/A
Deer Creek right bank, Unit 2 - Tehama County	1.45	Active	N/A	N/A
Elder Creek left bank, Unit 4 - Gerber levee	4.64	Inactive	09/30/2012	U
Elder Creek left bank, Unit 4 east	0.83	Inactive	09/30/2012	U
Elder Creek right bank, Unit 5	3.86	Inactive	09/30/2012	U

Table 9-7. DWR Flood System Repair Project Summary

POI Number	Status	Failure Mode	Location Start	Location End	Bank
Unit N/A: Obsrv-131070	Serious	Erosion			Right
Unit N/A: 24-4	Serious	Stability	000+10 to SRGL-R		Right
Unit No. 1 Deer Creek: DWR_NA0019_01_s _ 2012_1	Serious	Erosion	2.98	3.00	Left
Unit No. 1 Deer Creek: 56-3	Serious	Erosion	3.64	3.66	Left
Unit No. 4 Elder Creek: DWR_NA0019_04_s _ 2012_9	Critical	Erosion	1.38	1.51	Left
Unit No. 5 Elder Creek: 59-10	Serious	Other	2.35		Right
Unit No. 5 Elder Creek: DWR_NA0019_05_R_2012_03	Critical	Other	2.56		Right
Unit No. 5 Elder Creek: 59-9	Serious	Other	2.65		Right

Table 9-8. Summary of NULE Results for Tehama County FCWCD

Segment	Description	Overall Categorization	Underseepage Categorization	Stability Categorization	Through Seepage Categorization	Erosion Categorization	Freeboard (Does segment meet Freeboard Criteria?)
24	Gerber Levee	C	B	A	C	B	Not Assessed
54	Deer Creek Unit 1b	C	LD	A	LD	C	Not Assessed
55	Deer Creek Unit 2	C	LD	A	A	C	Not Assessed
56	Deer Creek Unit 1a	C	A	A	A	C	Not Assessed
57	Elder Creek Unit 4a - Tehama County	B	LD	A	A	B	No
58	Elder Creek Unit 4b - Tehama County	B	LD	A	LD	B	No
59	Elder Creek Unit 5 - Tehama County	B	LD	A	LD	B	No

Table 9-9. Summary of the Flood Control Improvement Projects for Tehama County FCWCD

MUSR ID	Project Name	Project Description	Project Cost Amount ($)
		<< Under Development; See Table 11-1 >>	

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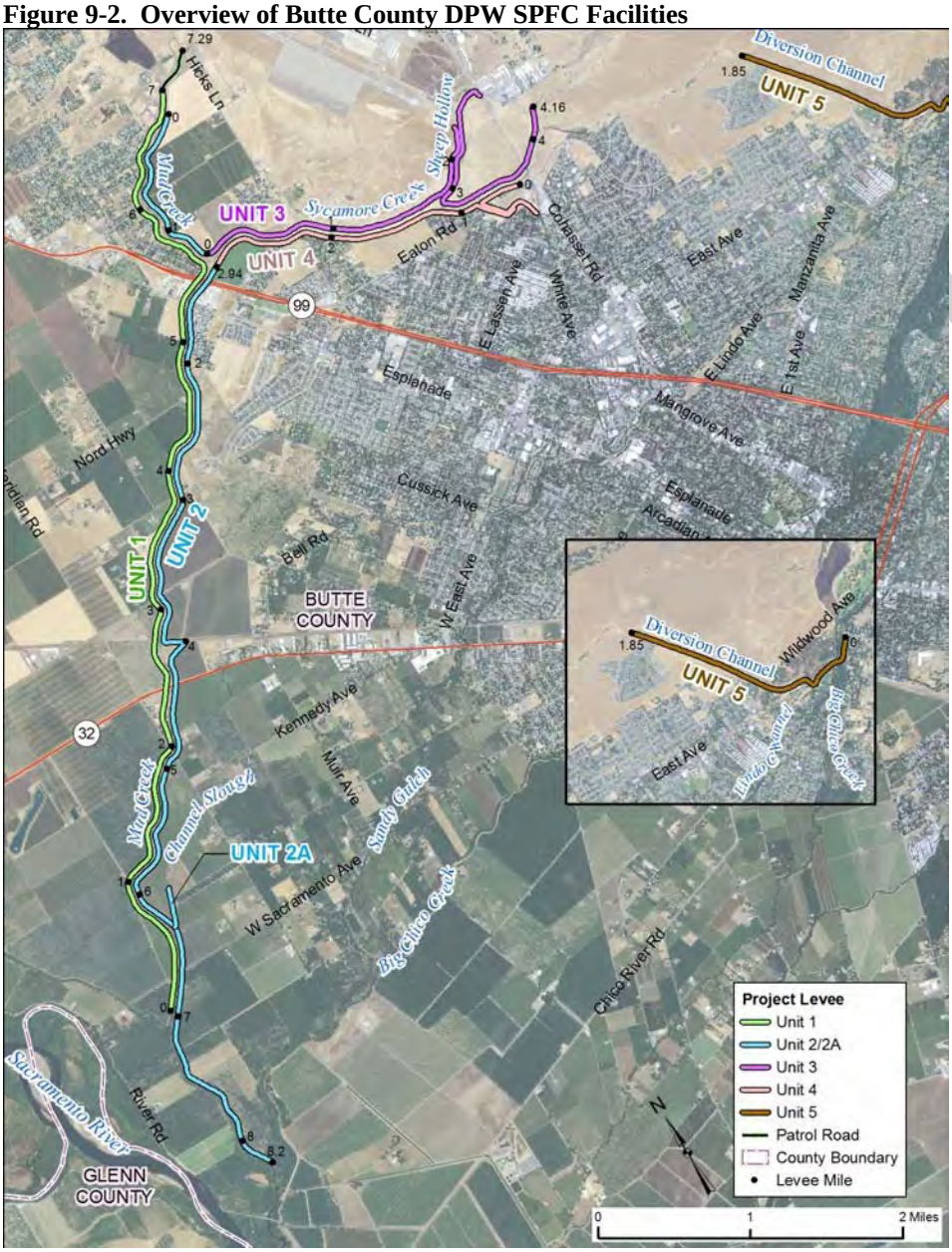
9.3. Butte County Department of Public Works

In the context of this RFMP, the Butte County Department of Public Works Department (DPW) maintains approximately 24.7 miles of SPFC levees along Mud Creek, Sycamore Creek, Sheep Hollow Creek, Dry Creek, and Big Chico Creek Diversion Channel. These levees protect the City of Chico and neighboring rural agricultural area.

Figure 9-2. Overview of Butte County DPW SPFC Facilities



Based on an initial assessment of flood threats and local input, the high priority goals for the District include:

- Address identified deficiencies to achieve 'Active' status in the USACE RIP and regain PL84-99 compliance for the Big Chico Creek-Mud Creek levee system.
- Repair identified erosion sites.

The following tables summarize the existing known levee deficiencies.

Table 9-10. DWR Overall Maintenance Area Rating

LMA Short Name	Area Name	Overall Rating						
		2007	2008	2009	2010	2011	2012	2013
NA0003	Butte County Department of Public Works	A	A	A	A	A	A	A

Table 9-11. Summary of Butte County Department of Public Works Levee Units

Unit	Bank	Length (Miles)
Unit No. 01 Mud Creek	RB	7.29
Unit No. 02 Mud Creek	LB	8.20
Unit No. 02A Channel Slough	LB	0.30
Unit No. 03 Sycamore and Sheep Hollow Creeks	RB	4.13
Unit No. 04 Sycamore and Dry Creeks	RB	2.94
Unit No. 05 Big Chico Diversion	LB	1.85

Table 9-12. DWR Levee Inspection Summary for Butte County Department of Public Works

NA0003	Total LMA	**24.71**											
	Fall 2012					**Fall 2013**					**Change**			
	Overall LMA		**A**			Overall LMA		**A**						
			M+4U	Thresh.				M+4U	Thresh.				M+4U	Thresh.
Rated Item	M	U	Miles	%		M	U	Miles	%		M	U	Miles	%
Earthen Levee														
Vegetation						0.08		0.08	**0.32**		0.08		0.08	**0.32**
Encroachments	0.05		0.05	**0.20**		0.05		0.05	**0.20**					**0.00**
Animal Control						0.01		0.01	**0.04**		0.01		0.01	**0.04**
Slope Stability	0.01		0.01	**0.04**		0.01		0.01	**0.04**					**0.00**
Supplemental														
USACE	0.05		0.05	**0.20**		0.05		0.05	**0.20**					**0.00**
LMA Totals:	0.11	0.00	0.11	**0.45**		0.20	0.00	0.20	**0.81**		0.09	0.00	0.09	**0.36**

Table 9-13. DWR Channel Inspection Summary for Butte County Department of Public Works

Channel Name	Overall Rating
No Channels Inspected in this District	

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Table 9-14. USACE 2012 Sacramento River Erosion Summary for Butte County Department of Public Works

Site ID	River Mile	Levee Mile Start	Levee Mile End	Status	Rating
MUD_4-4_R	0.00	4.32	4.37	eroding	M

Table 9-15. USACE Inspection Rating Summary

System Name	Length (Miles)	RIP Status	RIP Date	Rating
Chico Creek-Mud Creek - Unit 1	6.80	Inactive	09/30/2012	U
Chico Creek-Mud Creek - Unit 3 east, Sycamore right	1.87	Inactive	09/30/2012	U
Chico Creek-Mud Creek - Unit 4 east, Sycamore left	0.71	Inactive	09/30/2012	U
Chico Creek-Mud Creek - Unit 5, diversion levee	1.80	Inactive	09/30/2012	U
Chico Creek-Mud Creek - Units 2 north and 3	3.35	Inactive	09/30/2012	U
Chico Creek-Mud Creek - Units 2 south and 4	9.23	Inactive	09/30/2012	U

Table 9-16. DWR Flood System Repair Project Summary

POI Number	Status	Failure Mode	Location Start	Location End	Bank
USACE_CESPK_CM2A_2010_p_0075	Serious	Stability	5.73	6.05	Left

Table 9-17. Summary of NULE Results for Butte County Department of Public Works

Segment	Description	Overall Categorization	Underseepage Categorization	Stability Categorization	Through Seepage Categorization	Erosion Categorization	Freeboard (Does segment meet Freeboard Criteria?)
45 Reach 1	Chico-Mud Unit 1a	B	A	A	A	B	Yes
45 Reach 2	Chico-Mud Unit 1a	LD (A or B)	LD	A	LD	A	Not Assessed
47	Chico-Mud Unit 3a	LD (A or B)	LD	A	A	A	No
48 Reach 1	Chico-Mud Unit 3c	LD (A or B)	LD	A	A	A	Not Assessed
48 Reach 2	Chico-Mud Unit 3c	B	LD	A	A	B	No
269	Chico-Mud Unit 2a	LD (A or B)	LD	A	A	A	Not Assessed
379	Chico-Mud Unit 2b	A	A	A	A	A	No
1008	Non-Project Levee	B	A	A	A	B	Not Assessed
1010	Non-Project Levee	LD	LD	A	A	A	Not Assessed
1011	Non-Project Levee	B	A	A	A	B	Not Assessed
1014	Non-Project Levee	B	A	A	A	B	Not Assessed

Table 9-18 lists the specific flood control improvement projects for Butte County DPW.

Table 9-18. Summary of the Flood Control Improvement Projects for Butte County DPW

MUSR ID	Project Name	Project Description	Project Cost Amount ($)
		<< Under Development; See Table 11-1 >>	

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9.4. Lake County Watershed Protection District

The Lake County Watershed Protection District (WPD), was originally created as the Lake County Flood Control and Water Conservation District as a political subdivision of the State of California established under the Lake County Flood Control and Water Conservation Act, of the State Water Code in 1951. The District is administered by the Lake County Director of Water Resources who reports to the County Board of Supervisors, which acts as its Board of Directors.

The Watershed Protection District administers the National Flood Insurance Program for Lake County; plans and implements flood control projects including preliminary engineering and contract administration for Master Plans of Drainage, aerial photography, groundwater management planning, watershed management planning and development of grant proposals. The District is responsible for maintaining 10.5 miles of levees along Middle Creek, Scotts Creek, Alley Creek, Clover Creek, and the Clover Creek Diversion Channel. The District maintains 13.4 miles of creeks in four zones of benefit and a groundwater detention structure on Kelsey Creek. The District also operates and maintains the Adobe Creek Reservoir, the Highland Creek Reservoir, and the Highland Springs Park.

In the context of this RFMP, Lake County WPD maintains approximately 10.5 miles of SPFC levees as described above. This levee system protects the small community of Upper Lake, along with the neighboring rural agricultural areas.

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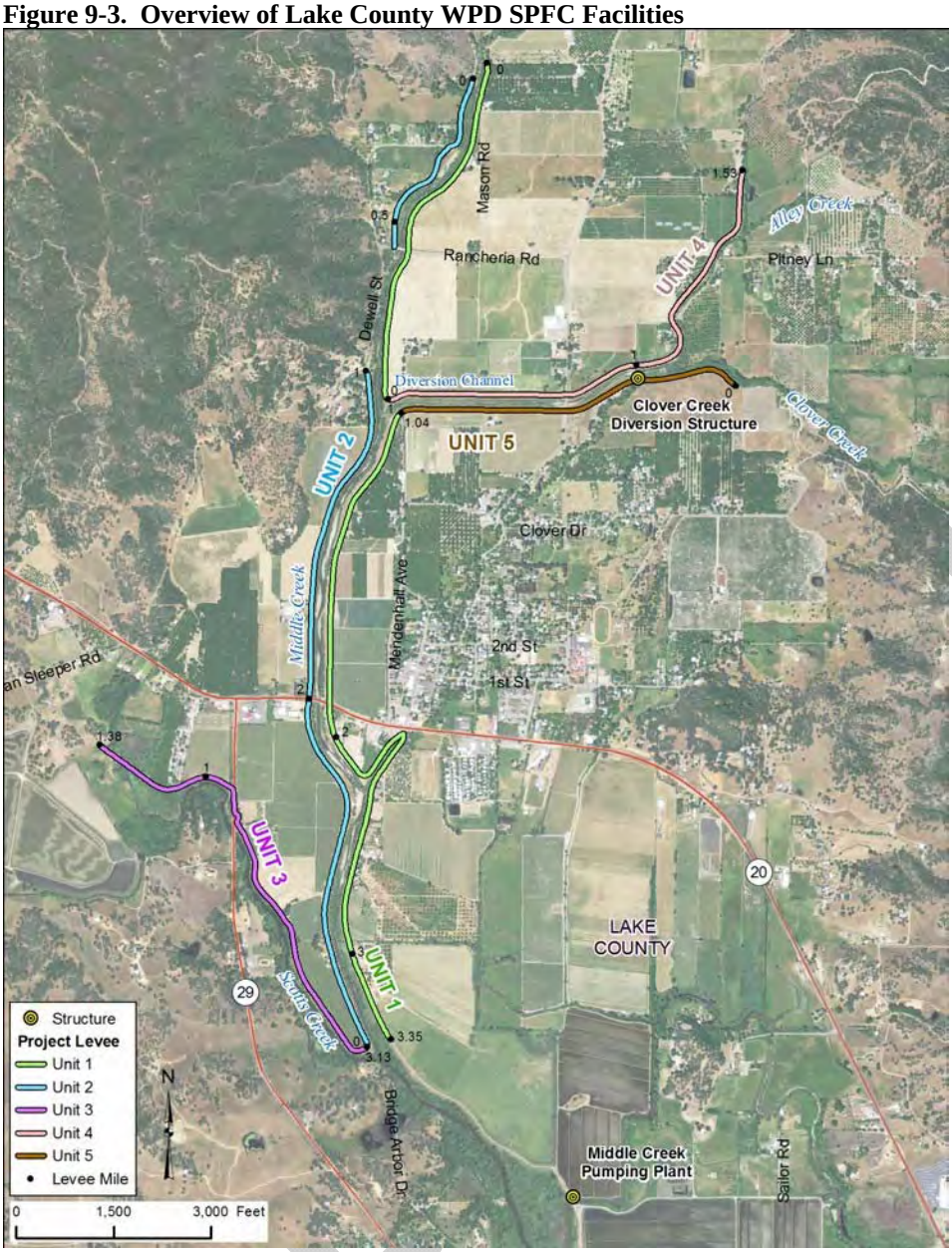
Figure 9-3. Overview of Lake County WPD SPFC Facilities



Based on an initial assessment of flood threats and local input, the high priority goals for the District include:

- Address identified deficiencies to achieve 'Active' status in the USACE RIP and regain PL84-99 compliance for the Middle Creek levee system.
- Continue with implementation of the Middle Creek Flood Relief and Restoration Project

The following tables summarize the existing known levee deficiencies.

Table 9-19. DWR Overall Maintenance Area Rating

LMA Short Name	Area Name	Overall Rating						
		2007	2008	2009	2010	2011	2012	2013
NA0009	Lake County Watershed Protection District	M	A	A	A†	A	A	A

Table 9-20. Summary of Lake County Watershed Protection District Levee Units

Unit	Bank	Length (Miles)
Unit No. 01 Middle Creek	LB	3.42
Unit No. 02 Middle Creek	RB	3.13
Unit No. 03 Scotts Creek	LB	1.35
Unit No. 04 Poge, Alley, and Clover Creek Diversion	RB	1.53
Unit No. 05 Clover Creek and Clover Creek Diversion	LB	1.04

Table 9-21. DWR Levee Inspection Summary for Lake County Watershed Protection District

NA0009	Total LMA	10.47											
	Fall 2012				Fall 2013				Change			
	Overall LMA		A		Overall LMA		A					
Rated Item	M	U	M+4U Miles	Thresh. %	M	U	M+4U Miles	Thresh. %	M	U	M+4U Miles	Thresh. %
Earthen Levee												
Vegetation	0.27		0.27	**2.58**	0.22		0.22	**2.10**	-0.05		-0.05	**-0.48**
Trim / Thin	0.13		0.13	**1.24**	0.34		0.34	**3.25**	0.21		0.21	**2.01**
Encroachments	0.01		0.01	**0.10**	0.01		0.01	**0.10**				**0.00**
Slope Stability	0.01		0.01	**0.10**	0.05		0.05	**0.48**	0.04		0.04	**0.38**
LMA Totals:	0.42	0.00	0.42	**4.01**	0.62	0.00	0.62	**5.92**	0.20	0.00	0.20	**1.91**

Table 9-22. DWR Channel Inspection Summary for Lake County Watershed Protection District

Channel Name	Overall Rating
No Channels Inspected in this District	N/A

Table 9-23. USACE 2012 Sacramento River Erosion Summary for Lake County Watershed Protection District

Site ID	River Mile	Levee Mile Start	Levee Mile End	Status	Rating
No Supplemental Erosion Sites	N/A	N/A	N/A	N/A	N/A

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Table 9-24. USACE Inspection Rating Summary

System Name	Length (Miles)	RIP Status	RIP Date	Rating
Middle Creek left bank - Unit 1 north	2.56	Inactive	03/05/2013	U
Middle Creek left bank - Unit 5 and part of 1	2.34	Inactive	03/05/2013	U
Middle Creek right bank - Unit 2	3.44	Inactive	03/05/2013	U
Middle Creek right bank - Unit 2 north	0.58	Active	03/07/2013	M

Table 9-25. DWR Flood System Repair Project Summary

POI Number	Status	Failure Mode	Location Start	Location End	Bank
No POI Repair Sites	N/A	N/A	N/A	N/A	N/A

Table 9-26. Summary of NULE Results for Lake County Watershed Protection District

Segment	Description	Overall Categorization	Underseepage Categorization	Stability Categorization	Through Seepage Categorization	Erosion Categorization	Freeboard (Does segment meet Freeboard Criteria?)
77	Middle Creek - Unit 2a	A	A	A	A	A	No
78	Middle Creek - Unit 1a	B	A	A	LD	B	No
79	Middle Creek - Unit 1b	LD (A or B)	LD	A	LD	A	No
80	Middle Creek - Unit 3 - Scotts Creek	LD (A or B)	LD	LD	LD	A	No
81 Reach 1	Middle Creek - Unit 1e	C	LD	LD	A	A	No
81 Reach 2	Middle Creek - Unit 1e	B	B	B	C	C	No
237	Middle Creek - Unit 4 Alley Creek-Channel	LD (A, B or C)	LD	A	LD	A	No
267	Middle Creek - Unit 5 Alley Creek-Channel	LD (A, B or C)	LD	A	LD	A	No
268	Middle Creek - Unit 3b Scotts Creek	LD (A or B)	LD	A	LD	A	No

Table 9-27 lists the specific flood control improvement projects for Lake County WPD.

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Table 9-27. Summary of the Flood Control Improvement Projects for Lake County WPD

MUSR ID	Project Name	Project Description	Project Cost Amount ($)
		<< Under Development; See Table 11-1 >>	

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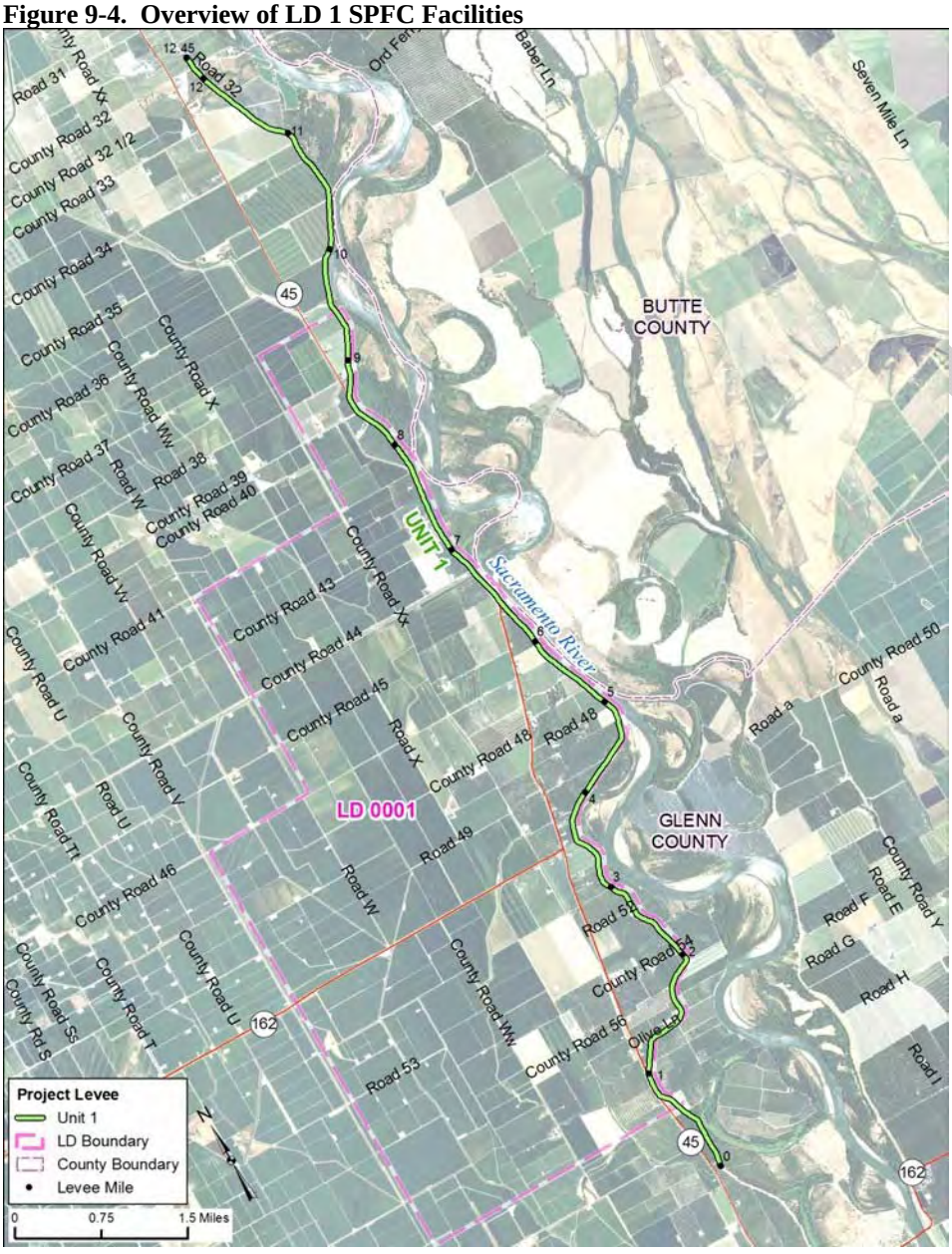
9.5. Levee District 1 (Glenn)

Levee District 1 (LD1) maintains 12.45 miles of SPFC levee along the right bank of the Sacramento River.

Figure 9-4. Overview of LD 1 SPFC Facilities



Based on an initial assessment of flood threats and local input, the high priority goals for the District include:

- Address identified deficiencies to achieve 'Active' status in the USACE RIP and regain PL84-99 compliance for the Sacramento River West Bank levee system.

The following tables summarize the existing known levee deficiencies.

Table 9-28. DWR Overall Maintenance Area Rating

LMA Short Name	Area Name	Overall						
		2007	2008	2009	2010	2011	2012	2013
LD0001G	Levee District No. 0001G (Glenn County)	U	M	M	U	M	A	A

Table 9-29. Summary of Levee District 1 (Glenn) Levee Units

Unit	Bank	Length (Miles)
Unit No. 1, Sacramento River	RB	12.45

Table 9-30. DWR Levee Inspection Summary for Levee District 1 (Glenn)

LD0001G	Total LMA	12.45											
	Fall 2012				Fall 2013				Change			
	Overall LMA		A		Overall LMA		A					
Rated Item	M	U	M+4U Miles	Thresh. %	M	U	M+4U Miles	Thresh. %	M	U	M+4U Miles	Thresh. %
Earthen Levee												
Vegetation	0.06		0.06	**0.48**	0.06		0.06	**0.48**				**0.00**
Trim / Thin	0.11		0.11	**0.88**	0.11		0.11	**0.88**				**0.00**
Encroachments	0.05		0.05	**0.40**	0.04		0.04	**0.32**	-0.01		-0.01	**-0.08**
Animal Control	0.23		0.23	**1.85**	0.15		0.15	**1.21**	-0.08		-0.08	**-0.64**
Slope Stability					0.01		0.01	**0.08**	0.01		0.01	**0.08**
Supplemental												
DWR UCIP												**0.00**
LMA Totals:	0.45	0.00	0.45	**3.61**	0.37	0.00	0.37	**2.97**	-0.08	0.00	-0.08	**-0.64**

Table 9-31. DWR Channel Inspection Summary for Levee District 1 (Glenn)

Channel Name	Overall Rating
No Channels Inspected in this District	N/A

Table 9-32. USACE 2012 Sacramento River Erosion Summary for Levee District 1 (Glenn)

Site ID	River Mile	Levee Mile Start	Levee Mile End	Status	Rating
No Supplemental Erosion Sites.	N/A	N/A	N/A	N/A	N/A

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Table 9-33. USACE Inspection Rating Summary

System Name	Length (Miles)	RIP Status	RIP Date	Rating
Sacramento River West Bank	119.72	Inactive	04/03/2013	U

Table 9-34. DWR Flood System Repair Project Summary

POI Number	Status	Failure Mode	Location Start	Location End	Bank
No POI Repair Sites	N/A	N/A	N/A	N/A	N/A

Table 9-35. Summary of NULE Results for Levee District 1 (Glenn)

Segment	Description	Overall Categorization	Underseepage Categorization	Stability Categorization	Through Seepage Categorization	Erosion Categorization	Freeboard (Does segment meet Freeboard Criteria?)
65	Levee District 1-Glenn, Sacramento River	B	B	A	LD	B	Yes

Below is a list of the specific flood control improvement projects for Levee District 1.

Table 9-36. Summary of the Flood Control Improvement Projects for Levee District 1

MUSR ID	Project Name	Project Description	Project Cost Amount ($)
		<< Under Development; See Table 11-1 >>	

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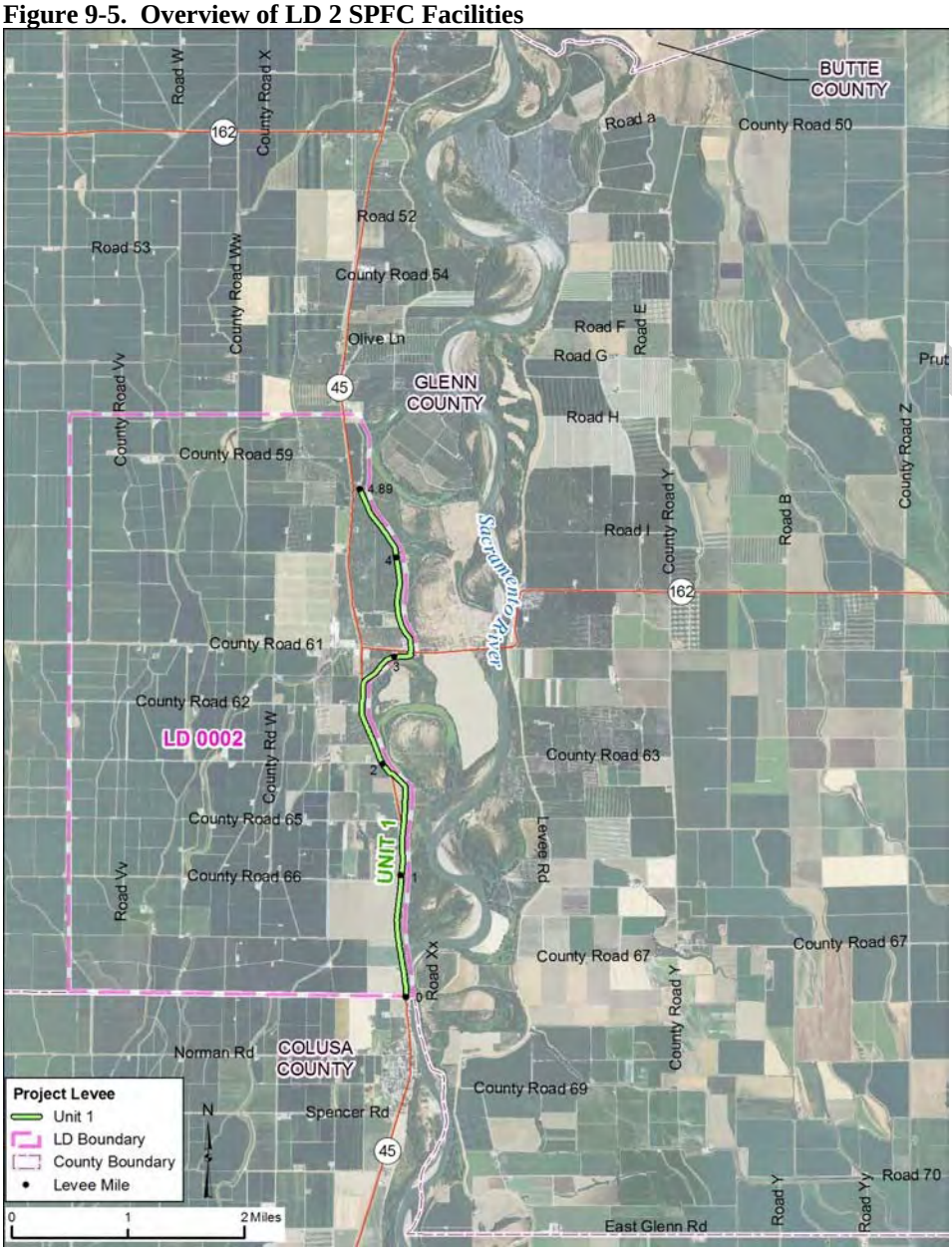
9.6. Levee District 2 (Glenn County)

Levee District 2 (LD 2) maintains 4.9 miles of SPFC levee along the right bank of the Sacramento River.

Figure 9-5. Overview of LD 2 SPFC Facilities



Based on an initial assessment of flood threats and local input, the high priority goals for the District include:

- Address identified deficiencies to achieve 'Active' status in the USACE RIP and regain PL84-99 compliance for the Sacramento River West Bank levee system.

The following tables summarize the existing known levee deficiencies.

Table 9-37. DWR Overall Maintenance Area Rating

LMA Short Name	Area Name	Overall						
		2007	2008	2009	2010	2011	2012	2013
LD0002	Levee District No. 0002	A	A	A	A	A	A	A

Table 9-38. Summary of Levee District 2 (Glenn County) Levee Units

Unit	Bank	Length (Miles)
Unit No. 1, Glenn County Sacramento River	RB	4.89

Table 9-39. DWR Levee Inspection Summary for Levee District 2 (Glenn County)

LD0002	Total LMA	4.89											
	Fall 2012					Fall 2013					Change			
	Overall LMA		A			Overall LMA		A						
			M+4U	Thresh.				M+4U	Thresh.				M+4U	Thresh.
Rated Item	M	U	Miles	%		M	U	Miles	%		M	U	Miles	%
Earthen Levee														
Animal Control	0.25		0.25	**5.11**		0.32		0.32	**6.54**		0.07		0.07	**1.43**
Slope Stability	0.01		0.01	**0.20**							-0.01		-0.01	**-0.20**
Supplemental														
USACE	0.01		0.01	**0.20**		0.01		0.01	**0.20**					**0.00**
DWR UCIP														**0.00**
LMA Totals:	0.27	0.00	0.27	**5.52**		0.33	0.00	0.33	**6.75**		0.06	0.00	0.06	**1.23**

Table 9-40. DWR Channel Inspection Summary for Levee District 2 (Glenn County)

Channel Name	Overall Rating
No Channels Inspected in this District	N/A

Table 9-41. USACE 2012 Sacramento River Erosion Summary for Levee District 2 (Glenn County)

Site ID	River Mile	Levee Mile Start	Levee Mile End	Status	Rating
SAC_164-7_R	164.70	0.08	0.08	eroding	M

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Table 9-42. USACE Inspection Rating Summary

System Name	Length (Miles)	RIP Status	RIP Date	Rating
Sacramento River West Bank	119.72	Inactive	04/03/2013	U

Table 9-43. DWR Flood System Repair Project Summary

POI Number	Status	Failure Mode	Location Start	Location End	Bank
DWR_LD0002_01_s _ 2012_6	Serious	Erosion	0.02	0.02	Right

Table 9-44. Summary of NULE Results for Levee District 2 (Glenn County)

Segment	Description	Overall Categorization	Underseepage Categorization	Stability Categorization	Through Seepage Categorization	Erosion Categorization	Freeboard (Does segment meet Freeboard Criteria?)
67	Levee District 2-Glenn, Sacramento River	B	B	A	LD	A	Yes

Below is a list of the specific flood control improvement projects for Levee District 2.

Table 9-45. Summary of the Flood Control Improvement Projects for Levee District 2

MUSR ID	Project Name	Project Description	Project Cost Amount ($)
		<< Under Development; See Table 11-1 >>	

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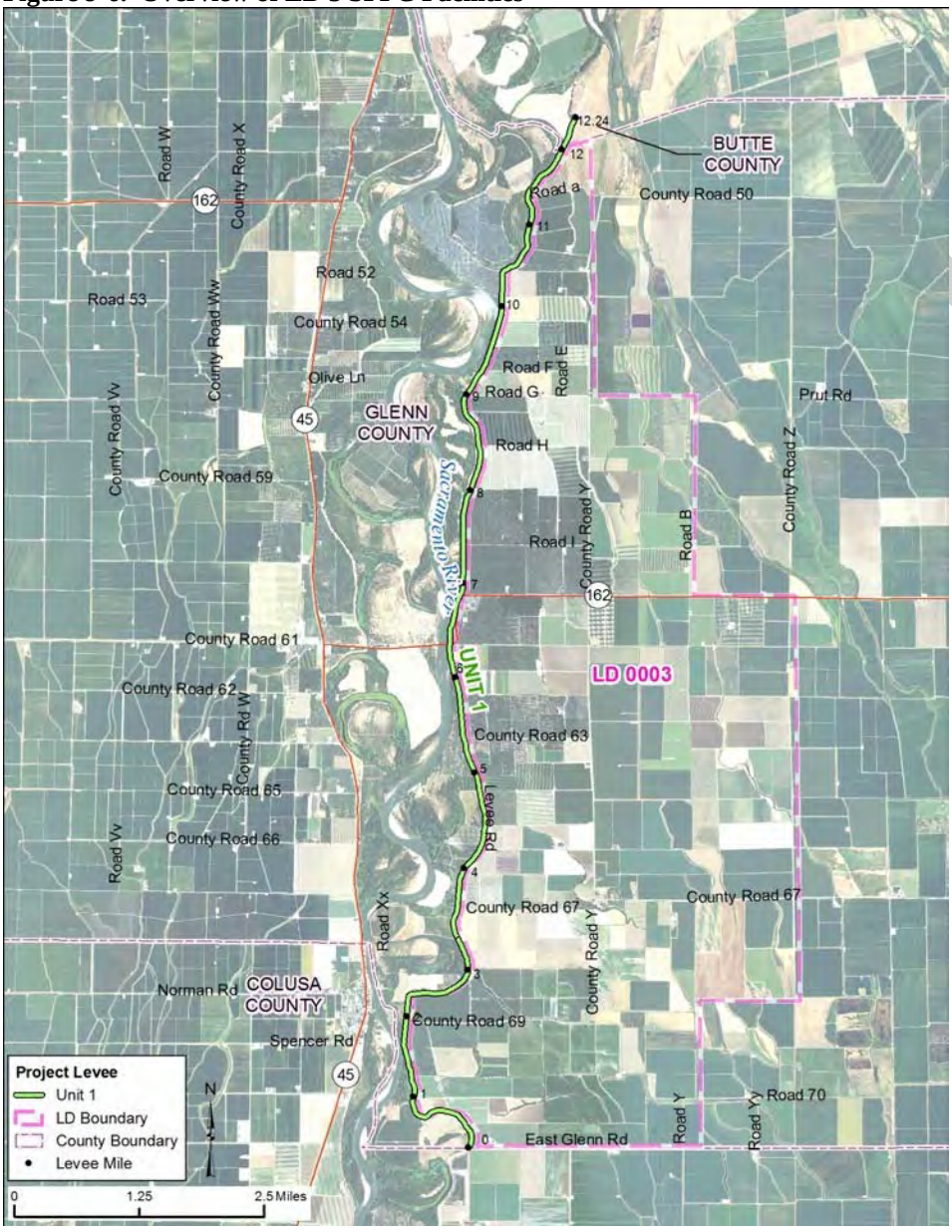
9.7. Levee District 3 (Glenn County)

Levee District 3 (LD 3) maintains 12.25 miles of SPFC levee along the left bank of the Sacramento River.

Figure 9-6. Overview of LD 3 SPFC Facilities



Based on an initial assessment of flood threats and local input, the high priority goals for the District include:

- Address identified deficiencies to achieve 'Active' status in the USACE RIP and regain PL84-99 compliance for the Sacramento River East levee system.
- Addressing critical erosion sites.
- Enhancing rodent control activity.

The following tables summarize the existing known levee deficiencies.

