DRAFT

Upper San Joaquin River Regional Flood Management Plan

Flood Management Operations and Maintenance

September 2013

Prepared by:
San Joaquin River Flood Control Project Agency
Table of Contents

4.0 Flood Management Operations and Maintenance ................................................................. 4-1
4.1 Background ............................................................................................................................ 4-1
  4.1.1 Agencies and Facilities .................................................................................................. 4-1
4.2 Local Agency Flood Management Operation and Maintenance .......................................... 4-3
  4.2.1 Lower San Joaquin Levee District ................................................................................. 4-3
  4.2.2 Merced Streams Group .............................................................................................. 4-11
  4.2.3 Madera County FCWCA ............................................................................................. 4-13
  4.2.4 Fresno Slough Improvement Group ............................................................................ 4-15
  4.2.5 Privately Owned Facilities .......................................................................................... 4-17
  4.2.6 Agencies with O&M Responsibility for Upstream Flood Facilities .......................... 4-17
4.3 Findings ............................................................................................................................. 4-18

List of Tables
Table 4-1. Levees within Planning Area ..................................................................................... 4-4

List of Figures
Figure 4-1. Upper San Joaquin River Regional Flood Management Planning Area within the SPFC .... 4-2
4.0 Flood Management Operations and Maintenance

4.1 Background

4.1.1 Agencies and Facilities

The Upper San Joaquin River (USJR) Region lies within the counties of Fresno, Madera, and Merced and encompasses the areas that are protected by the State Plan of Flood Control Facilities (SPFC) along the San Joaquin River from Gravelly Ford to the confluence of the Merced River; Ash Slough, Berenda Slough and the Fresno River in Madera County; and Mariposa Creek, Owens Creek, Bear Creek, and Merced River in Merced County. Figure 4-1 indicates the planning area boundaries, which lie within portions of Fresno, Madera, and Merced Counties. The Lower San Joaquin Levee District (LSJLD) is the primary agency responsible for flood management operations and maintenance (O&M) within the planning area. The LSJLD operates and maintains the Lower San Joaquin River Flood Control Project, which was completed in 1966. The project includes levees along portions of the San Joaquin River and other tributary east-side rivers and streams from Gravelly Ford to the Merced River, as well as flood bypass channels and various types of structures necessary for the project's operation.

Other agencies that operate and maintain flood facilities within the USJR Region include the Merced Streams Group (MSG) and the Madera County Flood Control and Water Conservation Agency (FCWCA). Both of these agencies are responsible for the O&M of lengthy levee systems along several of the aforementioned east-side rivers and streams that flow into the LSJLD project facilities. However, the length of these tributary rivers and streams that lie within the planning area is relatively small in comparison to the entirety of the LSJLD project facilities. Most of the background information in this section focuses on the LSJLD facilities and the portions of MSG and Madera County FCWCA facilities within the planning area. O&M issues identified by MSG and Madera County FCWCA upstream of the planning area are included to provide context for how those issues might impact flood operations within the planning area. It should be noted that two separate areas—one along Owens Creek and the other along Bear and Black Rascal creeks, which are operated and maintained by MSG—are included in the USJR region.

The Kings River system is connected to the San Joaquin River by the James Bypass Channel and Fresno Slough. There are several miles of privately owned flood protection levees along Fresno Slough, south of Highway 180, which are within the planning area. A group of eight agencies has formed the Fresno Slough Improvement Group to make upgrades in this area. The group includes Kings River Conservation District, Kings River Water Association, Tranquility Irrigation District, Fresno Slough Water District, James Irrigation District, Reclamation District 1606, San Luis & Delta-Mendota Water Authority, and the San Joaquin River Exchange Contractors.

Much of the levee system along the San Joaquin River from the LSJLD bifurcation structure east of Mendota to a point about 2 miles south of the Mariposa Bypass Channel is privately owned. As such, the maintenance of these facilities is often limited and not conducted at regular intervals.
Figure 4-1. Upper San Joaquin River Regional Flood Management Planning Area within the SPFC
Other agencies responsible for O&M of flood facilities that are entirely outside the planning area, but that flow into LSJLD project facilities, include Kings River Conservation District (and associated Kings River districts), Chowchilla Water District, and Madera Irrigation District. Typical operational activities that are performed by the agencies identified above include coordination with the Department of Water Resources (DWR) Flood Operations Center, patrols of the flood facilities, and flood fighting during periods of flood danger. Maintenance activities include periodic inspections of all project facilities; herbicide spraying in the floodways; removal of vegetation, trash, debris and sediment from the floodways and structures; repair of damaged or deteriorated project facilities; and control or extermination of burrowing animals in levees and embankments. Other responsibilities include review of encroachment applications for improvements within project easements, regulation of unauthorized encroachments, coordination of private livestock grazing on project easements, maintaining records of the project drawings, inspections and repairs.

4.2 Local Agency Flood Management Operation and Maintenance

4.2.1 Lower San Joaquin Levee District

The LSJLD was created by the California State Legislature in 1955. The purpose of the LSJLD is to ensure the flood protection benefits provided by the Lower San Joaquin River Flood Control Project are maintained. DWR designed and constructed this project, between 1959 and 1966. It is located along the San Joaquin River and portions of its east-side tributaries in Merced, Madera, and Fresno Counties. The service area of the project covers 108 river miles (RM) and 195 miles of levees, which protect more than 300,000 acres of land.

In 1958, the LSJLD agreed to operate and maintain the project after its completion in 1966. In 1978, the Reclamation Board authorized the former California Department of Fish and Game (now known as the California Department of Fish and Wildlife [CDFW]) to plant and maintain a pilot reach of the Chowchilla Canal Bypass north of Firebaugh for wildlife habitat. The O&M manual for the project was modified at that time for the wildlife plantings pilot program. The LSJLD is responsible for the O&M of the project, including all levees, channels, and control structures. CDFW is responsible for maintaining the wildlife plantings in the pilot reach, but has not had funding to attempt to develop or maintain habitat in this area for many years.

The project is located within the LSJLD boundaries in the counties of Merced, Madera, and Fresno. The improvements extend along and adjacent to the San Joaquin River from Gravelly Ford to the Merced River, excluding the portion of the river between the bifurcation structure for the Chowchilla Canal Bypass and Mendota Dam. The project includes the Chowchilla Canal Bypass, Eastside Bypass, and Mariposa Bypass channels. The Fresno River, Berenda Slough, Ash Slough, Chowchilla River, and Bear Creek also flow into the bypass channels, and the project improvements extend eastward various distances along the lower ends of these rivers, creeks, and sloughs.