Table 9-46. DWR Overall Maintenance Area Rating

LMA Short Name	Area Name	Overall Rating						
		2007	2008	2009	2010	2011	2012	2013
LD0003	Levee District No. 0003	A	A	A	U	U	M	U

Table 9-47. Summary of Levee District 3 (Glenn County) Levee Units

Unit	Bank	Length (Miles)
Unit No. 1, Glenn County Sacramento River	LB	12.24

Table 9-48. DWR Levee Inspection Summary for Levee District 3 (Glenn County)

LD0003	Total LMA	**12.24**											
	Fall 2012					**Fall 2013**				**Change**			
	Overall LMA		**M**			Overall LMA		**U**					
Rated Item	M	U	M+4U Miles	Thresh. %		M	U	M+4U Miles	Thresh. %	M	U	M+4U Miles	Thresh. %
Earthen Levee													
Vegetation						0.01		0.01	**0.08**	0.01		0.01	**0.08**
Trim / Thin	0.19		0.19	**1.55**		0.19		0.19	**1.55**	0.00			**0.00**
Encroachments	0.20		0.20	**1.63**		0.21		0.21	**1.72**	0.01		0.01	**0.08**
Animal Control	1.79		1.79	**14.62**		1.94		1.94	**15.85**	0.15		0.15	**1.23**
Slope Stability	0.06		0.06	**0.49**		0.07		0.07	**0.57**	0.01		0.01	**0.08**
Supplemental													
USACE	0.03		0.03	**0.25**		0.03		0.03	**0.25**				**0.00**
DWR UCIP													**0.00**
LMA Totals:	2.27	0.00	2.27	**18.55**		2.45	0.00	2.45	**20.02**	0.18	0.00	0.18	**1.47**

Table 9-49. DWR Channel Inspection Summary for Levee District 3 (Glenn County)

Channel Name	Overall Rating
No Channels Inspected in this District	

Table 9-50. USACE 2012 Sacramento River Erosion Summary for Levee District 3 (Glenn County)

Site ID	River Mile	Levee Mile Start	Levee Mile End	Status	Rating
SAC_163-0_L	163.00	1.35	1.35	eroding	M
SAC_168-3_L	168.30	5.96	5.96	eroding	M
SAC_172-0_L	172.00	9.60	9.60	eroding	M

Table 9-51. USACE Inspection Rating Summary

System Name	Length (Miles)	RIP Status	RIP Date	Rating
Sacramento River East Levee - LD 3 Glenn County	38.36	Inactive	05/08/2013	U

Table 9-52. DWR Flood System Repair Project Summary

POI Number	Status	Failure Mode	Location Start	Location End	Bank
68-12	Serious	Erosion	11.25	11.25	Left
DWR_LD0003_01_s _ 2012_52	Critical	Erosion	9.60	9.87	Left
DWR_LD0003_01_s _ 2012_40	Critical	Erosion	9.88	9.88	Left

Table 9-53. Summary of NULE Results for Levee District 3 (Glenn County)

Segment	Description	Overall Categorization	Underseepage Categorization	Stability Categorization	Through Seepage Categorization	Erosion Categorization	Freeboard (Does segment meet Freeboard Criteria?)
68	Levee District 3-Glenn, Sacramento River (Glenn Co)	B	B	A	LD	B	Yes

Below is a list of the specific flood control improvement projects for Levee District 3.

Table 9-54. Summary of the Flood Control Improvement Projects for Levee District 3

MUSR ID	Project Name	Project Description	Project Cost Amount ($)
		<< Under Development; See Table 11-1 >>	

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9.8. Sacramento River West Side Levee District

In 1915 the Sacramento River West Side Levee District (SRWLD) was created by the legislature with the purpose of forming a flood protection district for the area bounded by the Sacramento River on the east, the Colusa Drain on the west, between Colusa in the north and Knights Landing in the south. The SRWLD operates in coordination with RD 108. RD 108 uses its personnel to perform the maintenance of the levees and is reimbursed by the SRWLD.

The Sacramento River West Side Levee District levee segments were initially built in the 1800s by local interests. A construction project to raise the levee began around 1915, and a second raise was completed in 1919. The levee crest elevation has remained essentially unchanged from the grade completed in 1919. Levees were completed to USACE's Project grade by 1940. Since the late 1930s, SRWLD levees have experienced multiple erosion events, sand boils, rodent activity, overtopping, multiple bank caving/failure, erosion, seepage, sand boil, and sinkhole events.

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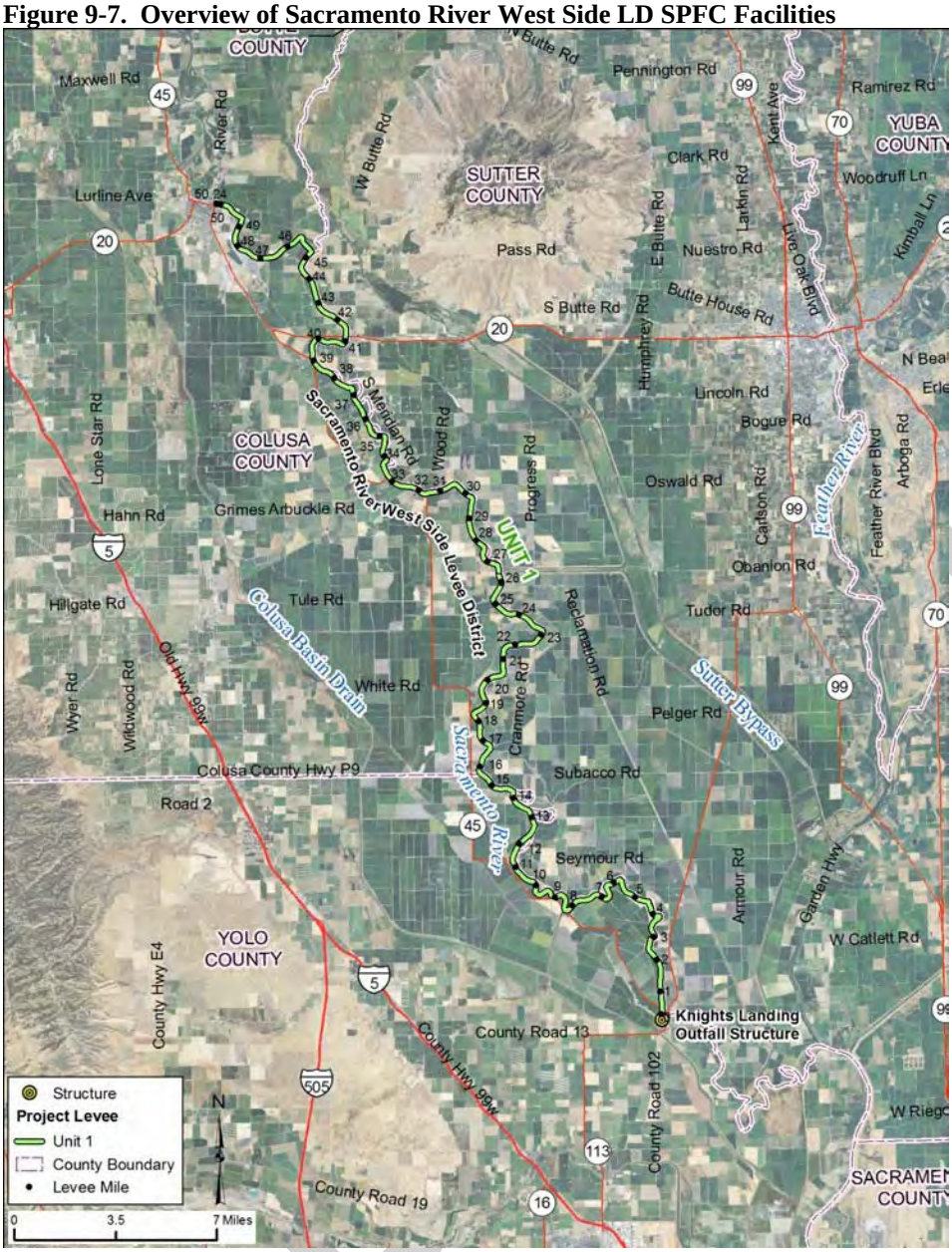
Figure 9-7. Overview of Sacramento River West Side LD SPFC Facilities



Based on an initial assessment of flood threats and local input, the high priority goals for the District include:

- Address identified deficiencies to achieve 'Active' status in the USACE RIP and regain PL84-99 compliance for the Sacramento River West Bank levee system.

The following tables summarize the existing known levee deficiencies.

Table 9-55. DWR Overall Maintenance Area Rating

LMA Short Name	Area Name	Overall Rating						
		2007	2008	2009	2010	2011	2012	2013
NA0016	Sacramento River West Side Levee District	U	M*	M*	M*	A	A	A

Table 9-56. Summary of Sacramento River West Side Levee District Levee Units

Unit	Bank	Length (Miles)
Unit No. 1, Sacramento River	RB	50.21

Table 9-57. DWR Levee Inspection Summary for Sacramento River West Side Levee District

NA0016	Total LMA	50.21											
	Fall 2012					Fall 2013				Change			
	Overall LMA		A			Overall LMA		A					
Rated Item	M	U	M+4U Miles	Thresh. %		M	U	M+4U Miles	Thresh. %	M	U	M+4U Miles	Thresh. %
Earthen Levee													
Vegetation						0.01		0.01	**0.02**	0.01		0.01	**0.02**
Trim / Thin	0.01		0.01	**0.02**						-0.01		-0.01	**-0.02**
Encroachments	0.02		0.02	**0.04**		0.02		0.02	**0.04**				**0.00**
Animal Control						0.01		0.01	**0.02**	0.01		0.01	**0.02**
Supplemental													
USACE	0.26		0.26	**0.52**		0.26		0.26	**0.52**	0.00			**0.00**
DWR UCIP Field Study													**0.00**
LMA Totals:	0.29	0.00	0.29	**0.58**		0.30	0.00	0.30	**0.60**	0.01	0.00	0.01	**0.02**

Table 9-58. DWR Channel Inspection Summary for Sacramento River West Side Levee District

Channel Name	Overall Rating
No Channels Inspected in this District	N/A

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Table 9-59. USACE 2012 Sacramento River Erosion Summary for Sacramento River West Side Levee District

Site ID	River Mile	Levee Mile Start	Levee Mile End	Status	Rating
SAC_101-3_R	101.30	11.48	11.48	eroding	M
SAC_101-3_R	101.30	11.48	11.48	eroding	M
SAC_111-0_R	111.00	18.74	18.74	eroding	M
SAC_115-9_R	115.90	23.54	23.54	eroding	M
SAC_118-0_R	118.00	25.90	26.05	eroding	M
SAC_122-0_R	122.00	29.67	29.67	eroding	M
SAC_122-3_R	122.30	29.93	29.93	eroding	M
SAC_123-7_R	123.70	31.42	31.42	eroding	M
SAC_125-6_R	125.60	33.27	33.27	eroding	M
SAC_127-9_R	127.90	35.21	35.21	eroding	M
SAC_136-6_R	136.60	42.93	42.93	eroding	M
SAC_141-5_R	141.50	47.61	47.61	eroding	M
SAC_143-5_R	143.50	49.44	49.44	eroding	M

Table 9-60. USACE Inspection Rating Summary

System Name	Length (Miles)	RIP Status	RIP Date	Rating
Sacramento River West Bank	119.72	04/03/2013	Inactive	U

Table 9-61. DWR Flood System Repair Project Summary

POI Number	Status	Failure Mode	Location Start	Location End	Bank
DWR_NA0016_01_s _ 2012_2	Critical	Erosion	19.00	19.00	Right
DWR_NA0016_01_s _ 2012_2	Critical	Erosion	19.00	19.00	Right
158-40	Serious	Seepage	2.6	5.8	Right
288-57	Serious	Seepage	34.15	35.13	Right
288-226	Serious	Seepage	34.75	35.5	Right
288-54	Critical	Seepage	35.08		Right
158-221	Serious	Seepage	4.8	6.72	Right
USACE_CESPK_SWS2_2010_p_0279	Serious	Erosion	44.014		Right
158-29	Serious	Seepage	6.16		Right
158-30	Serious	Seepage	6.72		Right
158-222	Serious	Seepage	9.1	11	Right

Table 9-62. Summary of NULE Results for Sacramento River West Side Levee District

Segment	Description	Overall Categorization	Underseepage Categorization	Stability Categorization	Through Seepage Categorization	Erosion Categorization	Freeboard (Does segment meet Freeboard Criteria?)
287	Sacramento River West Side Levee District	C	C	LD	B	B	No
288	Sacramento River West Side Levee District	C	C	LD	LD	B	Yes

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Below is a list of the specific flood control improvement projects for Sacramento River West Side Levee District.

Table 9-63. Summary of the Flood Control Improvement Projects for Sacramento River West Side LD

MUSR ID	Project Name	Project Description	Project Cost Amount ($)
		<< Under Development; See Table 11-1 >>	

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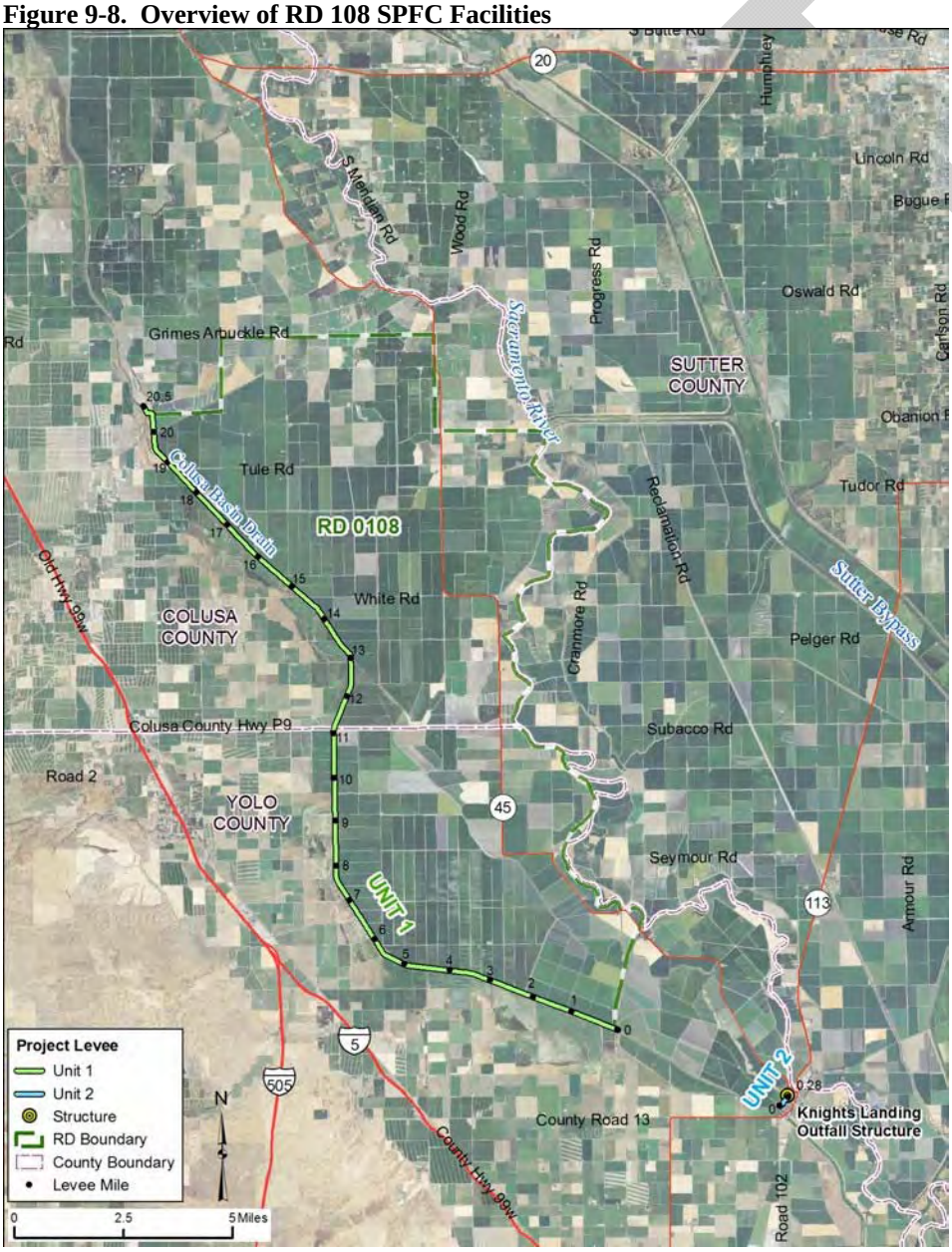
9.9. Reclamation District 108

Reclamation District 108 was established in October of 1870. Originally, the left bank levee along the Colusa Drain was constructed from local soils and dredged materials from the areas along the existing river channel starting in 1910 through the 1920s. In the 1950's approximately 21 miles of the back or westerly levee of RD 108 along the Colusa Drain were reconstructed using federal funds and were accepted into the federal Sacramento River Flood Control Project. This work was completed in July 1956. Since the late 1950s, RD 108 levees have also experienced erosion and slope stability problems.

Figure 9-8. Overview of RD 108 SPFC Facilities



Based on an initial assessment of flood threats and local input, the high priority goals for the District include:

- Address identified deficiencies to achieve 'Active' status in the USACE RIP and regain PL84-99 compliance for the Sacramento River West Bank levee system.

The following tables summarize the existing known levee deficiencies.

Table 9-64. DWR Overall Maintenance Area Rating

LMA Short Name	Area Name	Overall						
		2007	2008	2009	2010	2011	2012	2013
RD0108	Reclamation District No. 0108	A	A	A	A	A	A	A

Table 9-65. Summary of Reclamation District 108 Levee Units

Unit	Bank	Length (Miles)
Unit No. 01, Colusa Basin Drain	LB	20.59

Table 9-66. DWR Levee Inspection Summary for Reclamation District 108

RD0108	Total LMA		20.87									
	Fall 2012				Fall 2013				Change			
	Overall LMA		A		Overall LMA		A					
Rated Item	M	U	M+4U Miles	Thresh. %	M	U	M+4U Miles	Thresh. %	M	U	M+4U Miles	Thresh. %
Earthen Levee												
Animal Control	0.02		0.02	**0.10**					-0.02		-0.02	**-0.10**
Slope Stability					0.01		0.01	**0.05**	0.01		0.01	**0.05**
Cracking	0.01		0.01	**0.05**	0.05		0.05	**0.24**	0.04		0.04	**0.19**
Supplemental												
USACE	0.01		0.01	**0.05**	0.01		0.01	**0.05**				**0.00**
LMA Totals:	0.04	0.00	0.04	**0.19**	0.07	0.00	0.07	**0.34**	0.03	0.00	0.03	**0.14**

Table 9-67. DWR Channel Inspection Summary for Reclamation District 108

Channel Name	Overall Rating
No Channels Inspected in this District	N/A

Table 9-68. USACE 2012 Sacramento River Erosion Summary for Reclamation District 108

Site ID	River Mile	Levee Mile Start	Levee Mile End	Status	Rating
CBD_19-2_L	0.00	19.29	19.29	eroding	M

Table 9-69. USACE Inspection Rating Summary

System Name	Length (Miles)	RIP Status	RIP Date	Rating
Sacramento River West Bank	119.72	Inactive	04/03/2013	U

Table 9-70. DWR Flood System Repair Project Summary

POI Number	Status	Failure Mode	Location Start	Location End	Bank
Obsrv-131060	Serious	Erosion	11.5		Right
Obsrv-131062	Serious	Erosion	21.45		Right
Obsrv-131063	Serious	Erosion	39.8		Right
DWR_RD0108_01_R_2012_01	Critical	Stability	17.1	17.3	Left
DWR_RD0108_01_s _ 2012_3	Serious	Erosion	19.2		Left
116-2001	Serious	Stability	4.07		Left

Table 9-71. Summary of NULE Results for Reclamation District 108

Segment	Description	Overall Categorization	Underseepage Categorization	Stability Categorization	Through Seepage Categorization	Erosion Categorization	Freeboard (Does segment meet Freeboard Criteria?)
116	Reclamation District 0108 (Colusa Co, and Yolo Co)	LD (A or B)	A	C	A	B	No

Below is a list of the specific flood control improvement projects for Reclamation District 108.

Table 9-72. Summary of the Flood Control Improvement Projects for Reclamation District 108

MUSR ID	Project Name	Project Description	Project Cost Amount ($)
		<< Under Development; See Table 11-1 >>	

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9.10. Reclamation District 787

Reclamation District 787 is located just south of RD 108. Originally, the left bank levee along the Colusa Drain was constructed from local soils and dredged materials from the areas along the existing river channel starting in 1910 through the 1920s. In the 1950's the RD 787 levees were reconstructed using federal funds and were accepted into the federal Sacramento River Flood Control Project. This work was completed in July 1956. Since the late 1950s, RD 787 levees have experienced subsidence, erosion, cracking, and landside slope failure

Figure 9-9. Overview of RD 787 SPFC Facilities

Based on an initial assessment of flood threats and local input, the high priority goals for the District include:

- Address identified deficiencies to achieve 'Active' status in the USACE RIP and regain PL84-99 compliance for the Sacramento River West Bank levee system.

The following tables summarize the existing known levee deficiencies.

Table 9-73. DWR Overall Maintenance Area Rating

LMA Short Name	Area Name	Overall Rating						
		2007	2008	2009	2010	2011	2012	2013
RD0787	Reclamation District No. 0787	A	A	A	A	A	A	A

Table 9-74. Summary of Reclamation District 787 Levee Units

Unit	Bank	Length (Miles)
Unit No. 01, Colusa Basin Drain	LB	4.40

Table 9-75. DWR Levee Inspection Summary for Reclamation District 787

RD0787	Total LMA	4.40											
	Fall 2012					Fall 2013					Change			
	Overall LMA			A		Overall LMA			A					
Rated Item	M	U	M+4U Miles	Thresh. %		M	U	M+4U Miles	Thresh. %		M	U	M+4U Miles	Thresh. %
Earthen Levee														
Animal Control	0.02		0.02	**0.46**							-0.02		-0.02	**-0.46**
Flood Preparedness & Training	0.04		0.04	**0.91**		0.04		0.04	**0.91**					**0.00**
Supplemental														
USACE	0.13		0.13	**2.96**		0.13		0.13	**2.96**					**0.00**
LMA Totals:	0.19	0.00	0.19	**4.32**		0.17	0.00	0.17	**3.86**		-0.02	0.00	-0.02	**-0.45**

Table 9-76. DWR Channel Inspection Summary for Reclamation District 787

Channel Name	Overall Rating
No Channels Inspected in this District	N/A

Table 9-77. USACE 2012 Sacramento River Erosion Summary for Reclamation District 787

Site ID	River Mile	Levee Mile Start	Levee Mile End	Status	Rating
CBD_0-5_L	0.00	0.39	0.51	eroding	M
CBD_0-9_L	0.00	0.67	0.67	eroding	M

Table 9-78. USACE Inspection Rating Summary

System Name	Length (Miles)	RIP Status	RIP Date	Rating
Sacramento River West Bank	119.72	Inactive	04/03/2013	U

Table 9-79. DWR Flood System Repair Project Summary

POI Number	Status	Failure Mode	Location Start	Location End	Bank
DWR_RD0787_01_s _ 2012_2	Serious	Erosion	0.667	0.847	Left
USACE_CESPK_FAIR_2010_p_0029	Serious	Erosion	0.715		Left
USACE_CESPK_FAIR_2010_p_0030	Serious	Erosion	0.772		Left
USACE_CESPK_FAIR_2010_p_0038	Serious	Stability	1.084	1.168	Left
USACE_CESPK_FAIR_2010_p_0044	Critical	Stability	1.461		Left

Table 9-80. Summary of NULE Results for Reclamation District 787

Segment	Description	Overall Categorization	Underseepage Categorization	Stability Categorization	Through Seepage Categorization	Erosion Categorization	Freeboard (Does segment meet Freeboard Criteria?)
137	Reclamation District 0787	C	A	C	A	B	No

Below is a list of the specific flood control improvement projects for Reclamation District 787.

Table 9-81. Summary of the Flood Control Improvement Projects for Reclamation District 787

MUSR ID	Project Name	Project Description	Project Cost Amount ($)
		<< Under Development; See Table 11-1 >>	

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9.11. Reclamation District 70

Reclamation District (RD) 70 maintains 8 miles of the right bank levee of the Sutter Bypass and 15.8 miles of the left bank levee of the Sacramento River.

Figure 9-10. Overview of RD 70 SPFC Facilities

Based on an initial assessment of flood threats and local input, the high priority goals for the District include:

- Address identified deficiencies to achieve 'Active' status in the USACE RIP and regain PL84-99 compliance for the Sutter Basin North levee system.

The following tables summarize the existing known levee deficiencies.

Table 9-82. DWR Overall Maintenance Area Rating

LMA Short Name	Area Name	Overall Rating						
		2007	2008	2009	2010	2011	2012	2013
RD0070	Reclamation District No. 0070	M	A	A	A†	A	A	A

Table 9-83. Summary of Reclamation District 70 Levee Units

Unit	Bank	Length (Miles)
Unit No. 01, Sutter Bypass	RB	8.00
Unit No. 02, Sacramento River	LB	15.57

Table 9-84. DWR Levee Inspection Summary for Reclamation District 70

RD0070	Total LMA Miles	23.57											
	Fall 2012					Fall 2013					Change			
	Overall LMA		A			Overall LMA		A						
			M+4U	Thresh.				M+4U	Thresh.				M+4U	Thresh.
Rated Item	M	U	Miles	%		M	U	Miles	%		M	U	Miles	%
Earthen Levee														
Encroachments	0.06		0.06	**0.26**		0.06		0.06	**0.26**					**0.00**
Slope Stability	0.03		0.03	**0.13**		0.03		0.03	**0.13**					**0.00**
Erosion / Bank Caving						0.01		0.01	**0.04**		0.01		0.01	**0.04**
Supplemental														
USACE	0.83		0.83	**3.52**		0.83		0.83	**3.52**					**0.00**
LMA Totals:	0.92	0.00	0.92	**3.90**		0.93	0.00	0.93	**3.95**		0.01	0.00	0.01	**0.04**

Table 9-85. DWR Channel Inspection Summary for Reclamation District 70

Channel Name	Overall Rating
No Channels Inspected in this District	N/A

Table 9-86. USACE 2012 Sacramento River Erosion Summary for Reclamation District 70

Site ID	River Mile	Levee Mile Start	Levee Mile End	Status	Rating
SAC_138-1_L	138.10	0.04	0.33	eroding	M
SAC_138-1_L	138.10	0.04	0.33	eroding	M
SAC_136-6_L	136.60	1.78	1.91	eroding	M
SAC_133-8_L	133.80	4.44	4.48	removed	A/W

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SAC_133-0_L	133.00	5.30	5.52	removed	A/W
SAC_131-8_L	131.80	6.50	6.60	eroding	M
SAC_130-0_L	130.00	8.16	8.32	eroding	M
SAC_125-8_L	125.80	11.64	11.66	eroding	M
SAC_123-3_L	123.30	14.09	14.22	eroding	M

Table 9-87. USACE Inspection Rating Summary

System Name	Length (Miles)	RIP Status	RIP Date	Rating
RD 0070 and RD 1660 - Sutter Basin North	39.90	Inactive	10/18/2013	U

Table 9-88. DWR Flood System Repair Project Summary

POI Number	Status	Failure Mode	Location Start	Location End	Bank
Obsrv-131054	Serious	Erosion			RB
DWR_RD0070_02_s _ 2012_39	Serious	Erosion	4.472	4.512	Left

Table 9-89. Summary of NULE Results for Reclamation District 70

Segment	Description	Overall Categorization	Underseepage Categorization	Stability Categorization	Through Seepage Categorization	Erosion Categorization	Freeboard (Does segment meet Freeboard Criteria?)
115	Reclamation District 0070 Unit 2	C	C	B	LD	B	No
293	Reclamation District 0070 Unit 1	C	C	A	B	A	No

Below is a list of the specific flood control improvement projects for Reclamation District 70.

Table 9-90. Summary of the Flood Control Improvement Projects for Reclamation District 70

MUSR ID	Project Name	Project Description	Project Cost Amount ($)
		<< Under Development; See Table 11-1 >>	

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9.12. Reclamation District 1660

Reclamation District 1660 maintains 9 miles of the right bank levee of the Sutter Bypass and 3 miles of the left bank levee of the Sacramento River.

Figure 9-11. Overview of RD 1660 SPFC Facilities

Based on an initial assessment of flood threats and local input, the high priority goals for the District include:

- Address identified deficiencies to achieve 'Active' status in the USACE RIP and regain PL84-99 compliance for the Sutter Basin North levee system.

The following tables summarize the existing known levee deficiencies.

Table 9-91. DWR Overall Maintenance Area Rating

LMA Short Name	Area Name	Overall Rating						
		2007	2008	2009	2010	2011	2012	2013
RD1660	Reclamation District No. 1660	A	A	A	A†	A	A	A

Table 9-92. Summary of Reclamation District 1660 Levee Units

Unit	Bank	Length (Miles)
Unit No. 01, Sacramento River	LB	3.00
Unit No. 02, Sutter Bypass	RB	9.14

Table 9-93. DWR Levee Inspection Summary for Reclamation District 1660

RD1660	Total LMA	12.14											
	Fall 2012				Fall 2013				Change			
	Overall LMA		A		Overall LMA		A					
			M+4U	Thresh.			M+4U	Thresh.			M+4U	Thresh.
Rated Item	M	U	Miles	%	M	U	Miles	%	M	U	Miles	%
Earthen Levee												
Encroachments	0.01		0.01	**0.08**	0.01		0.01	**0.08**				**0.00**
Slope Stability	0.05		0.05	**0.41**	0.05		0.05	**0.41**				**0.00**
Supplemental												
USACE	0.03		0.03	**0.25**	0.03		0.03	**0.25**				**0.00**
LMA Totals:	0.09	0.00	0.09	**0.74**	0.09	0.00	0.09	**0.74**	0.00	0.00	0.00	**0.00**

Table 9-94. DWR Channel Inspection Summary for Reclamation District 1660

Channel Name	Overall Rating
No Channels Inspected in this District	N/A

Table 9-95. USACE 2012 Sacramento River Erosion Summary for Reclamation District 1660

Site ID	River Mile	Levee Mile Start	Levee Mile End	Status	Rating
SAC_120-6_L	120.60	1.32	1.35	eroding	M

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Table 9-96. USACE Inspection Rating Summary

System Name	Length (Miles)	RIP Status	RIP Date	Rating
RD 0070 and RD 1660 - Sutter Basin North	39.90	Inactive	10/18/2013	U

Table 9-97. DWR Flood System Repair Project Summary

POI Number	Status	Failure Mode	Location Start	Location End	Bank
248-17	Critical	Seepage	5.68		Right

Table 9-98. Summary of NULE Results for Reclamation District 1660

Segment	Description	Overall Categorization	Underseepage Categorization	Stability Categorization	Through Seepage Categorization	Erosion Categorization	Freeboard (Does segment meet Freeboard Criteria?)
149	Reclamation District 1660 Unit 1	LD (B or C)	LD	LD	LD	B	No
248	Reclamation District 1660 Unit 2	C	C	B	B	A	No

Below is a list of the specific flood control improvement projects for Reclamation District 1660.

Table 9-99. Summary of the Flood Control Improvement Projects for Reclamation District 1660

MUSR ID	Project Name	Project Description	Project Cost Amount ($)
		<< Under Development; See Table 11-1 >>	

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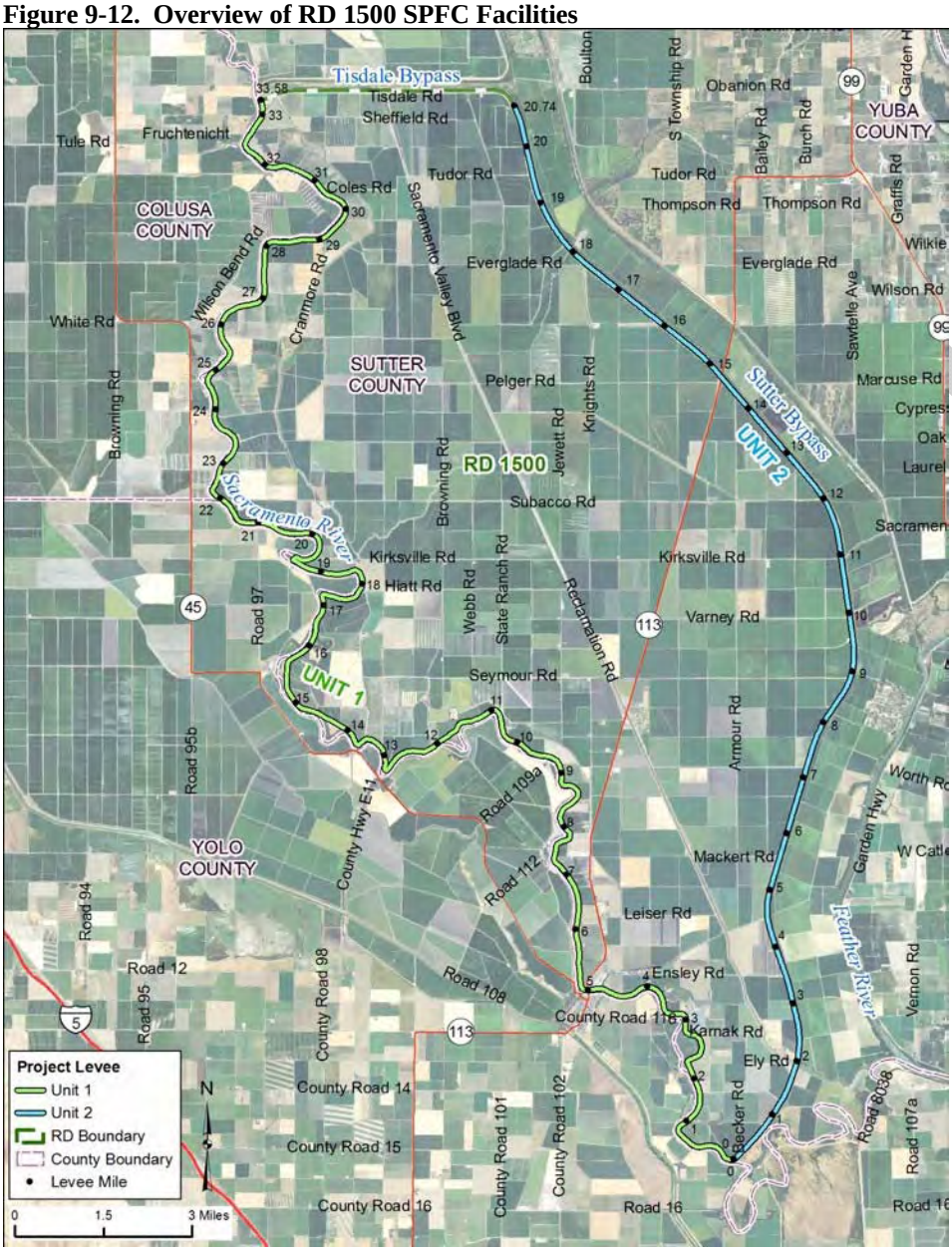
9.13. Reclamation District 1500

Reclamation District (RD) 1500 maintains 20.8 miles of the right bank levee of the Sutter Bypass and 33.6 miles of the left bank levee of the Sacramento River.

Figure 9-12. Overview of RD 1500 SPFC Facilities



Based on an initial assessment of flood threats and local input, the high priority goals for the District include:

- Address identified deficiencies to achieve 'Active' status in the USACE RIP and regain PL84-99 compliance for the Sutter Basin South levee system.

The following tables summarize the existing known levee deficiencies.

Table 9-100. DWR Overall Maintenance Area Rating

LMA Short Name	Area Name	Overall Rating						
		2007	2008	2009	2010	2011	2012	2013
RD1500	Reclamation District No. 1500	M	M*	M*	M*	A	M	M*

Table 9-101. Summary of Reclamation District 1500 Levee Units

Unit	Bank	Length (Miles)
Unit No. 01, Sacramento River	LB	33.58
Unit No. 02, Sutter Bypass	RB	20.77

Table 9-102. DWR Levee Inspection Summary for Reclamation District 1500

RD1500	Total LMA	54.35											
	Fall 2012				Fall 2013				Change			
	Overall LMA		M		Overall LMA		M					
Rated Item	M	U	M+4U Miles	Thresh. %	M	U	M+4U Miles	Thresh. %	M	U	M+4U Miles	Thresh. %
Earthen Levee												
Vegetation												**0.00**
Trim / Thin	0.01	0.01	0.05	**0.09**	0.01	0.01	0.05	**0.09**				**0.00**
Encroachments	0.10		0.10	**0.18**	0.13		0.13	**0.24**	0.03		0.03	**0.06**
Animal Control	0.54	0.02	0.62	**1.14**	0.14	0.01	0.18	**0.33**	-0.40	-0.01	-0.44	**-0.81**
Erosion / Bank Caving	0.04		0.04	**0.07**					-0.04		-0.04	**-0.07**
Cracking	0.01		0.01	**0.02**					-0.01		-0.01	**-0.02**
Crown Surface / Depressions /	5.70		5.70	**10.49**					-5.70		-5.70	**-10.49**
Underseepage Relief Wells		0.01	0.04	**0.07**	0.42	0.01	0.46	**0.85**	0.42		0.42	**0.77**
Supplemental												
USACE	0.10		0.10	**0.18**	0.10		0.10	**0.18**				**0.00**
LMA Totals:	6.50	0.04	6.66	**12.25**	0.80	0.03	0.92	**1.69***	-5.70	-0.01	-5.74	**-10.56**

Table 9-103. DWR Channel Inspection Summary for Reclamation District 1500

Channel Name	Overall Rating
No Channels Inspected in this District	

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Table 9-104. USACE 2012 Sacramento River Erosion Summary for Reclamation District 1500

Site ID	River Mile	Levee Mile Start	Levee Mile End	Status	Rating
SAC_86-3_L	86.30	1.34	1.34	eroding	M
SAC_86-3_L	86.30	1.34	1.34	eroding	M
SAC_87-1_L	87.10	2.31	2.31	eroding	M
SAC_92-8_L	92.80	8.26	8.26	eroding	M
SAC_95-8_L	95.80	11.79	11.79	eroding	M
SAC_96-2_L	96.20	11.98	11.98	eroding	M
SAC_99-0_L	99.00	13.98	13.98	eroding	M
SAC_103-4_L	103.40	18.28	18.28	removed	A/W
SAC_104-0_L	104.00	18.38	18.38	eroding	M
SAC_104-5_L	104.50	19.16	19.16	eroding	M
SAC_116-0_L	116.00	30.60	30.60	eroding	M
SAC_116-5_L	116.50	30.94	30.94	eroding	M

Table 9-105. USACE Inspection Rating Summary

System Name	Length (Miles)	RIP Status	RIP Date	Rating
RD 1500 and Tisdale Bypass - Sutter Basin South	59.22	Inactive	08/21/2012	U

Table 9-106. DWR Flood System Repair Project Summary

POI Number	Status	Failure Mode	Location Start	Location End	Bank
DWR_RD1500_01_s _ 2012_29	Serious	Erosion	11.91	12.09	Left
DWR_RD1500_01_s _ 2012_34	Serious	Erosion	11.91	12.38	Left
294-35	Serious	Seepage	0.8	1.8	Right
294-11	Critical	Seepage	10.32		Right
294-12	Critical	Seepage	10.38		Right
294-13	Critical	Seepage	10.41		Right
294-39	Serious	Seepage	7.3		Right
Sac-14	Serious	Seepage	7.5		Right
294-06	Serious	Seepage	7.67		Right
294-99	Serious	Seepage	9.0	11.0	Right
294-07	Critical	Seepage	9.13		Right
294-08	Critical	Seepage	9.53		Right
294-114	Critical	Seepage	9.58		Right
294-10	Critical	Seepage	9.6		Right
294-115	Critical	Seepage	9.8		Right

Table 9-107. Summary of NULE Results for Reclamation District 1500

Segment	Description	Overall Categorization	Underseepage Categorization	Stability Categorization	Through Seepage Categorization	Erosion Categorization	Freeboard (Does segment meet Freeboard Criteria?)
146	Reclamation District 1500 Unit 1	C	C	B	C	B	No
294	Reclamation District 1500 Unit 2	C	C	B	B	B	No

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Below is a list of the specific flood control improvement projects for Reclamation District 1500.