Levees

The project consists of levees constructed along natural drainage channels to increase floodwater carrying capacity and levees constructed for floodwater bypass channels. Top of levee crowns have widths of 12, 20, 24 or 28 feet and are covered with gravel patrol roads. Water-side slopes are 3 to 1 (horizontal to vertical [H:V]) and land-side slopes are 2 to 1 (H:V). The design freeboard is 3 feet for rivers and streams and 4 feet.
FLOOD MANAGEMENT OPERATIONS AND MAINTENANCE

for bypass channels. Actual freeboard may be different than the original design values due to land subsidence, along with erosion and sediment deposits in the channels. There are access roads to the levees and patrol bridges across the flood and river channels from levee crown to levee crown such that all portions of the flood control system are reachable by vehicle at all times for maintenance of the levee or flood fighting, as well as project maintenance activities. Fencing along the levees and fence gates on the levee patrol and access roads secure the project. Project channels are cleared and grubbed of debris, brush, trees, and other wild growth to maintain the floodwater design carrying capacity. Table 4-1 lists the locations of levees within the USJR region and the agencies responsible for their O&M. Agencies other than LSJLD are discussed later in this section.

Table 4-1. Levees within Planning Area

<table>
<thead>
<tr>
<th>Channel</th>
<th>From</th>
<th>To</th>
<th>County</th>
<th>Responsible Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Joaquin River</td>
<td>Gravelly Ford</td>
<td>Chowchilla Canal Bypass</td>
<td>Fresno, Madera</td>
<td>LSJ LD</td>
</tr>
<tr>
<td></td>
<td>Chowchilla Canal Bypass</td>
<td>Mendota Pool</td>
<td>Fresno, Madera</td>
<td>Private</td>
</tr>
<tr>
<td></td>
<td>Mendota Pool</td>
<td>1.6/2.2 miles upstream of Sand Slough</td>
<td>Fresno, Madera, Merced</td>
<td>Private</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Interchange Pool</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sand Slough Interchange Pool</td>
<td>Merced</td>
<td>LSJ LD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.0/3.0 miles upstream of Mariposa Bypass</td>
<td>Merced</td>
<td>Private</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mendota Pool</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chowchilla Canal</td>
<td>San Joaquin River</td>
<td>Junction with Eastside Bypass at Fresno River</td>
<td>Madera</td>
<td>LSJ LD</td>
</tr>
<tr>
<td>Bypass</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastside Bypass</td>
<td>Junction with Chowchilla Canal</td>
<td>San Joaquin River downstream of Bear Creek</td>
<td>Madera, Merced</td>
<td>LSJ LD</td>
</tr>
<tr>
<td></td>
<td>Bypass at Fresno River</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresno Slough</td>
<td>Junction with James Bypass (w</td>
<td>Mendota Pool</td>
<td>Fresno</td>
<td>Private</td>
</tr>
<tr>
<td></td>
<td>west of railroad tracks)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresno River</td>
<td>Road 18 (approximately)</td>
<td>Junction w/ Chowchilla Canal Bypass</td>
<td>Madera</td>
<td>Madera County</td>
</tr>
<tr>
<td>Berenda Slough</td>
<td>Avenue 17 1/2 (approximately)</td>
<td>Junction with Eastside Bypass</td>
<td>Madera</td>
<td>Madera County, LSJ LD</td>
</tr>
<tr>
<td>Ash Slough</td>
<td>Road 8 (approximately)</td>
<td>Junction with Eastside Bypass</td>
<td>Madera</td>
<td>Madera County, LSJ LD</td>
</tr>
<tr>
<td>Chowchilla River</td>
<td>Highway 59</td>
<td>Junction with Eastside Bypass</td>
<td>Madera, Merced</td>
<td>Madera County</td>
</tr>
<tr>
<td>Owens Creek</td>
<td>Upstream of Mission Avenue</td>
<td>Junction with Mariposa Creek</td>
<td>Merced</td>
<td>Merced Streams Group</td>
</tr>
<tr>
<td></td>
<td>Eastside Canal</td>
<td>Junction with Eastside Bypass</td>
<td>Merced</td>
<td>LSJ LD</td>
</tr>
<tr>
<td>Black Rascal Creek</td>
<td>u/s of Yosemite Avenue</td>
<td>Junction w/ Bear Creek</td>
<td>Merced</td>
<td>Merced Streams Group</td>
</tr>
<tr>
<td>Bear Creek</td>
<td>Eastside Canal</td>
<td>Junction with Eastside Bypass</td>
<td>Merced</td>
<td>LSJ LD</td>
</tr>
</tbody>
</table>
Control Structures

Primary control structures consist of reinforced concrete, abutments, pier walls, and bridge decks with electric-motor-operated radial gates. There are two identical gate control structures, one in each channel, at the junction of the San Joaquin River and the Chowchilla Canal Bypass. The structures are operated together to control the flow that is diverted from the San Joaquin River to the bypass channel. Each structure consists of four 20-foot-wide bays with fabricated steel radial gates. The gates are raised and lowered by cable hoists with electric motors. A standby engine-generator set with a propane fuel tank provides backup electrical power to the gate hoists in the event of a power outage. Electrical controls for the gates are located in a concrete-block control building.

There are two bypass control structures, one in each channel, at the junction of the Eastside Bypass and Mariposa Bypass. The bypasses generally remain dry, with the exception of some ponding in low-lying areas, until they are needed to convey higher flows. The structures control the flow that is diverted from the Eastside Bypass into the Mariposa Bypass, which discharges back into the San Joaquin River about 4 miles west of the structures. The Mariposa Bypass control structure consists of 14 bays, each 20 feet wide. The outer four bays on each end (eight total) are fitted with fabricated steel radial gates, and the inner six bays are not gated. The structure includes a reinforced concrete spillway on the downstream side to dissipate energy from the elevation drop from the Eastside Bypass to the Mariposa Bypass. The Eastside Bypass control structure consists of six 20-foot-wide bays with fabricated steel radial gates on all bays. The gates for both structures are raised and lowered by cable hoists with electric motors. A standby engine-generator set with a propane fuel tank provides backup electrical power to the gate hoists in the event of a power outage. Electrical controls for the gates are located in a concrete-block control building.

Other control structures are located at the confluence of the Fresno and San Joaquin rivers just north of Highway 152, at the Sand Slough interchange where the San Joaquin River intersects the Eastside Bypass Channel, and at the junction of Owens Creek and the Eastside Canal, and at the junction of Bear Creek and the Eastside Canal. The Fresno River drainage structure is a 4-foot by 6-foot reinforced-concrete box culvert through the right bank levee of the San Joaquin River. Drainage flow is controlled by a slide gate located on the landward side of the San Joaquin River. There is also a levee embankment just east of the gate structure that plugs the Fresno River. The Fresno River Channel between the Eastside Bypass and the San Joaquin River is considered interior drainage and is not part of the project facilities.

The Sand Slough interchange structures include a four-bay reinforced-concrete box culvert through the left bank of the San Joaquin River just south of Washington Road, and a reinforced concrete Parshall flume at the junction between the San Joaquin River and the Eastside Bypass Channel. Slide gates located on the upstream side of the box culverts control flow into Reach 4B of the San Joaquin River. Timber flashboards are sometimes used in the Parshall flume to control flow.

The Owens Creek structure has a reinforced-concrete invert slab, pier walls, end walls, and wing walls, with a 12-foot-wide timber bridge deck for access across Owens Creek along the west bank of the Eastside Canal. There are seven bays with timber flashboards in the upstream side of the structure. Flow from Owens Creek enters the Eastside Canal through a culvert at the east bank of the canal and can be released into the Eastside Bypass through the control structure. There are seven bays with timber flashboards at the upstream side of the structure.

The Bear Creek structure has a reinforced-concrete invert slab, pier walls, end walls, and wing walls, with a 3-foot-wide catwalk spanning six bays with flashboards. Bear Creek flows directly into the Eastside Canal.
and can be released into the Eastside Bypass through the control structure. There is a reinforced concrete patrol bridge along the west bank of the Eastside Canal about 250 feet downstream of the control structure.

**Drop Structures**

There are two drop structures within a 0.5-mile section of the Eastside Bypass, just upstream of Road 9, with an elevation drop of approximately 4 feet. Four drop structures are within a 1-mile section of Ash Slough, with an elevation drop of approximately 10 feet. There is a single drop structure at the confluence of the Mariposa Bypass and San Joaquin River, with an elevation drop of approximately 15 feet. As noted earlier, there is a drop structure at the beginning of the Mariposa Bypass, which is integral with the control gate structure at that location. Drop structures have reinforced-concrete cutoff walls, crest or head walls, spillway apron slabs, floor blocks, end sills, side walls, and wing walls. Riprap is included upstream and downstream of the drop structures to minimize erosion of the channels and levee slopes.

**Bridges, Low Water and Dip Crossings**

There are 24 bridge or low water and dip crossings included in the project. Bridges are reinforced-concrete structures consisting of piles, deck slabs, and abutments. Patrol and access bridges are 18.3 feet wide, county road bridges are 30.3 feet wide, and the bridge at Highway 152 is 34 feet wide. Embankments have riprap slope protection. As noted earlier, there are four additional bridges that are integral with the control gate structures at the San Joaquin River bifurcation and the Mariposa Bypass. Low water and dip crossings are generally gravel surfaced roads that cross the interior of the bypass channels. Low flows pass through culverts under the roads; however, at higher flows, the roads are inundated and cannot be used. There are also reinforced concrete bridges that cross the low flow channel that are inundated during high-water conditions.

**Irrigation and Drainage Structures**

Numerous irrigation and drainage structures pass through, under, or over the project levees. These facilities provide for the passage of water from the flood waterway to the protected area for irrigation or other usage, or from the protected area to the waterway for drainage purposes. The structures are generally corrugated metal, steel, or reinforced-concrete pipes and reinforced-concrete box culverts with reinforced-concrete end walls and head walls. Flow through the culverts is controlled with slide or flap gates. Slide gates are located in riser pipes near the top of the levees; therefore, the gates can be accessed during high-water conditions. Flap gates are attached to culvert ends on the water side of the levees.

**Sediment Basin**

A sediment settling basin is included at the upstream end of the Chowchilla Canal Bypass. The basin is design to store up to 200,000 cubic yards of sediment. On the land side of both the right and left banks of the bypass channel, there are sediment disposal areas that are about 1.3 miles long.

**Hydrologic Facilities**

Hydrologic facilities include staff gauges and water stage recorders that are located at critical locations such as control structures and channel junctions. Staff gauge installations consist of three timber posts in a line perpendicular to the levee centerline. One post is located in the low-water channel, another on the berm between the low-water channel and the levee, and a third is on the levee slope. Enamel-coated metal staff gauges graduated in tenths of a foot are attached to the timber posts and set to a known elevation datum. LSJLD notes that staff gauges might no longer be reliable reference points from one flood event to the next due to the land subsidence that persists throughout the area. Patrollers therefore drive a temporary lath
into the levees to monitor water level changes. Water stage recorders typically consist of a stilling well with an inlet from the channel and a water level telemetering device in the stilling well. Recorded flows from these wells are monitored by LSJLD, with adjustments made for flow curve corrections due to channel cross sectional changes. Due to unreliable automatic gate control equipment, the primary control structures described earlier are manually operated.

An additional feature critical to O&M activities is the mile marker. The project is divided into levee units, and mile markers are included every 0.5 mile of each unit. Signs on the markers indicate the levee unit number and the mile beginning at the downstream end and proceeding upstream. The signs are visible from vehicles traveling in either direction along the levee patrol roads.

**Operations**

Flood season, as defined in the LSJLD O&M manual, is from November 15 to June 15 of each year. In the early part of this season the San Joaquin Valley can be threatened by rain-flood runoff. In the latter part of the season, there can be a threat of flooding from snowmelt runoff. High water is defined as flow that overflows the low-water channel and comes in contact with the levee. There are also specific staff gauge readings at the Eastside Bypass near El Nido and the San Joaquin River near Newman that indicate a high-water condition.

The joint Federal-State river forecasters of the Flood Operations Center in Sacramento closely follow storm and snowmelt runoff events in the Central Valley. Flows are monitored from Pine Flat Dam on the Kings River, Friant Dam on the San Joaquin River, Big Dry Creek Reservoir and Diversion Channel, Fresno and Chowchilla Rivers, MSG reservoirs (Burns, Bear, Owens and Mariposa creeks), New Exchequer Dam on the Merced River, and other miscellaneous local streams. Forecasts of significant runoff, including a weather summary and other data pertinent to the situation, are issued to the LSJLD. After the initial notification from the Flood Operations Center, it is the responsibility of LSJLD to keep itself informed of river and weather conditions. The LSJLD maintains daily communication with the Flood Operations Center during flood events.