Table 9-108. Summary of the Flood Control Improvement Projects for Reclamation District 1500

MUSR ID	Project Name	Project Description	Project Cost Amount ($)
		<< Under Development; See Table 11-1 >>	

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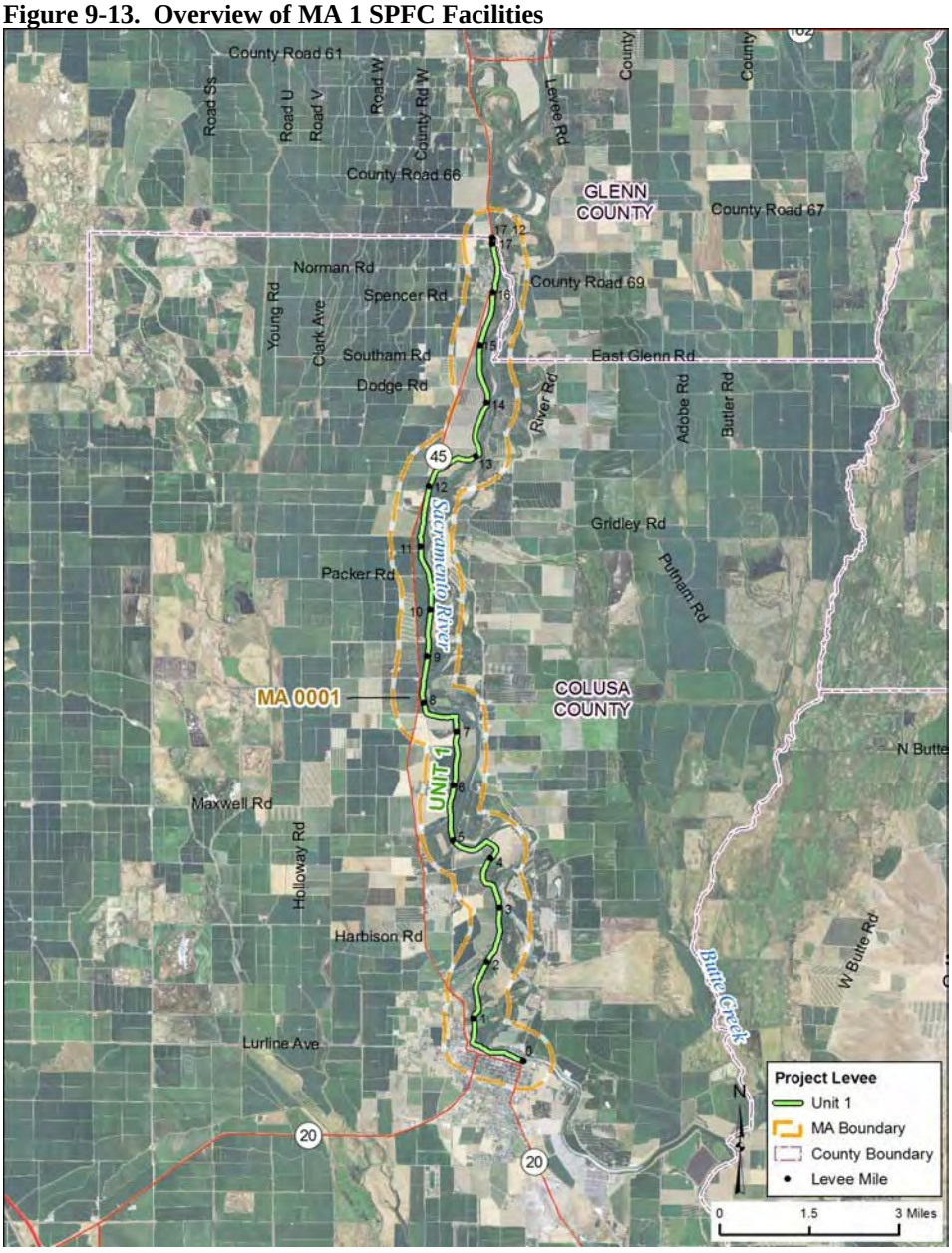
9.14. DWR Sutter Yard Maintenance Area 1 (Colusa North)

Maintenance Area (MA) 1 maintains 17 miles of the right bank levee of the Sacramento River.

Figure 9-13. Overview of MA 1 SPFC Facilities



Based on an initial assessment of flood threats and local input, the high priority goals for the District include:

- Address identified deficiencies to achieve 'Active' status in the USACE RIP and regain PL84-99 compliance for the Sacramento River West Bank levee system.

The following tables summarize the existing known levee deficiencies.

Table 9-109. DWR Overall Maintenance Area Rating

LMA Short Name	Area Name	Overall Rating						
		2007	2008	2009	2010	2011	2012	2013
MA0001	Maintenance Area 0001	M	M	A	A†	A	A	A

Table 9-110. Summary of DWR Sutter Yard Maintenance Area 1 (Colusa North) Levee Units

Unit	Bank	Length (Miles)
Unit No. 01, Sacramento River	RB	17.12

Table 9-111. DWR Levee Inspection Summary for DWR Sutter Yard Maintenance Area 1 (Colusa North)

MA0001	Total LMA	**17.12**											
	Fall 2012					**Fall 2013**					**Change**			
	Overall LMA		**A**			Overall LMA		**A**					
			M+4U	Thresh.				M+4U	Thresh.			M+4U	Thresh.
Rated Item	M	U	Miles	%		M	U	Miles	%		M	U	Miles	%
Earthen Levee														
Vegetation	0.04		0.04	**0.23**		0.04		0.04	**0.23**					**0.00**
Animal Control	0.08		0.08	**0.47**		0.01		0.01	**0.06**		-0.07		-0.07	**-0.41**
Supplemental														
USACE Erosion Survey	0.66		0.66	**3.86**		0.66		0.66	**3.86**					**0.00**
DWR UCIP Field														**0.00**
LMA Totals:	0.78	0.00	0.78	**4.56**		0.71	0.00	0.71	**4.15**		-0.07	0.00	-0.07	**-0.41**

Table 9-112. DWR Channel Inspection Summary for DWR Sutter Yard Maintenance Area 1 (Colusa North)

Channel Name	Overall Rating
No Channels Inspected in this District	

Table 9-113. USACE 2012 Sacramento River Erosion Summary for DWR Sutter Yard Maintenance Area 1 (Colusa North)

Site ID	River Mile	Levee Mile Start	Levee Mile End	Status	Rating
SAC_151-0_R	151.00	5.00	5.38	eroding	M
SAC_154-0_R	154.00	7.42	7.43	repaired	C
SAC_157-7_R	157.70	10.30	10.38	eroding	M
SAC_164-3_R	164.30	16.49	16.69	eroding	M

Table 9-114. USACE Inspection Rating Summary

System Name	Length (Miles)	RIP Status	RIP Date	Rating
Sacramento River West Bank	119.72	Inactive	04/03/2013	U

Table 9-115. DWR Flood System Repair Project Summary

POI Number	Status	Failure Mode	Location Start	Location End	Bank
286-35	Serious	Seepage	15.55	16.08	Right
USACE_CESPK_MA1C_2010_p_0554	Serious	Erosion	17.009		Right
USACE_CESPK_MA1C_2010_p_0542	Serious	Erosion	17.024		Right
380-25	Serious	Other	9.01	9.03	Right

Table 9-116. Summary of NULE Results for DWR Sutter Yard Maintenance Area 1 (Colusa North)

Segment	Description	Overall Categorization	Underseepage Categorization	Stability Categorization	Through Seepage Categorization	Erosion Categorization	Freeboard (Does segment meet Freeboard Criteria?)
286	Maintenance Area No. 01	B	B	A	LD	A	Yes
100	Maintenance Area No. 01	B	B	A	LD	A	Yes
380	Maintenance Area No. 01	C	C	A	B	B	Yes

Below is a list of the specific flood control improvement projects for MA 1.

Table 9-117. Summary of the Flood Control Improvement Projects for MA 1

MUSR ID	Project Name	Project Description	Project Cost Amount ($)
		<< Under Development; See Table 11-1 >>	

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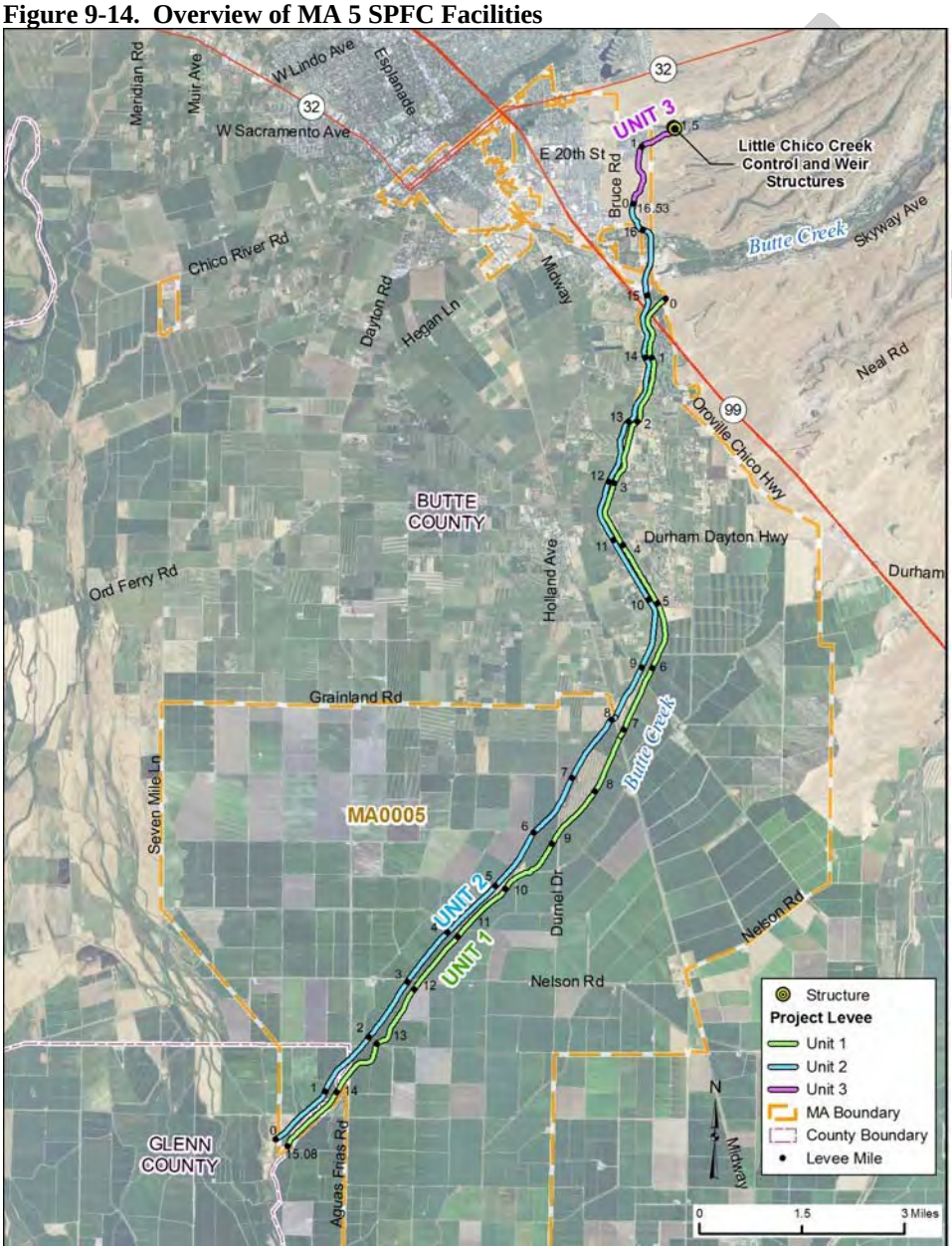
9.15. DWR Sutter Yard Maintenance Area 5 (Butte Creek)

Maintenance Area (MA) 5 maintains 15.3 miles of the left bank levee of Butte Creek, 16.5 miles of the right bank levee of Butte Creek, and 1.5 miles of the left bank of the Little Chico Creek Diversion.

Figure 9-14. Overview of MA 5 SPFC Facilities



Based on an initial assessment of flood threats and local input, the high priority goals for the District include:

- Address identified deficiencies to achieve 'Active' status in the USACE RIP and regain PL84-99 compliance for the Butte Creek levee system.

The following tables summarize the existing known levee deficiencies.

Table 9-118. DWR Overall Maintenance Area Rating

LMA Short Name	Area Name	Overall Rating						
		2007	2008	2009	2010	2011	2012	2013
MA0005	Maintenance Area 0005	M	M	M	M	A	A	A

Table 9-119. Summary of DWR Sutter Yard Maintenance Area 5 (Butte Creek) Levee Units

Unit	Bank	Length (Miles)
Unit No. 01, Butte Creek 1	LB	15.29
Unit No. 02, Butte Creek 1	RB	16.53
Unit No. 03, Little Chico Creek Diversion 1	LB	1.50

Table 9-120. DWR Levee Inspection Summary for DWR Sutter Yard Maintenance Area 5 (Butte Creek)

MA0005	Total LMA	33.32											
	Fall 2012					Fall 2013					Change		
	Overall LMA		A			Overall LMA		A					
Rated Item	M	U	M+4U Miles	Thresh. %		M	U	M+4U Miles	Thresh. %		M	U	M+4U Miles	Thresh. %
Earthen Levee														
Vegetation	0.02		0.02	**0.06**		0.02		0.02	**0.06**					**0.00**
Encroachments	0.09		0.09	**0.27**		0.08		0.08	**0.24**		-0.01		-0.01	**-0.03**
Animal Control	0.01		0.01	**0.03**		0.01		0.01	**0.03**					**0.00**
Slope Stability	0.05		0.05	**0.15**		0.04		0.04	**0.12**		-0.01		-0.01	**-0.03**
Repair Gates	0.02		0.02	**0.06**		0.01		0.01	**0.03**		-0.01		-0.01	**-0.03**
Supplemental														
DWR UCIP														**0.00**
LMA Totals:	0.19	0.00	0.19	**0.57**		0.16	0.00	0.16	**0.48**		-0.03	0.00	-0.03	**-0.09**

Table 9-121. DWR Channel Inspection Summary for DWR Sutter Yard Maintenance Area 5 (Butte Creek)

Channel Name	Overall Rating
No Channels Inspected in this District.	N/A

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Table 9-122. USACE 2012 Sacramento River Erosion Summary for DWR Sutter Yard Maintenance Area 5 (Butte Creek)

Site ID	River Mile	Levee Mile Start	Levee Mile End	Status	Rating
BTC_2-5_R	0.00	2.50	2.51	removed	A/W

Table 9-123. USACE Inspection Rating Summary

System Name	Length (Miles)	RIP Status	RIP Date	Rating
MA 05 Unit 1 - Butte Creek left bank	15.08	Inactive	03/26/2013	U
MA 05 Unit 2 - Butte Creek right bank	16.71	Inactive	03/27/2013	U

Table 9-124. DWR Flood System Repair Project Summary

POI Number	Status	Failure Mode	Location Start	Location End	Bank
263-6	Serious	Seepage	10.7		Right
263-7	Serious	Seepage	10.76		Right

Table 9-125. Summary of NULE Results for DWR Sutter Yard Maintenance Area 5 (Butte Creek)

Segment	Description	Overall Categorization	Underseepage Categorization	Stability Categorization	Through Seepage Categorization	Erosion Categorization	Freeboard (Does segment meet Freeboard Criteria?)
103	Maintenance Area No. 05 - Unit 1	B	LD	LD	A	B	No
104	Maintenance Area No. 05 - Unit 2c	C	LD	LD	A	B	No
274 Reach 1	Maintenance Area No. 05 - Unit 2a	A	A	A	A	A	Yes
381 Reach 1	Maintenance Area No. 05 - Unit 1	B	B	A	LD	B	No
381 Reach 2		A	A	A	A	A	No

Below is a list of the specific flood control improvement projects for MA 5.

Table 9-126. Summary of the Flood Control Improvement Projects for MA 5

MUSR ID	Project Name	Project Description	Project Cost Amount ($)
		<< Under Development; See Table 11-1 >>	

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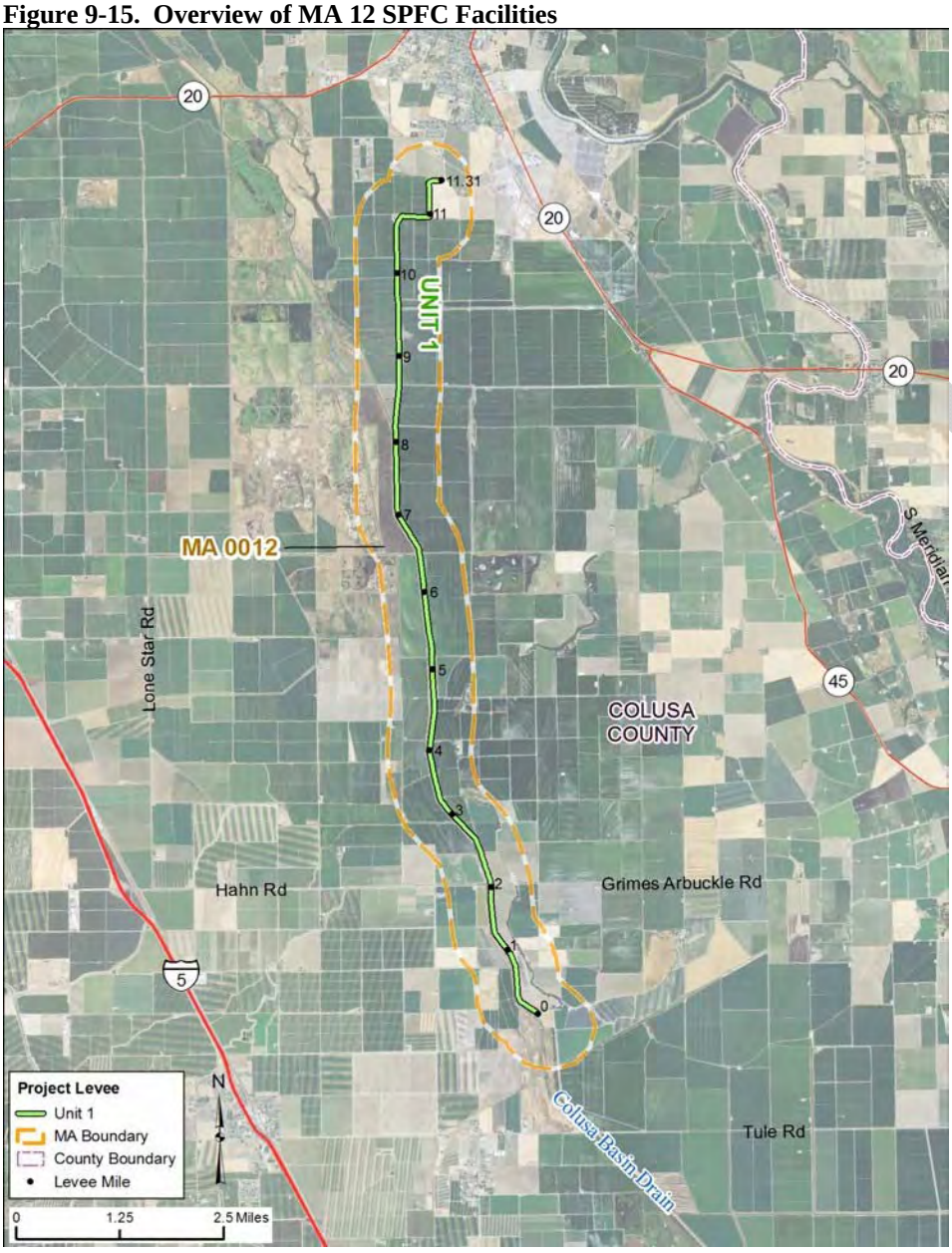
9.16. DWR Sutter Yard Maintenance Area 12 (Colusa Drain)

Maintenance Area (MA) 12 maintains 11.3 miles of the left bank levee Colusa Basin Drain.

Figure 9-15. Overview of MA 12 SPFC Facilities



Based on an initial assessment of flood threats and local input, the high priority goals for the District include:

- Address identified deficiencies to achieve 'Active' status in the USACE RIP and regain PL84-99 compliance for the Sacramento River West Bank levee system.

The following tables summarize the existing known levee deficiencies.

Table 9-127. DWR Overall Maintenance Area Rating

LMA Short Name	Area Name	Overall Rating						
		2007	2008	2009	2010	2011	2012	2013
MA0012	Maintenance Area 0012	A	A	A	A†	A	A	A

Table 9-128. Summary of DWR Sutter Yard Maintenance Area 12 (Colusa Drain) Levee Units

Unit	Bank	Length (Miles)
Unit No. 01, Colusa Drain	LB	11.31

Table 9-129. DWR Levee Inspection Summary for DWR Sutter Yard Maintenance Area 12 (Colusa Drain)

MA0012	Total LMA	**11.31**											
	Fall 2012				**Fall 2013**				**Change**			
	Overall LMA		**A**		Overall LMA		**A**					
Rated Item	M Miles	U Miles	M+4U Miles	Thresh. %	M Miles	U Miles	M+4U Miles	Thresh. %	M Miles	U Miles	M+4U Miles	Thresh. %
Earthen Levee												
Animal Control					0.02		0.02	**0.18**	0.02		0.02	**0.18**
Slope Stability					0.01		0.01	**0.09**	0.01		0.01	**0.09**
Supplemental												
USACE	0.01		0.01	**0.09**	0.01		0.01	**0.09**				**0.00**
DWR UCIP												**0.00**
LMA Totals:	0.01	0.00	0.01	**0.09**	0.04	0.00	0.04	**0.35**	0.03	0.00	0.03	**0.27**

Table 9-130. DWR Channel Inspection Summary for DWR Sutter Yard Maintenance Area 12 (Colusa Drain)

Channel Name	Overall Rating
No Channels Inspected in this District	N/A

Table 9-131. USACE 2012 Sacramento River Erosion Summary for DWR Sutter Yard Maintenance Area 12 (Colusa Drain)

Site ID	River Mile	Levee Mile Start	Levee Mile End	Status	Rating
SYC_9-3_L	0.00	9.02	9.02	eroding	M

Table 9-132. USACE Inspection Rating Summary

System Name	Length (Miles)	RIP Status	RIP Date	Rating
Sacramento River West Bank	119.72	Inactive	04/03/2013	U

Table 9-133. DWR Flood System Repair Project Summary

POI Number	Status	Failure Mode	Location Start	Location End	Bank
Obsrv-131055	Critical	Stability	8.1		left
Obsrv-131058	Serious	Stability	LM 1.3		Left Bank
DWR_MA0012_01_R_2012_01	Serious	Erosion	8.75		Left
DWR_MA0012_01_s _ 2012_7	Serious	Erosion	9.1		Left

Table 9-134. Summary of NULE Results for DWR Sutter Yard Maintenance Area 12 (Colusa Drain)

Segment	Description	Overall Categorization	Underseepage Categorization	Stability Categorization	Through Seepage Categorization	Erosion Categorization	Freeboard (Does segment meet Freeboard Criteria?)
107	Maintenance Area No. 12	LD (A or B or C)	LD	C	A	A	Yes

Below is a list of the specific flood control improvement projects for MA 12.

Table 9-135. Summary of the Flood Control Improvement Projects for MA 12

MUSR ID	Project Name	Project Description	Project Cost Amount ($)
		<< Under Development; See Table 11-1 >>	

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9.17. DWR Sutter Yard Maintenance Area 17 (Upper Lake)

Maintenance Area (MA) 17 maintains 3.9 miles of the left bank levee of Middle Creek in Kale County.

Figure 9-16. Overview of MA 17 SPFC Facilities

Based on an initial assessment of flood threats and local input, the high priority goals for the District include:

- Implementation of the Middle Creek Flood Relief and Restoration Project.

The following tables summarize the existing known levee deficiencies.

Table 9-136. DWR Overall Maintenance Area Rating

LMA Short Name	Area Name	Overall Rating						
		2007	2008	2009	2010	2011	2012	2013
MA0017	Maintenance Area 0017	U	U	U	U	U	U	U

Table 9-137. Summary of DWR Sutter Yard Maintenance Area 17 (Upper Lake) Levee Units

Unit	Bank	Length (Miles)
Unit No. 01, Lake County Sutter Maintenance Yard - Middle Creek	LB	3.90

Table 9-138. DWR Levee Inspection Summary for DWR Sutter Yard Maintenance Area 17 (Upper Lake)

MA0017	Total LMA	**3.90**											
	Fall 2012				**Fall 2013**				**Change**			
	Overall LMA Rating		**U**		Overall LMA Rating		**U**					
			M+4U	Thresh.			M+4U	Thresh.			M+4U	Thresh.
Rated Item	M	U	Miles	%	M	U	Miles	%	M	U	Miles	%
Earthen Levee												
Vegetation		3.13	12.52	**321.03**		3.13	12.52	**321.03**				**0.00**
Trim / Thin Trees		3.12	12.48	**320.00**		3.12	12.48	**320.00**				**0.00**
Supplemental												
DWR UCIP Field												**0.00**
LMA Totals:	0.00	6.25	25.00	**641.03**	0.00	6.25	25.00	**641.03**	0.00	0.00	0.00	**0.00**

Table 9-139. DWR Channel Inspection Summary for DWR Sutter Yard Maintenance Area 17 (Upper Lake)

Channel Name	Overall Rating
No Channels Inspected in this District	N/A

Table 9-140. USACE 2012 Sacramento River Erosion Summary for DWR Sutter Yard Maintenance Area 17 (Upper Lake)

Site ID	River Mile	Levee Mile Start	Levee Mile End	Status	Rating
No Supplemental Erosion Sites	N/A	N/A	N/A	N/A	N/A

Table 9-141. USACE Inspection Rating Summary

System Name	Length (Miles)	RIP Status	RIP Date	Rating
Middle Creek left bank - Unit 1 at Clear Lake	1.33	Inactive	03/05/2013	U
Middle Creek left bank - Unit 1 south	3.51	Active	03/07/2013	M

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Table 9-142. DWR Flood System Repair Project Summary

POI Number	Status	Failure Mode	Location Start	Location End	Bank
81-10	Critical	Seepage	4.82	4.95	Left
81-11	Critical	Seepage	4.9		Left
81-12	Critical	Seepage	4.91		Left
81-8	Critical	Seepage	5.4	5.5	Left
Sac-10	Critical	Seepage	5.4	5.4	Left

Table 9-143. Summary of NULE Results for DWR Sutter Yard Maintenance Area 17 (Upper Lake)

Segment	Description	Overall Categorization	Underseepage Categorization	Stability Categorization	Through Seepage Categorization	Erosion Categorization	Freeboard (Does segment meet Freeboard Criteria?)
78	Middle Creek - Unit 1a	B	A	A	LD	B	No
79	Middle Creek - Unit 1b	LD (A or B)	LD	A	LD	A	No
81 Reach 1	Middle Creek - Unit 1e	C	LD	LD	A	A	No
81 Reach 2	Middle Creek - Unit 1e	B	B	B	C	C	No

Below is a list of the specific flood control improvement projects for MA 17.

Table 9-144. Summary of the Flood Control Improvement Projects for MA 17

MUSR ID	Project Name	Project Description	Project Cost Amount ($)
		<< Under Development; See Table 11-1 >>	

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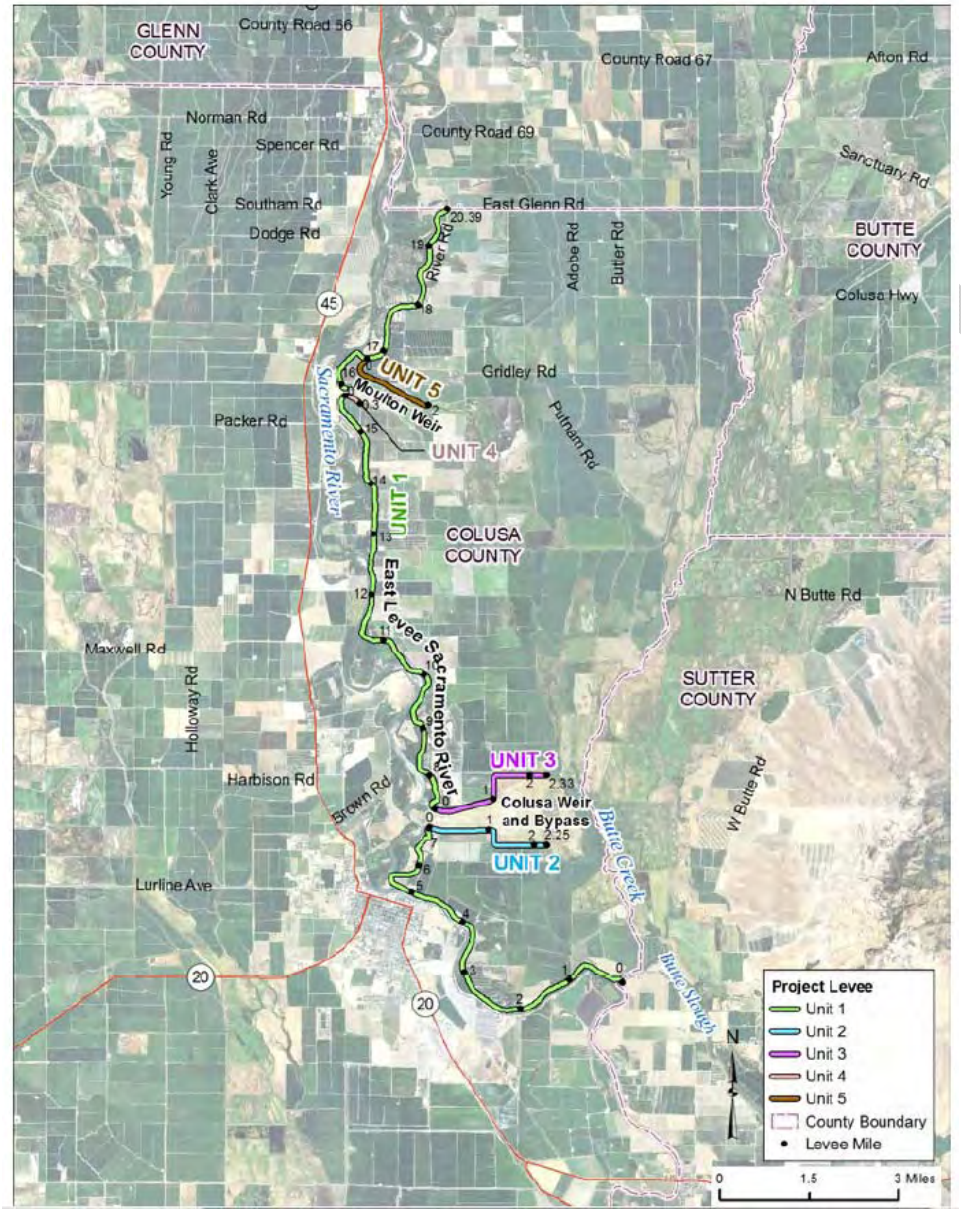
9.18. DWR Sutter Yard Sacramento River East Levee

The Sacramento East River Maintenance Area maintains 20.4 miles of the Sacramento River left bank levee, 2.2 miles of levees on both banks of the Colusa Bypass, 0.3 miles of the Moulton Bypass right bank levee, and 2.0 miles of the Moulton Bypass left bank levee.

Figure 9-17. Overview of Sutter Maintenance Yard East Levee Sacramento River SPFC Facilities



Based on an initial assessment of flood threats and local input, the high priority goals for the District include:

- Repairing erosion sites.

The following tables summarize the existing known levee deficiencies.

Table 9-145. DWR Overall Maintenance Area Rating

LMA Short Name	Area Name	Overall Rating						
		2007	2008	2009	2010	2011	2012	2013
ST0003	Sutter Maintenance Yard East Levee Sacramento River	A	A	A	A	A	A	A

Table 9-146. Summary of East Levee Sacramento River Levee Units

Unit	Bank	Length (Miles)
Unit No. 01 Sacramento River	LB	20.39
Unit No. 02 Colusa Bypass	RB	2.20
Unit No. 03 Colusa Bypass	LB	2.28
Unit No. 04 Moulton Bypass	RB	0.30
Unit No. 05 Moulton Bypass	LB	2.00

Table 9-147. DWR Levee Inspection Summary for East Levee Sacramento River

ST0003	Total LMA Miles		**27.17**									
	Fall 2012				**Fall 2013**				**Change**			
	Overall LMA Rating		**A**		Overall LMA Rating		**A**					
			M+4U	Thresh.			M+4U	Thresh.			M+4U	Thresh.
Earthen Levee												
Vegetation	0.05		0.05	**0.18**	0.04		0.04	**0.15**	-0.01		-0.01	**-0.04**
Trim / Thin Trees	0.01		0.01	**0.04**	0.01		0.01	**0.04**				**0.00**
Encroachments	0.25		0.25	**0.92**	0.25		0.25	**0.92**				**0.00**
Animal Control	0.08		0.08	**0.29**	0.01		0.01	**0.04**	-0.07		-0.07	**-0.26**
Slope Stability					0.02		0.02	**0.07**	0.02		0.02	**0.07**
Erosion / Bank Caving	0.19		0.19	**0.70**	0.20		0.20	**0.74**	0.01		0.01	**0.04**
Supplemental												
USACE Erosion Survey	0.07		0.07	**0.26**	0.07		0.07	**0.26**				**0.00**
DWR UCIP Field Study												**0.00**
LMA Totals:	0.65	0.00	0.65	**2.39**	0.60	0.00	0.60	**2.21**	-0.05	0.00	-0.05	**-0.18**

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Table 9-148. DWR Channel Inspection Summary for East Levee Sacramento River

No Structures Inspected in this District.

Table 9-149. USACE Inspection Rating Summary

No Channels Inspected in this District.

Table 9-150. USACE 2012 Sacramento River Erosion Summary - Unit No. 01 Sacramento River, LB

SAC_150-2_L	150.20	10.46	10.46	removed	A/W
SAC_152-6_L	152.60	11.51	11.51	eroding	M
SAC_152-8_L	152.80	11.83	11.89	eroding	M

Table 9-151. DWR Flood System Repair Project Summary - Unit No. 01 Sacramento River

Sacramento River East Levee - LD 3 Glenn County	38.36	Inactive	05/08/2013	U

Table 9-152. Summary of NULE Results for DWR East Levee Sacramento River

Segment	Description	Overall Categorization[2]	Underseepage Categorization	Stability Categorization	Through Seepage Categorization	Erosion Categorization	Freeboard (Does segment meet Freeboard Criteria?)
159	Sacramento River East Levee Unit 1a	LD (A, B or C)	LD	A	LD	A	Yes
160	Sacramento River East Levee Unit 1b, and Unit 1c	C	B	A	LD	C	No
161	Sacramento River East Levee Unit 1d	B	B	A	LD	B	No

Below is a list of the specific flood control improvement projects for DWR East Levee Sacramento River.

Table 9-153. Summary of the Flood Control Improvement Projects for DWR East Levee Sacramento River

MUSR ID	Project Name	Project Description	Project Cost Amount ($)
		<< Under Development; See Table 11-1 >>	

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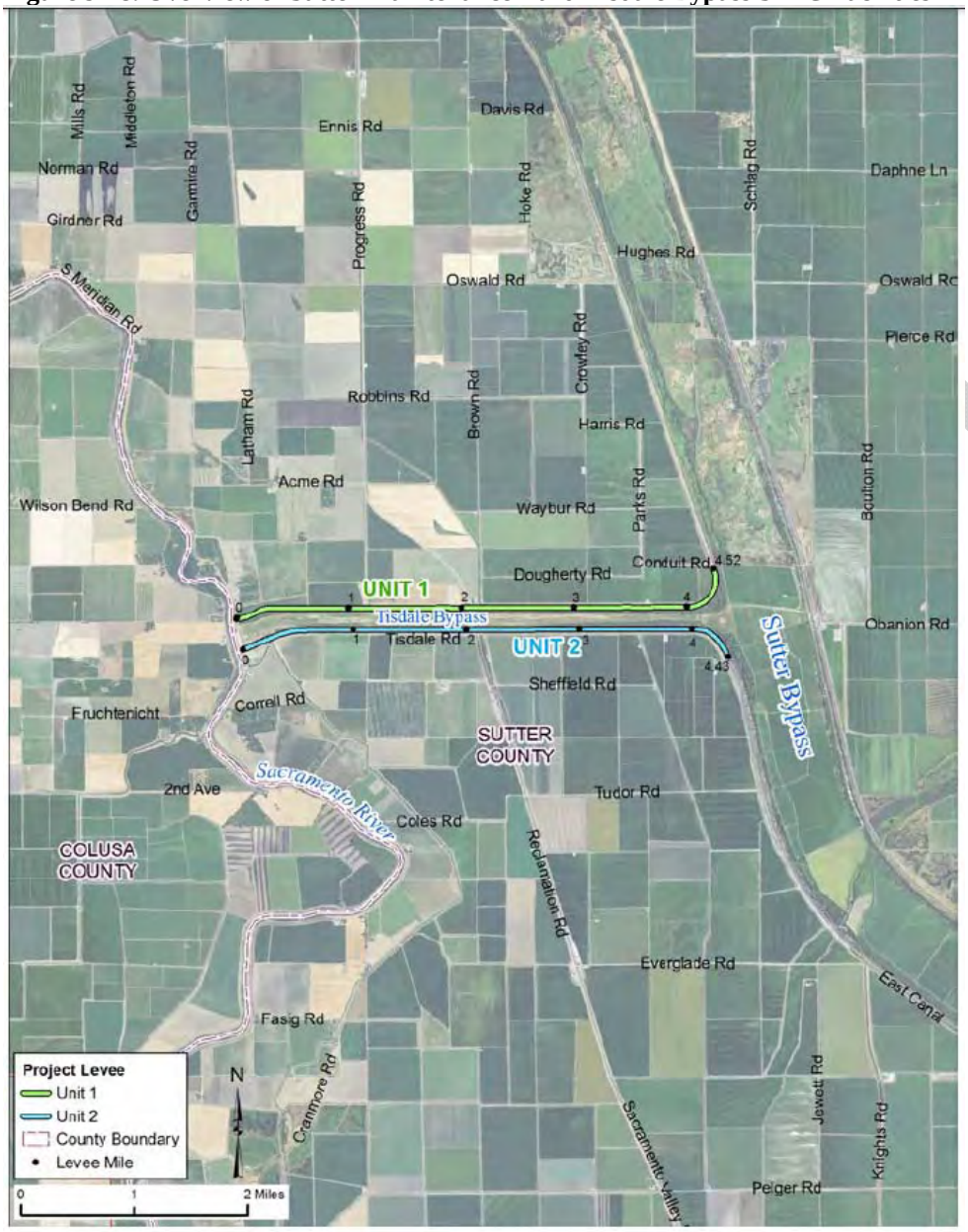
9.19. DWR Sutter Yard Tisdale Bypass

Sutter Yard maintains the left and right bank levees (4.5 miles each) of the Tisdale Bypass.

Figure 9-18. Overview of Sutter Maintenance Yard Tisdale Bypass SPFC Facilities



Based on an initial assessment of flood threats and local input, the high priority goals for the District include:

- Repairing erosion sites.

The following tables summarize the existing known levee deficiencies.

Table 9-154. DWR Overall Maintenance Area Rating

LMA Short Name	Area Name	Overall Rating						
		2007	2008	2009	2010	2011	2012	2013
ST0009	Tisdale Bypass	A	A	A	A	A	A	A

Table 9-155. Summary of Levee Units

Unit	Bank	Length (Miles)
Unit No. 01 Tisdale Bypass	LB	4.50
Unit No. 02 Tisdale Bypass	RB	4.43

Table 9-156. DWR Levee Inspection Summary for Tisdale Bypass

ST0009	Total LMA	**8.93**											
	Fall 2012				**Fall 2013**				**Change**			
	Overall LMA			**A**	Overall LMA			**A**				
			M+4U	Thresh.			M+4U	Thresh.			M+4U	Thresh.
Earthen Levee												
Animal Control	0.01		0.01	**0.11**					-0.01		-0.01	**-0.11**
Erosion / Bank	0.01		0.01	**0.11**	0.03		0.03	**0.34**	0.02		0.02	**0.22**
Supplemental												
DWR UCIP Field												**0.00**
LMA Totals:	0.02	0.00	0.02	**0.22**	0.03	0.00	0.03	**0.34**	0.01	0.00	0.01	**0.11**

Table 9-157. DWR Structure Inspection Summary for Tisdale Bypass

No Structures Inspected in this District.

Table 9-158. DWR Channel Inspection Summary for Tisdale Bypass

No Channels Inspected in this District.

Table 9-159. USACE 2012 Sacramento River Erosion Summary

No Supplemental Erosion Sites.

Table 9-160. USACE Inspection Rating Summary

System Name	Length (Miles)	RIP Status	RIP Date	Rating
RD 0070 and RD 1660 - Sutter Basin North	39.90	Inactive	10/18/2013	U
RD 1500 and Tisdale Bypass - Sutter Basin South	59.22	Inactive	08/21/2012	U

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Table 9-161. DWR Flood System Repair Project Summary

POI Number	Status	Failure Mode	Location Start	Location End	Bank
DWR_ST0009_02_s _ 2012_3	Serious	Erosion	1.01	1.01	Right

Table 9-162. Summary of NULE Results for Tisdale Bypass

Segment	Description	Overall Categorization[2]	Underseepage Categorization	Stability Categorization	Through Seepage Categorization	Erosion Categorization	Freeboard (Does segment meet Freeboard Criteria?)
165	Tisdale Bypass Unit 1 - north bank	B	B	B	A	A	No
166	Tisdale Bypass Unit 2 - south bank	C	C	B	B	A	No

Below is a list of the specific flood control improvement projects for Tisdale Bypass.