During high-water periods, the LSJLD patrols the project levees continuously to locate possible sand boils or unusual wetness on the landward slope of the levees, slides or sloughs, wave wash or scouring, overtopping, debris jams, or other conditions that might endanger the levees. Seven LSJLD staff members are available for patrolling. Each patrol vehicle has one person driving and one person observing the flood conditions. When a flood event begins, it is not uncommon for patrollers to work 20-hour shifts until the event becomes stabilized. LSJLD uses 12-hour patrol shifts that begin and end at 12 am and 12 pm. This allows patrollers to assess the conditions from both day and nighttime perspectives. During critical events staff from DWR, USBR, local counties, landowners and irrigation districts can be used for additional patrols. Irrigation district staff is typically available for patrolling and flood fighting during non-irrigation winter periods, but they might not be available during snowmelt flood events, which can occur during the irrigation season. DWR, USBR and local county participation is governed by available funding.

Advanced measures are taken to ensure the availability of adequate labor and materials to make repairs or otherwise mitigate conditions that threaten the levees. Prior to an anticipated flood event, trailers with sandbags, rubble, and other levee repair materials are staged at key locations within the project areas. Before each flood season, Irrigation and drainage structures are inspected for debris that might prevent gates from closing, and gates and valves are closed to prevent the escape of floodwater from the channels.
FLOOD MANAGEMENT OPERATIONS AND MAINTENANCE

Wooden guard rails on private access bridges are removed during flood season to provide unimpeded flow of water across the low bridges.

There are specific protocols in the LSJLD O&M manual for operation of the primary gate structures at the San Joaquin River bifurcation and the Mariposa Bypass. The procedures are dependent upon upstream reservoir releases, water levels, and whether water levels are rising or falling. The sequence in which individual gate bays are to be opened or closed and the rates of opening or closure are specified. Should the flows exceed the specified rates at the control structures, in conjunction with Kings River flows, the LSJLD will operate the control structures at their own discretion with the objective of minimizing damage to the flood project and protected area. Manual operation procedures are preferred due to issues with attempting to use the originally installed automatic systems.

Flood operations per the O&M manual have been impacted by subsidence and aggradation of the system that has reduced the capacity of the channels to convey published design flows during flood events. A recent DWR study estimated that the Eastside Bypass would experience a reduction in freeboard of up to 1.5 feet between 2011 and 2016 if current trends continue. This would cause a reduction in capacity of up to 25%, but would be variable based on location. If subsidence continues along the bypass it will have significant impacts on future flood management operations.

Flood fighting operations include placing sandbags and other levee repair materials to reduce or eliminate boils, increase levee freeboard, and minimize erosion. LSJLD staff members perform such operations themselves or direct the use of equipment and manpower provided by State and local agencies. Following a declared flood event, FEMA, Cal EMA and USACE have programs available to reimburse LSJLD for flood fighting expenses and the repair of specific damages to the project facilities resulting from flood flows.

Maintenance
The project is inspected every 90 days. DWR makes two inspections (Spring & Fall), and the LSJLD makes two inspections (Summer & Winter). Inspections are to confirm that brush, trees, and wild growth other than sod are removed from the levee crown and slopes; burrowing animals are exterminated or otherwise controlled; damage to the levees such as caves, sloughs, burrows, holes, or slips are repaired; no revetment work or riprap slope protection is displaced; the crown of the levee is well shaped; floodway channels are clear of debris and wild vegetation growth (except for authorized plantings in the CDFW pilot reach); channel capacity is not reduced by excessive formation of shoals; sufficient space is available in the sediment basin; unauthorized vehicular travel on the project facilities is restricted; livestock grazing is being appropriately managed; no unauthorized encroachments or structures are present on the project easements; control structures, bridges, irrigation and drainage structures, hydrologic facilities, fences and gates are undamaged, in good working condition, and free of debris.

In recent years, the United States Army Corps of Engineers (USACE) has also made inspections of the project and issued notifications of facilities not in conformance with USACE standards. LSJLD must respond to these violations or USACE, through non-compliance with their Rehabilitation and Inspection Program (RIP) for eligibility for PL 84-99 assistance, will not provide support for future repairs of the project following flood events. Inspections of culverts that pass through project levees is a requirement of that compliance, but can only be accomplished through possible video surveillance.
Typical levee repairs include scarifying the surface and placing compacted layers of suitable fill material to restore the original cross section. Patrol roads must be usable for all-weather access, so approximately 5 miles of roads are resurfaced with gravel annually within the LSJLD budget.

Channels are to be kept clear of regrowth vegetation that can change flood flow characteristics. According to the LSJLD O&M manual, channels are to be maintained in a condition similar to when the project was constructed. Regrowth is primarily controlled by herbicide spraying. Shoaling or aggradation at inlets and outlets of side drainage structures is removed so the drains function properly. Eroded riprap material is replaced for slope protection and at critical points of channel stabilization. Sediment is periodically removed from the sediment basin, and the basin is regraded to the approximate original lines and grade.

Maintenance and repairs to structures includes replacement of broken or missing gate parts, lubrication of moving gate parts, repair of protective coatings on metal, and repair of eroded structural concrete or structure settlement. Prior to flood season each year, an electrician from LSJLD checks the electrical systems of the gate hoists in the primary control structures. The backup electrical generators at these structures are started to confirm that they are operational. LSJLD staff note that it is better to repair rusty areas on the control gates than to sand blast and recoat the control gates because new coatings do not bond to the metal as well as the original coatings. LSJLD, Madera County, and Merced County share responsibilities for maintenance of bridges that cross the project. The LSJLD maintains the substructure, water-side approach embankments, and riprap embankment slope protection. The counties are generally responsible for maintaining roadway surfaces, bridge superstructures (including the deck, roadway and guard rails), signage, and traffic control.

Enhanced Operations and Maintenance

The preceding text generally summarizes LSJLD O&M as it is defined in the LSJLD O&M manual. The following narrative summarizes difficulties that LSJLD has implementing its O&M obligations, methods it has used to improve O&M, and improvements that could be made to enhance existing O&M of the project.

The LSJLD service area is large relative to other special districts, and it is inspected, maintained, and patrolled by a small staff of employees. LSJLD's only source of revenue for general operating expenses is through benefit assessments on the lands within the LSJLD boundary. Lands within its jurisdiction are being acquired by State and Federal agencies for wildlife refuges, which exempt the areas from property assessments. LSJLD operating expenses are increasing with typical inflation indices while their revenue base shrinks. LSJLD's limited staffing and financial resources are currently not sufficient to reliably meet their statutory obligations to the State.

USACE has recently begun making inspections of the project and has issued notices of violation for facilities not conforming to USACE RIP standards. If LSJLD does not respond to these notices, it will be denied assistance from USACE to repair damage from future flood events. Failure to repair future flood damage will accelerate aging of the project and result in further reduction of performance of these facilities.

DWR has requested video inspections of culverts that pass through project levees. Routine inspections by the LSJLD and DWR have identified numerous levee sections in need of repair. Land-side slopes lack stabilizing vegetation in some areas. The right-of-way fences near the outside toe of the levees limit the work space available to replace eroded material and seed the slopes.
LSJLD is currently able to resurface with gravel about 5 miles of levee patrol roads each year. Resurfacing of patrol roads is done in accordance with the LSJLD O&M manual, but with 195 miles of levees to maintain, a given section of patrol road might not be resurfaced for about 40 years.

Sediment is periodically removed from designated and other sediment-collection areas in the channels, but much more sediment removal is needed. The material is essentially pure sand with no cohesion, so it is not marketable for urban development projects or road building. There is limited demand for the material to provide dust control. As such, LSJLD typically, along with assistance from landowners, water districts, local public agencies and contractors, bears the cost of excavating, hauling, and disposing of the material.

Recent regulations for spraying herbicides in wet environments have severely limited the LSJLD’s ability to control vegetation growth inside project levees. Employing a permanent herbicide consultant to complete the necessary permitting paperwork and direct spraying operations would improve this problem.

LSJLD currently uses bait stations for rodent control. Traps do not work well and require more attention by staff. With additional manpower and equipment, a grout rig could be used to regularly fill rodent holes in levees with bentonite cement, which would greatly reduce rodent damage to levees. Alternatively, LSJLD could contract to others a grout rig program.

LSJLD needs additional financial resources to:

• Bring the project into conformance with current USACE standards
• Perform video inspections of culverts that pass through project levees
• Secure temporary construction easements to repair and stabilize land-side levee erosion
• Regularly resurface levee patrol roads
• Sufficiently remove and dispose of sediment deposited in the floodways
• Hire a spray consultant for vegetation control
• Implement a grout rig program to fill rodent holes in levees

LSJLD has also identified a number of infrastructure improvements that would enhance its O&M, which are summarized as follows:

• The electrical controls and water level sensors for the primary control structures were installed in the 1960s with the original project. They are antiquated and should be modernized for improved reliability and integration with a new supervisory control and data acquisition (SCADA) system.

• The control structure at the head works of the Chowchilla Canal Bypass should be enlarged with two additional gate bays to increase the flow capacity into the bypass channel. Settlement has occurred at the San Joaquin River bifurcation structure, resulting in the wing walls separating from the structure. The joint has been temporarily filled, but it continues to widen. The wing wall backfill could be excavated and voids grouted under the spread footings, or spread footings could be added or enlarged to minimize further settlement. Erosion of the structural concrete is minimal, and no repairs of this type are currently needed.

• The existing Bear Creek diversion weir was built in the 1960s with the original project. The structure invert is higher than the upstream channel invert, which constrains Bear Creek flood flows entering the Eastside Bypass and causes upstream ponding on Bear Creek. Flows migrate around the project levee and flood the land side of the project levee. Modifying the structure to minimize the flow
restriction and adding spills through the project levees on each side of the Eastside Canal siphon would allow ponded water to drain into Bear Creek and then flow to the Eastside Bypass.

- Currently, project levees are breached at Unit 1, mile 9.90, and at Unit 5, mile 0.25. Recent USACE inspections rated the levee units as unacceptable and suggested new structures be installed to allow the project to operate as intended. The new structures would include flashboards to prevent floodwater from escaping the project floodway, but the flashboards could be manually removed to allow flooding on the land side of the levees to drain into the river channel.

- The right bank of levee Units 5, 7, 8, 9, and 10 were constructed as much as 2 feet higher than the left bank levees. As such, these reaches do not have the design freeboard documented in the LSJLD O&M manual. The left bank levees should be raised to the same elevation as the right bank levees.

**Subsidence**

LSJLD, along with other local, State, and Federal agencies, is very concerned about the impacts land subsidence could be having on its project facilities. Recent surveys indicate that subsidence has a rate of more than 0.5 foot per year. Flood flows that passed through the system just a few years ago might no longer be possible without encroaching on the design freeboard of levees and structures. This not only will reduce the level of protection for lands within the planning area, it also will limit flood flows upstream of the planning area, which in turn will reduce protection for those lands. Mitigation of subsidence impacts could be a very costly undertaking involving major upgrades or replacement of project facilities.

**4.2.2 Merced Streams Group**

The MSG does not maintain a regular staff. Its facilities are maintained by Merced County, the City of Merced, and Merced Irrigation District. These three agencies share the cost of O&M equally, and the combined resources they provide are typically sufficient for required O&M. Currently, no formal (written) agreement exists between the agencies although they have considered formation of a Joint Powers Authority.

MSG’s flood facilities include detention dams, channelized streams and levees on the Bear Creek system with its tributaries, Black Rascal Creek, Fahrens Creek, and Burns Creek, as well as the Mariposa Creek system with its tributaries, Miles Creek, and Owens Creek. Most of the project facilities were constructed by USACE in the 1950s, and USACE operates the reservoirs. Castle Reservoir was built in the 1990s and is operated by MSG. The original project facilities were designed to protect about 136,000 acres of agricultural land, the City of Merced, and communities of Planada and Le Grand.

MSG’s system is incomplete, and consequently the City of Merced is not protected from flooding along Black Rascal Creek. A detention reservoir called Haystack Reservoir is needed on Black Rascal Creek upstream of Merced, but the project has been delayed due to environmental concerns at the reservoir site. The project would provide 200-year flood protection for Merced. The latest cost estimate of the Haystack Reservoir project is $35 million. MSG had conducted a study for an alternative reservoir site that is downstream from the Haystack site. The new site includes almond orchards, so the land value could make the alternative even more costly. Since 2006, MSG has not received the funding from the USACE that it did in previous years. The lack of funding has limited the implementation of studies that are necessary to mitigate the environmental concerns or identify a new project site that is more feasible. MSG has applied for grant funds to complete the environmental studies and is reviewing project cost-sharing options between the State and USACE.