Table 9-163. Summary of the Flood Control Improvement Projects for Tisdale Bypass

MUSR ID	Project Name	Project Description	Project Cost Amount ($)
		<< Under Development; See Table 11-1 >>	

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9.20. Rock Creek Reclamation District

Rock Creek Reclamation District (RCRD) was initially formed in 1985 under the State Reclamation Act. The District provides flood control services to approximately 4,644 acres of agricultural and single-family residential parcels in an area surrounding Nord in northern Butte County. The District consists of large agricultural properties and low-density residential uses. Pine Creek forms a portion of the western boundary above Highway 32. Additionally, Rock Creek flows through the District and joins Mud and Big Chico Creeks in the southern portion of the District. The majority of the Rock Creek Reclamation District has been identified as a 100-year flood zone on Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps. The primary sources of flooding include Rock Creek and Keefer Slough.

Rock Creek frequently floods farmlands within the Rock Creek Reclamation District, impacting 4,700 acres of farmland in total and affects the town of Nord and Highway 99. Sand Creek (or the North Fork of Rock Creek) is a major tributary, joining Rock Creek from the north just east of Hwy 99. At the Rock Creek-Keefer Slough confluence, sediment has accumulated on the Rock Creek side and the majority of flood flows are now routed down through Keefer Slough, causing flood damages to areas downstream and closing Highway 99. There is a potential to detain storm runoff within the Sand Creek system, which could significantly reduce the peak discharge in Rock Creek downstream. The lower reaches of Rock Creek periodically inundate the agricultural areas and leave the Town of Nord vulnerable to flooding. There have been several studies of the Rock Creek Keefer Slough drainage area dating back to 1979. The most recent study is the 1999 U.S. Army Corps of Engineers (USACE) Rock Creek – Keefer Slough Flood Protection Project Feasibility Study which has not been completed due to a lack of funding.

The proposed Rock and Sand Creek Flood Mitigation Project will build upon the work already completed by the USACE to develop and assess potential solutions to flooding from Rock Creek, focusing on the potential floodwater detention on Sand Creek. The project will assess potential hydrologic benefits of alternative detention strategies including creation of seasonal wetland habitats. The magnitude and timing of flood flows down Sand Creek and down the main-stem of Rock Creek will be analyzed. The analysis will be carried out through hydrologic modeling of storm runoff from the Sand Creek basin using HEC-HMS. The calculated runoff will be used as input to a HEC-RAS hydraulic model to evaluate the magnitude of flooding below the confluence of Sand and Rock Creeks under existing and proposed detention scenarios.

The project will include an assessment of potential detention dam sites and examine the potential ecological benefits of new seasonal wetlands and groundwater recharge. Deliverables will include a feasibility analysis and conceptual designs for the detention project.

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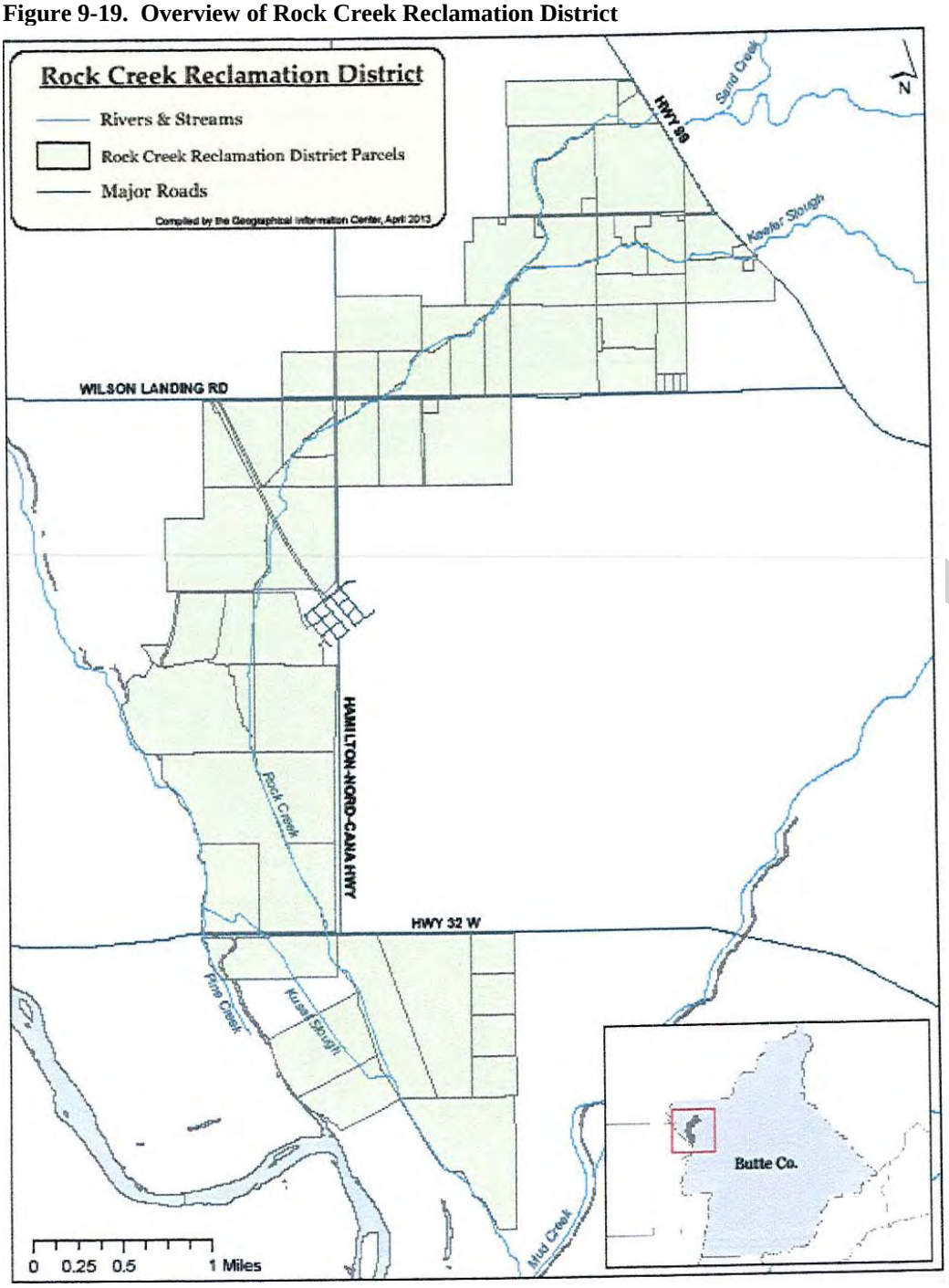
Figure 9-19. Overview of Rock Creek Reclamation District



9.21. Reclamation District 2140

<< Under Development>>

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9.22. Colusa Basin Drainage District

<< Under Development>>

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10. System-Wide Improvements

10.1. Overview

<< Note to Reviewer: As DWR's Sacramento Basin-Wide Feasibility Study is currently in-progress, revisions to this chapter should be expected following release of the BWFS proposed configurations for the State System Improvement Approach. >>

The 2012 CVFPP describes the State System-wide Investment Approach (SSIA) which is the State's strategy for addressing flood risk reduction within the Central Valley (see Chapter 1 for a more detailed discussion of the 2012 CVFPP and the SSIA). The physical elements of the SSIA are organized into regional, and system-wide elements. The SSIA considers regional elements to be those physical actions or projects that provide local and regional benefits for urban areas, small communities, and rural agricultural areas. The SSIA considers system-wide elements to be those physical actions or projects which provide cross-regional benefits, and improve the overall function and performance of the State Plan of Flood Control. The system improvements discussed in the 2012 CVFPP and included in the SSIA, are largely related to expansions of the bypass and weir system. The 2012 CVFPP includes one new surface water storage project, the Folsom Dam Raise, which was authorized by the Energy and Water Development and Appropriations Act of 2004. The State intends to take the lead in developing and implementing the system improvements envisioned under the SSIA. It is anticipated that the State's Basin-wide Feasibility Study for Sacramento River System will provide greater detail of the SSIA system improvements which the State intends to pursue.

Regional and local stakeholder have expressed concerns that the 2012 CVFPP suggested system improvements, such as expanded bypasses and associated large-scale ecosystem enhancements, were not thoroughly vetted at the local and regional level during development of the 2012 CVFPP. The purpose of this chapter is to discuss system-wide improvements which have the potential to impact MUSR RFPM areas. It is important to note that there are other actions discussed elsewhere in the MUSR RFMP which provide system-wide benefits. However, the intent of this chapter is to capture those additional actions which have not been discussed previously within the MUSR RFMP.

10.2. Surface Water Storage - Reservoirs, Detention Basins, Transitory Storage, and Groundwater Recharge

10.2.1. *Sites Reservoir*

Sites Reservoir is located in north-central Colusa County and south-central Glenn County, approximately 10 miles west of the community of Maxwell. Water would be diverted from the Sacramento River to fill the reservoir and the proposed reservoir will primarily inundate

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grassland currently used for cattle grazing. The reservoir is in the Funks Creek and Stone Corral Creek watersheds (59,700 acres). The proposed project contains substantial fisheries enhancements such as replacing the Red Bluff Diversion Dam with state-of-the-art fish screens and pumps and increasing the Lake Shasta cold water pool. The project also includes modifications to the Glenn-Colusa Irrigation District intake and a potential new diversion opposite Moulton Weir. A mean full pool elevation of 520 feet would inundate 14,000 acres and could store a maximum of 1.81 MAF.

The project is currently being evaluated under the North-of-the-Delta Offstream Storage (NODOS) feasibility studies, which are underway and being directed by the U.S. Bureau of Reclamation, DWR, and the Sites Joint Powers Authority.

Alternative reservoir sizes of 1.27 and 1.81 MAF are under consideration. At 1.27 MAF, six saddle dams and two major dams (Sites and Golden Gate Dams) would be required. At 1.81 MAF, Sites Reservoir would require the construction of two major dams (Sites and Golden Gate Dams) and nine saddle dams along the southern edge of the Hunters Creek watershed. Diversions from the Colusa Basin Drain (CBD), the Sacramento River, Stony Creek, and local tributaries would provide potential sources of water supply for the Sites Reservoir project.

The total project cost is estimated at $2.3 to 3.2 billion depending on conveyance options. The annual costs for operations, maintenance and power are estimated at $10 to $21 million. These estimates are based on preliminary feasibility studies and include all capital costs for construction, engineering, administration, environmental compliance and mitigation (including the costs of relocating infrastructure), legal, real estate and contingencies.

Sites Reservoir will add flexibility to the state's water management system and can provide unique benefits which include, but not limited to:

- Enhanced water supply reliability for urban, agricultural, and environmental uses
- Improved Delta water quality
- Mitigation of snowpack storage losses due to climate change
- Contribute to flood damage reduction in the Central Valley
- Ecosystem restoration actions in the Sacramento River
- Dedicated storage that can be adaptively managed to respond to Delta emergencies and help with restoration actions

The NEPA/CEQA process is underway to identify potential environmental impacts and mitigation measures. After appropriation of state and federal funds, there will be a two-year design phase followed by a five to seven year construction phase, for a total of seven to nine years. The current planning schedule shows project construction to be completed in 2025.

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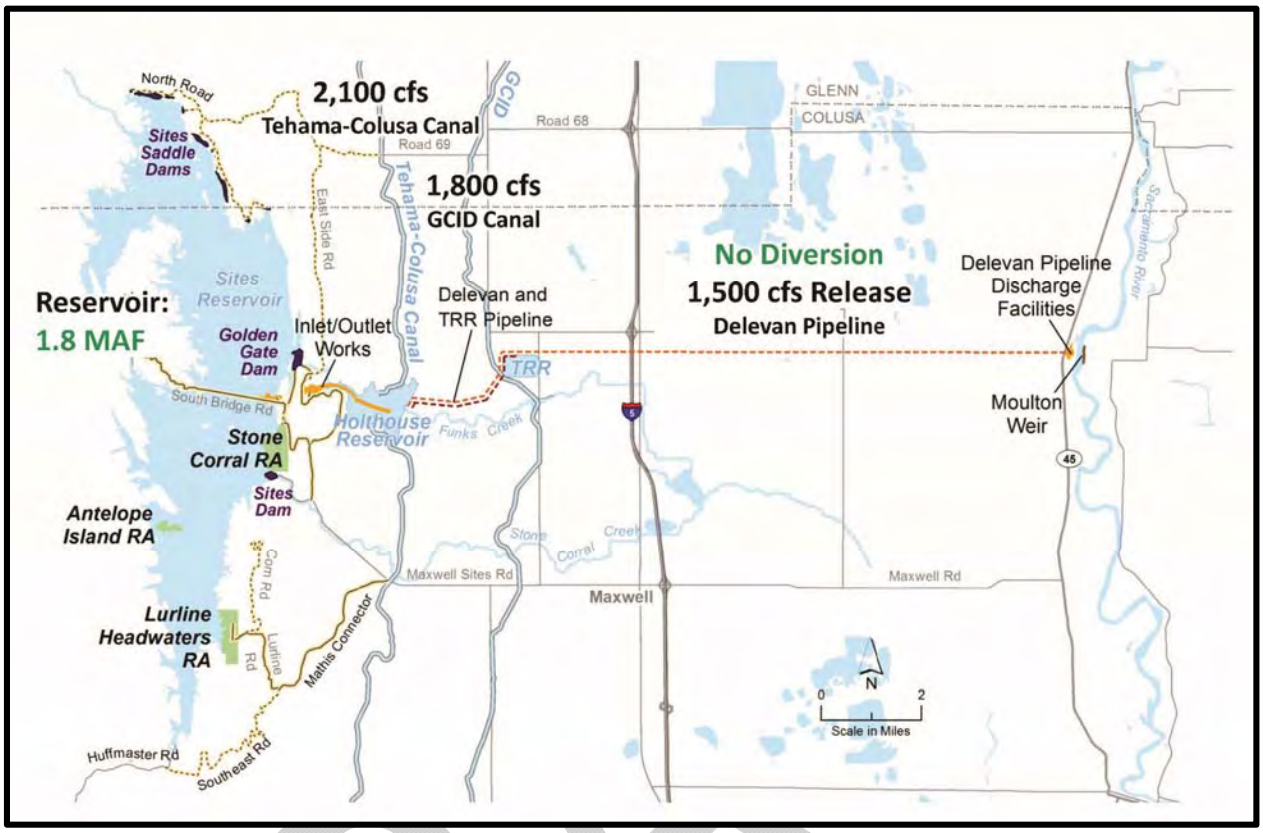
Figure 10-1. One of the Configurations for the Proposed Sites Reservoir (Alternative B)



10.2.2. *Oroville Dam Improvements*

The State Water Project (SWP) of DWR operates Oroville Dam and Lake (Oroville). It is the second largest state reservoir in northern California (Shasta lake is the largest), with more than 167 miles of shoreline. It is also the tallest dam in the United States, measuring 770 feet high – 44 feet taller than Hoover Dam – and 6,920 feet across. The lake is located where the North, Middle, and South Forks, and the West Branches of the Feather River join. Lake Oroville is operated for multiple purposes, including flood control.

The reservoir captures drainage from a 3,611 square-mile watershed. It provides a full pool with 3,538,000 acre-feet of storage, up to 750,000 acre-feet of which is governed by flood control regulations. The emergency spillway at Oroville Dam is 1,730 feet long with a crest elevation of 901feet msl. Thermalito Afterbay (Thermalito) is located downstream from Oroville Dam. It has 45,000 acre-feet of reservoir storage space for re-regulation of Oroville power releases.

The operational flood control rules for Oroville are determined by the USACE (1970) and published in the Oroville Dam and Reservoir Flood Control Manual. The Flood Control Diagram (FCD) and Emergency Spillway Release Diagram (ESRD) contained in that manual together govern the flood control releases from Oroville. The operational flood rules dictate the amount

of flood space that is required to be made available and provide criteria for determination of outflows from Oroville during a flood event.

The amount of flood control space in Oroville is a function of the time of the year and the seasonal accumulation of precipitation for the reservoir's drainage basin. No flood space is required from June 15 to September 15. During the peak flood season (October 15 – March 31), the flood control space varies between 375,000 and 750,000 acre-feet, depending on the accumulated precipitation parameter prescribed in the flood control manual.

There are several release restrictions on Oroville Dam and Reservoir:

- The first constraint is that maximum flood control releases should not exceed 150,000 cfs.
- The second constraint is that flows should not exceed 180,000 cfs flow just upstream of the mouth of the Yuba River. However, in practice, this rarely constrains operations since a combined 30,000 cfs contribution of local inflow to the Feather River (i.e., Honcut Creek, local accretions) between Oroville and Yuba City would be required in order to limit Oroville outflow to anything less than the release of 150,000 cfs.
- The next downstream condition that potentially limits the outflow from Oroville is the 300,000 cfs Feather River target flow below the mouth of the Yuba River. Regulating outflows for this requirement at Oroville implies a foreknowledge of the flow in the Yuba River at its mouth, and therefore, Oroville operations must rely on a forecast of the Yuba River flow at Marysville (the New Bullards Bar outflow and the unregulated South and Middle Yuba River flows) to meet this target. The Yuba River flow at its mouth must exceed 120,000 cfs before Oroville operations are affected.
- The final downstream peak flow constraint on Oroville outflow is the 320,000 cfs target for flow below the Bear River.

In addition, the rate of increase in releases and decrease in releases must not exceed 10,000 cfs and 5,000 cfs per two-hour period, respectively. The maximum rate-of-decrease criterion is the more influential of these two for large flood events. In some cases, the rapidly peaking flows of the Yuba River require cutbacks in Oroville releases to keep total flows below the combined flow targets downstream of the Yuba and Bear rivers, but the required cutback rates greatly exceed the 5,000 cfs per two-hour target. The only practical solution is to operate for a target flow of less than 300,000 cfs below the Yuba River. This condition would only exist for floods significantly larger than the 1997 flood.

The emergency spillway at Oroville was designed to pass a flood with a peak inflow of 718,000 cfs, yielding an outflow of 623,200 cfs operating with the use of the FCD and ESRD.

The ESRD computes a required release from Oroville based on the elevation and rate-of-rise of the reservoir. The ESRD becomes active when required releases under the ESRD become larger than the release specified by the FCD. It is important to note that this diagram uses the rate of rise criteria as a surrogate for reservoir inflow.

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ESRD was created with the assumption that the Marysville Dam would be constructed on the Yuba River. With Marysville Reservoir in place, approximately 120,000 cfs would enter the Feather River from the Yuba River during major flood events. Since Marysville Reservoir has not been constructed, a large portion of the Yuba River flow is unregulated, and the Yuba River contribution to the Feather can exceed 200,000 cfs during flood events. Consequently, Oroville must reduce outflows to avoid exceeding its flow target downstream of Marysville-Yuba City under such a condition. The Flood Control Manual requires that, until Marysville Dam is constructed, Oroville's outflow gates be operated to hold 150,000 cfs while the reservoir surcharges up to the elevation of the emergency spillway. The reduced outflows from Oroville mean greater rates of rise in Lake Oroville levels. Consequently, the ESRD activates sooner, and could result in emergency releases that are larger than would be required if Marysville Dam was in place. The ESRD controls outflows at Oroville for floods larger than the 1 in 150 annual expectancy probabilities (AEP).

The spillway of the Oroville emergency spillway is an unprotected hillside, which would suffer severe erosion in the event that the emergency spillway is used. The hillside damage, as well as the downstream transport of eroded soil and rock, would both be operational concerns, leading to consideration of options for limiting such structural damage under large flood scenarios. Erosion of the hillside would also release large amounts of soil and rock into the channel downstream, with potential impacts on downstream channel capacity and environmental quality. Therefore, erosion protection for this hillside may be considered a long-term investment in the integrity and environmental quality of the channel system downstream of the dam. By eliminating this operational concern, there is a greater likelihood that DWR would elect to surcharge the reservoir rather than exceed the 150,000 cfs objective release during major flood events, such as occurred during the 1997 New Year's Flood.

There may also be opportunities to upgrade facilities, including gates, spillways, dam raises, and power plants to improve reliability, efficiency, capacity and performance.

10.2.3. *Shasta Reservoir Expansion*

Constructed between 1938 and 1945, Shasta Dam serves multiple purposes, including navigation, flood control, irrigation and municipal and industrial water supplies, hydropower generation, and fish and wildlife conservation. These purposes significantly contribute to California's economy. In addition, through its extensive recreational resources, Shasta Lake is a critical component of the regional economy of Northern California.

Releases from Shasta Dam often are made for flood management. Releases for flood management occur either in the fall, beginning in early October, to reach the prescribed vacant flood space, or to evacuate space during or after a storm event to maintain the prescribed vacant flood space in the reservoir. During a storm event, releases for flood management occur either over the spillway during large events or through river outlets for smaller events. Between 1950 and 2006, flows over the spillway occurred in 12 years, or in 21 percent of years. During the same time interval, releases for flood management (either for seasonal space evacuation or

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during a flood event, and including spills over the spillway) occurred in about 37 years, or nearly 70 percent of the years.

Shasta Dam provides flood protection to the nearby communities of Redding, Anderson, Red Bluff, and Tehama, as well as to agricultural lands, industrial developments, and communities downstream along the Sacramento River. Shasta Dam is operated for an objective release of 100,000 cfs at Bend Bridge in Red Bluff, and the Reservoir capacity is 4,552 TAF. The end-of-September storage target for Shasta Reservoir is 1,900 TAF, except in the driest 10 percent of water years, to conserve sufficient cold water for meeting temperature criteria for the winter-run Chinook incubation period (summer to early fall). Storage levels are lowest by October to provide sufficient flood protection and capture capacity during the following wet months. The storage target gradually increases from October to full pool in May. Storage is then withdrawn for high water demand (i.e., municipal, agricultural, fishery, and water quality uses) during summer.

A storage space of up to 1.3 MAF below a full pool elevation of 1,067 feet is also kept available for flood management purposes in the reservoir in accordance with the Shasta Dam and Lake Flood Control Diagram, as prescribed by USACE (USACE 1977). Under the diagram, flood management storage space increases from zero on October 1 to 1.3 MAF (elevation 1,018.55) on December 1, and is maintained until December 23. From December 23 to June 15, the required flood management space varies according to parameters based on the accumulation of seasonal inflow. This variable space allows for the storage of water for conservation purposes, unless it is required for flood management based on basin wetness parameters and the level of seasonal inflow. Daily flood management operation consists of determining the required flood storage space reservation, and scheduling releases in accordance with flood operations criteria.

As discussed in Chapter 3, an increase to the storage capacity of Shasta Reservoir is currently proposed by the USBR and is currently in the Feasibility Analysis stage of project development. A draft feasibility report was released in February 2012, which recommended an 18.5 foot increase to the dam as the feasibility analysis shows this to have the greatest net economic benefits. The USBR released the project environmental impact statement (EIS) in July 2013 (USBR, 2013). The 14% (634,000 acre-feet) increase in storage capacity has primary objectives of anadromous fish survival and water supply reliability, with reduced flood damage being a secondary objective. The construction cost is estimated at $1.07 billion (USBR, 2013), and the current schedule shows potential construction beginning in 2020.

10.2.4. *Reservoir Reoperation (Forecast-Coordinated and Forecast-Based)*

<< Under Development >>

10.2.5. *Cottonwood Creek Reservoirs*

<< Under Development >>

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10.2.6. *Glenn County and Colusa County Detention Basins*

<< Under Development >>

10.2.7. *Rock Creek Detention Basin*

<< Under Development >>

10.2.8. *Butte Sink and Colusa Drain Transitory Storage*

10.2.8.1. Butte Sink:

The Butte Basin (also referred to as the Butte Sink) is a natural overflow area that extends south of Big Chico Creek to the Sutter Buttes. Located along the western boundary of Butte County and the eastern boundary of Glenn County, it is bisected by State Highway 162 and located approximately halfway between State Highways 99 and 45.

Degradation of the 3 B's weir has resulted in increased frequency and volume of flooding in the middle and lower parts of the Butte Basin watershed (see more detailed discussion in Section 10.3.1). The increased frequency of flooding has particularly become an issue for agricultural production lands and associated facilities, and for the human-inhabited reaches such as the residential areas along the middle section of Butte Creek and Cherokee Canal. Also, limited road access is very problematic for emergency response and evacuation planning in this area. Major roadways, such as Ord Ferry Road and Highway 162, become inundated when flood waters enter the basin and bridge crossings over the Sacramento River become inaccessible. In addition, when water levels rise in the Butte Sink, backwater effects have far reaching impacts, such as limiting the flow conveyance of Cherokee Canal and limiting the interior drainage capabilities for the areas southwest of Chico and for the northwestern areas of the Sutter Basin.

The Butte Sink is a critical component of the Sacramento River Flood Control System and it provides essential storage which detains and attenuates peak flood flows. However, there is currently a relative lack in definition of this existing system-wide benefit. No established flood flowage easements currently exist and no compensation is currently received by existing landowners who are inundated and impacted by the high water flooding within the Butte Basin. In addition, there are no existing mechanisms in place to protect this essential function from further growth and future development. Recognizing, quantifying, and establishing an approach for protecting the system-wide transitory storage benefits which are already provided by private property agricultural lands within the Butte Sink is important.

10.2.8.2. Colusa Basin Drain:

Similar to the Butte Sink, the Colusa Basin Drain is a critical component of the Sacramento River Flood Control System and it provides essential storage which detains and attenuates peak

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flood flows. Colusa Basin Drain extends from its junction with Willow Creek south to the vicinity of Colusa and then follows the alignment of RD 108's back levee, terminating at the Knights Landing Outfall Gates in Yolo County.

The Colusa Basin Drain was originally constructed to provide drainage for agricultural production, not to provide conveyance for winter flood prevention. As agricultural production and volumes of applied irrigation water have expanded, the drain has also been shown to be undersized in places for handling summer irrigation return flows. The typical pattern of flooding occurring along the Colusa Drain is primarily the result of runoff from foothill streams during the winter and releases of irrigation water from rice fields during the summer. Its original capacity was approximately 1,450 cfs with 1 foot of freeboard; current capacity is about 2,100 cfs at Highway 20 and approximately 12,450 cfs at Knights Landing.

When water levels rise in the Yolo Bypass, the resulting hydraulic barrier prevents the Knights Landing Ridge Cut and other areas upstream from effectively draining. The water that runs off of the western foothills thus runs up against the Colusa Drain levees and forms an unintentional lake which threatens the City of Colusa, major commerce/evacuation routes (such as Interstate 5 and Highway 20), along with homes and agricultural infrastructure up and down the basin.

The locally preferred option for reducing the flood risks posed by the Colusa Basin includes the construction of flood control reservoirs in the western foothills, in combination with other watershed management practices, such as the potential establishment of transitory storage agreements with existing stakeholders.

10.2.9. *Transitory Flood Water Storage & Flowage Easements*

Although specifically applicable to areas within the Butte Sink and Colusa Basin Drain, transitory flood water storage areas and flowage easements may become a significant element of future flood management planning efforts. The terms "transitory flood water storage areas", and "flowage easement areas" need to be clearly defined and subject to broad stakeholder agreement. If these concepts are pursued through the Basin-wide Feasibility Study effort, they should be done so with the principle that they need to support the continued capability of agricultural operations to diversify and remain flexible to meeting changing market demands and crop production technology. The concepts and distinctions of each require an unambiguous and clearly characterized description.

Transitory storage areas should be defined as areas negotiated and mutually agreed to as suitable and designated to provide temporary flood water storage relief on private or public properties, which have been strategically identified in the flood control system and utilized during times of extraordinary and/or emergency storm or flood events. Transitory storage should be undertaken in a planned and coordinated manner with all affected landowners, including compensation and post-flooding recovery plans developed to the satisfaction of all parties. Additional notes regarding some of the common types of transitory storage agreements is provided below.

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- The involved agency(ies) must consider, discuss, and identify such areas in an early, transparent, and open manner with the affected landowner(s), and with the participation of the local flood control agency(ies)
- Fair value for such areas must recognize the public desire and need of such areas or properties for the overall system-wide benefit of functioning as emergency flood control and protection of the urban areas
- Identify areas with minimal human occupation and activity
- Identify areas with minimal number of ownerships or larger single ownership properties
- Identify areas with minimal costly farming or agricultural support infrastructure
- Identify areas with minimal cropping diversity such as large common field crop production fields
- Identify areas with least cost and easily established, required, and implementable farming reconstitution needs and recovery efforts
- Appropriate easements must be perfected and consummated to identify and secure such properties (i.e.; include timeframe of storage use, responsibilities of parties, etc.)

Flowage Easements should be defined as areas negotiated and mutually agreed to as the most suitable for existing or expanded flood conveyance, and which are strategically located with the following considerations:

- The involved agency(ies) must consider, discuss, and identify such areas in an early, transparent, and open manner with the affected landowner(s), and with the participation of local flood protection governing agency(ies)
- Fair value for such areas must recognize the public desire and need of such areas or properties for the overall system wide benefit
- Identify property areas that are easily separated physically and naturally from other properties in the basin area and other impacted areas
- Identify areas with minimal human occupation and activity
- Identify areas with minimal costly farming or agricultural support infrastructure
  The easement should be designed to maximize the owner's continued future use of the property while still being consistent with the purpose and need for the easement.
- Payments to compensate for the reduced usefulness of the property should be flexible enough to be provided to the owner in a revenue stream that best meets their particular needs.
- In some cases, there will be a large up-front payment with smaller payments over the years to reflect the more limited use of the property. In other cases, it may be a smaller up-front payment with a more substantial residual payment stream. The payment stream should also recognize larger balloon payments to compensate the owner for property damage and restoration costs after a flood event.

10.2.10. *Groundwater Recharge*

<< Note to reviewer: The study of groundwater recharge opportunities is beyond the scope of the MUSR RFMP. However, the MUSR RFMP has been coordinating with the North Sacramento

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Valley Integrated Regional Water Management Plan (NSVIRWPM) which includes a number of groundwater recharge projects. The NSVIRWMP is expected to be finalized in spring 2014 and the final draft of the MUSR RFPM will include a discussion of the NSVIRWMP recharge projects which have potential flood management benefits. >>

10.3. Conveyance Improvements

10.3.1. *3B's Weir Improvements*

The 3B's is one of the three low points on the east side of the Sacramento River where floodwater flows away from the main river channel during high flows. The 3B's is critical to the operation of the Butte Basin but was never designed or constructed to operate as a Flood Relief Structure (FRS), and is not actively maintained. The result is that head cuts allow overflows into the Butte Basin when the Sacramento River is well below flood stage, resulting in damages to infrastructure and agriculture and reducing the storage capacity of Butte Basin for a major storm event. Modifications of the existing 3B's area for proper weir design, maintenance and operation would have the dual benefits of reducing the frequency of flood damages in the Butte Basin, while reserving transitory storage capacity for major storm events.

The State Plan of Flood Control relies on the 3B's weir to reduce peak flows downstream on the Sacramento River as overflow in the Butte Basin is essential to the success of the downstream flood management system along the Sacramento River. The Central Valley Flood Protection Board requires the elevation of 3B's weir to remain at or below the elevation required for flood flows to overtop when the gage at Ord Ferry Bridge reaches 114 feet (NGVD29), which is roughly equivalent to a flood flow of 100,000 cfs. However, based upon information from local stakeholders, the weir currently overtops when the gage reaches an elevation of ~110 feet (NGVD29). Restoring the 3B's to elevation 114 feet and developing and implementing a plan for long-term maintenance and operation would help to preserve the flood storage capacity of the Butte Basin for major storm events and would help eliminate the unnecessary damage that occurs to roads, property, agriculture, and infrastructure.

10.3.2. *Colusa, Moulton, and Tisdale Weir Improvements*

<< Under Development. >>

10.3.3. *Fremont Weir/Yolo Bypass Modifications*

Generally, stakeholders within the Mid and Upper Sacramento River Regions are supportive of improvements to the Fremont Weir and Yolo Bypass proposed in the 2012 CVFPP. Modifications to the Fremont Weir have the potential to provide a direct benefit to stakeholders in the Regions by lowering stages in the Sutter Bypass and Sacramento River. In addition, modifications which lower the stage and decrease the duration of high water in the Yolo Bypass would benefit the areas affected by the backwater flooding of the Colusa Drain as the Knights

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Landing Ridge Cut does not effectively drain when there are high stages in the Yolo Bypass. Therefore, the Yolo Bypass enhancements must be carefully planned since water can flow backward (to the north) through the Cut if the water in the bypass becomes higher than that in the Colusa Basin. This can affect lands as far north as the City of Colusa, which is commonly threatened by backwater of the Colusa Drain during times of flooding.

10.3.4. *Cherokee Canal*

Cherokee Canal is a channelized portion of Dry Creek that flows southwesterly from central Butte County to the Butte Sink. Tributaries of Dry Creek/Cherokee Canal include Clear Creek, Gold Run Creek, and Cottonwood Creek. Cherokee Canal is mainly used for irrigation, drainage, and protection of agricultural lands, buildings, and homes. Cherokee Canal flows into the Butte Sink, forms the majority of the northern boundary of the Sutter Basin area, and is surrounded by highly productive rice cultivation.

Cherokee Canal is a component of the SPFC that conveys floodwater originating in the foothills north of the Thermalito Forebay and Afterbay complex. The contributing watershed includes the site of the former Cherokee hydraulic gold mine. During active hydraulic mining of the Cherokee Mine between 1854 and 1916, approximately 51 million cubic yards of sediment were washed into Dry Creek (the un-channelized upper reach of Cherokee Canal). There is accumulated sediment in the creek and valley downstream of Highway 70 that is presently being commercially mined for sand and gravel.

The SPFC facilities consist of levees along Cherokee Canal, the lower reaches of Cottonwood Creek and Gold Run Creek. The facilities reduce flood risk to Richvale, agricultural lands, area transportation facilities, and irrigation canals. The facilities are maintained by DWR as Maintenance Area 13.

Downstream of Highway 99, Cherokee Canal is constrained within relatively narrow levees, creating a floodway that, when subject to flood flows, exceeds minimum freeboard relatively frequently. The right-bank levee along Dry Creek and Gold Run Creek extends about 5.2 miles from high ground to the confluence with Cottonwood Creek. The left-bank levee extends about 3.5 miles from high ground to the confluence with Cottonwood Creek. The design capacity of this reach is about 8,500 cfs with 3 feet of freeboard, based on the O&M manual.

The lower reach of Cottonwood Creek has a design capacity of about 3,500 cfs. Right- and left-bank levees, each about 1.3 miles long, extend from high ground to the connection with the Cherokee Canal levees.

Downstream from Cottonwood Creek, the Cherokee Canal has a design capacity varying from 11,500 cfs to 12,500 cfs, based on the O&M manual. The right-bank levee extends about 14 miles. The left-bank levee is about 17 miles long. About midway along this reach, to allow flow to enter from the east, the left-bank levee is broken into two parallel segments for approximately 1.5 miles.

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10.3.4.1. Issues

Original Design Deficiencies:
The Cherokee Canal was designed and built in its current location by the USACE in 1960 under the authorization of the Flood Control Act of 1944. The design flow of 11,500 cfs is to be passed through the lower portion of the project (downstream of Cottonwood Creek) at or below the 1957 design flood profiles. Recent studies (ESA PWA, 2011) have been conducted to assess conveyance of the original design. Results show that the original as-designed conditions do not provide 3 feet of freeboard at the design capacity of 11,500 cfs.

Also, based on recently-observed stage and discharge data, as well as modeling of existing and as-designed conditions, the original design assumptions related to channel and floodplain roughness (e.g., the assumption of "bare ground") were unrealistic and are unmaintainable—particularly given the current regulatory constraints associated with prohibit vegetation removal (ESA PWA, 2011).

Capacity:
DWR is required to maintain the project so that the channel can pass the design flow of 11,500 cfs at or below the 1957 design flood profiles. Typically in Cherokee Canal, this means having 3 feet of freeboard at the design discharge.

Based on hydraulic assessments completed using a calibrated HEC-RAS model for existing conditions (ESA PWA, 2011):

- Conveyance of the design flow of 11,500 cfs breaks the 1957 design flood profiles, with overtopping located immediately downstream of the Richvale Highway bridge.
- The maximum capacity for existing conditions is 10,140 cfs.
- The discharge at which 3 feet of freeboard is attained is 5,030 cfs.

History of Failures:
Major floods have occurred along Cherokee Canal in 1964, 1986, 1989, 1996, and 1997, with numerous reports of water at the levee crown. Cherokee Canal levees were overtopped in 1989, 1996, and 1997. In 1986, the Cottonwood Creek levees broke at the confluence with Cherokee Canal. The right bank breach was approximately 20 feet to 30 feet wide and the breach caused ponding in the area northeast of the Cottonwood/Cherokee confluence. The left bank also failed in 1986 into the Richvale-Butte Canal. The canal contained the breach and flooding did not occur southward.

In March 1989, the left-bank (east) levee just upstream from the Nelson-Shippee Road was overtopped and failed when debris blocked a portion of the Nelson-Shippee Road bridge. The west levee was overtopped at the Richvale Highway in January 1996. On January 22, 1997, the north levee on Gold Run Creek and the south levee on Cottonwood Creek were overtopped at several locations. In December 1997, the levee was sandbagged to prevent overtopping at the Richvale Irrigation District's main canal, located approximately 1 mile upstream of Butte City-Biggs Highway.

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Sedimentation:

In the following years after initial construction, sediment from historic hydraulic mining began to accumulate within the canal. As a result, flood flows reached or exceeded flood stage on numerous occasions in the 1960's. Sediment deposition is a major maintenance issue for much of the length of Cherokee Canal, due to the continued discharge of sediment from gravel pits and the Cherokee Hydraulic Mine on Dry Creek and Gold Run Creek.

Past studies show that a 2-year storm event delivers approximately 23,000 tons of sediment to the canal and a 100-year storm event delivers approximately 103,000 tons; the addition of this sediment to the Cherokee Canal between the Cottonwood Creek junction and Highway 162 bridge has reduced this section's original design hydraulic capacity by 30 to 40 percent (URS, 2003).

However, sediment data collected by USGS in 2010 at Nelson Road suggests that the sediment supply and transport through the valley reaches of Cherokee Canal may be decreasing. There is still a substantial amount of hydraulic mine-derived sediment in the upper reaches of Dry Creek (upstream of Clark Road/Highway 191 and downstream of Highway 70), but these areas are being mined for sand and aggregate and future changes in the magnitude of mining activities or a change in mining practices could influence future sediment supply to downstream reaches.

DWR has removed large quantities of sediment accumulation from the canal as part of its ongoing maintenance activities and is continuing to refine its maintenance practices in attempt to restore and maintain channel capacity while retaining the wildlife habitat values of the channel. However, these efforts have become increasingly challenging through time, primarily due to the high costs and time constraints of environmental mitigation associated with Giant Garter Snake habitat, along with the costs associated with the long-distance trucking (and associated air quality impacts) of removed sediment.

In June of 2009, the California Department of Water Resources (DWR) published the Proposed *Mitigated Negative Declaration and Draft Initial Study for the Cherokee Canal Corridor Management Strategy (CMS) Pilot Project: Phase 1 Sediment Removal*. This study assessed the existing channel habitat and geomorphology and evaluated the potential environmental effects of a proposed CMS Pilot Project. The study proposed to remove approximately 750,000 cubic yards of accumulated sediment in the Cherokee Canal for the four mile section between the Cottonwood Creek confluence and the UPRR Bridge. Conversations with DWR staff note that the Cherokee Canal CMS project was put on hold because of two primary reasons: 1) because of cost overruns on environmental compliance and 2) because of the inclusion of a Feather River bypass component in the 2012 CVFPP.

Vegetation:

Volunteer riparian vegetation grows quickly on the deposited sediment. The combination of mineral soil, suitable topography, and inflows of water from the contributing watershed and agricultural return has created ideal conditions for germination and growth of riparian vegetation. Typical riparian species within the canal are cottonwoods, willows, and alders making it difficult and expensive to maintain channel capacity.