Upper San Joaquin River Regional Flood Management Plan
Flood Management
Operations and Maintenance
The only MSG project facilities that are included in the USJR region are diversion channel levees on Owens Creek and Black Rascal Creek.

**Channels, Floodways, and Levees**
The Black Rascal Diversion Channel is approximately 10,000 feet long with levees on both sides. It begins just north of Yosemite Avenue outside the city of Merced and discharges into Bear Creek south of Olive Avenue. The design capacity of the channel is 3,000 cubic feet per second (cfs).

The Owens Creek Diversion Channel is approximately 8,900 feet long with levees on both sides and is located outside the city boundaries. It begins just north of Mission Avenue in the city of Merced and discharges into Mariposa Creek at the east side of Burchell Road. The design capacity of the channel is 400 cfs.

Other channelized creeks that make up the project facilities include Miles Creek (1,000 cfs), Burns Creek (2,000 cfs), Bear Creek (2,000 to 7,000 cfs), Black Rascal Slough (3,900 cfs), Owens Creek (250 to 400 cfs), and Mariposa Creek (1,000 to 1,250 cfs).

**Dams**
Four detention dams are included in the project. Burns Creek and Bear Creek dams each have two nongated culvert outlets rated at 1,800 cfs. Owens Creek dam has a single nongated culvert outlet rated at 185 cfs. Mariposa Creek dam has two nongated culvert outlets rated at 1,000 cfs.

**Irrigation and Drainage Structures**
Numerous irrigation and drainage structures exist, extending through the levees of the Black Rascal and Owens Creek diversion channels. These structures are either inverted siphons that run under the channels or drainage inlets into the channels. Most of the siphons and drainage inlets are corrugated metal pipe, and most drainage inlets have flap gates on the water side of the levees to prevent flood flows from escaping the channel.

**Operations**
MSG monitors flood flows through the DWR Web site and notifies fire department officials if flood fighting is needed. Flood fighting operations include placing sandbags and other levee repair materials to reduce or eliminate boils, increase levee freeboard and minimize erosion. Merced Irrigation District staff and equipment are typically used for patrolling.

Reserve supplies of materials needed for flood emergencies are kept on hand at all times. This includes staging rock or other suitable protection materials at critical locations in the system.

**Maintenance**
Inspections of the project facilities are to be made just before flood season, at the beginning of the season, and at the end of flood season, as well as immediately after each high-water period, and otherwise at intervals not exceeding 90 days. Flood season is defined as November 1 through May 1 of each year. Inspections of flood channels include a recorded assessment of vegetation growth, debris accumulation, new construction in the right-of-way, aggradation or degradation, riprap areas, and bridges. Inspections of levees confirm that no unusual settlement, sloughing, or loss of material has occurred; no caving has occurred on either the land side or water side that might affect the stability of the levee; no seepage, saturated areas, or sand boils have occurred; drains through the levees and appurtenant gates are in good working condition; no revetment work or riprap has been displaced; cattle guards and gates are in good
condition; the crown of the levee and roadway, if any, are well shaped and readily drain; no unauthorized grazing or other encroachments to the right-of-way exist; and all burrowing animals have been exterminated.

Immediate steps are to be taken to correct dangerous conditions disclosed by inspections. Repairs are made to restore the project facilities to their original line and grade. Maintenance is done in a manner that minimizes adverse environmental impacts. Dead trees with wildlife value are retained, except where they constitute a hazard to the project. Drains are kept open and unobstructed where shoaling or aggradation has occurred at inlets and outlets. Sediment, debris plugs, or other obstructions are removed from channels particularly at the mouth of tributary channels. Weeds and other vegetation in the channel are cut in advance of flood season and removed from the channels along with trash. Rodent control measures are implemented at project levees. Eroded structural concrete is repaired and major settlement, uplift, or failures of concrete structures are referred to the State Engineer for remedial measures. Damaged fencing and gates are repaired. Automatic drainage gates that become jammed with debris in the open position are cleared and verified to swing freely. Missing or broken parts are replaced.

Enhanced Operations and Maintenance
The preceding text generally summarizes O&M as it is defined in the MSG O&M manual. The following narrative summarizes difficulties MSG has in implementing its O&M obligations and improvements that are needed to enhance existing O&M of the project.

A major O&M limitation identified by MSG is its inability to effectively remove vegetation from floodways while remaining in compliance with its 2007 programmatic permitting agreement with the CDFW. Sediment, trash removal, and rodent control activities are permitted in dry season, but vegetation removal can be done only in wet season when there is often flood and runoff water in the channels. Downed trees can be removed in dry season. Trees larger than 3-inches in diameter that are removed must be replanted with saplings at a replacement ratio of 10 to 1. Only one bank of a given channel is permitted to be cleared during a maintenance cycle. These limitations are in conflict with the MSG O&M manual, but MSG elects to comply with the CDFW permit under the threat of possible fines or prosecution for noncompliance. Streamlining or rectifying obvious conflicts between O&M obligations and CDFW permitting would enhance MSG's O&M capabilities.

MSG did not identify any lack of equipment or manpower, which is provided primarily by Merced Irrigation District, as well as by the City and County of Merced. The main infrastructure improvement needed is the detention reservoir on Black Rascal Creek and the associated project funding by USACE. MSG indicated that a dry stockpile facility would improve its O&M.

4.2.3 Madera County FCWCA
Madera County FCWCA is responsible for O&M of the Fresno River, Berenda Slough, and Ash Slough, portions of which are within the SPFC planning area. The agency has a one-person staff with limited availability of County staff and equipment. The operating budget, which relies entirely upon property assessments, is limited for the scope of facilities to be maintained. The current annual budget is about $170,000 for removal of channel vegetation and flood fighting.

The only Madera County FCWCA project facilities that are included in the SPFC planning area are channels and levees for the farthest downstream reaches of Berenda Slough, Ash Slough, and the Chowchilla River.
FLOOD MANAGEMENT OPERATIONS AND MAINTENANCE

Much of the Fresno River, which Madera County FCWCA also maintains, is within the USJR Region but does not include SPFC facilities.

**Channels, Floodways and Levees**

Berenda Slough is rated at 2,000 cfs where it enters the planning area south of 17-1/2 Avenue. The project levees are approximately 1.7 miles long on the right bank and 2.5 miles long on the left bank. The channel discharges into the Chowchilla Canal Bypass.

Ash Slough is rated at 5,000 cfs where it enters the planning area west of Road 8. The project levees are approximately 2.4 miles long, and the channel discharges into the Chowchilla Canal Bypass.

The Chowchilla River is rated 20,000 cfs at the upper end of the project, but it is diverted into Ash Slough east of Chowchilla and the capacity rating is only 75 cfs within the planning area.

**Upstream Project Facilities**

Weir structures exist where Berenda and Ash Sloughs split and the Chowchilla River is diverted. These structures are operated and maintained by Chowchilla Water District. Weirs and diversion gate structures are also operated and maintained by Madera Irrigation District. These structures are east of Chowchilla and far upstream of the planning area, but their operation could affect flood flows that enter the planning area and the Chowchilla Canal Bypass.

**Operations**

The Madera County FCWCA monitors flood flows primarily on the DWR Web site. Flood fighting consists mainly of monitoring and maintaining levees by placing sandbags and other levee repair materials to reduce or eliminate boils, increase levee freeboard, and minimize erosion. Two Madera County staff members are generally dispatched to patrol the levees and look for sand boils during a flood event. An additional three, for a maximum of five County staff can be called for flood fighting. If necessary, additional personnel from the County's Probations Department can be used. Madera County FCWCA maintains stockpiles of materials for flood fighting at the County's corporation yard. Drainage structures in the floodway levees are sometimes opened to intentionally flood adjacent lands, thereby avoiding a levee breach. Owners of these lands accept the practice. On the Fresno River, gates can be opened to allow adjacent flooded lands to drain to the river after the river level subsides.

**Maintenance**

Inspections of the project facilities are to be made just before flood season, at the beginning of the season, and at the end of flood season, as well as immediately after each high-water period, and otherwise at intervals not exceeding 90 days. Flood season is defined as November 1 through April 15 of each year. Inspections of flood channels include a recorded assessment of vegetation growth, debris accumulation, aggradation or degradation, and riprap areas. Inspections of levees confirm that no unusual settlement, sloughing, or loss of material has occurred; no caving has occurred on either the land side or water side that might affect the stability of the levee; no seepage, saturated areas, or sand boils occurred; drains through the levees and appurtenant gates are in good working condition; no revetment work or riprap has been displaced; cattle guards and gates are in good condition; the crown of the levee and roadway are well shaped and readily drain; the levee patrol roads are accessible at all times for truck delivery of flood fighting materials; no unauthorized grazing or other encroachments to the right-of-way exist; and all burrowing animals have been exterminated.
Immediate steps are to be taken to correct dangerous conditions disclosed by inspections. Repairs are made to restore the project facilities to their original line and grade. Maintenance is done in a manner that minimizes adverse environmental impact. Dead trees with wildlife value are retained, except where they constitute a hazard to the project. Drains are kept open and unobstructed where shoaling or aggradation has occurred at inlets and outlets. Sediment, debris plugs, or other obstructions are removed from channels, particularly at the mouth of tributary channels. Weeds and other vegetation in the channel are cut in advance of flood season and removed from the channels along with trash. Rodent control measures are implemented at project levees. Damaged fencing and gates are repaired. Automatic drainage gates that become jammed with debris in the open position are cleared and verified to swing freely. Missing or broken parts are replaced.

**Enhanced Operations and Maintenance**

The preceding text generally summarizes Madera County FCWCA O&M as it is defined in the project’s O&M manual. The following narrative summarizes difficulties that Madera County FCWCA has in implementing its O&M obligations and improvements needed to enhance existing O&M of the project.

The Agency’s biggest maintenance challenges are removal of the aggressive Arundo (*Arundo donax*) bamboo species and mitigating impacts of land subsidence. Primary O&M activities are mulching and spraying to eradicate bamboo growth. County staff also responsible for landscape maintenance was formerly used to assist with vegetation removal; however, those staff positions were restructured about 2 years ago and since then, little or no maintenance has been done. Madera County FCWCA is reviewing options to use outside contractors for this work. The County Roads Department is responsible for maintaining road culverts and bridges at channel crossings. Oftentimes the Roads Department will remove debris and vegetation approximately 100 feet upstream and downstream of the crossings, which assists the Madera County FCWCA.

Madera County FCWCA has very similar permitting restrictions for vegetation removal as that described for MSG. Areas that are not within the USACE levee units require onerous preliminary monitoring; therefore, those areas are not currently being maintained. A sediment removal project was recently suspended due to these restrictions.

The greatest need that Madera County FCWCA has in terms of improving its O&M is more funding. The funding could be used for the following:

- **Purchasing mowing equipment and hiring new staff to operate it would improve vegetation control in the flood channels.**
- **Hiring an herbicide applicator and purchasing a spray rig would reduce the amount of mowing needed and further reduce regrowth.**
- **Implementing a more aggressive rodent control program is needed. Currently, only a few bait stations are being used. More staff and funding would improve the program.**
- **Renting a grout rig and finding staff to operate it could help to regularly fill rodent holes in levees with bentonite cement and reduce rodent damage to levees.**

### 4.2.4 Fresno Slough Improvement Group

The Kings River system is connected to the San Joaquin River by the James Bypass Channel and Fresno Slough. There are several miles of privately owned flood protection levees along Fresno Slough, south of Upper San Joaquin River Regional Flood Management Plan. Flood Management Operations and Maintenance
Highway 180, that are within the SPFC planning area. Eight local agencies, identified earlier in the section, have formed the Fresno Slough Improvement Group to coordinate better O&M of these private levees. Currently, no formal agreement exists among the member agencies, but there have been several meetings and discussions among members about improving the levees and reducing flood risks along this section of Fresno Slough.

Reclamation District 1606 is responsible for O&M of the levees along the James Bypass from Highway 140 to the railroad crossing where the James Bypass flows into Fresno Slough. Fresno Slough and the associated levees from the railroad crossing to Highway 180 are within the SPFC planning area. The levees are privately owned and generally are in poor condition. The levee crowns are too low in areas, the levees were constructed of unsuitable materials, and there is cracking and settlement. In recent years, a levee failure occurred at one specific location. During a 2006 flood event, there were levee breaches and flooding of private lands west of the railroad crossing. Adjacent landowners have open drains at the toe of the levees to intercept seepage. The drains promote underflow and sloughing of the land side levee slopes, making them unstable and vulnerable to failure.