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DWR is responsible for maintaining the canal for flood management purposes. Portions of the Cherokee Canal and its levee slopes are mowed, burned, or sprayed with herbicides on an annual or more frequent basis in an effort to maintain the required capacity of the canal. Under the terms and conditions of a Memorandum of Understanding issued to DWR by the California Department of Fish and Wildlife (CDFW), DWR maintenance crews do not currently remove trees greater than 4-inches diameter at breast height (DBH). CDFW agreed to DWR maintaining the floodway to include a 15 foot riparian buffer along the low-flow channel; however, because annual maintenance budgets are not consistent, if trees expand beyond this buffer width and grow to exceed the 4-inch DBH size, then those trees outside the buffer area may not be removed. This has occurred, and existing vegetation in the floodway is excessive in some locations and removal as a part of normal channel maintenance as permitted by CDFW is not viable. Thus, removal must be done as a part of a dedicated effort that includes mitigation for the impacts to riparian habitat, and it is therefore difficult and expensive to remove vegetation to increase channel capacity.

Bridge Crossings:

Numerous bridge crossings pose additional hurdles for potential channel modifications. From upstream to downstream, the main bridge crossings include:

1. Nelson Road Bridge
2. Nelson-Shippee Road Bridge
3. Richvale Highway Bridge
4. UPRR Bridge
5. Highway 162 Bridge

During high water events, there are issues with debris buildup at the bridge crossings, particularly at the UPRR bridge. This railroad trestle is aligned at an approximate 45 degree skew from normal flow, and the piers of the trestle are aligned perpendicular to the track. Thus, the floodway, as considered from the vantage of looking downstream, is almost completely obstructed and, according to DWR maintenance staff, the trestle acts like a 'debris net' during floods.

Levee Height:

There are issues regarding the elevation of the right bank levee near the Richvale Highway bridge crossing. This section of levee protects major infrastructure including the small community of Richvale, high value agriculture processing and storage facilities, wastewater treatment facilities, local public water supply wells, and a local fertilizer plant. Locals have expressed the concern that if overtopping of the levee were to occur, it would occur here first and thus result in the flooding of the only major infrastructure in the area.

10.3.4.2. Potential Solutions

The 2012 CVFPP discussed the possibility of expanding and extending the Cherokee Canal to act as a Feather River Bypass (see additional discussion in Section 10.4 below). Significant concerns regarding redirected hydraulic impacts, were raised during MUSR RFMP development

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by local property owners and stakeholders. Therefore the physical and operational elements recommended in the MUSR RFPM do not include expansion of the Cherokee Canal as a locally preferred project. Instead there are a number of locally preferred alternatives including:

- Develop a long-term Corridor Management Plan that establishes a regular schedule for clearing vegetation and removing sediment. The CMP should include a consistent and reliable funding source, and it should examine the entire system of the Cherokee Canal and not revolve around a 'segment by segment' approach. Cost saving options should be explored for contracting with locals to perform maintenance activities. The CMP should recognize and protect the benefits and value of existing Giant Garter Snake habitat provided by adjacent private property rice lands, in addition to the habitat concept of 'quality' over 'quantity'. Options may also exist to coordinate rice field operations with the local rice growers association (i.e. do not flood specific rice fields during the fallow season to improve GGS habitat), or to restore areas just outside of the canal, in exchange for less restrictive permitting requirements inside the levees.
- Construct upstream detention basins to control hydraulic mining sediment deposits, potentially incorporating a groundwater recharge component.
- In addition to in-channel maintenance to increase conveyance, levee raises/repairs should be implemented—either as a part of the channel maintenance or separately. The right bank reach upstream of the Richvale Highway Bridge downstream to the UPRR trestle should be the priority area, as this stretch of levee protects existing infrastructure including the small community of Richvale, high value agriculture processing and storage facilities, wastewater treatment facilities, local public water supply wells, and a local fertilizer plant. Existing studies show that by simply continuing the grade from the 1974 levee raise (i.e., use the same slope and tie in to the downstream elevation of the levee raise) from the Richvale Highway Bridge to the UPRR would likely solve the issue of overtopping in this area.
- Construct an overflow relief weir along left bank levee to limit water stages within the canal during times of high flow and secure flood flowage easements on local agricultural areas which become inundated as a result. Preliminary review of existing studies indicates that overflows escaping outside of the channel would flow somewhat adjacent to the existing canal and eventually end up in the Butte Sink. This option could direct flood impacts away from existing infrastructure, however, it should only be implemented with the willing consent of impacted local landowners.
- Construct flow conveyance improvements at the various bridges, particularly to the UPRR railroad crossing and Richvale Highway Bridge.
- Continue to monitor sediment transport and supply into the project area, and explore potential changes to existing upstream mining activities (i.e., extraction in-channel versus floodplain; BMP alternatives).
- Identify and develop a process for the beneficial reuse of sediment extracted from the canal (material management planning)
- Improved flood depth mapping (See Chapter 7)

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10.4. Bypass Systems

The Sutter and Yolo bypasses, in combination with their appurtenant control features, the Moulton, Colusa, Tisdale, Fremont, and Sacramento weirs/bypasses – function as the central backbone of the Sacramento River Flood Control Project. Floods from storms centered within different tributary watersheds of the Sacramento River Basin have different characteristics, and the 2012 CVFPP proposed bypass system expansion as a way to increase the overall capacity and to accommodate greater system flexibility in managing large flood events. The DWR led Sacramento River Basin-Wide Feasibility Study is expected to describe in more detail how bypass system expansion will be accomplished and what benefits will be achieved. This section discusses the 2012 CVFPP bypass system expansions as they relate to the MUSR RFMP planning area.

10.4.1. *Sutter Bypass*

The Sutter Bypass was constructed to create a bypass flood channel for the Sacramento River system as a component of the State Plan of Flood Control. The Sutter Bypass conveys overflow flood waters in a southeasterly direction away from the Sacramento River at a capacity substantially greater than the Sacramento River. As such, it is an integral part of the existing integrated flood management system, which helps protect the small agricultural legacy communities of Colusa, Meridian, Grimes, Robins, Kirkville, and Knights Landing. The Sutter Bypass originates southwest of the Sutter Buttes, downstream of Butte Slough, and terminates at Fremont Weir, 35 miles downstream.

It receives flood flows from the Butte Basin overflow area near Ord, from Moulton Weir, Colusa Weir, Tisdale Weir, Butte Creek, Cherokee Canal, local drainage from the western portion of the Sutter Buttes, local drainage from the eastern portion of the Sutter Buttes via Wadsworth Canal, and local drainage from the Sutter Basin via pump stations.

The Sutter Bypass is a wide flat channel dropping less than 30 feet over a distance of over 35 miles and varying in width from approximately 4,000 feet in its upper reaches to 6,200 feet along its furthest downstream reach between Nelson and Sacramento sloughs where the bypass parallels the Feather River channel.

The West Borrow and East Borrow canals were excavated parallel to the bypass levees to supply the borrow materials needed to construct the bypass channel levees. Both canals convey water year round. Small weirs with fish bypass facilities control the water levels in the canals to facilitate irrigation of the agricultural lands within the bypass.

USACE design flows for the Sutter Bypass increase in the downstream direction, from 150,000 cfs at its upstream starting point at Butte Slough near State Route 20 to the Wadsworth Canal, to 155,000 cfs between the Wadsworth Canal and the Tisdale Weir. Further downstream the Sutter Bypass was designed to pass 180,000 cfs between Tisdale Weir and Nelson Slough and then 380,000 between Nelson Slough and the confluence with the Sacramento River at Verona.

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In the 2012 CVFPP, DWR recommended consideration of increasing the capacity of the Sutter Bypass to convey larger flood events. This expansion would likely require building a new levee for about 15 miles along one side of the bypass to widen the bypass (shown as the eastern side in the 2012 CVFPP) for increased flow capacity. DWR used a 1,000-foot increase in the bypass width for 2012 CVFPP planning purposes, with 75 percent of the new width allocated to agricultural use and 25 percent allocated to habitat restoration. Modifications to the Colusa and Tisdale weirs and the Butte Basin overflow areas from the Sacramento River would be considered as part of the expansion. The expansion may also require rebuilding some SPFC facilities, such as weirs and pumping stations.

Study of the proposed Sutter Bypass expansion is beyond the scope of the MUSR RFMP; DWR intends to further analyze the Sutter Bypass Expansion in the Sacramento River Basin-Wide Feasibility Study. However, concerns raised by local stakeholders during the MUSR RFMP development have included:

Sedimentation and Vegetation:
Given its importance in conveying massive flood flows for the Sacramento River Flood Control Project while protecting adjacent lands and communities, a significant concern is the incremental loss of channel capacity over time due to sediment accumulation and the growth of woody vegetation in portions of the bypass. While sediment is occasionally removed by DWR from the bypass channels of Moulton Weir, Colusa Weir, and Tisdale Weir, the Sutter Bypass itself is losing depth and capacity over time due to sediment and vegetation buildup.

Based on a recent analysis prepared by CVFPB (CH2M Hill, 2013):

1. Under Existing Conditions, the Sutter Bypass cannot pass the 1957 design flow at the design stage along a cumulative distance of 22 miles.

2. Water surface elevations would be reduced by as much as 1.5 feet if 2,098 acres within the Sutter National Wildlife Refuge (SNWR) were converted to agriculture land use. 16 miles of the Sutter Bypass would still be unable to pass the 1957 design flow at the design stage.

3. Water surface elevations would be reduced by as much as 0.8 feet if 1,646 acres of the managed parcels in the SNWR were converted to agriculture land use. 19.5 miles of the Sutter Bypass would still be unable to pass the 1957 design flow at the design stage.

Loss of Agricultural Land:
Incorporating a 1,000 foot wide bypass expansion on the east side of the Sutter Bypass is predicted to encompass 2,459 acres of land into the active floodplain. Land uses currently in the expansion zone are comprised of 90% productive agricultural land and 10% habitat. Incorporating a 2,000 foot wide expansion on the east side of the Sutter Bypass would move an estimated 5,324 acres of land, which is 91% productive agricultural land and 9% habitat, into the active floodplain.

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A recent study (California Polytechnic State University, 2013) analyzed the economic impact from the annual loss of agricultural production from widening the Sutter Bypass. Direct impacts include the initial change in expected economic activity from lost wages and agricultural expenditures over a thirty-year horizon. Indirect impacts include the local "business-to-business" transactions necessary to support the direct activity, for instance, local purchase of farm machinery, hiring of agricultural consultants, and other goods purchased from supporting industries. Additional induced impact occur when wages generated by the direct and indirect economic activity are spent on local goods and services; for example, when agricultural laborers or farm proprietors use earnings to purchase food, clothing, automobiles, real estate, education, and health and social services.

The California Polytechnic State University Study's draft finding include:

- A 1,000 foot wide expansion of the Sutter Bypass is estimated to result in:
  - an annual loss of 45 job-years;
  - a total annual economic impact of $4,687,888;
  - a total economic impact over a thirty-year horizon of $141 million.

- A 2,000 foot wide expansion of the Sutter Bypass is estimated to result in:
  - an annual loss of 106 job-years;
  - an annual economic impact of $10,589,883; and
  - an economic impact over a thirty-year horizon of $318 million.

The estimated economic losses over a 30-year horizon are substantial in relation to the combined economic productivity of Sutter County. For the 1,000 foot wide expansion scenario, this amounts to a one-time payment of approximately $1,480 for every person residing in Sutter County, or $4,438 per household. For the 2,000 foot wide expansion scenario, this amounts to a one-time payment of approximately $3,343 for every person residing in Sutter County, or $10,032 per household. Considering that the median household income in Sutter County was $50,010 in 2009, the economic losses resulting from widening the East side of the Sutter bypass are significant.

Potential solutions that were brought forth locally for future study consideration in the Basin-wide Feasibility Study effort as alternatives to a Sutter Bypass expansion include:

- Develop a long-term Corridor Management Plan that establishes a regular schedule for clearing vegetation and removing sediment. The CMP should examine the entire system and associated elements of the Sutter Bypass and not revolve around a 'segment by segment' approach. Cost saving options should be explored for contracting with locals to perform maintenance activities. The CMP should recognize and protect the benefits and value of existing habitat provided by adjacent private property agricultural lands, in addition to the habitat concept of 'quality' over 'quantity'. Options may also exist to coordinate agriculture operations (i.e. do not flood specific rice fields during the fallow season to improve GGS habitat), in exchange for less restrictive permitting requirements inside the levees. There are significant opportunities to encourage wildlife-friendly

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farming practices within the Sutter Bypass since the majority of the Bypass is privately-owned and actively farmed.

- Construct and/or expand upstream reservoirs to increase capacity and improve system flexibility. Specific potential locations (discussed previously) include: Sites Reservoir, Shasta Dam Raise, Oroville Dam, and Cottonwood Creek Reservoirs.
- Implement Forecast-Coordinated Operations (F-CO) to improve system flexibility. F-CO seeks to improve the management of reservoir flood control pools to reduce peak flood flows downstream through the use of improved watershed and river forecasting and the coordination of releases during flood operations. Opportunities exist for coordinating the releases from Shasta Dam (Bureau of Reclamation), Black Butte Dam (USACE), Oroville Dam (DWR), and Bullard's Bar Dam (Yuba County Water Agency) to improve upon the management of flows through the Sutter Bypass.
- Implement repairs to the 3B's overflow weir, along with other improvements to the Butte Basin (see Section 10.2.8) to reserve its transitory storage capacity and allow for better detainment of peak flood flows. Opportunities may also exist for integrating the improved management of flows within the Butte Sink with F-CO of Shasta Dam and Black Butte Dam.
- In addition to in-channel maintenance to increase conveyance, levee raises/repairs should be implemented—either as a part of the channel maintenance or separately, in order to re-establish the bypass to its original design capacity, and to reduce the flood risk on the adjacent lands protected by the Sutter Bypass levees. Raising the existing levees should also be explored as a way to increase capacity and improve system flexibility.
- Channelization could be performed throughout the Sutter Bypass to create a larger low-flow channel which may provide a more rapid drainage of the Butte Basin. This could potentially reserve the transitory storage capacity of the Butte Basin and allow better detainment of peak flood flows. There also may be potential within the CMP to balance the results of regularly dredging a channelized bypass to accommodate a continuous path of quality habitat.
- Identify and develop a process for the beneficial reuse of sediment (material management planning)

10.4.2. *Feather River Bypass*

The 2012 CVFPP proposed evaluating the feasibility of constructing a new bypass from the Feather River to the Butte Basin to improve flood protection along the Feather River south of Thermalito. The new bypass would require construction of about 16 miles of new levees across the northern end of the Sutter Basin

In adopting the 2012 CVFPP, the CVFPB voiced serious concerns about the proposed Feather River Bypass in that it: (a) could have adverse, unmitigated hydraulic effects on downstream landowners; and (b) is unlikely to be found economically justifiable. Therefore, in its adoption resolution the CVFPB removed the Feather River Bypass from the CVFPP and advised DWR to instead:

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- Consider improving Cherokee Canal to its original design capacity; and
- Consider alternatives to the Feather River Bypass with alternatives being evaluated on an equal footing.

The CVFPB did allow that the Feather Bypass may be brought forward again in the 2017 update of the CVFPP.

As with the proposed Sutter Bypass expansion, study of the Feather River Bypass is beyond the scope of the MUSR RFMP; DWR intends to further analyze the Feather River Bypass in the Sacramento River Basin-wide Feasibility Study. However, serious concerns have been raised by local stakeholders during MUSR RFMP development regarding redirected hydraulic impacts. In lieu of constructing the a new Feather River bypass, MUSR RFMP local stakeholders have strongly urged that the Basin-wide Feasibility Study fully evaluate other alternatives such as expanding surface water storage, developing and implementing a plan for effective operation and maintenance of the current Cherokee Canal, implementing Forecast-Coordinated Operations to improve system flexibility, improving the use of the Oroville Wildlife Area for retaining peak flood flows, and others.

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11. Implementation Strategies

11.1. Overview

The MUSR RFMP process has identified a large number of projects local stakeholder would like to see implemented to improve flood system management with the Regions. However to implement flood system improvements, project proponents must navigate a myriad of funding, political, and regulatory challenges. Also many of the projects identified will need to meet multiple objectives (i.e. reduce flood risk, promote ecosystem restoration, improve water system reliability etc.) in order to fully leverage every local dollar spent against State and Federal dollars.

Potential projects identified by stakeholders during development of the MUSR RFMP include both structural system improvements (such as levee/channel/bypass improvements) and non-structural improvements (such as improved flood warning systems, coordinated emergency response operations, programmatic permitting, etc.). In addition, non-structural projects also include additional recommended studies and/or evaluations for areas where information on the existing flood management facilities is lacking or the preferred path for moving forward is unclear.

This chapter summarizes the various structural and non-structural projects presented throughout this RFMP, and will attempt to develop strategies for project implementation.

11.2. Summary of Potential Projects

A summary of the potential projects discussed throughout this RFMP is presented in Table 11-1.

11.3. Project Assessment

<< Note to Reviewer: The projects included in Table 11-1 will be assessed and evaluated by Regional stakeholders during the review of the Working Draft to determine if they should be carried forward to the final draft RFMP.>>

11.4. Project Implementation Strategies

11.4.1. *Introduction*

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<< Note to Reviewer: In the final MUSR RFMP, this chapter will present implementation strategies for the projects included in the final RFMP. These strategies may include:

- Grouping similar type projects into 'programs' to aid with programmatic regulatory and environmental permit streamlining;
- Pairing/combining projects to develop multi-benefit projects;
- Refining project descriptions to better align with State and Federal funding programs;
- Petitioning State and Federal agencies to develop streamline permitting approaches for identified programs of projects;
- Petitioning State and Federal agencies to develop funding new programs and/or modify existing programs to better assist with project implementation in rural areas; and
- Developing funding strategies for project implementation>>

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Table 11-1. Mid and Upper Sacramento River Regional Flood Management Plan

WORKING DRAFT - Potential Project List, March 28, 2014

MUSR ID	County	Project Partners		Project Name/Type	Project Description	Project Cost
		Lead Agency	Partner Agency(s)			Amount ($)
A1	All	*	Northern California Regional Land Trust	Northern Sacramento Valley Regional Atlas	Development of a centralized GIS database and Digital Atlas for the Northern Sacramento Valley Region to build a comprehensive collection of water and resource management-related spatial information.	
A2	All	*		Improve Flood Reservoir Operations	Implement Flood-Coordinated Operations (F-CO) for Shasta Dam and Black Butte Dam.	
A3	All	*		Sites Reservoir	New off-stream storage reservoir.	
A4	All	*		Deer Special Hunt Permits	Manage deer populations through special hunt permits.	
A5	All	*		Property Line Survey	Surveying property lines and sign posting on private lands so CDFW enforcement staff can help keep the public off of private lands adjacent to CDFW owned or managed lands.	
A6	All	*		Establish Flood Structure Protection Area Zones	To ensure LMAs have an opportunity to review and comment on land-use activities which could impact their systems, improved communication and interaction between LMAs and land-use authorities is needed. Creation of "Flood Structure Protection Areas" directly adjacent to levees and other flood control structures would provide LMAs an opportunity for input on land-use decisions occurring in the vicinity of their facilities. These areas would be identified in county and city floodplain management ordinances and/or general plans as zones in which input is required from LMAs before land-use decisions are finalized.	
A7	All	*		ER Training	Training for Emergency Response Responders	
A8	All	*		Vegetation and Sediment Removal Programs	Establish regularly scheduled vegetation maintenance and sediment removal programs for the Sutter Bypass, Tisdale Bypass, and Cherokee Canal.	
A9	All	*		Develop more detailed 100-year/200-year/500-year floodplain delineations for areas near the Sacramento River and Butte Basin.		
A10	All	*		Continuance in Federal Program Feasibility Study	A feasibility level analysis to identify levees that while providing critical flood protection, may benefit from being removed from the Federal program, while remaining in the State Plan of Flood Control. In this study, consideration should be given to the ability of LMAs and the State to meet standards which would provide emergency and rehabilitation assistance, the ability to fund levee improvement projects without Federal cost-share dollars, and liability for damages in the event of failures. Further consideration should be given for evaluating where levees may not be necessary and could altogether be removed from the Federal program.	
A11	All	*		Levee Easement and Property Line Survey	Research and survey the existing levee easements and adjacent property lines. There is no existing clear definition regarding the locations of LMA's legal boundaries.	
A12	All	*		Activity-Specific Programmatic Permitting	Develop program level permitting to streamline permit acquisition to avoid repeating permitting processes each time an activity is undertaken. Similar to the DWR approach with the Small Erosion Repair Program (SERP).	
A13	All	*		Master or Programmatic Streambed Alteration Agreements	A Master SAA (Master Agreement) may be obtained to cover a large, multi-phased project consisting of smaller specific projects for which detailed project plans are not available at the time the SAA is applied for. The SAA process would then be streamlined as each smaller future project is implemented.	
A14	All	*		Program EIRs	Develop a program EIR for series' of actions that can be characterized as one large project. When subsequent activities considered in the program EIR are ready for implementation, a checklist may be used to determine whether the environmental effects of the activity were covered in the program EIR. If it is found that the subsequent activity has no new effects not already identified in the program EIR, and no new mitigation would be required, the subsequent activity can be approved as being within the scope of the project covered by the program EIR, and no new CEQA document would be required. If there are new effects or new mitigation measures are needed, a CEQA document addressing the subsequent activity may focus solely on the new effects or mitigation that had not been considered before.	
A15	All	*		Regional General Permits (RGPs)	A Regional General Permit (RGP) is issued by a USACE district or division and authorizes a class of activities within a geographic region that are similar in nature and have minimal individual and cumulative environmental effects. RGPs may be used to collectively meet permitting needs for multiple projects, over longer planning horizons, while also consolidating mitigation and conservation efforts into larger, more viable conservation areas. Overall RGPs streamline the USACE permitting process by avoiding the need to obtain separate permits on a project-by-project basis.	
A16	All	*		Advanced Regional Mitigation Banks	Advanced mitigation of flood management improvements provides a means of making flood maintenance less expensive and timelier	
A17	All	*		Corridor Management Strategy	The Corridor Management Strategy (CMS) approach is a concept for improving flood management and ecological conditions at scales that are both manageable and flexible to meet multiple needs. The CMS process involves developing a vision, strategy, and plan (CMP) for managing a corridor that integrates flood risk management, improved ecosystem function and integrated water management over a long-term (greater than 30 years) planning horizon.	
A18	All	*		Safe Harbor Agreements	A Safe Harbor Agreement is a voluntary agreement between any non-Federal property owner(s) and the USFWS or the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (collectively, the Services) whereby performing actions that contribute to the recovery of listed species and fulfilling the conditions of the Safe Harbor Agreement, the property owner(s) will receive formal assurances from the Services that they will not require any additional or different management activities by the parties without their consent.	
A19	All	*		Working Landscapes	The purpose of Working Landscapes is to encourage farmers to invest in habitat on farmland in a manner that is mutually beneficial to production agriculture and the ecosystem	
A20	All	*		Levee Maintenance Issues	Develop a Regional Roundtable including LMA, Resource Agencies, State, and USACE representatives to develop strategies, programs, and projects to address the O&M issues discussed in Chapter 4 of the MUSR RFMP.	
B1	Butte	Butte County Department of Water and Resource Conservation		Identification and Evaluation of Groundwater Recharge	To provide a more comprehensive, defensible characterization of this important asset, Butte County is proposing a Project that will characterize countywide groundwater recharge areas, identify potential areas for active recharge projects, and investigate possible groundwater recharge processes at one location. The first task involves preparing a countywide map identifying areas based on their potential to recharge groundwater. The purpose of the map will be to provide technical assistance to local land managers and planners to fulfill obligations to protect groundwater recharge areas. The second task will further identify specific areas in the county where groundwater recharge projects (e.g., flood detention basins, storm water or similar facilities) could provide benefits and may be viable. A third task will involve an investigation of groundwater recharge processes in a defined study area. The location will be chosen based on results from task one and two, availability of existing data, and site accessibility. Although data exists to reasonably characterize recharge conditions in some areas of Butte County, uncertainty exists in specific locations due to complex hydrology and geology. Therefore, the site investigation will use a suite of data types and analyses, including a geophysical investigation to better characterize the subsurface and possibly quantify recharge.	

Table 11-1. Mid and Upper Sacramento River Regional Flood Management Plan

WORKING DRAFT - Potential Project List, March 28, 2014

MUSR ID	County	Project Partners		Project Name/Type	Project Description	Project Cost
		Lead Agency	Partner Agency(s)			Amount ($)
B2	Butte	Butte County Division of Environmental Health		Butte County Well Abandonment Program	The Division of Environmental Health proposes to fund staff time and procurement of field equipment in order to begin a field survey to document and create an inventory of improperly abandoned domestic and irrigation wells throughout the county. It is the intent of the Division to work collaboratively with other County departments in order to ensure project success. The key recharge areas of the County will be given the highest priority for initial land surveys, and any well presenting a fall in hazard to humans or animals will be designated as critical for proper abandonment. Once the field portion of the work is under way, staff will develop a database management system. Each abandoned well will be categorized and assigned a tracking number that includes all the pertinent physical data associated with that location. This information will also be utilized for creation of map layers in GIS.	
B3	Butte	Butte County PWD		Levee Patrol Road Improvements		
B4	Butte	Butte County PWD		PL84-99	Unit #1 (RB Mud Creek): Repair deficiencies to regain active status in the PL84-99 Program. Deficiencies include: Vegetation, Encroachments, Animal Control, Slope Stability, and Erosion	
B5	Butte	Butte County PWD		PL84-99	Unit #2 (LB Mud Creek): Repair deficiencies to regain active status in the PL84-99 Program. Deficiencies include: Vegetation, Encroachments, Animal Control, Slope Stability, and Erosion	
B6	Butte	Butte County PWD		PL84-99	Unit #2A (LB Channel Slough): Repair deficiencies to regain active status in the PL84-99 Program. Deficiencies include: Vegetation, Encroachments, Animal Control, Slope Stability, and Erosion	
B7	Butte	Butte County PWD		PL84-99	Unit #3 (RB Sycamore and Sheep Hollow Creeks): Repair deficiencies to regain active status in the PL84-99 Program. Deficiencies include: Vegetation, Encroachments, Animal Control, Slope Stability, and Erosion	
B8	Butte	Butte County PWD		PL84-99	Unit #4 (RB Sycamore and Dry Creeks): Repair deficiencies to regain active status in the PL84-99 Program. Deficiencies include: Vegetation, Encroachments, Animal Control, Slope Stability, and Erosion	
B9	Butte	Butte County PWD		PL84-99	Unit #5 (Big Chico Diversion): Repair deficiencies to regain active status in the PL84-99 Program. Deficiencies include: Vegetation, Encroachments, Animal Control, Slope Stability, and Erosion	
B10	Butte	Butte County PWD		Erosion	Bank protection project to repair erosion site at RM 0.00, LM start 4.32, LM end 4.37	
B11	Butte	Butte County PWD		Stability Repair	Bank protection project to repair serious stability site, LM start 5.73, LM end 6.05 LB	
B12	Butte	Butte County PWD		Other	Unit#1, RB, LM start 4.8. Undercut out fall associated aggradations.	
B13	Butte	Butte County PWD		Erosion Repair	Unit#1, RB, LM start 4.22. 2011: Two large erosion scallops at the toe from a rotational failure. Deep cracks along the slope indicate the potential for further failures. [2011 Site ID: MUD_4-4_R]	
B14	Butte	Butte County PWD		Other	Unit#1, RB, LM start 1.87. Large Sandbar, most critical location, loss of capacity.	
B15	Butte	Butte County PWD		Other	Unit#1, RB, LM start 2.34, LM end 2.4. Sandbar through HWY 32 Bridge.	
B16	Butte	Butte County PWD		Encroachments	Unit#1, RB, LM start 2.95. Remove encroachments. Sandbar causing loss of capacity.	
B17	Butte	Butte County PWD		PL84-99	Unit#1, RB, General PL84-99 repair of deficiencies including: Vegetation, Encroachments, Animal Control, Slope Stability, and Erosion	
B18	Butte	Butte County PWD		PL84-99	Unit#1, RB, Bank protection project to repair erosion site at RM 0.00, LM start 4.32, LM end 4.37	
B19	Butte	Butte County PWD		Stability Repair	Unit#1, RB, Bank protection project to repair serious stability site, LM start 5.73, LM end 6.05 LB	
B20	Butte	Butte County PWD		Serious Slope Stability	Unit#2, LB, LM start 5.73, LM end 6.05. Cracking at waterside toe, 5 inches deep by 15 to 20 ft. long.	
B21	Butte	Butte County PWD		PL84-99	Unit#2, General PL84-99 repair of deficiencies including: Vegetation, Encroachments, Animal Control, Slope Stability, and Erosion	
B22	Butte	Butte County PWD		Other	Unit#2b, LB, LM start 4.2, LM end 4.4. Aggradations associated with cut.	
B23	Butte	Butte County PWD		PL84-99	Unit#2A, General PL84-99 repair of deficiencies including: Vegetation, Encroachments, Animal Control, Slope Stability, and Erosion	
B24	Butte	Butte County PWD		PL84-99	Unit#3, General PL84-99 repair of deficiencies including: Vegetation, Encroachments, Animal Control, Slope Stability, and Erosion	
B25	Butte	Butte County PWD		PL84-99	Unit#4, General PL84-99 repair of deficiencies including: Vegetation, Encroachments, Animal Control, Slope Stability, and Erosion	
B26	Butte	Butte County PWD		PL84-99	Unit#5, General PL84-99 repair of deficiencies including: Vegetation, Encroachments, Animal Control, Slope Stability, and Erosion	
B27	Butte	DWR		The 3B's Weir Improvements	The 3B's Weir Improvements: The 3B's weir has degraded over time and allows overflows into Butte Basin when the Sacramento River is well below flood stage. Improvements are needed to raise the weir and then harden it so that the weir does not degrade in the future. Overflows from the 3B's weir result in damages to agricultural lands and infrastructure. Overflows from the 3B's weir result in numerous road and bridge closures such as Hwy 162 and Ord Ferry (in 1995, Hwy 162 east of Butte City was closed for 26 days). It is believed that the Goose Lake Weir and the Phelan Levee have already been hardened and do not need improvements.	
B28	Butte	DWR		Cherokee Canal Improvements		
B29	Butte	DWR		Butte Basin Overflow Weir Maintenance	State maintains Goose Lake and M&T weirs; no maintenance at 3 B's. Improved maintenance is needed following flood events (cleaning debris, repairing washout damage, etc.).	
B30	Butte	DWR		Butte Slough Outfall Gates Replacement	Butte Slough Outfall Gates- DWR is beginning the environmental process for replacement of the Butte Slough outfall gates. Historical confluence of Butte Creek with Sac River.	
B31	Butte	MA 05		Levee Patrol Road Improvements	Levee Patrol Road Improvements, Unit#1, LB.	
B32	Butte	MA 05		Levee Patrol Road Improvements	Levee Patrol Road Improvements, Unit#2, RB.	
B33	Butte	MA 05		Seepage Repair	Bank protection project to repair serious Seepage site, Unit#1. LM start 10.7, Right Bank.	
B34	Butte	MA 05		Seepage Repair	Bank protection project to repair serious Seepage site, Unit#1. LM start 10.76, Right Bank.	
B35	Butte	MA 05		Seepage Repair	Unit#1, LB, LM start 3.8. Repair Seepage problem.	
B36	Butte	MA 05		SPRR Bridge Improvements	Unit#1, LB, LM start 7.35. SPRR bridge design creates blockage and flow obstruction during high water; needs maintenance on a regular basis.	
B37	Butte	MA 05		Encroachments	Unit#1, LB, LM start 2.95. Remove encroachments.	
B38	Butte	MA 05		Encroachments	Unit#1, LB, LM start 5.7. Encroachment gates near top of waterside crest 1.68 miles north of 381-25.	
B39	Butte	MA 05		Slope Stability Repair	Unit#1, LB, LM start 12.1. 0.56 miles north of USACE-2011-0098, cracking at landside toe for a length of 350 feet or more. Cracks are up to 1 foot deep and 1.5 inches wide. Bench is spalling off into ditch. Embankment material is fat clay.	
B40	Butte	MA 05		PL84-99	Unit#1, LB, LM start 2.08. Proposed "Order 1" PL84-99 Repair Site. 250' long. Nature of damage unknown.	
B41	Butte	MA 05		Breach Repair	Unit#1, LB, LM start 13.8. Levee Break is 100 ft. long and 6 ft. deep.	
B42	Butte	MA 05		Slope Stability Repair	Unit#1, LB, LM start 12.673. Slope failure on the landside for approximately 10 feet wide, separation between soil layers and bulge of soil at the toe observed.	
B43	Butte	MA 05		PL84-99	Unit#1, LB, General PL84-99 repair of deficiencies including: Vegetation, Encroachments, Animal Control, Slope Stability, and Repair Gates	
B44	Butte	MA 05		Overtopping Repairs	Unit#2, RB, LM start 0.5, LM end 1.36. Landside Erosion from Overtopping; restore levee to preflood condition; PL84-99 (Site 1A)	

Table 11-1. Mid and Upper Sacramento River Regional Flood Management Plan

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		Lead Agency	Partner Agency(s)			Amount ($)
B45	Butte	MA 05		Overtopping Repairs	Unit#2, RB, LM start 6.7. Landside Erosion from Overtopping; recommended repair - to be completed by DWR (Site 3)	
B46	Butte	MA 05		Other	Unit#2, RB, LM start 8.14. Provide for temporary closure.	
B47	Butte	MA 05		Erosion Repair	Unit#2, RB, LM start 2.50, LM end 2.51. 2008 - Sandy non-cohesive bank with rotational/slab failure. 2011: No observed change. [2011 Site ID: BTC_2-5_R]	
B48	Butte	MA 05		Overtopping Repairs	Unit#2, RB, LM start 3.36. Levee Overtopped (Site 2; Phase I Repair as project no. COE-CO-33)	
B49	Butte	MA 05		Overtopping Repairs	Unit#2, RB, LM start 4.15. LM end 4.92. Overtopping. 7/18/2013 - No change. Crown in good condition. Recommend removal from annual site visit list unless a high water event occurs.	
B50	Butte	MA 05		Overtopping Repairs	Unit#2, RB, LM start 4.25, LM end 4.35. Landside Erosion from Overtopping; recommended repair - restore to preflood conditions; PL84-99 (Site 2B).	
B51	Butte	MA 05		Overtopping Repairs	Unit#2, RB, LM start 6.3. Butte Creek in Butte County is experiencing overtopping of the levee (both banks). 2100 ft. left bank and 1000 ft. Right bank This area (incident No. 97-013-0101) is immediately up stream of Nelson Bridge, left bank levee. Landside is eroded due to overt.	
B52	Butte	MA 05		PL84-99	Unit#2, RB, General PL84-99 repair of deficiencies including: Vegetation, Encroachments, Animal Control, Slope Stability, and Repair Gates	
B53	Butte	MA 05		Erosion Repair	Unit#2, RB, Bank protection project to repair erosion site at RM 0.0, LM start 2.50, LM end 2.51	
B54	Butte	MA 05		PL84-99	Unit#2b, RB, LM start 14. Proposed "Order 1" PL84-99 Repair Site. 280' long. Nature of damage unknown.	
B55	Butte	MA 05		Serious Seepage Repair	Unit#2b, RB, LM start 10.7. Boil on Landside; recommended repair - slurry wall by DWR, status unknown (Site 5).	$450,000
B56	Butte	MA 05		Serious Seepage Repair	Unit#2b, RB, LM start 10.76. Boil on Landside; recommended repair - slurry wall by DWR, status unknown (Site 5).	$450,000
B57	Butte	MA 05		Other	Unit#2b, RB, LM start 15.36. Abandoned SPRR crosses levee 3 ft. below crown. Provide for temporary closure, or remove RR and close low spot.	
B58	Butte	MA 05		PL84-99	Unit#3, General PL84-99 repair of deficiencies including: Vegetation, Encroachments, Animal Control, Slope Stability, and Repair Gates	
B59	Butte	Rock Creek RD		Rock Creek and Sand Creek Flood Mitigation Project	The proposed Rock and Sand Creek Flood Mitigation Project will build upon the work already completed by the ACOE to develop and assess potential solutions to flooding from Rock Creek, focusing on the potential floodwater detention on Sand Creek. The project will assess potential hydrologic benefits of alternative detention strategies including creation of seasonal wetland habitats. The magnitude and timing of flood flows down Sand Creek and down the mainstem of Rock Creek will be analyzed. The analysis will be carried out through hydrologic modeling of storm runoff from the Sand Creek basin using HEC-HMS. The calculated runoff will be used as input to a HEC-RAS hydraulic model to evaluate the magnitude of flooding below the confluence of Sand and Rock Creeks under existing and proposed detention scenarios. The project will include an assessment of potential detention dam sites and examine the potential ecological benefits of new seasonal wetlands and groundwater recharge. Deliverables will include a feasibility analysis and conceptual designs for the detention project.	150,000
B60	Butte	Rock Creek RD		Rock Creek Interior Drainage Improvements	Flood waters currently pond up against the railroad tracks; need to install larger culverts through the tracks in order to relieve ponding	
B61	Butte	Rock Creek RD		Rock Creek Groundwater Recharge Feasibility Study	Feasibility Study to examine potential groundwater recharge sites to address depleting groundwater levels in the area.	
B62	Butte	Rock Creek RD		Rock Creek/Keefer Slough Flow Split	Implement improvements at the Rock Creek/Keefer Slough flow split in order to re-establish Rock Creek as the main channel	
B63	Butte	ST 03		Seepage Repair	Unit#1 LB, LM start 8.36. Recommend vegetation control. Monitor and repair LS encroachment.	
B64	Butte	ST 03		Seepage Repair	Unit#1 LB, LM start 12.7, LM end 13.0. No evidence of underseepage observed on LS (walked full length). Regular occurrence of landside boils at toe since before 1986 to the present, low velocity flow. Underseepage.	
B65	Butte	ST 03		Seepage Repair	Unit#1 LB, LM start 15.0. No evidence of seepage. Levee LS toe is also SR45 south-bound lane gutter. Low velocity flow underseepage in 1986. GAR reports multiple channels on this segment which may be coarser grained.	
B66	Butte	ST 03		Other	Unit#1 LB, Slight sag in levee profile. 0.75 feet below design WSE. Continue monitoring.	
B67	Butte	ST 03		Erosion Repair	Unit#1 LB, LM start 13.47, LM end 13.66. Deep, eroded tire ruts along road at waterside.	
B68	Butte	ST 03		Erosion Repair	Unit#1 LB, LM start 11.51, LM end 11.77. 2008 - Large rotational/mass failure in the bank with tree slump. 2009 - Minimal new erosion, the tree is leaning further into the river. 2011: Site extended downstream. [2011 Site ID: SAC_152-6_L]	
B69	Butte	ST 03		Erosion Repair	Unit#1 LB, LM start 11.81, LM end 11.83. 2006 - Large rotational/mass failure in the bank with tree slump. Tough clayey toe material. 2007 - Site is between stone revetments with a pump station at the downstream end. 2010 - Erosion is into the levee toe. 2011: Minor new erosion.	
B70	Butte	ST 03		Critical Erosion Repair	Unit#1 LB, LM start 6.71. Monitor and repair rodent holes and erosion. Combine with DWR_ST0003_01_s_2012_31.	
B71	Butte	ST 03		Critical Erosion Repair	Unit#1 LB, LM start 6.71, LM end 6.76. Monitor and repair rodent holes and erosion. Group with DWR_ST0003_01_s_2012_30.	
B72	Butte	ST 03		Erosion Repair	Unit#1 LB, LM start 13.47, LM end 13.66. Longitudinal erosion along waterside ground beyond toe;	
B73	Butte	ST 03		Slope Stability Repair	Unit#1 LB, LM start 16.969, LM end 17.467. Start point. Longitudinal cracking on the upper half of the waterside embankment. Up to 13 inches deep and 1/2 inch wide. Crack lengths exceed levee height at some places. No displacement observed along the cracks. End point is 18.	
B74	Butte	ST 03		Slope Stability Repair	Unit#1 LB, LM start 17.864. Cracking on the waterside embankment for 40 foot stretch, up to 1.5 inches wide and 20 inches deep. The crack length exceeds the levee height. No displacement observed along the cracks.	
B75	Butte	ST 03		Critical Seepage Repair	Unit#1 LB, LM start 3.776, LB. Landside pipe encroachment has been excavated for repairs. This site should remain critical until the repairs are verified. Recommend merging with USACE_CESPK_SE1C_2011_p_0206.	$600,000
B76	Butte	ST 03		Critical Seepage Repair	Unit#1 LB, LM start 3.776. Seepage is being repaired. Recommend verifying repairs and continue monitoring.	$600,000
B77	Butte	ST 03		Seepage Repair	Unit#1 South LB, Continue monitoring seepage. Possible need for cut-off wall due to coarse distributary channels, high susceptability.	
B78	Butte	ST 03		Other	Unit#1 South LB, LM start 5.16. No evidence of seepage, leakage, or ponding. Continue monitoring.	
B79	Butte	ST 03		Rodent Control	Unit#1, RB, LM start 0.50 LM end 0.57. Numerous large rodent holes on waterside and lanside levee slope. Total site length is approx. 400 feet. Levee miles were approximated. Recommend rodent control.	
B80	Butte		M&T Ranch	M&T Pump Repair short-term	M&T pumps short-term project. Gravel dredge and toe rock extension of time. This is being done to keep the M&T operable until a long-term solution is identified.	

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MUSR ID	County	Project Partners		Project Name/Type	Project Description	Project Cost
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B81	Butte		M&T Ranch	M&T Pump Repair long-term	M&T pumps long-term project. Public scoping will begin early 2014. Begin EIR/EIS process for identifying a long term solution to the gravel migration problem at the site.	
B82	Butte		M&T Ranch	Repair Critical Erosion Site	A critical erosion site exists in the Phelan levee upstream of the M&T weir at R.M. 192.5. A breach at this site would result in major changes to the hydraulics of the Butte Basin.	
B83	Butte		M&T Ranch	Protect M&T/Llano Seco Pumping Facilities	The current meandering of the Sacramento River is resulting in the need for dredging of the river to keep pump facilities operational. Either the river or the pump intake need to be relocated to allow for pumping without dredging. A long term solution is needed; there are existing studies being completed by Tetra Tech and Stillwater Sciences. The City of Chico Wastewater outfall facility was recently relocated to resolve short term issues associated with the gravel bar encroachment. M&T's pumping facility was originally relocated in the mid 90's from Big Chico Creek to its current location. It was relocated to protect threatened and endangered fish. Sediment removal has been completed twice since the mid 90's via excavation and large trucks. Future dredging is being planned via suction dredge. A large, 300,000 ton state-owned stockpile of the dredged material is located nearby.	
B84	Butte		M&T Ranch	Big Chico Creek, Little Chico Creek, and Comanche Creek Flood Reduction Improvements	Big Chico Creek, Little Chico Creek, and Comanche Creek have been experiencing higher and higher runoff flows due to City of Chico expansion.	
B85	Butte		Rock Creek Reclamation District	Rock and Sand Creek Flood Mitigation	As identified in the Butte FMP and the 2012 CVFPP documents, this area is a known flood hazard. At the Rock Creek-Keefer Slough Split increased accumulation at one side of the fork will send the entire upstream flow down the open side in a high flow event, potentially causing significant damages to areas adjacent to the channel carrying the majority of the flow. We are also seeing the desire to increase development upstream. This project would potentially lead to much needed understanding of the hydrologics of this area and storm water storage. We will also address the sizing, design, and installation of existing flood control measures (i.e. flap gates, detention basins) that have allowed for flooding in the past. With a clearer understanding of what is needed, this project will help the Reclamation Board and County to understand what options are available to address the future flood issues that surround this area.	
B86	Butte			Slope Stability Repair	Latitude 39.76883N, Longitude -121.90213W. Longitudinal dessication cracking along waterside berm near toe. Approximate length = 300 feet. Largest crack about 2 inches wide and 15 inches deep.	
B87	Butte			Little Chico Creek/Little Chico Creek Diversion to Butte Creek		
B88	Butte			Butte Creek Levee Improvments	West Butte Creek levees protect Durham; look at the feasibility of bringing the west Durham levees up to 100-yr standards	
B89	Butte			Nelson/Richvale Small Community Improvements	Portions of Richvale and Nelson lie within the FEMA designated 100-yr floodplain; look at the feasibility of providing 100-yr protection to Richvale and Nelson. Look at the feasibility of using existing agricultural lands as temporary detention basins to relieve high flows within Butte Creek.	
B90	Butte			Flood Protection for Richvale WWTP	Richvale Sanitation District owns and operates a wastewater treatment plant. The treatment plant and associated 18-acre pond system would benefit from local flood protection improvements.	
C1	Colusa	Colusa County OES	Cities of Colusa and Williams	Colusa County LHMP	The Colusa County Local Hazard Mitigation Plan includes the folowing action items: 1) Educate county-wide on potential threats of flooding; support flood control efforts, 2) Maintain flood protection infrastructure in place to protect homes, agribusiness west of City of Colusa, 3) Maintain stream bank integrity to protect homes north of City of Williams, 4) Creating defensible space Low around secondary homes in mountainous area, 5) Provide earthquake preparedness education for those in the fault area, 6) Utilize grant funding to purchase terrorism response equipment, and use to train personnel. Continue elevated awareness level.	
C2	Colusa	Colusa County RCD	Counties of Colusa, Glenn and Yolo, and CA-DWR.	Colusa Basin WMP	The objectives and action items of the Water Management Plan include: 1) Assess the status and functionality of degrading flood control infrastructure (e.g., drainage canals, ditches, canal banks, levees) and identify areas of risk, work with other agencies, coordinate efforts, support maintenance of flood control infrastructure and levees, 2) Manage flood water for short term retention and groundwater recharge where appropriate and promote recharge infrastructure, Realize that all flooding is not bad and recognize situations where flooding can be beneficial, Utilize flood flows for managed groundwater recharge and habitat creation/enhancement, Improve infiltration ability of flood-prone areas and natural drainages, Provide incentives for farmers whose cropland is used for off stream storage, 3) Develop and implement measures to control runoff in foothills and on agricultural lands, Utilize vegetation to increase infiltration and create "sponge effect" in foothills, Incorporate good grazing management strategies such as minimizing grazing when soils are wet and improving plant litter and plant production (Residual Dry Matter, or RDM), Install tailwater ponds, Create natural floodplains and detention ponds where appropriate.	
C3	Colusa	MA 01		Erosion	Unit#01, RB, repair erosion.	
C4	Colusa	MA 01		Encroachments	Unit#01, RB, LM start 0.43, LM end 0.47. Concrete retaining wall with pipe guardrail on landward shoulder. (ABC No. 9480-Grenfell)	
C5	Colusa	MA 01		Encroachments	Unit#01, RB, LM start 0.68, LM end 0.71. Concrete retaining wall on the landward shoulder. (ABO No. 9479 - City of Colusa)	
C6	Colusa	MA 01		Seepage	Unit#01, RB, LM start 4.00, LM end 5.00. Moderate seepage along landward levee toe.	
C7	Colusa	MA 01		Seepage	Unit#01, RB, LM start 6.37. Boil on landward toe.	
C8	Colusa	MA 01		Seepage	Unit#01, RB, LM start 15.55, LM end 16.08. Seepage along the landward levee toe.	
C9	Colusa	MA 01		Serious Seepage	Unit#01, RB, LM start 15.55, LM end 16.08	$7,600,000
C10	Colusa	MA 01		Seepage	Unit#01, RB, LM start 4.00, LM end 5.00. Moderate seepage (underseepage) along landward toe, running clear.	
C11	Colusa	MA 01		Seepage	Unit#01, RB, LM start 6.37, LM end 6.37. Boil at landward levee toe flowing clear water (underseepage).	
C12	Colusa	MA 01		Seepage	Unit#01, RB, LM start 8.8, LM end 8.8. Seepage area of considerable seepage that occurs when high stages continue for extended periods. In 1983 seepage was particularly bad.	
C13	Colusa	MA 01		Serious Encroachment	Unit#01, RB, LM start 9.01, LM end 9.03. Concrete retaining wall failed along water ward slope.	
C14	Colusa	MA 01		Seepage	Unit#01, RB, LM start 9.44. Seepage.	
C15	Colusa	MA 01		Erosion	Unit#01, RB, LM start 4.89, LM end 5.25. 2009 - Slump in the middle of the section has left a vertical section on the bank. 2010 - Old cobble site unraveling, site extended downstream. 2011: No observed change. [2011 Site ID: SAC_151-0_R]	
C16	Colusa	MA 01		Erosion	Unit#01, RB, LM start 7.60, LM end 7.61. 2010 - Downstream end of 154.5, needs maintenance, small amount to erosion into the levee toe. 2011: Old cobble site starting to unravel. Some new minor erosion since last year. [2011 Site ID: SAC_154-0_R]	
C17	Colusa	MA 01		Erosion	Unit#01, RB, LM start 10.46, LM end 10.46. 2004 - Slowly eroding but near vertical with no vegetation to hold it. 2005 - Erosion is close to levee toe but not into the levee section yet. 2010 - Some new toe scour. 2011: No observed change. [2011 Site ID: SAC_157-7_R]	
C18	Colusa	MA 01		Erosion	Unit#01, RB, LM start 16.66, LM end 16.66. Erosion site added in 1997 and removed in 2005. 2009 - Site added back in, hard toe with slow moving erosion. Potential geotechnical failure. 2011: Site extended downstream. [2011 Site ID: SAC_164-3_R]	

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C19	Colusa	MA 01		Seepage	Unit#01, RB, LM start 0.4, LM end 0.8. Seepage in tunnels beneath streets (underseepage - boil).	
C20	Colusa	MA 01		Serious Erosion	Unit#01, RB, LM start 17.024. The waterside slope is over steepened (less than 3:1) and shows signs of sliding.	Prefer No Action
C21	Colusa	MA 01		Serious Erosion	Unit#01, RB, LM start 17.009. Over a roughly 400 foot long segment, vertical scarp is present about 2/3 way up the landside levee slope up to 18 inches deep. Irregular slope is present below the scarp and may be associated with former sloughing of the landside slope.	Prefer No Action
C22	Colusa	MA 01		Other	Unit#01, RB, LM start LM 9.05.	
C23	Colusa	MA 01		Levee Patrol Road Improvements	Unit#01, RB, Levee Patrol Road Improvements	
C24	Colusa	MA 01		PL84-99	Unit#01, RB, General PL84-99 repair of deficiencies including: Vegetation, Animal Control, and Erosion	
C25	Colusa	MA 01		Erosion Repair	Unit#01, RB, Bank protection project to repair erosion site at RM 151.0, LM start 5.00, LM end 5.38	
C26	Colusa	MA 01		Erosion Repair	Unit#01, RB, Bank protection project to repair erosion site at RM 154.0, LM start 7.42, LM end 7.43	
C27	Colusa	MA 01		Erosion Repair	Unit#01, RB, Bank protection project to repair erosion site at RM 157.7, LM start 10.30, LM end 10.38	
C28	Colusa	MA 01		Erosion Repair	Unit#01, RB, Bank protection project to repair erosion site at RM 164.3, LM start 16.49, LM end 16.69	
C29	Colusa	MA 01		Seepage Repair	Unit#01, RB, Bank protection project to repair serious Seepage site, LM start 15.55, LM end 16.08, Right Bank	
C30	Colusa	MA 01		Erosion Repair	Unit#01, RB, Bank protection project to repair serious Seepage site, LM start 17.009, Right Bank	
C31	Colusa	MA 01		Erosion Repair	Unit#01, RB, Bank protection project to repair serious Seepage site, LM start 17.024, Right Bank	
C32	Colusa	MA 01		Other Repair	Unit#01, RB, Bank protection project to repair other serious site, LM start 9.01, LM end 9.03Right Bank	
C33	Colusa	MA 12		Serious Stability	Unit#01, LB, LM start 1.3	
C34	Colusa	MA 12		Serious Erosion	Unit#01, LB, LM start 8.75. At approximate LM 8.5 the landside access road appears to be eroding away bank. Landside ditch is extremely wide at this location (up to 800 ft. wide) which could result in waves being generated during windy days.	Prefer No Action
C35	Colusa	MA 12		Stability	Unit#01, LB, LM start 7.54. Site had been repaired last year by pushing material up slope and track-walking to compact. Site currently has localized low point (up to 2.5 inches deep) where material may be sliding again.	
C36	Colusa	MA 12		Serious Erosion	Unit#01, LB, LM start 9.1. 2011: Erosion occurring upstream and downstream of an irrigation diversion structure. [2011 Site ID: SYC_9-3_L]	
C37	Colusa	MA 12		Critical Stability	Unit#01, LB, LM start 8.10. Continuous longitudinal cracking for 260' along the LS hinge and slope. Cracks are 1-3" wide and up to 24" deep. In a 75' long section near the middle of the cracking we observed a welldeveloped slump with a 2' vertical scarp toward the LS edge of the crown, and signs of obvious slope bulging at midslope and toe. Scarp has removed a maximum of 5' of crown width.	$270,000
C38	Colusa	MA 12		Rodent Control	Unit#01, LB, LM start 10.42, LM end 10.67. Collapsed rodent burrows; Landside erosion.	
C39	Colusa	MA 12		Slope Stability Repair	Unit#01, LB, Bank protection project to repair critical stability site, LM start 8.1, Left Bank	
C40	Colusa	MA 12		Slope Stability Repair	Unit#01, LB, Bank protection project to repair serious stability site, LM start 1.3, Left Bank	
C41	Colusa	MA 12		PL84-99	Unit#01, LB, General PL84-99 repair of deficiencies including: Animal Control, Slope Stability, and Erosion	
C42	Colusa	MA 12		Erosion Repair	Unit#01, LB, Bank protection project to repair erosion site at RM 0.0, LM start 9.02, LM end 9.02	
C43	Colusa	MA 12		Erosion Repair	Unit#01, LB, Bank protection project to repair serious Erosion site, LM start 8.75, Left Bank	
C44	Colusa	MA 12		Erosion Repair	Unit#01, LB, Bank protection project to repair serious Erosion site, LM start 9.1, Left Bank	
C45	Colusa	RD 0108		Serious Erosion	Unit#, RB, LM start 11.5.	
C46	Colusa	RD 0108		Erosion	Unit#, RB, LM start 21.4.	
C47	Colusa	RD 0108		Serious Erosion	Unit#, RB, LM start 21.45.	
C48	Colusa	RD 0108		Serious Erosion	Unit#, RB, LM start 39.8.	
C49	Colusa	RD 0108		PL84-99	Develop System Wide Improvement Framework (SWIF) to repair deficiencies including: Animal Control, Slope Stability, Cracking, and Erosion	
C50	Colusa	RD 0108		PL84-99	Implement SWIF	
C51	Colusa	RD 0108		Stability	Unit#01, LB, LM start 1.5	
C52	Colusa	RD 0108		Erosion	Unit#01, LB, Repair erosion.	
C53	Colusa	RD 0108		Other	Unit#01, LB, LM start 4.7, LM end 5.8.Segment 116 flood damage. Crown Subsidence, erosion on water and land side, slips on landside.	
C54	Colusa	RD 0108		Stability	Unit#01, LB, LM start 4.7, LM end 5.8. Segment 116 flood damage. Crown Subsidence, erosion on water and land side, slips on landside.	
C55	Colusa	RD 0108		Serious Stability	Unit#01, LB, LM start 4.07. minor sloughing.	
C56	Colusa	RD 0108		Other	Unit#01, LB, LM start 2.35, LM end 2.48. subsided to a depth of 5' for a length of 600'.	
C57	Colusa	RD 0108		Stability	Unit#01, LB, LM start 19. Sloughing.	
C58	Colusa	RD 0108		Stability	Unit#01, LB, LM start 17.8. slips on Colusa basin drain.	
C59	Colusa	RD 0108		Critical Stability	Unit#01, LB, LM start 17.1, LM end 17.3. Levee section approximately 300 ft. long with evidence of subsidence. RD points out this is an area of concern. RD is adding aggregate base every year. Presence of cracks at hinge points and upper third of levee (1 inch wide and two inches deep).	$370,000
C60	Colusa	RD 0108		Serious Erosion	Unit#01, LB, LM start 19.2. 2011: Toe scour at the bottom of a steep bank, large sections of the toe are sliding down. Erosion may be due to the upstream bend. [2011 Site ID: CBD_19-2_L]	
C61	Colusa	RD 0108		Stability	Unit#01, LB, LM start 13.74. 2" crack (4" wide and 24" deep) sloughed down landside slope of levee. Slough is 85' long, dropped 13" at the greatest point, and extends into the center of the levee crown.	
C62	Colusa	RD 0108		Stability	Unit#01, LB, LM start 0.049, LM end 5.812. Start point. Typical conditions - cracking on landside from toe to slope. Depth on landside varies from 6 to 30 inches, width from 1 to 4 inches. End point is 120.	
C63	Colusa	RD 0108		Stability	Unit#01, LB, LM start 0.036, LM end 0.088. Start point. Longitudinal and perpendicular cracks in top half of the waterside slope 0.5-1 inch wide, 6-12 inches deep, 3-5 feet long. End point is 10.	
C64	Colusa	RD 0108		Stability	Unit#01, LB, LM start 0.9. Crack along landside slope 6-16 inches deep approximately 25 feet long.	
C65	Colusa	RD 0108		Stability	Unit#01, LB, LM start 0.971, LM end 2.78. Cracks in crown road about 6-7 inches deep, 2 inches wide. Gravel filling in the voids in the crack, 10 ft. from edge of crown. Occurs intermittently for lengths of 20-100 feet at each occurrence.	
C66	Colusa	RD 0108		Seepage	Unit#01, LB, LM start 1.119. Possible evidence of a sand boil remnant, approximately 15 feet from landside toe.	
C67	Colusa	RD 0108		Stability	Unit#01, LB, LM start 1.376. Longitudinal cracks on landside slope at landside toe. 6 to 12 inch deep, 20 to 30 feet long.	
C68	Colusa	RD 0108		Stability	Unit#01, LB, LM start 2.051. Cracking along waterside slope approximately 15 feet above the toe, 11 inches deep, 1.5 inches wide, and 8 feet long.	
C69	Colusa	RD 0108		Stability	Unit#01, LB, LM start 4.146. Seasonal cracking on waterside of crown up to 12 inches deep, 1.5 inches wide and 25 feet long.	
C70	Colusa	RD 0108		Stability	Unit#01, LB, LM start 5.814, LM end 10.118. Start point. Cracking on landside slope and toe, 1 to 8 inches deep. End point is 158.	

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C71	Colusa	RD 0108		Stability	Unit#01, LB, LM start 8.523. Seasonal cracking in the middle of waterside slope, 1 inch wide, up to 6-17 inches deep and 20 feet long.	
C72	Colusa	RD 0108		Stability	Unit#01, LB, LM start 9.112. Seasonal cracking on waterside slope approximately 15 feet above toe, 100 feet long, 1-1.5 inches wide and up to 15 inches deep.	
C73	Colusa	RD 0108		Stability	Unit#01, LB, LM start 10.12. Typical cracking in landside slope, up to 24 inches deep and 2 inches wide. Cracks are buried due to grading of slopes.	
C74	Colusa	RD 0108		Stability	Unit#01, LB, LM start 11.251. Start point. Typical conditions - seasonal cracking along waterside slope and toe, typically about 18 inches deep and 1 inch wide. End point is 273.	
C75	Colusa	RD 0108		Stability	Unit#01, LB, LM start 14.875. Cracking along waterside toe. 16-21 inches deep, 3 inches wide, extends 100 feet.	
C76	Colusa	RD 0108		Stability	Unit#01, LB, LM start 15.284. Cracking along waterside toe. 12-16 inch deep, extends about 100 feet.	
C77	Colusa	RD 0108		Levee Patrol Road Improvements	Levee Patrol Road Improvements, Unit#01, LB.	
C78	Colusa	RD 0108		Erosion Repair	Unit#01, LB, Bank protection project to repair erosion site at RM 0.0, LM start 19.29, LM end 19.29	
C79	Colusa	RD 0108		Slope Stability Repair	Unit#01, LB, Bank protection project to repair critical stability site, LM start 17.1 LM end 17.3 LB	
C80	Colusa	RD 0108		Erosion Repair	Unit#01, LB, Bank protection project to repair serious erosion site, LM start 19.2	
C81	Colusa	RD 0108		Slope Stability Repair	Unit#01, LB, Bank protection project to repair serious stability site, LM start 4.07	
C82	Colusa	RD 0108		Seepage Repair	Unit#01, LB, 400 feet of partial levee replacement	$370,000
C83	Colusa	mento River West Side Levee District		Seepage	Unit#01, RB, LM start 25.02. Undefined Seepage at a penetration.	
C84	Colusa	mento River West Side Levee District		Serious Seepage	Unit#01, RB, LM start 2.60 LM end 6.72. Seepage area designated worst by SRWSLD personnel	
C85	Colusa	mento River West Side Levee District		Serious Seepage	Unit#01, RB, LM start 9.1, LM end 11. seepage area.	$10,500,000
C86	Colusa	mento River West Side Levee District		Seepage	Unit#01, RB, LM start 15.2. bad seepage area.	
C87	Colusa	mento River West Side Levee District		Seepage	Unit#01, RB, LM start 19.7, LM end 22.7. Long stretch of bad seepage.	
C88	Colusa	mento River West Side Levee District		Other	Unit#01, RB, LM start 0.3. Overtopping in 1997 at the boat ramp that is at the confluence of the Sacramento River and the Colusa Basin Drainage Canal, near the Knights Landing Outfall Gates-overtopping from river into CBDC, over Highway 45.	
C89	Colusa	mento River West Side Levee District		Serious Seepage	Unit#01, RB, LM start 6.16. Bad seepage area on L/S shoulder and slope, continuing as of 3/91.	
C90	Colusa	mento River West Side Levee District		Serious Seepage	Unit#01, RB, LM start 6.72. Bad seepage (through seepage) area on L/S shoulder and slope.	
C91	Colusa	mento River West Side Levee District		Other	Unit#01, RB, LM start 0.26 LM end 0.30. 1.5' below design WSE.	
C92	Colusa	mento River West Side Levee District		Other	Unit#01, RB, LM start 9.9. 2' below design WSE.	
C93	Colusa	mento River West Side Levee District		Other	Unit#01, RB, LM start 14.1, LM end 14.2. 2.5' below design WSE.	
C94	Colusa	mento River West Side Levee District		Other	Unit#01, RB, LM start 19.2, LM end 19.2. 2.5' below design WSE.	
C95	Colusa	mento River West Side Levee District		Seepage	Unit#01, RB, LM start 25.15. Seepage (through seepage) on L/S shoulder and slope.	
C96	Colusa	mento River West Side Levee District		Other	Unit#01, RB, LM start 20.46. Two Sinkholes, LM 20.46 (landside levee toe).	
C97	Colusa	mento River West Side Levee District		Seepage	Unit#01, RB, LM start 0.8. Bank failure caused by underseepage from irrigation ditch.	
C98	Colusa	mento River West Side Levee District		Serious Seepage	Unit#01, RB, LM start 2.6 LM end 5.8. Landside seepage and boils (site 1).	
C99	Colusa	mento River West Side Levee District		Seepage	Unit#01, RB, LM start 13.2, LM end 15.5. Landside seepage and boils (site 2).	
C100	Colusa	mento River West Side Levee District		Seepage	Unit#01, RB, LM start 21.7, LM end 24.6. Landside seepage and boils (site 3).	
C101	Colusa	mento River West Side Levee District		Seepage	Unit#01, RB, LM start 49.23, LM end 50.12. boils/seepage/Small boils, Sac River, Right Bank (Site 12).	
C102	Colusa	mento River West Side Levee District		Seepage	Unit#01, RB, LM start 34.5. boil appeared at high water flood stage/Two locations with boils.	
C103	Colusa	mento River West Side Levee District		Seepage	Unit#01, RB, LM start 34.0. boils near Cecil lake.	
C104	Colusa	mento River West Side Levee District		Seepage	Unit#01, RB, LM start 33.1, LM end 33.6. Seepage area including boils in yards of Grimes residents (not moving much material), up to 15' from levee toe.	
C105	Colusa	mento River West Side Levee District		Serious Seepage	Unit#01, RB, LM start 34.15, LM end 35.5. Seepage area designated as next-to-worst by SRWSLD personnel.	$3,900,000
C106	Colusa	mento River West Side Levee District		Seepage	Unit#01, RB, LM start 33.1, LM end 33.6. Seepage area including boils in yards of Grimes residents (not moving much material), up to 15' from levee toe.	
C107	Colusa	mento River West Side Levee District		Critical Seepage	Unit#01, RB, LM start 35.08. Boils (2 with ring sacks), RB.	$400,000
C108	Colusa	mento River West Side Levee District		Seepage	Unit#01, RB, LM start 26.74, LM end 27.78. Seepage and recommended stability berm (2,700 ft.), Sac River (Site 4).	
C109	Colusa	mento River West Side Levee District		Seepage	Unit#01, RB, LM start 30.1, LM end 30.7. Seepage, Sac River, Right Bank (Site 5).	
C110	Colusa	mento River West Side Levee District		Serious Seepage	Unit#01, RB, LM start 34.15, LM end 35.13. Seepage, Sac River, Right Bank (Site 4 near Cecil Lake).	
C111	Colusa	mento River West Side Levee District		Seepage	Unit#01, RB, LM start 41.5, LM end 41.85. Seepage, Sac River (Site 10).	
C112	Colusa	mento River West Side Levee District		Erosion	Unit#01, RB, LM start 10.0, LM end 11.51. 1997 - Toe damage and loss of cobble revetment and small patch of local damage to the cobble revetment. 2000 - Cohesive vertical toe; revegetation site. 2011: No observed change. [2011 Site ID: SAC_101-3_R]	
C113	Colusa	mento River West Side Levee District		Erosion	Unit#01, RB, LM start 29.98, LM end 29.98. 1997 - Mass failure of the lower cohesive bank and toe. 2000 - Still eroding, steeply dipping foresets in the toe are falling off. 2010 - Some new erosion and some new deposition. Eddy current off the upstream rock. 2011: Still plenty of berm left.	
C114	Colusa	mento River West Side Levee District		Erosion	Unit#01, RB, LM start 30.21, LM end 30.21. 2002 - Upstream end has recent slope failure and exposure of tree roots. 2003 - Some new minor slope erosion with new snags on the bank. 2004 - Appears a little worse. 2005 - Scallop in bank at the upstream end looks worse. 2009 - Minimal new erosion.	
C115	Colusa	mento River West Side Levee District		Erosion	Unit#01, RB, LM start 31.76, LM end 31.78. 1997 - Erosion into the levee section; old concrete rubble loss at toe; transition between the rock upstream and the cobble downstream. 2000 - Cohesive bench with concrete slabs on top; 25 ft. deep scour hole on the downstream end. 2011: No observed chan	
C116	Colusa	mento River West Side Levee District		Erosion	Unit#01, RB, LM start 33.64, LM end 33.64. 2008 - Slow erosion of the hard toe. 2010 - Cobble rubble is failing, erosion is into the toe of the levee, with vertical slumping. 2011: No observed change. [2011 Site ID: SAC_125-6_R]	
C117	Colusa	mento River West Side Levee District		Erosion	Unit#01, RB, LM start 35.62, LM end 35.62. 1997 - Major scour off the downstream end of existing rock, creating a scour pocket where the levee starts diverging from the bankline. 2000 - Some minor erosion, 20 ft. deep hole at downstream end. 2004 - Small amount of new erosion.	
C118	Colusa	mento River West Side Levee District		Erosion	Unit#01, RB, LM start 43.35, LM end 43.35. 2010 - Lower portion of 136.7 that did not extend far enough. Abrupt transition from upstream site. 2011: No observed change. [2011 Site ID: SAC_136-6_R].	
C119	Colusa	mento River West Side Levee District		Critical Erosion	Unit#01, RB, LM start 19.00, LM end 19.00. 2009 - Minor erosion, should be repaired under maintenance. 2011: Some new minor erosion at the toe. [2011 Site ID: SAC_111-0_R]	
C120	Colusa	mento River West Side Levee District		Erosion	Unit#01, RB, LM start 48.11, LM end 48.11. 2010 - Old cobble site starting to unravel at toe. 2011: Cobbles continue to unravel. [2011 Site ID: SAC_141-5_R].	

Table 11-1. Mid and Upper Sacramento River Regional Flood Management Plan

WORKING DRAFT - Potential Project List, March 28, 2014

MUSR ID	County	Project Partners		Project Name/Type	Project Description	Project Cost
		Lead Agency	Partner Agency(s)			Amount ($)
C121	Colusa	mento River West Side Levee District		Erosion	Unit#01, RB, LM start 50.03, LM end 50.14. 2011: multiple scallops, one tree pop out. old cobble site starting to unravel [2011 Site ID: SAC_143-5_R].	
C122	Colusa	mento River West Side Levee District		Erosion	Unit#01, RB, LM start 23.69, LM end 23.69. 2008 - Slippage of cobbles off hard underlying toe material. 2011: Minor slumping site. [2011 Site ID: SAC_115-9_R]	
C123	Colusa	mento River West Side Levee District		Erosion	Unit#01, RB, LM start 25.91, LM end 25.91. 2008 - Whole bank is eroding, nearly vertical slope with cohesive toe. Bed is very deep along the toe (greater than 30 ft. deep at 20 ft. from the shore) 2011: Some new minor erosion. [2011 Site ID: SAC_118-0_R]	
C124	Colusa	mento River West Side Levee District		Serious Erosion	Unit#01, RB, LM start 44.014. Erosion of river bank 5 to 10 feet from waterside toe. 300 foot long section between pump and access ramp.	
C125	Colusa	mento River West Side Levee District		Erosion	Unit#01, RB, LM start 42.736. Sloughing on upper third of the landside levee slope 50 feet long and up to 13 inches deep.	
C126	Colusa	mento River West Side Levee District		Stability	Unit#01, RB, LM start 42.695. Sloughing on upper third of the landside levee slope up to 12 inches deep, which leaves an over steepened levee slope of 1.5:1.	
C127	Colusa	mento River West Side Levee District		Stability	Unit#01, RB, LM start 39.958. Tension cracking on upper half of the landside levee slope up to 15 inches deep.	
C128	Colusa	mento River West Side Levee District		Stability	Unit#01, RB, LM start 39.756. Slumping up to 7 feet wide with an 18 inch scarp about 23 way up the landside levee slope.	
C129	Colusa	mento River West Side Levee District		Erosion	Unit#01, RB, LM start 20.098, LM end 20.243. Start point. Apparent erosion at waterside toe is 2-3 feet deep. End point is 490.	
C130	Colusa	mento River West Side Levee District		Other	Unit#01, RB, LM start 36.07, LM end 36.61. Levee slopes damaged by over pasturing.	
C131	Colusa	mento River West Side Levee District		Other	Unit#01, RB, LM start 37.94. 0.25' below design WSE.	
C132	Colusa	mento River West Side Levee District		Other	Unit#01, RB, LM start 41.08. State highway No. 20 crosses the levee, 2 feet at below the crown.	
C133	Colusa	mento River West Side Levee District		Seepage	Unit#01, RB, LM start 46.06, LM end 50.12. Seepage, Sac River, Right Bank, (Site 11).	
C134	Colusa	mento River West Side Levee District		Stability	Unit#01, RB, LM start 48.189. Section of levee shoulder appears to be slumping onto the adjacent access road.	
C135	Colusa	mento River West Side Levee District		Levee Patrol Road Improvements	Levee Patrol Road Improvements, Unit#01, RB.	
C136	Colusa	mento River West Side Levee District		Other	Unit#01, RB, LM start 35.32, LM end 35.48.	
C137	Colusa	mento River West Side Levee District		Stability	Unit#01, RB, LM start 36.22.	
C138	Colusa	mento River West Side Levee District		Seepage	Unit#01, RB, LM start 39.97, LM end 40.70.	
C139	Colusa	mento River West Side Levee District		Other	Unit#01, RB, LM start 41.27.	
C140	Colusa	mento River West Side Levee District		PL84-99	Unit#01, RB, General PL84-99 repair of deficiencies including: Vegetation, Encroachments, Animal Control and Erosion	
C141	Colusa	mento River West Side Levee District		Erosion Repair	Unit#01, RB, Bank protection project to repair erosion site at RM 101.3, LM start 11.48, LM end 11.48	
C142	Colusa	mento River West Side Levee District		Erosion Repair	Unit#01, RB, Bank protection project to repair erosion site at RM 111.0, LM start 18.74, LM end 18.74	
C143	Colusa	mento River West Side Levee District		Erosion Repair	Unit#01, RB, Bank protection project to repair erosion site at RM 115.9, LM start 23.54, LM end 23.54	
C144	Colusa	mento River West Side Levee District		Erosion Repair	Unit#01, RB, Bank protection project to repair erosion site at RM 118.0, LM start 25.90, LM end 25.90	
C145	Colusa	mento River West Side Levee District		Erosion Repair	Unit#01, RB, Bank protection project to repair erosion site at RM 122.0, LM start 29.67, LM end 29.67	
C146	Colusa	mento River West Side Levee District		Erosion Repair	Unit#01, RB, Bank protection project to repair erosion site at RM 122.3, LM start 29.93, LM end 29.93	
C147	Colusa	mento River West Side Levee District		Erosion Repair	Unit#01, RB, Bank protection project to repair erosion site at RM 123.7, LM start 31.42, LM end 31.42	
C148	Colusa	mento River West Side Levee District		Erosion Repair	Unit#01, RB, Bank protection project to repair erosion site at RM 125.6, LM start 33.27, LM end 33.27	
C149	Colusa	mento River West Side Levee District		Erosion Repair	Unit#01, RB, Bank protection project to repair erosion site at RM 127.9, LM start 35.21, LM end 35.21	
C150	Colusa	mento River West Side Levee District		Erosion Repair	Unit#01, RB, Bank protection project to repair erosion site at RM 136.6, LM start 42.93, LM end 42.93	
C151	Colusa	mento River West Side Levee District		Erosion Repair	Unit#01, RB, Bank protection project to repair erosion site at RM 141.5, LM start 47.61, LM end 47.61	
C152	Colusa	mento River West Side Levee District		Erosion Repair	Unit#01, RB, Bank protection project to repair erosion site at RM 143.5, LM start 49.44, LM end 49.44	
C153	Colusa	mento River West Side Levee District		Erosion Repair	Unit#01, RB, Bank protection project to repair critical erosion site, LM start 19.0 Right Bank	
C154	Colusa	mento River West Side Levee District		Seepage Repair	Unit#01, RB, Bank protection project to repair serious seepage site, LM start 2.6, LM end 5.8 Right Bank	
C155	Colusa	mento River West Side Levee District		Seepage Repair	Unit#01, RB, Bank protection project to repair serious seepage site, LM start 34.15, LM end 35.13 Right Bank	
C156	Colusa	mento River West Side Levee District		Seepage Repair	Unit#01, RB, Bank protection project to repair serious seepage site, LM start 34.75, LM end 35.5 Right Bank	
C157	Colusa	mento River West Side Levee District		Seepage Repair	Unit#01, RB, Bank protection project to repair critical seepage site, LM start 35.08, Right Bank	
C158	Colusa	mento River West Side Levee District		Seepage Repair	Unit#01, RB, Bank protection project to repair serious seepage site, LM start 4.8, LM end 6.72, Right Bank	
C159	Colusa	mento River West Side Levee District		Erosion Repair	Unit#01, RB, Bank protection project to repair serious seepage site, LM start 44.014, Right Bank	
C160	Colusa	mento River West Side Levee District		Seepage Repair	Unit#01, RB, Bank protection project to repair serious seepage site, LM start 6.16, Right Bank	
C161	Colusa	mento River West Side Levee District		Seepage Repair	Unit#01, RB, Bank protection project to repair serious seepage site, LM start 6.72, Right Bank	
C162	Colusa	mento River West Side Levee District		Seepage Repair	Unit#01, RB, Bank protection project to repair serious seepage site, LM start 9.1, Right Bank	
C163	Colusa	mento River West Side Levee District		Erosion Repair	Unit#01, RB, 320 feet of Rock Revetment	$850,000
C164	Colusa	mento River West Side Levee District		Seepage Repair	Unit#01, RB, 250 feet of drained seepage berm	$400,000
C165	Colusa		Colusa County	City of Williams Flood Hazard Mitigation Project	The Plan is to implement alternative methods of reducing flood damages to the City of Willows and surrounding agricultural lands while increasing ecological value within the South Fork Willow Creek, North Fork Willow Creek, and Wilson Creek Sub-basins in Glenn County.	
C166	Colusa		Colusa County Resource Conservation District	Foothill Stream Restoration and Recharge Enhancement	The Colusa County Resource Conservation District (CCRCD) is proposing a ten acre foothill stream corridor restoration project that will achieve multiple resource objectives. Activities and benefits will include:•Remove and/or control invasive vegetation at the upstream-most affected areas of infestation•Reestablish riparian vegetation and improve connectivity of high quality riparian habitat to provide habitat corridors, streambank stabilization, improved water infiltration and stormwater filtration•Reduce existing and potential bank erosion, focusing on sites with bank materials dominated by sediment grain sizes known or thought to have the greatest water quality impacts in the Colusa Basin and Sacramento River watershed•Reestablish flood plain(s) to facilitate groundwater recharge, retain floodwater and provide habitat•Establish deep-rooted native perennial grasses in riparian areas to provide increased infiltration for groundwater recharge, floodwater retention and improved soil structure•Utilize the project as a demonstration site to facilitate education and outreach through workshops and field days, and studies to evaluate project effectiveness This project is currently in the concept/planning stage. The Colusa Basin Watershed Limited Streambank Analysis, which was prepared for the CCRCD in 2010, identified 24 Critical Management Reaches (CMRs). These CMRs are areas of foothill streams with the greatest potential to benefit from the above activities.	
C167	Colusa			Animal Control	Animal burrows are present throughout the segment (sparsely dispersed).	
C168	Colusa			Animal Control	Animal Burrows approx. 2-3 inches in diameter.	
C169	Colusa			Wildlife Area improvements-Princeton SE	Wildlife Area improvements- Princeton SE restoration of 50 acres and addition of a parking lot, Invasive removal and restoration on 8 acres at the Stegman Unit.	