Vegetation removal is not a significant issue in this reach of Fresno Slough and would most likely be infeasible near or within the Mendota Wildlife Refuge or other habitat areas. Sediment buildup downstream of the reach, north of Highway 180, has been problematic. In 2011 sediment was removed near a levee failure area during a maintenance dewatering of Mendota Pool. This project was successfully undertaken by several of the Fresno Slough Improvement Group agencies. Tranquility Irrigation District, Fresno Slough Water District, and James Irrigation District provided labor and equipment forces. Kings River Conservation District completed applications and acquired environmental permitting. The Exchange Contractors coordinated lowering of the water level in the Mendota Pool.

Group members have suggested drafting written agreements among the members to implement future improvement projects. The scope of the projects and the agencies that will need to be involved will vary, depending on whether the location is in or out of the Wildlife Refuge or other sensitive habitat areas. The following O&M improvement projects have been identified by the Fresno Slough Improvement Group, but a source of funding and/or a group of stakeholders to implement the work is not yet identified.

- **Levee Improvements** - Improve the south levee, which has open toe drains and inadequate freeboard. Improvements might include removing the toe drains, rebuilding the levees, and bringing the levees under the jurisdiction of a responsible stakeholder.

- **Sediment Removal** - Remove sediment from Fresno Slough both inside and outside the Wildlife Refuge. It is uncertain, but probable to obtain permits to do this work. It would be easier and less costly if the work could be done at the same time that the Mendota Pool is dewatered for maintenance.

- **Floodplain enhancements** – Enhancements would involve the modification of existing levees surrounding a State-owned parcel of land. The levee modifications would improve flow over the land and reduce pressure on other nearby levees during flood events. The current configuration of levees and cuts concentrates channel flow and increases the pressure at a weak point of the nearby levees.
Kings River agencies and Kings River Conservation District in particular also want to promote levee improvements in the towns of Mendota and Firebaugh so upstream Kings River capacities can be maintained.

4.2.5 Privately Owned Facilities

Privately owned facilities within the SPFC planning area include levees along portions of the San Joaquin River and Fresno Slough. Private levees along the San Joaquin River begin after the bifurcation structure at the Chowchilla Canal Bypass and continue north of Highway 152. There are 1.6 miles (left bank) and 2.2 miles (right bank) of Lower San Joaquin River Flood Control Project levees along the San Joaquin River south of the Sand Slough interchange pool. River flows at this location are typically diverted into the Eastside Bypass channel. A box culvert structure with slide gates in the left bank levee of the river can divert flow into San Joaquin River Reach 4B, which continues northwesterly from the Sand Slough interchange structures. Much of this river reach is currently unsuitable for significant flows due to heavy sedimentation and vegetation growth in the channel. There are private levees along River Reach 4B to a point approximately 3 miles south of the Mariposa Bypass channel. A project levee begins on the right bank of the river at this location, and a project levee begins on the left bank at about 2 miles south of the Mariposa Bypass channel.

Because there are no public agencies responsible for the O&M of these San Joaquin River levees, their condition is uncertain. Fresno County staff indicated that private levees along the river north of Mendota Pool might be repaired at times by local irrigation districts such as Firebaugh Canal Water District and Central California Irrigation District (CCID). CCID’s Poso and Riverside Canals run directly adjacent to the left bank of the San Joaquin River from Firebaugh to the project levees south of the Sand Slough interchange pool. The left bank of the river is common to the right bank of these canals. Therefore, the left-bank levee along this 20-mile-plus reach of the river is most likely being maintained much better than other private levees. The DWR and LSJLD have documented and reviewed San Joaquin River levee sloughing and erosion within the town of Firebaugh. Because there is typically no significant flow through River Reach 4B, it is unlikely that the private levees along this reach are being well maintained.

The conditions of the private levees along Fresno Slough, south of Highway 180, are described under the subsection for the Fresno Slough Improvement Group.

Improving the O&M of private levees, and more specifically, implementing regular inspection and maintenance of the levees, would require bringing them under the jurisdiction of one or more public agencies as has been suggested by the Fresno Slough Improvement Group. This would be a costly endeavor in terms of acquiring easements, environmental permitting, and the construction necessary to bring the levees into conformance with acceptable minimum standards.

4.2.6 Agencies with O&M Responsibility for Upstream Flood Facilities

As noted previously, there are upstream facilities and local agencies responsible for the O&M that are not within the SPFC planning area. Kings River Conservation District, Tranquility Irrigation District, and Reclamation District 1606 operate and maintain levees along the Kings River system, including the James Bypass. Chowchilla Water District and Madera Irrigation District are responsible for O&M of weir structures east of Chowchilla, which divert and control flood flows in the Chowchilla River, Berenda Slough, and Ash Slough. The Madera County FCWCA has written agreements with these agencies for the O&M of these structures, which are critical in managing downstream flood flows. O&M activities by Kings River agencies,
FLOOD MANAGEMENT OPERATIONS AND MAINTENANCE

Chowchilla Water District, and Madera Irrigation District can impact flood facilities within the planning area. Conversely, O&M activities within the planning area can affect upstream flood flows in the Kings River system.

4.3 Findings

The SPFC Upper San Joaquin River planning area encompasses several flood protection projects that are operated and maintained by LSJLD, MSG, and Madera County FCWCA. There are also privately owned levee systems along portions of the San Joaquin River and Fresno Slough, south of Highway 180.

The public agencies continue to perform O&M activities in accordance with their respective project O&M manuals or other agreements. LSJLD and Madera County FCWCA are limited in their capabilities due to budget shortfalls. LSJLD has identified the need for additional staffing, equipment, and infrastructure improvements to enhance their current level of O&M. Madera County FCWCA could also enhance its O&M activities with additional staff and equipment, but its biggest limitation is funding. Both MSG and Madera County FCWCA have identified difficulties in reconciling their O&M obligations with stringent permitting requirements by CDFW for vegetation control and removal in floodways. Streamlining or rectifying conflicts between O&M obligations and environmental permitting would enhance the O&M capabilities of these agencies.

Privately owned levees and flood facilities that are within the planning area are in most cases not well maintained. Bringing these facilities under the jurisdiction of public agencies would enhance the O&M by requiring regular maintenance and inspections.