Table 11-1. Mid and Upper Sacramento River Regional Flood Management Plan

WORKING DRAFT - Potential Project List, March 28, 2014

MUSR ID	County	Project Partners		Project Name/Type	Project Description	Project Cost
		Lead Agency	Partner Agency(s)			Amount ($)
G1	Glenn	LD 01G		Stability	Unit#01, RB, LM start 5.03. Tension cracking, 7 inches deep, 1 inch wide, 15 feet long.	
G2	Glenn	LD 01G		Other	Unit#01, RB, LM start 6.83. Concrete bulkheads on both levee slopes.	
G3	Glenn	LD 01G		Seepage	Unit#01, RB, LM start 2.5, LM end 2.9. Significant seepage in the field between the levee and the highway. Levee underseepage analysis performed.	
G4	Glenn	LD 01G		Other	Unit#01, RB, LM start 4.05. Concrete bulkhead landside.	
G5	Glenn	LD 01G		Other	Unit#01, RB, LM start 11.3	
G6	Glenn	LD 01G		Other	Unit#01, RB, Area of Concern	
G7	Glenn	LD 01G		Stability	Unit#01, RB, LM start 11.988. Cracking on the landside levee slope, up to 10 inches deep.	
G8	Glenn	LD 01G		Stability	Unit#01, RB, LM start 7.027. Cracking on the waterside slope, 6 feet above the toe, 5 inches deep, extends for 40 feet.	
G9	Glenn	LD 01G		PL84-99	Unit#01, RB, Develop Systemwide Improvement Framework (SWIF) to regain active status in the PL84-99 Program. Deficiencies include: Vegetation, Thin and Trim Tress, Encroachments, Animal Control, and Slope Stability	
G10	Glenn	LD 01G		PL84-99	Unit#01, RB, Implement SWIF Program Repairs	
G11	Glenn	LD 01G		Pipe Penetration Repairs & Replacements	Unit#01, RB	
G12	Glenn	LD 01G		Levee Patrol Road Improvements	Levee Patrol Road Improvements, Unit#01, RB	
G13	Glenn	LD 01G		Other	Unit#01, RB, LM start 1.16, LM end 1.19. Slopes severely stock damaged.	
G14	Glenn	LD 01G		Stability	Unit#01, RB, LM start 0.152. Cracking up to 7 inches deep and 0.5 inches wide on the waterside levee slope.	
G15	Glenn	LD 02		Seepage	Unit#01, RB, LM start 3.8, LM end 3.8. Seepage (underseepage) into a perpendicular ditch that intercepts the sand layer.	
G16	Glenn	LD 02		Seepage	Unit#01, RB, LM start 1.9, LM end 1.9. Seepage (through) was observed adjacent to a 4-inch cast iron pipe through the levee, below the design flood level.	
G17	Glenn	LD 02		Seepage	Unit#01, RB, LM start 3.3, LM end 3.3. Water reportedly flows out of the ground between the levee and the highway during high-water events (underseepage).	
G18	Glenn	LD 02		PL84-99	Develop Systemwide Improvement Framework (SWIF) to regain active status in the PL84-99 Program. Deficiencies include: Animal Control, Slope Stability, and Erosion, Unit#01, RB	
G19	Glenn	LD 02		Erosion Repair	Bank protection project to repair erosion site at XXXX, Unit#01, RB	
G20	Glenn	LD 02		Pipe Penetration Repairs & Replacements	Unit#01, RB	
G21	Glenn	LD 02		Levee Patrol Road Improvements	Levee Patrol Road Improvements, Unit#01, RB	
G22	Glenn	LD 02		Seepage Repair	Unit#1, RB, LM start 0.4. Area of seepage (underseepage) reportedly develops when the river is at high stages for several days. Seepage occurs in the irrigation district and in the field away from the levee. No repairs were recommended or performed.	
G23	Glenn	LD 02		Serious Erosion Repair	Unit#2, RB, LM start 0.02. 2009 - Very slow retreat, hard toe, encroaching into the levee projection. 2010 - Slowly eroding. 2011: Site extended downstream. [2011 Site ID: SAC_164-7_R]	
G24	Glenn	LD 03		Patrol Road and Seepage Repairs	Unit 1, LB, LM start 0, LM end 2. Numerous potholes on levee crown. Water-preferring vegetation identified along waterside of levee between toe and 5 feet upslope. Low severity underseepage, clear water, levee underlain by coarse grained distributary channels. Recommend crown re-surfacing, and vegetation control.	
G25	Glenn	LD 03		Critical Erosion Repair	Unit#1, LM start 9.88. Combine with DWR_LD0003_01_s_2012_52.	$2,300,000
G26	Glenn	LD 03		Erosion Repair	Unit#1, LM start 5.99. Vegetation is an issue, especially poison oak. Recommend vegatation control, inspect for erosion and repair as required. Monitor and repair landside encroachment.	
G27	Glenn	LD 03		Critical Erosion Repair	Unit#1, LM start 9.60, LM end 9.88. Repair 1500 feet of critical erosion on WS.	$2,300,000
G28	Glenn	LD 03		Erosion Repair	Unit#1, LM start 1.35, LM end 1.61. Erosion WS bench appears to be about 200 feet. Site remains inaccessible from levee. Recommend vegetation control, WS erosion repair.	
G29	Glenn	LD 03		Slope Stability Repair	Unit#1, LM start 3.586. Monitor minor cracking on the landside at mid-embankment. Recommend rodent control.	
G30	Glenn	LD 03		Slope Stability Repair	Unit#1, LM start 9.204. Monitor and repair cracking in levee. Monitor and control rodents.	
G31	Glenn	LD 03		Slope Stability Repair	Unit#1, LM start 11.812. Cracking on the levee crown at the landside hinge, 1/2 to 1 inch wide, up to 8 inches deep, with no displacement along the crack.	
G32	Glenn	LD 03		Slope Stability Repair	Unit#1, LM start 11.925, LM end 12.201. Start point. Longitudinal cracking along the landside hinge, up to 1/2 inch wide, 7 inches deep, with no displacement. The crack lengths exceed the levee height. End point is 350.	
G33	Glenn	LD 03		PL84-99	General PL84-99 repair of deficiencies including: Vegetation, Thin and Trim Tress, Encroachments, Animal Control, Slope Stability, and Erosion, Unit#1, LB	
G34	Glenn	LD 03		Erosion Repair	Bank protection project to repair erosion site at RM 163.00, LM Start 1.35, LM end 1.35, Unit#1, LB.	
G35	Glenn	LD 03		Erosion Repair	Bank protection project to repair erosion site at RM 168.30, LM start 5.96, LM end 5.96, Unit#1, LB.	
G36	Glenn	LD 03		Erosion Repair	Bank protection project to repair erosion site at RM 172.0, LM start 9.60, LM end 9.60, Unit#1, LB.	
G37	Glenn	LD 03		Serious Erosion Repair	Bank protection project to repair erosion sites, serious erosion at , Unit#1, LB, LM 11.25, LM end 11.25, LB. Area identified where WS toe has been cut into by almost 20 ft. Took a cross-section and coordinates to provide to LMA to repair. Cut is 6' high, 20' deep (into levee) and 40' long.	
G38	Glenn	LD 03		Erosion Repair	Bank protection project to repair erosion sites, Critical erosion at LM 9.60 to 9.87 LB, Unit#1, LB.	
G39	Glenn	LD 03		Erosion Repair	Bank protection project to repair erosion sites, Critical erosion at LM 9.88 LB, Unit#1, LB.	
G40	Glenn	LD 03		Pipe Penetration Repairs & Replacements	Unit#1, LB.	
G41	Glenn	LD 03		Levee Access Road Improvements	Address high water levee access issues north of Butte City, Unit#1, LB.	

Table 11-1. Mid and Upper Sacramento River Regional Flood Management Plan

WORKING DRAFT - Potential Project List, March 28, 2014

MUSR ID	County	Project Partners		Project Name/Type	Project Description	Project Cost
		Lead Agency	Partner Agency(s)			Amount ($)
G42	Glenn	RD 2140		Hamiliton City Flood Damage and Ecosystem Restoration Project (J Levee)	There is a long history of flooding in Hamilton City, Glenn County. This farming town of around 2,000 people and the surrounding area have been evacuated or engaged in flood fighting six times in the past 30 years, and was prepared to evacuate again in January of 2006. The existing degraded levee, referred to by locals as the "J-Levee," is privately owned and made mostly of earthen material susceptible to erosion. It curves around property lines bordering the Sacramento River and is more than 100 years old. The J-levee does not meet the U.S. Army Corps of Engineers or any other levee construction standards and could fail at river levels well below the top of the levee. The Corps has calculated that the J Levee has only a 66% confidence of protecting against a 10 year flood event. In 2000 and again in 2002, Glenn County used its entire flood control budget to repair portions of the J Levee. In 2008, Glenn County, working with The Nature Conservancy, Glenn- Colusa Irrigation District and the State of California, repaired an 800 foot stretch of the J Levee that was suffering from serious erosion. All of these efforts have extended the life of the J Levee, but the only effective, long-term solution for Hamilton City is the construction of a new levee. Without question, absent funding of construction of this Corps project, an imminent threat exists which could result in bodily harm to residents and financial devastation. The surrounding land is primarily agricultural, with fruit and nut orchards being the primary crops. As part of the project, native vegetation would be restored along the river, and several federally listed species would have important new habitat. By setting the new levee back from the river and opening the floodplain, flood pressure will be relieved on both sides of the river in Glenn and Butte counties, and Highway 32, a critical east-west corridor in the region, would be protected from high water events. Recreation would increase, and scouring of farmland from high river velocities would end. The economic benefits of the project are substantially greater than the costs. In summary, the project will protect lives in Hamilton City, reduce flood damages in both Glenn and Butte Counties, keep a vital economic and emergency services route open, provide jobs, and contribute to the recovery of federally-listed species, thereby reducing the regulatory burden on landowners up and down the river. This is a win-win-win investment in our region. Construction of this project could commence immediately, and that would mean creating jobs. The design, engineering and environmental due diligence needed to commence construction on the project has been finalized and we are ready to build. The project partners and supporters include: Reclamation District 2140; Sacramento River Conservation Area Forum; the Hamilton City Community Services District; Hamilton City Citizens in Action; Glenn County; Glenn-Colusa Irrigation District; California Central Valley Flood Control Association; Glenn County Farm Bureau; Hamilton City Fire Protection District; Provident Irrigation District; Hamilton Unified School District; local agricultural interests; the Fish and Wildlife Service; the Central Valley Flood Protection Board; the Department of Water Resources; the California Bay-Delta Authority, and the Nature Conservancy. Rarely is such a diverse coalition so strongly united behind a shared goal to enhance public safety and stimulate a regional economy while simultaneously conserving and enhancing vital natural resources.	
G43	Glenn	River Partners		USFWS Riparian Sanctuary project	Riparian Sanctuary project. This project is on hold while information is gathered for CVFPB so they can issue permits for rock removal. This project is riparian restoration on the Llano Seco Riparian Sanctuary Unit (USFWS) and to protect alignment of the Sac River at the Princeton-Codora-Glenn-Provident Irrigation District. Environmental Documentation has been complete, but the project has stalled in the permitting process.	
G44	Glenn			In-lieu Recharge in North-Eastern Glenn County	A feasibility study has been performed to investigate the possibility of delivering surface water to the north-eastern portion of Glenn County which relies primarily on groundwater for irrigation. This area typically experiences annual fluctuations in groundwater levels greater than 25 feet due to pumping for irrigation. Providing surface water in-lieu of groundwater pumping would provide for greater flexibility and supply reliability for the property operators as well as providing in-lieu recharge to the aquifer below. The groundwater would then be able to be pumped during dry periods allowing for the surface water to remain in the system and be used for other purposes. This may be accomplished through the utilization of existing conveyance facilities, expansion of existing conveyance facilities, or the construction new conveyance facilities. The feasibility study collected information on the area, developed a conceptual canal layout, and performed planning level analysis on the costs of developing an in-lieu delivery system. The conceptual layout serves 3,670 acres with an on-demand surface water delivery system. This project intends to implement the planning, environmental documentation, permitting and construction (implementation) portions of the in-lieu project.	
G27	Glenn, Butte, Colusa, Sutter, Yolo	DWR	USACE	Develop 100-year/200year WS Profiles for Sacramento River and Butte Basin		
L1	Lake	Lake County WPD	Lake County WPD	DFIRM Re-Mapping	The flooding that occurred in 1995 was about 2' below the current FIRM BFE. Re-mapping efforts are needed and desired by the County in order to adequately relay the flood risk to the public.	
L2	Lake	Lake County WPD		Levee Access Road Improvements		
L3	Lake	Lake County WPD		PL84-99	Unit #1 (LB Middle Creek): Address deficiencies to regain active status in the PL84-99 Program. Deficiencies include: Vegetation, Thin/Trim Trees, Encroachments, and Slope Stability	
L4	Lake	Lake County WPD		PL84-99	Unit #2 (RB Middle Creek): Address deficiencies to regain active status in the PL84-99 Program. Deficiencies include: Vegetation, Thin/Trim Trees, Encroachments, and Slope Stability	
L5	Lake	Lake County WPD		PL84-99	Unit #3 (LB Scotts Creek): Address deficiencies to regain active status in the PL84-99 Program. Deficiencies include: Vegetation, Thin/Trim Trees, Encroachments, and Slope Stability	
L6	Lake	Lake County WPD		PL84-99	Unit #4 (RB Poge, Alley and Clover Creek Diversion): Address deficiencies to regain active status in the PL84-99 Program. Deficiencies include: Vegetation, Thin/Trim Trees, Encroachments, and Slope Stability	
L7	Lake	Lake County WPD		PL84-99	Unit #5 (LB Clover Creek and Clover Creek Diversion): Address deficiencies to regain active status in the PL84-99 Program. Deficiencies include: Vegetation, Thin/Trim Trees, Encroachments, and Slope Stability	
L8	Lake	Lake County WPD		Upper Lake Interior Drainage Improvements	Interior drainage for Upper Lake is achieved via flap gates and during high water events along Middle Creek, no drainage is possible. The preferred solution is to construct a diversion to convey high water flows to the lower Middle Creek restoration area (once project is complete). The other alternative is to install a pump station; however, this is not the preferred alternative due to high O&M costs.	
L9	Lake	Lake County WPD		Clover Diversion Channel Improvements	Increase the capacity of the Diversion Channel (currently ~7,000 cfs). Construct improvements to the Clover Creek inlet structure (currently consists of (5) unregulated pipes and (2) 36-inch gated culverts. Install monitoring gage.	
L10	Lake	Lake County WPD		Upper Lake 100-year Feasibility Study	A Feasibility Study for achieving 100-year protection for Upper Lake	
L11	Lake	Lake County WPD		Scotts Creek Levee Improvements Feasibility Study		
L12	Lake	Lake County WPD		Upper Lake Flood Safety Plan	Develop a Flood Emergency Response Plan for Upper Lake area.	

Table 11-1. Mid and Upper Sacramento River Regional Flood Management Plan

WORKING DRAFT - Potential Project List, March 28, 2014

MUSR ID	County	Project Partners		Project Name/Type	Project Description	Project Cost
		Lead Agency	Partner Agency(s)			Amount ($)
L13	Lake	Lake County WPD		Middle Creek Recreational Trail	Construct new bike and pedestrian access along the Middle Creek east levee. Project includes a new Middle Creek crossing just below the Confluence with Scotts Creek.	
L14	Lake	Lake County WPD		Other	Observed low area of levee where pipe crosses. Approximately 60 feet in length.	
L15	Lake	Lake County WPD		Overtopping Repairs	Unit#3, LB, LM start 0.92. Overtopping.	
L16	Lake	MA 17		Critical Seepage Repair	Unit#1, LB, LM start 4.82, LM end 4.95. Boil.	
L17	Lake	MA 17		Seepage Repair	Unit#1, LB, LM start 5.8. Boil.	
L18	Lake	MA 17		Breach Repair	Unit#1, LB, LM start 6.0. Breach.	
L19	Lake	MA 17		Critical Seepage Repair	Unit#1, LB, LM start 5.4, LM end 5.5. Boil.	
L20	Lake	MA 17		Seepage Repair	Unit#1, LB, A 30-in pipe that penetrates through the levee is seeping approx. 100-GPM and carrying soil.	
L21	Lake	MA 17		PL84-99	General PL84-99 repair of deficiencies including: Vegetation and Thin/Trim Trees, Unit#1, LB.	
L22	Lake	MA 17		PL84-99	General PL84-99 repair of deficiencies including: Vegetation and Thin/Trim Trees, Unit#1, LB.	
L23	Lake	MA 17		Seepage Repair	Bank protection project to repair critical stability site, Unit#1, LB, LM start 4.82, LM end 4.95, Left Bank	
L24	Lake	MA 17		Seepage Repair	Bank protection project to repair critical stability site, Unit#1, LB, LM start 4.9, Left Bank	
L25	Lake	MA 17		Seepage Repair	Bank protection project to repair critical Seepage site, Unit#1, LB, LM start 4.91, Left Bank	
L26	Lake	MA 17		Seepage Repair	Bank protection project to repair critical Seepage site, Unit#1, LB, LM start 5.4, LM end 5.5, Left Bank	
L27	Lake	MA 17		Seepage Repair	Bank protection project to repair critical Seepage site, Unit#1, LB, LM start 5.4, LM end 5.4, Left Bank	
L28	Lake	MA 17		Seepage Repair	800 feet of drained seepage berm, Unit#1, LB.	$810,000
L29	Lake	MA 17		Seepage Repair	650 feet of a combined drained seepage and stability berm, Unit#1, LB.	$490,000
L30	Lake	USACE	DWR, Lake County WPD	Middle Creek Flood Relief and Restoration	This is a Federally Authorized project approved for $50 million in funding, however, it has not received funding through Appropriations yet. The project consists of de-authorizing and breaching the lower east Middle Creek levees in multiple locations and restoring about 1,650 acres of floodplain. The project provides water quality benefits to Clear Lake (alleviates sediment inflow), and the depths of flooding within the Southern zone of benefit are estimated to be between 5' and 10' during the 100-year event. The District is currently in the process of acquiring properties in fee; no conservation easements have been issued to date. Approximately 350 acres out of the 1,650 have been acquired; 14 of 16 homes have been acquired. There is currently a shortage of local funding of about $5-$6 million. Support from conservation agencies is desired. The project would include improvements to the Lucerne Cutoff Road and bridge, along with a raise of Highway 20.	
S1	Sutter	RD 0070	RD 70*RD 1660*Meridian	Emergency Response Flood Safety Plan	RD 70/RD 1660 Emergency Response Plan: Prepare Emergency Response Plan that contains contact information for every resident within the basin. Pre-design of a future Meridian emergency berm is needed (alignment agreements, interior drainage, top of berm elevations, etc.) Improve coordination with E.R. responders in order to allow District staff access to the levees during an emergency.	
S2	Sutter	RD 0070		PL84-99	Develop Systemwide Improvement Framework (SWIF) to regain active status in the PL84-99 Program for the Right Bank of the Sutter Bypass. Deficiencies include: Animal Control, Slope Stability, and Erosion, Unit#01, RB.	
S3	Sutter	RD 0070		PL84-99	Develop Systemwide Improvement Framework (SWIF) to regain active status in the PL84-99 Program for the Left Bank of the Sacramento River. Deficiencies include: Animal Control, Slope Stability, and Erosion, Unit#02, LB.	
S4	Sutter	RD 0070		PL84-99	Implement SWIF Program Repairs for Left Bank of the Sacramento River, Unit#02, LB.	
S5	Sutter	RD 0070		PL84-99	Implement SWIF Program Repairs for Right Bank of the Sutter Bypass	
S6	Sutter	RD 0070		Erosion Repair	Bank protection project to repair erosion sites, Unit#02, LB, RM 138.10, LM start 0.04 LM end 0.33	
S7	Sutter	RD 0070		Erosion Repair	Bank protection project to repair erosion sites, Unit#02, LB, RM 136.60, LM start 1.78, LM end 1.91	
S8	Sutter	RD 0070		Erosion Repair	Bank protection project to repair erosion sites, Unit#02, LB, RM 133.80, LM start 4.44, LM end 4.48	
S9	Sutter	RD 0070		Erosion Repair	Bank protection project to repair erosion sites, Unit#02, LB, RM 133.00, LM start 5.30, LM end 5.52	
S10	Sutter	RD 0070		Erosion Repair	Bank protection project to repair erosion sites, Unit#02, LB, RM 131.80, LM start 6.50, LM end 6.60	
S11	Sutter	RD 0070		Erosion Repair	Bank protection project to repair erosion sites, Unit#02, LB, RM 130.0, LM start 8.16, LM end 8.32	
S12	Sutter	RD 0070		Erosion Repair	Bank protection project to repair erosion sites, Unit#02, LB, RM 125.80 LM start 11.64, LM end 11.66	
S13	Sutter	RD 0070		Erosion Repair	Bank protection project to repair erosion sites, Unit#02, LB, RM 123.30, LM start 14.09, LM end 14.22	
S14	Sutter	RD 0070		Erosion Repair	Repair serious erosion on RB at XXXXXXXXX, Unit#01.	
S15	Sutter	RD 0070		Erosion Repair	Bank protection project to repair critical stability site, Unit#01, RB, LM start 4.472 LM end 4.512 LB	
S16	Sutter	RD 0070		Pipe Penetration Repairs & Replacements	Unit#01, RB.	
S17	Sutter	RD 0070		Levee Access Road Improvements	Levee Patrol Road Improvements, Unit#01, RB.	
S18	Sutter	RD 0070		Critical Erosion	Unit#01, RB, LM start 0.50. 350 feet of Rock Revetment.	$580,000
S19	Sutter	RD 0070		Seepage	Unit#01, RB, LM start 5.98, LM end 6.67, Seepage Area	
S20	Sutter	RD 0070		Seepage	Unit#01, RB, LM start 3.4, LM end , A number of small boils near levee toe	
S21	Sutter	RD 0070		Other	Unit#01, RB, LM start 7.1, Depression 3' deep and 9'x11'	
S22	Sutter	RD 0070		Seepage	Unit#01, RB, LM start 4.01, LM end , Seepage (Site B)	
S23	Sutter	RD 0070		Other	Unit#01, RB, LM start 4.521, LM end 4.559, 1-2.7' below design WSE	
S24	Sutter	RD 0070		Stability	Unit#02, LB, LM start 0.83, LM end 0.6, Sloughing	
S25	Sutter	RD 0070		Stability	Unit#02, LB, LM start 2.19, LM end 2.35, Sloughing	
S26	Sutter	RD 0070		Stability	Unit#02, LB, LM start 12.22, LM end 12.35, Slips	
S27	Sutter	RD 0070		Other	Unit#02, LB, LM start 14.46, Sinkhole on Berm	
S28	Sutter	RD 0070		Seepage	Unit#02, LB, LM start 12.0, Boils	
S29	Sutter	RD 0070		Seepage	Unit#02, LB, LM start 12.18, LM end 12.19, Boils in landside ditch. Documented as running and carrying sand (CLD).	
S30	Sutter	RD 0070		Seepage	Unit#02, LB, LM start 12.24, Boil in landside ditch.	
S31	Sutter	RD 0070		Stability	Unit#02, LB, LM start 12.17, Slough in ditch at landward toe, 25 feet in length.	
S32	Sutter	RD 0070		Stability	Unit#02, LB, LM start 7.7, Sloughing on Berm (S.R. Site O)	
S33	Sutter	RD 0070		Seepage	Unit#02, LB, LM start 12.1, Excessive Seepage	
S34	Sutter	RD 0070		Other	Unit#02, LB, LM start 4.65, LM end 4.99, Wide Levee Section	
S35	Sutter	RD 0070		Erosion	Unit#02, LB, LM start 0.041, LM end 0.326, 1997 - Loss of cobble revetment in levee section. 2004 - New fresh erosion in a short section of the downstream end. 2010 - New deposition on cobbles. 2011: No observed change. [2011 Site ID: SAC_138-1_L]	

Table 11-1. Mid and Upper Sacramento River Regional Flood Management Plan

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MUSR ID	County	Project Partners		Project Name/Type	Project Description	Project Cost
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S36	Sutter	RD 0070		Erosion	Unit#02, LB, LM start 1.796, LM end 1.916, 1997 - Toe erosion on a cobble revetment on the outside of a low receding bend. 2011: No observed change. [2011 Site ID: SAC_136-6_L]	
S37	Sutter	RD 0070		Erosion	Unit#02, LB, LM start 0.01, LM end 0.17, 1997 - Loss of cobble revetment in levee section. 2004 - New fresh erosion in a short section of the downstream end. 2010 - New deposition on cobbles. 2011: No observed change. [2011 Site ID: SAC_138-1_L]	
S38	Sutter	RD 0070		Serious Erosion	Unit#02, LB, LM start 4.472, LM end 4.512, 1997 - Local toe scour of cobble site, eroded into the levee section. Outside of a moderate receding bend. Some rock rehabilitation performed. 2010 - Failing cobble site 2011: Cobble site starting to unravel. [2011 Site ID: SAC_133-8_L]	
S39	Sutter	RD 0070		Erosion	Unit#02, LB, LM start 5.349, LM end 5.561, 1997 - Cobble toe failures. 2000 - Erosion into the levee toe at the downstream end. 2002 - Some fresh erosion at the upstream and downstream end. 2010 - Cobble appears to be at the end of its design life, 1 - 2 ft. slump in mid-bank of the cobble, up	
S40	Sutter	RD 0070		Erosion	Unit#02, LB, LM start 6.469, LM end 6.594, 2005 - (known as 132) On inside of bend. Erosion of berm toe. Levee slope is steep. Erosion probably due to eddy scour off upstream cobble. 2009 - Groins may be a good option for repair. 2010 - Scour off the upstream rock, some new erosion. 2011: Sit	
S41	Sutter	RD 0070		Erosion	Unit#02, LB, LM start 8.165, LM end 8.294, 1997 - Critical Site - Erosion of cobble site on outside of a bend. Failure caused by erosion of a material from behind the cobbles and cobbles rolling down the slope. Failure is just above the toe levee. Some repairs had been done at the upstream end.	
S42	Sutter	RD 0070		Erosion	Unit#02, LB, LM start 11.717, LM end 11.755, 2005 - Site was repaired. 2009 - Site is at upstream end of the repair site. 2011: Still minor erosion. [2011 Site ID: SAC_125-8_L]	
S43	Sutter	RD 0070		Erosion	Unit#02, LB, LM start 14.173, LM end 14.193, 2006 - Erosion into the levee toe. Rock at upstream end has poor transition causing eddy scour. 2010 - Minor new erosion. 2011: Some fresh erosion. [2011 Site ID: SAC_123-3_L]	
S44	Sutter	RD 0070		Seepage	Unit#02, LB, LM start 3.625, LM end , Possible sand boils (between 3 and 7 in number) on lower 1/3 of LS slope, about 24-36 inches in diameter, material consists of fine to medium sand with silt, extends about 200 feet.	
S45	Sutter	RD 0070		Stability	Unit#02, RB, LM start 14.43, LM end 14.5, Sloughing	
S46	Sutter	RD 0070		Stability	Unit#02, RB, LM start 14.48, Sloughing	
S47	Sutter	RD 1500		PL84-99	Develop Systemwide Improvement Framework (SWIF) to regain active status in the PL84-99 Program. Deficiencies include: Thin and Trim Tress, Encroachments, Animal Control, Underseepage, and Erosion	
S48	Sutter	RD 1500		PL84-99	Implement SWIF Repairs	
S49	Sutter	RD 1500		Erosion Repair	Unit#01, LB, Bank protection project to repair erosion site at RM 86.3, LM start 1.34, LM end 1.34	
S50	Sutter	RD 1500		Erosion Repair	Unit#01, LB, Bank protection project to repair erosion site at RM 87.1, LM start 2.31, LM end 2.31	
S51	Sutter	RD 1500		Erosion Repair	Unit#01, LB, Bank protection project to repair erosion site at RM 92.8, LM start 8.26, LM end 8.26	
S52	Sutter	RD 1500		Erosion Repair	Unit#01, LB, Bank protection project to repair erosion site at RM 95.8, LM start 11.79, LM end 11.79	
S53	Sutter	RD 1500		Erosion Repair	Unit#01, LB, Bank protection project to repair erosion site at RM 96.2, LM start 11.98, LM end 11.98	
S54	Sutter	RD 1500		Erosion Repair	Unit#01, LB, Bank protection project to repair erosion site at RM 99.0, LM start 13.98, LM end 13.98	
S55	Sutter	RD 1500		Erosion Repair	Unit#01, LB, Bank protection project to repair erosion site at RM 103.4, LM start 18.28, LM end 18.28	
S56	Sutter	RD 1500		Erosion Repair	Unit#01, LB, Bank protection project to repair erosion site at RM 104.0, LM start 18.38, LM end 18.38	
S57	Sutter	RD 1500		Erosion Repair	Unit#01, LB, Bank protection project to repair erosion site at RM 104.5, LM start 19.16, LM end 19.16	
S58	Sutter	RD 1500		Erosion Repair	Unit#01, LB, Bank protection project to repair erosion site at RM 116.0, LM start 30.6, LM end 30.6	
S59	Sutter	RD 1500		Erosion Repair	Unit#01, LB, Bank protection project to repair erosion site at RM 116.5, LM start 30.94, LM end 30.94	
S60	Sutter	RD 1500		Erosion Repair	Unit#01, LB, Bank protection project to repair serious erosion site, LM start 11.91, LM end 12.09, LB	
S61	Sutter	RD 1500		Erosion Repair	Unit#01, LB, Bank protection project to repair serious erosion site, LM start 11.91, LM end 12.38, LB	
S62	Sutter	RD 1500		Heavy Seepage	Unit#01, LB, Known heavy seepage, need core sampling and borings	
S63	Sutter	RD 1500		Dip in levee crown on paved road	Unit#01, LB, Known dip in levee crown, need core sampling and borings	
S64	Sutter	RD 1500		Seepage Boils	Unit#01, LB, Known boils, need landside stability berm	$25,000
S65	Sutter	RD 1500		Erosion and sloughing	Unit#01, LB, Known erosion and sloughing, need rock rip-rap	$250,000
S66	Sutter	RD 1500		Heavy Seepage	Unit#01, LB, Known heavy seepage, need landside stability berm	$610,000
S67	Sutter	RD 1500		Erosion and sloughing	Unit#01, LB, Known erosion and sloughing, need rock rip-rap	$2,150,000
S68	Sutter	RD 1500		Erosion Repair	Unit#01, LB, Known bank erosion, need SR Bank Protection Project	
S69	Sutter	RD 1500		Erosion Repair	Unit#01, LB, Known bank erosion, need SR Bank Protection Project	
S70	Sutter	RD 1500		Erosion Repair	Unit#01, LB, Known bank erosion, need SR Bank Protection Project	
S71	Sutter	RD 1500		Erosion and sloughing	Unit#01, LB, Known erosion and sloughing, need to reslope and add rock rip-rap	
S72	Sutter	RD 1500		Erosion and sloughing	Unit#01, LB, Known erosion and sloughing, need to reslope and add rock rip-rap	
S73	Sutter	RD 1500		Heavy Seepage	Unit#01, LB, Known heavy seepage, need core sampling and borings	
S74	Sutter	RD 1500		Vegetation Variance	Determine if a vegetation variance from USACE, Unit#01, LB.	
S75	Sutter	RD 1500		Permitting for Maintenance	Secure permits for maintenance issues from PL84-99 inspection, Unit#01, LB.	
S76	Sutter	RD 1500		Other	Unit#01, LB, LM start 0, LM end 1.5. Near overtopping (20 inches of freeboard)	
S77	Sutter	RD 1500		Seepage	Unit#01, LB, LM start 0.5, LM end 1.2. Seepage	
S78	Sutter	RD 1500		Seepage	Unit#01, LB, LM start 13, LM end . Two boils behind building 10 feet off the levee toe; carried a small amount of material, not sand bagged.	
S79	Sutter	RD 1500		Seepage	Unit#01, LB, LM start 13, LM end 13.19. Seepage	
S80	Sutter	RD 1500		Seepage	Unit#01, LB, LM start 13.92, LM end 14.35. Seepage	
S81	Sutter	RD 1500		Seepage	Unit#01, LB, LM start 19.88, LM end 20.75. Seepage	
S82	Sutter	RD 1500		Seepage	Unit#01, LB, LM start 20.3, LM end 22.5. Through and Under seepage and Boils	
S83	Sutter	RD 1500		Stability	Unit#01, LB, LM start 31.07, LM end . 2364 Foot Long Berm Localized Mass Failures	
S84	Sutter	RD 1500		Stability	Unit#01, LB, LM start 9.06. 765 Foot Long Toe, Levee Slope Fluvial Mass Failure	
S85	Sutter	RD 1500		Seepage	Unit#01, LB, LM start 23.30, LM end 23.70. Foundation Seepage Daylights in Ag Field	
S86	Sutter	RD 1500		Stability	Unit#01, LB, LM start 0.50, LM end 1.00. Slope slippage and cracking, heavy seepage, and near overtopping (14 inches of freeboard); levee settled up to 32 inches	
S87	Sutter	RD 1500		Stability	Unit#01, LB, LM start 31.34, LM end 31.81. Beaver holes, tension cracks, and slumping.	
S88	Sutter	RD 1500		Overtopping Repairs	Unit#01, LB, LM start 18.04, LM end . 85 Foot Long Full Bank Overtopping Scour and Eddy	

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S89	Sutter	RD 1500		Seepage	Unit#01, LB, LM start 11, LM end 12.7. Heavy Seepage	
S90	Sutter	RD 1500		Other	Unit#01, LB, LM start 24.4, LM end 25. Proposed levee reconstruction (fill ditch and restore landside toe).	
S91	Sutter	RD 1500		Encroachments	Unit#01, LB, LM start 19.18, LM end 19.25. Concrete Retaining Wall Along Landward Slope	
S92	Sutter	RD 1500		Seepage	Unit#01, LB, LM start 31.2, LM end 31.7. Boils; This site experiences through seepage and foundation seepage during high flows.	
S93	Sutter	RD 1500		Other	Unit#01, LB, LM start 31.34, LM end 31.81. Beaver holes, tension cracks, and slumping.	
S94	Sutter	RD 1500		Encroachments	Unit#01, LB, LM start 33.3, LM end 33.35. Concrete Retaining Wall on Landward Slope.	
S95	Sutter	RD 1500		Erosion	Unit#01, LB, LM start 1.36, LM end 1.97. 2006 - New erosion upstream, new bank failures near levee but still fairly wide berm in most places. 2008 - Large berm, questionable as to if it should remain in the inventory. 2010 - Minor new erosion, old cobble starting to fail. 2011: Cobble continue	
S96	Sutter	RD 1500		Erosion	Unit#01, LB, LM start 8.35, LM end 8.57. 1997 - Damage to cobble revetment on top left bank and toe damage. 2004 - Site is pretty minor. 2010 - Cobbles continue to deteriorate. 2011: Minor new erosion at the toe. [2011 Site ID: SAC_92-8_L]	
S97	Sutter	RD 1500		Erosion	Unit#01, LB, LM start 2.33, LM end 2.55. 2010 - The upstream end of the repair site at 87.0. Repair did not extend far enough upstream. 2011: New erosion pockets. [2011 Site ID: SAC_87-1_L]	
S98	Sutter	RD 1500		Serious Erosion	Unit#01, LB, LM start 11.91, LM end 12.09. 1997 - No toe on the large upstream rubble (mix of broken concrete, bricks, rock, and steal) - should be replaced. Oversized bank. 2001 - New slump at the downstream end. 2003 - Some minor bank retreat at the downstream end. 2004 - Some new retreat at	
S99	Sutter	RD 1500		Serious Erosion	Unit#01, LB, LM start 11.91, LM end 12.38. 2000 - Vertical Modesto Formation bank with mass failure. 2003 - Upstream end has some new bank retreat. 2004 - Upstream end is worse. 2006 - Some new erosion, mainly on the steep slope and scarps. (Pumping station is not part of the erosion site.) 2	
S100	Sutter	RD 1500		Erosion	Unit#01, LB, LM start 14.12, LM end 14.37. 1997 - Intermittent toe failure of the hand placed riprap; failure of toe materials. 2011: No observed change. [2011 Site ID: SAC_99-0_L]	
S101	Sutter	RD 1500		Erosion	Unit#01, LB, LM start 18.40, LM end 18.41. 2006 - Eddy flow and overtopping flow collide on the inside of a tight bend. Scour caused by converging flows created large scallop on the inside of a bend. 2007 - Site still looks bad. Would be a good candidate for a setback levee. 2008 - Some new de	
S102	Sutter	RD 1500		Erosion	Unit#01, LB, LM start 18.58, LM end 19.27. 1997 - Pocket failures of cobble revetment toe; scallops of rock loss along the bank; irregular bankline developing. 2001 - Small scallops in the toe of the berm. 2005 - Still multiple erosion pockets in the toe. 2006 - Two new small slumps. 2011: Old	
S103	Sutter	RD 1500		Erosion	Unit#01, LB, LM start 19.38, LM end 19.69. 1997 - Cobbles eroded off the clay materials; not much evidence of erosion on the toe; cobble loss on the toe. 2011: Some new minor erosion. [2011 Site ID: SAC_104-5_L]	
S104	Sutter	RD 1500		Erosion	Unit#01, LB, LM start 31.34, LM end 32.01. 2003 - New sedimentation and some new small toe scallops at the upstream end; downstream end has some new erosion. 2004 - Some new erosion at the toe and upper bank and some small new rotational failures (mainly minor, except at the downstream end). 200	
S105	Sutter	RD 1500		Erosion	Unit#01, LB, LM start 8.43, LM end 8.43.	
S106	Sutter	RD 1500		Erosion	Unit#01, LB, LM start 31.00, LM end 31.15. 2000 - Eroding, vertical berm slope over a vertical cohesive toe; slow erosion but getting close to the toe. 2002 - Erosion is getting close to the levee, still eroding with some new small slumps. 2004 - Some minor new erosion. 2006 - Some new erosion,	
S107	Sutter	RD 1500		Erosion	Unit#01, LB, LM start 8.43, LM end 8.43.	
S108	Sutter	RD 1500		Seepage	Unit#02, LB, LM start 18.5, LM end 19.5. Seepage (S.R. Site G)	
S109	Sutter	RD 1500		Seepage Repair	Bank protection project to repair serious seepage site, LM start 0.8, LM end 1.8, RB, Unit#02, LB.	
S110	Sutter	RD 1500		Seepage Repair	Bank protection project to repair critical seepage site, LM start 10.32, RB, Unit#02, LB.	
S111	Sutter	RD 1500		Seepage Repair	Bank protection project to repair critical seepage site, LM start 10.38, RB, Unit#02, LB.	
S112	Sutter	RD 1500		Seepage Repair	Bank protection project to repair critical seepage site, LM start 10.41, RB, Unit#02, LB.	
S113	Sutter	RD 1500		Seepage Repair	Bank protection project to repair serious seepage site, LM start 7.3, RB, Unit#02, LB.	
S114	Sutter	RD 1500		Seepage Repair	Bank protection project to repair serious seepage site, LM start 7.5, RB, Unit#02, LB.	
S115	Sutter	RD 1500		Seepage Repair	Bank protection project to repair serious seepage site, LM start 7.67, RB, Unit#02, LB.	
S116	Sutter	RD 1500		Seepage Repair	Bank protection project to repair serious seepage site, LM start 9.0, RB, Unit#02, LB.	
S117	Sutter	RD 1500		Seepage Repair	Bank protection project to repair critical seepage site, LM start 9.13, RB, Unit#02, LB.	
S118	Sutter	RD 1500		Seepage Repair	Bank protection project to repair critical seepage site, LM start 9.53, RB, Unit#02, LB.	
S119	Sutter	RD 1500		Seepage Repair	Bank protection project to repair critical seepage site, LM start 9.58, RB, Unit#02, LB.	
S120	Sutter	RD 1500		Seepage Repair	Bank protection project to repair critical seepage site, LM start 9.6, RB, Unit#02, LB.	
S121	Sutter	RD 1500		Seepage Repair	Bank protection project to repair critical seepage site, LM start 9.8, RB, Unit#02, LB.	
S122	Sutter	RD 1500		Pipe Penetration Repairs & Replacements	Unit#02, LB.	
S123	Sutter	RD 1500		Levee Patrol Road Improvements	Levee Patrol Road Improvements, Unit#02, LB.	
S124	Sutter	RD 1500		Stability	Unit#02, RB, LM start 2.30, LM end . Slip (S.B. Site B)	
S125	Sutter	RD 1500		Serious Seepage	Unit#02, RB, LM start 7.67, LM end . Boil # 3 in Irrigation Ditch	$350,000
S126	Sutter	RD 1500		Critical Seepage	Unit#02, RB, LM start 9.13, LM end . Boil # 4 in Irrigation Ditch	$350,000
S127	Sutter	RD 1500		Critical Seepage	Unit#02, RB, LM start 9.53, LM end . Boil # 5 in Irrigation Ditch	$970,000
S128	Sutter	RD 1500		Critical Seepage	Unit#02, RB, LM start 9.6, LM end . Boil # 6 in Irrigation Ditch	$970,000
S129	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 13.6, LM end 14.6. Numerous clear water boils (S.B. Site F)	
S130	Sutter	RD 1500		Critical Seepage	Unit#02, RB, LM start 10.32, LM end . Boil # 7 in Irrigation Ditch	$930,000
S131	Sutter	RD 1500		Critical Seepage	Unit#02, RB, LM start 9.58, LM end . Seepage was well reported in the 2005 Inspection Log.	$970,000
S132	Sutter	RD 1500		Critical Seepage	Unit#02, RB, LM start 9.8, LM end . Seepage well reported in 2005 Inspection Log at LMá9.58	$350,000

Table 11-1. Mid and Upper Sacramento River Regional Flood Management Plan

WORKING DRAFT - Potential Project List, March 28, 2014

MUSR ID	County	Project Partners		Project Name/Type	Project Description	Project Cost
		Lead Agency	Partner Agency(s)			Amount ($)
S133	Sutter	RD 1500		Critical Seepage	Unit#02, RB, LM start 10.38, LM end . Boil # 8 in Irrigation Ditch	$930,000
S134	Sutter	RD 1500		Critical Seepage	Unit#02, RB, LM start 10.41, LM end . Boil in Irrigation Ditch	$930,000
S135	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 12.09, LM end . Boil # 9 in Irrigation Ditch	
S136	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 13.99, LM end . Seepage at toe	
S137	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 14.11, LM end . Boil # 11 in Irrigation Ditch	
S138	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 14.22, LM end . Boil # 12 in Irrigation Ditch	
S139	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 14.26, LM end . Boil # 13 in Irrigation Ditch	
S140	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 14.48, LM end . Boil # 14 in Irrigation Ditch	
S141	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 14.56, LM end . Boil # 16 in Irrigation Ditch	
S142	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 15.45, LM end . Boil # 17 in Irrigation Ditch	
S143	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 15.71, LM end . Boil # 18 Flows Back When Irrigation Ditch is Full	
S144	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 16.2, LM end . Boil # 19 in Irrigation Ditch	
S145	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 17.14, LM end . Boil # 20 in Irrigation Ditch	
S146	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 17.73, LM end . Seepage at toe	
S147	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 17.76, LM end . Boil at toe, Carried Material in 1973	
S148	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 19.88, LM end 20.75. Excessive Seepage	
S149	Sutter	RD 1500		Serious Seepage	Unit#02, RB, LM start 0.8, LM end 1.8. Excessive Seepage (S.B. Site A)	$11,500,000
S150	Sutter	RD 1500		Stability	Unit#02, RB, LM start 2.70, LM end . Landside slide approximately 300 feet long (Site C).	
S151	Sutter	RD 1500		Serious Seepage	Unit#02, RB, LM start 7.3, LM end . Boils (S.B. Site D)	$630,000
S152	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 18.3, LM end . Boil (S.B. Site G)	
S153	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 18.6, LM end . Seepage (S.B. Site H)	
S154	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 18.9, LM end . Boils (S.B. Site I)	
S155	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 20.3, LM end . Seepage (S.B. Site J)	
S156	Sutter	RD 1500		Seepage	Unit#02, RB, LM start 21.2, LM end . Seepage	
S157	Sutter	RD 1500		Serious Seepage	Unit#02, RB, LM start 9.0, LM end 11.0. S.B. Site E: Additional small boils appeared and existing boils flowed substantial quantities of water at the landside levee toe.	$14,500,000
S158	Sutter	RD 1500		Serious Seepage	Unit#02, RB, LM start 7.5, LM end . Bank sloughing and seepage in the irrigation canal @ Sutter Bypass; RM92.2	$340,000
S159	Sutter	RD 1660		PL84-99	Develop Systemwide Improvement Framework (SWIF) to regain active status in the PL84-99 Program for the Left Bank of the Sacramento River. Deficiencies include: Encroachments, Slope Stability, and Erosion Left Bank of Sacramento River	
S160	Sutter	RD 1660		PL84-99	Implement SWIF Program Repairs for Sac River LB	
S161	Sutter	RD 1660		PL84-99	Develop Systemwide Improvement Framework (SWIF) to regain active status in the PL84-99 Program for the Right Bank of the Sutter Bypass. Deficiencies include: Encroachments, Slope Stability, and Erosion	
S162	Sutter	RD 1660		PL84-99	Implement SWIF Program Repairs for Sutter Bypass RB	
S163	Sutter	RD 1660		Erosion Repair	Bank protection project to repair erosion site at RM 120.6, LM start 1.32, LM end 1.35	
S164	Sutter	RD 1660		Seepage Repair	Bank protection project to repair serious stability site, LM start 5.68, RB	
S165	Sutter	RD 1660		Pipe Penetration Repairs & Replacements		
S166	Sutter	RD 1660		Erosion	Unit#01, LB, LM start 1.352, LM end 1.358, 2009 - Erosion on levee toe where an old cobble site is failing. 2011: Some new minor erosion. [2011 Site ID: SAC_120-6_L]	
S167	Sutter	RD 1660		Stability	Unit#01, LB, LM start 2.388, LM end 2.44,	
S168	Sutter	RD 1660		Stability	Unit#01, LB, LM start 2.44, LM end 2.44,	
S169	Sutter	RD 1660		Stability	Unit#01, LB, LM start 2.676, LM end 2.713,	
S170	Sutter	RD 1660		Stability	Unit#01, LB, LM start 1.151, LM end , Slope failure indicated by horizontal cracks on the LS slope with a bulge at the base of the slope and a zone of no vegetation above the bulge, approximately 50 feet wide.	
S171	Sutter	RD 1660		Other	Unit#01, LB, LM start 1.824, LM end , Possible sand boil on lower 1/3 of LS slope, about 36 inches in diameter, material consists of fine to medium sand with silt.	
S172	Sutter	RD 1660		Seepage	Unit#02, RB., LM start 0.07, LM end , Boil	
S173	Sutter	RD 1660		Seepage	Unit#02, RB, LM start 4.05, LM end , Two Boils	
S174	Sutter	RD 1660		Seepage	Unit#02, RB, LM start 4.18, LM end , Two Boils	
S175	Sutter	RD 1660		Stability	Unit#02, RB, LM start 0.5, LM end , Sloughing	
S176	Sutter	RD 1660		Stability	Unit#02, RB, LM start 1.4, LM end , Sloughing	
S177	Sutter	RD 1660		Stability	Unit#02, RB, LM start 1.8, LM end , Sloughing	
S178	Sutter	RD 1660		Seepage	Unit#02, RB, LM start 5.2, Boil	
S179	Sutter	RD 1660		Critical Seepage	Unit#02, RB, LM start 5.68, Piping hole in an agricultural ditch on the landside of the levee approx. 40 ft. from the landside toe. The piping hole was reported to flow with as little as 1 to 2 ft. of water in the Sutter Bypass and be moving material. No visible sink holes or depres	$920,000
S180	Sutter	RD 1660		Seepage	Unit#02, RB, LM start 0.21, LM end , Boil in drainage ditch	
S181	Sutter	RD 1660		Seepage	Unit#02, RB, LM start 0.27, LM end , Boil in drainage ditch	
S182	Sutter	RD 1660		Seepage	Unit#02, RB, LM start 0.52, LM end , Boil in drainage ditch	
S183	Sutter	RD 1660		Seepage	Unit#02, RB, LM start 0.63, LM end , Boil in drainage ditch	
S184	Sutter	RD 1660		Seepage	Unit#02, RB, LM start 1.14, LM end , Boil in drainage ditch	
S185	Sutter	RD 1660		Seepage	Unit#02, RB, LM start 1.58, LM end , Boil in drainage ditch	
S186	Sutter	RD 1660		Seepage	Unit#02, RB, LM start 2.81, LM end , Large boil and small boil in drainage ditch	
S187	Sutter	RD 1660		Seepage	Unit#02, RB, LM start 4.14, LM end 4.18, Three boils in drainage ditch	
S188	Sutter	RD 1660		Seepage	Unit#02, RB, LM start 4.41, LM end , Boil in drainage ditch	

Table 11-1. Mid and Upper Sacramento River Regional Flood Management Plan

WORKING DRAFT - Potential Project List, March 28, 2014

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		Lead Agency	Partner Agency(s)			Amount ($)
S189	Sutter	RD 1660		Seepage	Unit#02, RB, LM start 4.65, LM end , Large boil in drainage ditch	
S190	Sutter	RD 1660		Seepage	Unit#02, RB, LM start 4.77, LM end , Boil in drainage ditch	
S191	Sutter	RD 1660		Seepage	Unit#02, RB, LM start 4.94, LM end , Boil in drainage ditch	
S192	Sutter	RD 1660		Seepage	Unit#02, RB, LM start 5.39, Boil in drainage ditch	
S193	Sutter	RD 1660		Seepage	Unit#02, RB, LM start 6.32, Boil in drainage ditch	
S194	Sutter	RD 1660		Seepage	Unit#02, RB, LM start 6.82, Boil in drainage ditch	
S195	Sutter	RD 1660		Stability	Unit#02, RB, LM start 0.0, LM end , Crack is 80 ft. in length and about 3 ft. from the landward levee shoulder	
S196	Sutter	RD 1660		Stability	Unit#02, RB, LM start 1.8, LM end , Crack is 100 ft. in length and about 3 ft. from the landward levee shoulder	
S197	Sutter	RD 1660		Stability	Unit#02, RB, LM start 7.977, Slump of the LS toe into an adjacent irrigation ditch. 10 foot wide failure of a 2 foot high vertical bank, accompanied by tension cracks up to 2in wide, no bulges of the lower slope observed.	
S198	Sutter	RD 1660		Stability	Unit#02, RB, LM start 5.208, A line of longitudinal cracking up to 12in deep over 100ft on the LS crest and upper slope. No displacement observed.	
S199	Sutter	RD 1660		Stability	Unit#02, RB, LM start 3.716, LM end , Up to 10 inch deep crack approximately 30 feet running parallel to levee at the WS crown. No displacement observed.	
S200	Sutter	RD 1660		Stability	Unit#02, RB, LM start 3.338, LM end , Up to 13 inch deep, up to 1 inch wide crack running approximately 50 feet at lower 1/3 of WS slope. No displacement observed.	
S201	Sutter	RD 1660		Stability	Unit#02, RB, LM start 3.107, LM end , Up to 8 inch deep, up to 1 inch wide crack running approximately 30 feet at midslope of WS slope. No displacement observed.	
S202	Sutter	RD 1660		Erosion	Unit#02, RB, LM start 1.537, LM end 1.544, Erosion above WS toe in levee prism, up to 10 feet deep, 5 feet wide.	
S203	Sutter	RD 1660		Erosion	Unit#02, RB, LM start 1.544, LM end , Erosion above WS toe in levee prism, up to 10 feet deep, 5 feet wide.	
S204	Sutter	ST 09		Stability	Unit#01, LB, LM start 4.402, LM end , Cracking observed on lower 1/3 of LS slope. Cracks are 1-4 inches wide and 2-14 inches deep and extend over a 25 foot area.	
S205	Sutter	ST 09		Stability	Unit#01, RB, LM start 4.35, LM end , Landside slip	
S206	Sutter	ST 09		Other	Unit#02, RB, LM start 0.25, LM end 0.6. Blanket Drain to Repair Erosion Site	
S207	Sutter	ST 09		Stability	Unit#02, RB, LM start 0.25, LM end 0.56. Sloughing of bench at landside levee toe	
S208	Sutter	ST 09		Stability	Unit#02, RB, LM start 1.2, LM end 2.1. Slides (T.B. Site A)	
S209	Sutter	ST 09		Seepage	Unit#02, RB, LM start 1.2, LM end 2.1. Seepage in Irrigation Ditch	
S210	Sutter	ST 09		Stability	Unit#02, RB, LM start 3.5, LM end . Cracks vary in size from 8 inches wide to 1 foot depth. Cover about 300 ft. on waterside and about 200 ft. on landside. Patterns of cracks are indicative of shrinkage	
S211	Sutter	ST 09		Stability	Unit#02, RB, LM start 0.4, LM end 2. Sloughing along landside bench at 4 sites	
S212	Sutter	ST 09		Seepage	Unit#02, RB, LM start 0.35, LM end 0.59. Heavy seepage on landward slope	
S213	Sutter	ST 09		Serious Erosion	Unit#02, RB, LM start 1.01, LM end 1.01.	
S214	Sutter		Sutter County	Robbins Backup Power Supply	Install a new backup power supply at the Robbins' wastewater treatment plant, plus all appurtenances necessary to integrate the backup power supply into the existing electrical system. This project is required by the State under the treatment plant's operating permit.	
T1	Tehama	Deer Creek Watershed Conservancy	Tehama Co. FCWCD, CDFW Northern Region (Region 1)	Lwr Deer Creek Levee Improvements & Habitat Restoration Ph1	The overall Lower Deer Creek Project as described in the 2011 feasibility study is anticipated to include five (5) phases along Deer Creek from the Sacramento River to approximately River mile 8. This proposal includes the first phase that will result in a complete project that locally achieves the dual purposes of the Lower Deer Creek Restoration and Flood Management project to implement actions that lead to improved ecosystem health and reliable flood protection. Since there are five phases to the overall project, it is anticipated the USACE and State Regulatory Agencies will require one CEQA and NEPA document to support permitting (404 permit and CVFPB encroachment permit) and USACE 408 authorization that addresses all phases of the project. The first phase of the Lower Deer Creek Project	
T2	Tehama	Deer Creek Watershed Conservancy	Tehama Co. FCWCD, CDFW Northern Region (Region 1)	Lwr Deer Creek Levee Improvements & Habitat Restoration Ph2	Phase 2 of the Lower Deer Creek Levee Improvements and Habitat Restoration project will evaluate options to improve the existing SVRIC Diversion Dam and fish ladders. An agreement with Dam owner will be negotiated to allow modifications to occur. The selected alternative will be designed so that construction will not interfere with irrigation water being delivered customers, or impact fish passage. This alternative would result in all Deer Creek flows (up to 21,000 cfs) and sediment going through the dam location, and no flows bypassing the dam on the south bank. If other sources of funding are secured the dam and fish ladder designs will be constructed.	
T3	Tehama	Deer Creek Watershed Conservancy	Tehama Co. FCWCD, CDFW Northern Region (Region 1)	Lwr Deer Creek Levee Improvements & Habitat Restoration Ph3	Phase 3 of the Lower Deer Creek Levee Improvements and Habitat Restoration project will be the final design and construction of a new 4,620 LF levee. The new levee will be setback (566 LF at the largest point). The existing Deer Creek Project Levee 2 will be removed. The Levee setback will create approximately 40 acres of new floodway with floodway and migration easements, which will be contoured and improved to greatly assist fish passage (e.g. Salmon). The new floodway would be incorporated into the current DWR floodway maintenance program.	
T4	Tehama	Deer Creek Watershed Conservancy	Tehama Co. FCWCD, CDFW Northern Region (Region 1)	Lwr Deer Creek Levee Improvements & Habitat Restoration Ph4	Leininger Road Bridge (Red Bridge) would be rebuilt with a conveyance width of about 450 feet. The section of the north bank levee upstream of Red Bridge (PL2) would be removed, and the spoils would be used to raise the north bank road abutment, thus maintaining the flooding use of the flood easement on the Leininger property. Additional engineering of the north bank road abutment is likely.	
T5	Tehama	Deer Creek Watershed Conservancy	Tehama Co. FCWCD, CDFW Northern Region (Region 1)	Lwr Deer Creek Levee Improvements & Habitat Restoration Ph5	Miscellaneous improvements to non project levees, and removal of rock revetment and spurs will further enhance the flood benefits and habitat restoration efforts for the reach.	

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		Lead Agency	Partner Agency(s)			Amount ($)
T6	Tehama	Tehama Co. FCWCD	Tehama County	Tehama FMP Projects	The Action Program presented in the Flood Mitigation Plan (FMP) consists of the following: 1) Formulate Design Criteria and Standards to Handle Storm Runoff Quantity and Quality, 2) Prepare Topographic Mapping of the Valley Area of Tehama County, 3) Review, Update, and Implement Existing and/or New Ordinances, 4) Perform a Detailed Floodplain Analysis to Determine Drainage Patterns, the Extent and Cause of Flooding, and to Establish the Base Flood Elevation (BFE) to Administer the National Flood Insurance Program (NFIP) and Floodplain Management Regulations, 5) Formulate and Implement an "Elevation" Project to Identify Homes and Structures that Should be Elevated and Homeowners that Would be Interested in Participating in the Project, 6) Determine the 100-Year Floodplain Along the Sacramento River to be Used for the NFIP – FEMA FIRM vs. USACE Comprehensive Study, 7) Formulate and Implement an Invasive Plant Species Removal and Maintenance Program, 8) Formulate a Flood Hazard Mitigation Plan and Perform a Feasibility Study, 9) Formulate a Flood Management Plan for Jewett and Burch Creeks in the Vicinity of Corning, 10) Investigate and Implement Debris Management at Bridges, 11) Establish a Flood Hazard Mitigation Coordinating Committee (FHMCC), 12) Formulate and Implement a Flood Hazard Public Outreach Program, 13) Develop an Early Warning and Flood Alert System.	
T7	Tehama	Tehama Co. FCWCD		PL84-99	Unit #1 (LB Deer Creek): General PL84-99 repair of deficiencies including: Vegetation, Encroachments, Animal Control, Slope Stability, and Erosion/Bank Caving	
T8	Tehama	Tehama Co. FCWCD		Erosion Repair	Unit #1 (LB Deer Creek): Bank protection project to repair erosion site at RM 0.0, LM start 2.98, LM end 3.00	
T9	Tehama	Tehama Co. FCWCD		PL84-99	Unit #2 (RB Deer Creek): General PL84-99 repair of deficiencies including: Vegetation, Encroachments, Animal Control, Slope Stability, and Erosion/Bank Caving	
T10	Tehama	Tehama Co. FCWCD		Erosion Repair	Unit #2 (RB Deer Creek) Bank protection project to repair erosion site at RM 0.0, LM start 0.86, LM end 0.91	
T11	Tehama	Tehama Co. FCWCD		PL84-99	Unit #4 (LB Elder Creek): Develop System Wide Improvement Framework (SWIF) to repair identified deficiencies including: Vegetation, Encroachments, Animal Control, Slope Stability, and Erosion/Bank Caving	
T12	Tehama	Tehama Co. FCWCD		PL84-99	Unit #4 (LB Elder Creek): Develop System Wide Improvement Framework (SWIF) to repair deficiencies including: Vegetation, Encroachments, Animal Control, Slope Stability, and Erosion/Bank Caving	
T13	Tehama	Tehama Co. FCWCD		Erosion Repair	Unit #4 (LB Elder Creek): Bank protection project to repair erosion site at RM 0.0, LM start 1.44, LM end 1.51	
T14	Tehama	Tehama Co. FCWCD		PL84-99	Unit #5 (RB Elder Creek): Develop System Wide Improvement Framework (SWIF) to repair deficiencies including: Vegetation, Encroachments, Animal Control, Slope Stability, and Erosion/Bank Caving	
T15	Tehama	Tehama Co. FCWCD		Erosion Repair	Unit #5 (RB Elder Creek): Bank protection project to repair erosion site at RM 0.0, LM start 3.08, LM end 3.10	
T16	Tehama	Tehama Co. FCWCD		Erosion Repair	Bank protection project to repair serious seepage site, Right Bank	
T17	Tehama	Tehama Co. FCWCD		Slope Stability Repair	Bank protection project to repair serious stability site, 00+10 to SRGL-R, Right Bank	
T18	Tehama	Tehama Co. FCWCD		Erosion Repair	Unit #1 (LB Deer Creek): Bank protection project to repair serious erosion site, LM start 2.98, LM end 3.00, Left Bank	
T19	Tehama	Tehama Co. FCWCD		Erosion Repair	Unit #1 (LB Deer Creek): Bank protection project to repair serious erosion site, LM start 3.64, LM end 3.66, Left Bank	
T20	Tehama	Tehama Co. FCWCD		Erosion Repair	Unit #4 (LB Elder Creek): Bank protection project to repair critical erosion site, LM start 1.38, LM end 1.51, Left Bank	
T21	Tehama	Tehama Co. FCWCD		Other Repair	Unit #5 (RB Elder Creek): Bank protection project to repair other critical site, LM start 2.56, Right Bank	
T22	Tehama	Tehama Co. FCWCD		Other Repair	Unit #5 (RB Elder Creek): Bank protection project to repair other serious site, LM start 2.35, Right Bank	
T23	Tehama	Tehama Co. FCWCD		Other Repair	Unit #5 (RB Elder Creek): Bank protection project to repair other serious site, LM start 2.65, Right Bank	
T24	Tehama	Tehama Co. FCWCD		Seepage Repair	Unit #5 (RB Elder Creek): 400 feet of partial levee replacement	$310,000
T25	Tehama	Tehama Co. FCWCD		Elder Creek Flood Management, Restoration, and Invasive Species Removal	There is work that needs to be done on Elder Creek for flood management, restoration and invasive species removal. There are numerous elderberries there, so consultation with the USFWS for impacts to VELB may be one of the largest components of mitigation.	
T26	Tehama	Tehama Co. FCWCD		100yr/200-yr WS Profiles		
T27	Tehama	Tehama Co. FCWCD		Salt Creek Flood Hydraulics Study	Flooding along Salt Creek closes Highway 36. This is a major issue since highway 36 is the lowest pass into the Sierra's and is routinely used during winter emergencies. Historical flooding along Salt Creek has inundated the local Sheriff's facility (high water marks exist on the wall). A Cal Fire station is also at-risk of flooding from Salt Creek. The study would analyze flood hydraulics and identify potential remediation alternatives.	
T28	Tehama	Tehama Co. FCWCD		Flood Detention Basin FS	A Feasibility Study for constructing flood detention basins on foothill streams.	
T29	Tehama	Tehama Co. FCWCD		Small Community of Gerber Feasibility Study	Feasibility Study for providing a 100-year level of protection to Gerber.	
T30	Tehama	Tehama Co. FCWCD		Re-vegetation	Reduce peak flow runoff by re-vegetating agricultural areas.	
T31	Tehama	Tehama County FCWCD		Serious Stability	SRGL-R 1000+10 to SRGL-R 1083+84. A few burrows found, but not many.	
T32	Tehama	Tehama County FCWCD		Freeboard	SRGL-R 1016+56 to SRGL-R 1083+47. Low spot in levee is apparent to the naked eye. The levee drops down approximately 2.4 feet. Considered Freeboard Serious. (Failure mode for this POI changed from Other to Freeboard based on the 2012 field reconnaissance.) A few burrows found but not many.	
T33	Tehama	Tehama County FCWCD		Stability	Slopes are hummocky possibly due to spoils piles from digging out ditches on both land and water sides. Silty-clayey sand may erode to form hummocks.	
T34	Tehama	Tehama County FCWCD		Seepage Repair	SRGL-R 1021+57 to SRGL-R 1083+35. See description of 24-14 which is at the same location. No evidence of seepage observed. In the winter of 1983 sheet flow was at the toe for a distance of 100 feet. Loamy soil. Silty-clayey sand by field inspection. Through seepage susceptibility is class C.	
T35	Tehama	Tehama County FCWCD		Burrowing Animal Control	SRGL-R 1000+18 to SRGL-R 1037+64. A few burrows were found, but not many.	
T36	Tehama	Tehama County FCWCD		Burrowing Animal Control	SRGL-R 1055+37 to SRGL-R 1081+17. Some burrows, but not many.	
T37	Tehama	Tehama County FCWCD		Seepage Repair	SRGL-R 1038+65 to SRGL-R 1039+85. Area of reported seepage. No signs of seepage. Embankment composed of lean clay, low plasticity. A few small stumps waterside. Moderately high underseepage potential, throughseepage class C. Clear water seepage from base of levee at toe.	
T38	Tehama	Tehama County FCWCD		Stability	SRGL-R 1000+10 to SRGL-R 1083+84. Near 24-1 spoil piles or possibly slumps on the waterside slope. Two piles approximately 10 feet wide.	
T39	Tehama	Tehama County FCWCD		Erosion Repair	LM start (?). Approximately 250 feet of bank erosion on outside bend. Loose silty sand; no trees; small shrubs and weeds. Riprap located on portion of levee and bank. Area of concern should be monitored annually for advancing erosion.	
T40	Tehama	Tehama County FCWCD		Serious Erosion Repair	LM start (?). Approximately 120 feet of active erosion. Near vertical scarp is about 14 feet high. Soil is very loose Poorly Graded Sand with Gravel. Erosion has not progressed into levee prism at time of field visit, but likely will in near future with just nominal flows.	
T41	Tehama	Tehama County FCWCD		Breach Repair	Unit#1, LB, LM start 2.2. Levee breached by erosion and scour.	
T42	Tehama	Tehama County FCWCD		Breach Repair	Unit#1, LB, LM start 2.9, LM end 3.03. Scouring/Breach. Water side bank erosion present at this location.	
T43	Tehama	Tehama County FCWCD		Breach Repair	Unit#1, LB, LM start 3.2. 50 ft. Levee Break.	
T44	Tehama	Tehama County FCWCD		Breach Repair	Unit#1, LB, LM start 3.29, LM end 3.58. Breach.	

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		Lead Agency	Partner Agency(s)			Amount ($)
T45	Tehama	Tehama County FCWCD		Breach Repair	Unit#1, LB, LM start 3.64, LM end 3.66. Levee Breach.	
T46	Tehama	Tehama County FCWCD		Breach Repair	Unit#1, LB, LM start 3.46. Levee Breach (450 ft. in length Just East of Hwy 99).	
T47	Tehama	Tehama County FCWCD		Serious Erosion Repair	Unit#1, LB, LM start 2.98, LM end 3.03. Erosion along bank may be entering levee prism.. Leaning trees along bank. Five-foot near vertical drop off bank into creek. Overlaps 54-4.	
T48	Tehama	Tehama County FCWCD		Breach Repair	Unit#2, RB, LM start 1.0. 100 feet levee breach caused by erosion (interview with local Maintenance Authority).	
T49	Tehama	Tehama County FCWCD		Erosion Repair	Unit#2, RB, LM start 0.76, LM end 0.91. Bank is continuing to erode. Trees are tilting, roots exposed.	
T50	Tehama	Tehama County FCWCD		Rodent Control	Unit#4, LB, LM start 0.31. Gopher or Rodent Burrows, North side of Elder Creek, about 1/4-mile easterly of Central Avenue.	
T51	Tehama	Tehama County FCWCD		Other	Unit#4, LB, LM start 3.75. Emergency repair site (Site 2A), waterside berm, waterside widening. No indication work was completed.	
T52	Tehama	Tehama County FCWCD		Breach Repair	Unit#4, LB, LM start 3.8. 110 ft. Levee Break.	
T53	Tehama	Tehama County FCWCD		Overtopping Repairs	Unit#4, LB, LM start 3.91. Overtopping of the levee caused erosion on both sides of the levee.	
T54	Tehama	Tehama County FCWCD		Erosion Repair	Unit#4, LB, LM start 2.57. 8/30/2013: No change observed. Appears to be a common occurrence near to utility poles adjacent to landside levee.	
T55	Tehama	Tehama County FCWCD		Vegetation Removal	Unit#4, LB. Due to lack of maintenance of vegetation, levee is not accessible. Large trees and foliage present throughout levee prism.	
T56	Tehama	Tehama County FCWCD		Critical Erosion Repair	Unit#4, LB, LM start 1.38, LM end 1.51. 2006 - High vertical bank due to mass failures. Thalweg meandering and erosion of bank. Banks are cohesive with non-cohesive gravel horizons. 2011: Foundation is silty-sand with gravel. New slumping at the toe, mass failure continues. [2011 Site ID: EL	
T57	Tehama	Tehama County FCWCD		Serious Breach Repair	Unit#5, RB, LM start 2.35. Levee break, 50 ft. plus 300 ft. west levee erosion (Site 5).	
T58	Tehama	Tehama County FCWCD		Rodent Control	Unit#5, RB, LM start 0.29. Gopher or Rodent Holes, South side of Elder Creek, about 1/4-mile easterly of Central Avenue.	
T59	Tehama	Tehama County FCWCD		Rodent Control	Unit#5, RB, LM start 0.38. Gopher or Rodent Holes, South side of Elder Creek, about 1/4-mile easterly of Central Avenue.	
T60	Tehama	Tehama County FCWCD		Breach Repair	Unit#5, RB, LM start 3.1. Levee break, 100 ft. (Site 3).	
T61	Tehama	Tehama County FCWCD		Serious Breach Repair	Unit#5, RB., LM start 2.65. Levee break, 200 ft. (Site 4).	
T62	Tehama	Tehama County FCWCD		Critical Rodent Control	Unit#5, RB, LM start 2.56. 8/29/2013: Rodent burrows persist. Length of section measured approxmately 230 feet. Additional photos taken. Appears rodent bait/trap is non-operational. No other changes observed.	
T63	Tehama	Tehama County FCWCD		Erosion Repair	Unit#5, RB, LM start 2.98, LM end 3.00. 2006 - Mass failure of this bank due to being along the outside of a bend where erosion and undercutting are the greatest. Low flow is being forced into the toe of this bank by point bar on the opposite side of the creek. 2011: Toe of the bank continues	
T64	Tehama	Tehama County FCWCD		Erosion Repair	Unit#5, RB, LM start 3.45.	
T65	Tehama	Tehama County FCWCD		Levee Patrol Road Improvements		
T66	Tehama	Tehama County Public Worls	Tehama County	Tehama HMP County Wide Projects	The Tehama County Hazard Mitigation Plan (HMP) contains the following County Wide action plans: 1) Continue to maintain a countywide hazard mitigation plan website to house the plan and plan updates, in order to provide the public an opportunity to monitor plan implementation and progress. Each planning partner may support the initiative by including an initiative in its action plan and creating a web link to the website, 2) Leverage public outreach partnering capabilities to inform and educate the public about hazard mitigation and preparedness, 3) Coordinate all mitigation planning and project efforts, including grant application support, to maximize all resources available to the planning partnership, 4) Support the collection of improved data (hydrologic, geologic, topographic, volcanic, historical, etc.) to better assess risks and vulnerabilities, 5) Provide coordination and technical assistance in grant application preparation that includes assistance in cost vs. benefit analysis for grant-eligible projects, 6) Where appropriate, support retrofitting, purchase, or relocation of structures or infrastructure located in hazard-prone areas to protect structures/infrastructure from future damage, with repetitive loss and severe repetitive loss properties as priority when applicable, 7) Continue to maintain the steering committee as a viable committee to monitor the progress of the hazard mitigation plan, provide technical assistance to planning partners and oversee the update of the plan as necessary.	
T67	Tehama	Tehama County Public Worls	Tehama County	Tehama HMP Unincorporated County Projects	Tehama County unincorporated areas have the following action plans: 1) Maintain compliance and good standing under the National Flood Insurance Program (NFIP), 2) Consider participation in the NFIP, Community Rating System (CRS), 3) Where appropriate, support retrofitting, purchase, or relocation of structures located in hazardprone areas to protect structures from future damage, with repetitive loss and severe repetitive loss properties as priority, 4) Integrate Local Hazard Mitigation Plan into the Safety Element of the General Plan, 5) Support County-wide initiatives identified above, 6) Continue to support the implementation, monitoring, maintenance, and updating of this Plan, as defined in Volume 1 of the HMP, 7) Consider appropriate higher regulatory standards that prevent or reduce risk to the built environment from the known hazards of concern, 8) Identify and implement a feasible risk reduction solution to the flooding problems around Corning along the Jewett and Burch Creek flood plain. The creeks get choked up with vegetation and merge during high flow events causing harm and danger emergency responders, citizens, property, crops, roads, and bridges, 9) Implement and maintain those actions identified in the October 2006, Tehama County Flood Hazard mitigation Plan. This plan identified and prioritized 13 actions to reduce the risk to flooding in Tehama County. The future maintenance of this plan will be integrated in to the plan maintenance strategy for this hazard mitigation plan as described in Chapter 7 of Volume 1, 10) Implement and maintain those actions identified in the 2005 Tehama-Glenn Unit Fire Management Plan. This plan identifies and prioritizes projects for 10 zones within the Tehama-Glenn unit.	

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T68	Tehama	Tehama County Public Worls	Tehama County	Tehama HMP City of Tehama Projects	The City of Tehama action plans include: 1) Designate floodplain areas; preserve open space; ensure consistency of floodplain regulations with General Plan, 2) Refer development proposals that impact flood protection to other agencies as applicable, including Army Corps, FEMA. Require drainage plans, 3) Continue participation in NFIP and CRS; seek CRS classification improvements. Promote purchase of flood insurance, 4) Continue outreach program to provide information needed to increase awareness and modify actions to reduce flood damage, encourage flood insurance coverage and protect natural functions of floodplains, 5) Continue to pursue regional approach to flood issues by remaining involved in County Multi-Hazard Mitigation Plan, 6) Continue to develop, implement, and expand the Flood Alert and Early Warning Program systems, 7) Identify special needs residents and stay-at-home children that may require special assistance in hazard situations, 8) Monitor and regularly update City hazard studies whenever information becomes available that would significantly modify previous date. Update GIS data, 9) Implement a plan to keep brush & debris clear from Tehama Simpson Slough, 10) Continue annual inspection and maintenance of City's storm drain systems, 11) Analyze solutions to Gyle Rd flooding & funding sources. Improve barricading of Gyle Rd during flooding, 12) Repair culvert on Gyle Rd for drainage of Oak Creek, 13) Continue to promote programs to elevate and retrofit structures to protect from future damage, with repetitive loss properties as priority, 14) Perform a dam failure analysis to determine probably impact of flooding within Tehama if Shasta Dam fails & create a dam failure element for City's emergency response plan, 15) Investigate accuracy of river gauge to obtain readings on water levels and educate public on readings, 16) Elevate or move City Hall to a structure with lower risk for flooding, 17) Integrate, where appropriate, goals, objectives and initiatives of Tehama Hazard Mitigation Plan into City General Plan, regulations and programs where appropriate, 18) Support county-wide initiatives identified in Volume 1, 19) Collect information and participate in programs which address emergency preparedness, 20) Continue to participate in agreement with County for cooperative response to all hazards and disasters, 21) Inform and educate public on hazard mitigation; develop web site; annual dissemination of information, 22) Continue tree trimming program of 140-year old black walnut trees, 23) Undertake Earthquake Study for all critical facilities and non-reinforced masonry buildings. Seismic retrofit of identified buildings, 24) Implement an automatic gas shut off valve install program, 25) Continue to support the implementation, monitoring, maintenance, and updating of this Plan, as defined in Volume 1, 26) Continue to participate in mutual-aid agreements, such as in WARN –Water Assistance Resource Network- to get assistance in disaster situations, 27) Develop and promote water conservation programs, 28) Continue weed abatement program, 29) Continue to maintain compliance and god standing under the national Flood Insurance program (NFIP), 30) Consider appropriate higher regulatory standards that prevent or reduce risk to the built environment from the known hazards of concern.	
T69	Tehama		Tehama County, City of Corning, The Nature Conservancy, CA State Parks, CA DWR, Sacramento River Conservation Area Forum	Kopta Slough	Project Goals include: 1) provide flood damage reduction benefits through reduced bank erosion to protect public resources, 2) provide advance mitigation credits for Projects on State-maintained Central Valley Flood Control facilities (DWR Flood Control Projects) for mixed riparian forest habitat, including habitat for valley elderberry longhorn beetle (VELB), 3) provide ecosystem benefits, along 5,600 feet of river channel bank and over 700 acres of floodplain, through the restoration of natural fluvial and floodplain processes and mitigate for the loss of shaded riverine aquatic (SRA) habitat from DWR and USACE Flood Control Projects, and 4) establish long term public ownership of the Kopta Slough property to protect public trust resources and expand recreational opportunities for the people of the State of California on a portion of the Project area. Project Elements include: 1) remove revetment along 5,600 feet of the riverbank at the Kopta Slough property to restore fluvial and floodplain processes and mitigate for the loss of SRA habitat from DWR Flood Control Projects, 2) facilitate reestablishment of the river's historical channel alignment through Kopta Slough, 3) establish erosion protection for the west abutment of Woodson Bridge and the City of Corning sewer outfall, 4) restore 176 acres of mixed riparian forest habitat on the Kopta Slough property as mitigation for DWR flood control Projects, and 5) transfer the 708-acre Kopta Slough property from the California State Controller's Environmental Trust to a resource agency for long-term management. This element may include expansion of the Woodson Bridge SRA to the west side of the Sacramento River, with consideration for increasing public recreational opportunities. Next steps include a draft EIR/EIS and Feasibility Study.	
T70	Tehama and Shasta	Tehama Co. FCWCD		Veterans/Cottonwood Lake No-Pump Off-Stream Surface Storage	Veterans Lake (up to 1 million AF) and Cottonwood Lake (up to 1.4 million AF) no-pump off-stream surface storage reservoirs would be constructed on minor tributaries of Cottonwood Creek that do not support/impact anadromous fish and will not impact sediment flow/gravel migration. Water Sources: A portion of Trinity River water already headed to the Sacramento River could be diverted via Whiskeytown w/new 13 mile tunnel. Increased releases from Shasta Lake would replace flows diverted to Veterans/Cottonwood. In addition, fish/sediment/gravel friendly diversions within the Cottonwood Creek watershed could also be used. Water Releases: Releases in the Cottonwood Creek watershed can be limited to just the amount needed to enhance anadromous fish spawning, with the remainder sent back through Whiskeytown/Keswick. Fishery Enhancement: A DWR study outlines spectacular increases in spawning salmon within the Cottonwood watershed with managed releases w/ similar benefits for steelhead expected.	
Y1	Yolo	RD 0787		PL84-99	Develop System Wide Improvement Framework (SWIF) to repair deficiencies including: Animal Control, Slope Stability, Cracking, and Erosion	
Y2	Yolo	RD 0787		PL84-99	Implement SWIF	
Y3	Yolo	RD 0787		Erosion	Unit#01, LB, LM start 0.391 LM end 0.503. 2011: Large scallops throughout the entire reach. Toe scour due to tree pop-outs, resulting in a steepening slope. The reduced resistive forces plus clay levee may increase the loading. Additional erosion due to human use. [2011 Site ID: CBD_0-5_L].	
Y4	Yolo	RD 0787		Serious Erosion	Unit#01, LB, LM start 0.667 LM end 0.847. 2011: Large scallops throughout the entire reach. Toe scour due to tree pop-outs, resulting in a steepening slope. The reduced resistive forces plus clay levee may increase the loading. [2011 Site ID: CBD_0-9_L].	
Y5	Yolo	RD 0787		Stability	Unit#01, LB, LM start 1.292.	
Y6	Yolo	RD 0787		PL84-99	General PL84-99 repair of deficiencies including: Animal Control, Flood Preparedness & Training, and Erosion, Unit#01, LB.	
Y7	Yolo	RD 0787		Erosion Repair	Bank protection project to repair erosion site at Unit#01, LB, RM 0.0, LM start 0.39, LM end 0.51	
Y8	Yolo	RD 0787		Erosion Repair	Bank protection project to repair erosion site at Unit#01, LB, RM 0.0, LM start 0.67, LM end 0.67	
Y9	Yolo	RD 0787		Erosion Repair	Bank protection project to repair serious erosion site, Unit#01, LB, LM start 0.667 LM end 0.847	
Y10	Yolo	RD 0787		Erosion Repair	Bank protection project to repair serious erosion site, Unit#01, LB, LM start 0.715	
Y11	Yolo	RD 0787		Slope Stability Repair	Bank protection project to repair serious stability site, Unit#01, LB, LM start 1.084, LM end 1.168	
Y12	Yolo	RD 0787		Slope Stability Repair	Bank protection project to repair critical stability site, Unit#01, LB, LM start 1.461	
Y13	Yolo	RD 0787		Stability	Unit#01, LB, LM start 2.28 LM end 3.05. Segment 137 flood damage. Slips on landside. See map. (perhaps the maps would provide useful info).	
Y14	Yolo	RD 0787		Subsidence Repair	Unit#01, LB, LM start 2.25. subsided to a depth of 2' vertically and 8' to 10' into the crown of the levee for 50'.	

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Y15	Yolo	RD 0787		Stability	Unit#01, LB, LM start 4.4. Landside (East) Slip (RD 787).	
Y16	Yolo	RD 0787		Serious Erosion	Unit#01, LB, LM start 0.715. Bottom of waterside slope appears to be undercut and eroding. Slope appears to be sloughing down toward toe.	
Y17	Yolo	RD 0787		Serious Erosion	Unit#01, LB, LM start 0.772. Waterside slope appears to be failing. Noticeable head scarp is about 2 feet deep. Bottom may be undercut by high water leading to instability. Failure area extends for 200 feet.	
Y18	Yolo	RD 0787		Stability	Unit#01, LB, LM start 1.034. Cracking on waterside slope up to 36 inches deep and 1 inch wide.	
Y19	Yolo	RD 0787		Serious Stability	Unit#01, LB, LM start 1.084 LM end 1.168. Cracking on waterside slope up to 2 inches wide and less than 36 inches deep. Extends for 50 feet.	
Y20	Yolo	RD 0787		Critical Stability	Unit#01, LB, LM start 1.461. Slope failure on waterside slope with noticeable head scarp and toe bulge. Up to 40 feet wide and 10-15 feet tall.	$290,000
Y21	Yolo	RD 0787		Stability	Unit#01, LB, LM start 0.5. Waterside slip and landside slope failure./Surficial Slope Failure at LM 0.5 RD787.	

12. Financial Plan

12.1. << Under Development >>

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