**Annual Report to the**
**Delta Stewardship Council**

# State Funds Awarded for Delta Levee Improvement and Rehabilitation Projects

**November 2019**

**State of California**

**California Natural Resources Agency**

**California Department of Water Resources**

# PREFACE

## California Sacramento-San Joaquin Delta Unique Characteristics and Importance

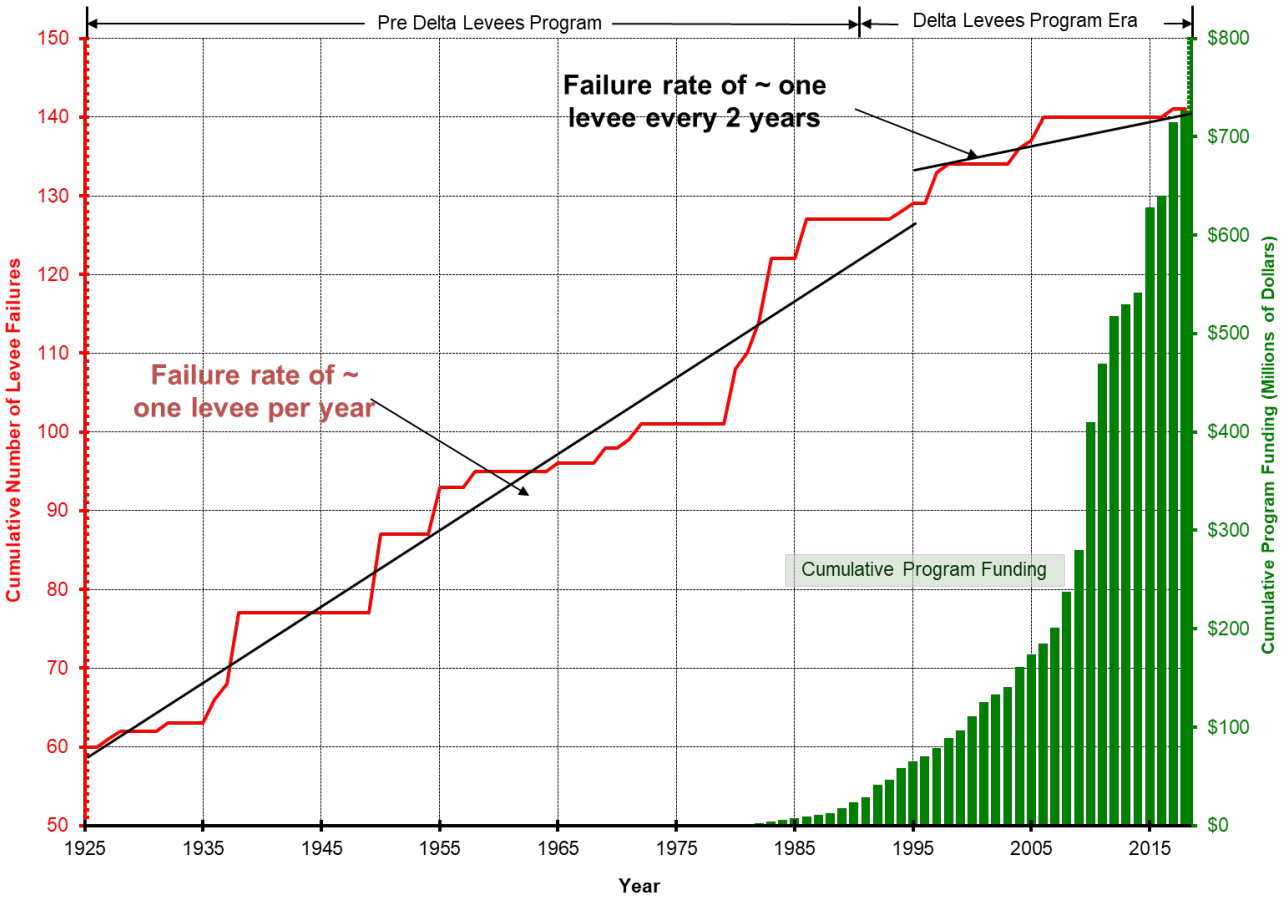
The Sacramento-San Joaquin Delta (Delta) lies at the confluence of the Sacramento and San Joaquin rivers, adjacent to San Pablo Bay. Here, the freshwater flows of these rivers and local streams meet seawater in numerous waterways, creating a rich and diverse landscape and ecosystem. While most of the vast expanses of tule marsh that once characterized the Delta have been converted to agricultural uses, a rich mosaic of habitats still exists and supports a multitude of fish, wildlife, and waterfowl. The Delta is a significant stopover for birds migrating along the Pacific Flyway and a migration corridor for millions of salmon annually. Because of its geographic location – stretching from Sacramento to the confluence of the San Joaquin and Stanislaus rivers, from Stockton to the Suisun Bay – the Delta is also an infrastructure hub laced with highways, railroads, aqueducts, oil and gas pipelines, powerlines, and other important infrastructure. With its legacy communities reflecting the rich cultural heritage and history of the region, as well as its natural and recreational resources, the Delta is a National Heritage Area and has been recognized in statute as a unique place that has immense value and must be protected. The Delta is also a key component of California's water infrastructure, providing a critically important source of water for Californians.

A defining feature of the Delta is its 1,100 miles of levees that have facilitated reclamation and development of the islands they protect. However, unlike typical river levees that are only stressed by high water during floods, Delta levees constantly have water against them and must continuously withstand the pressures and erosive forces of river flows, tides, and wind waves. Many of these levees were built over 150-years ago with readily available borrow material from adjacent lands or channels and are underlain with low strength/stability organic peat soil and alluvial sands. Current and future threats to the integrity of Delta levees include subsidence, climate change and sea level rise. Subsidence in the Delta increases flood risk by lowering the elevation of lands protected by levees and threatening the stability of levees. Many Delta islands have subsided to 15 feet or more below sea level. Due to this subsidence, levees must withstand greater hydraulic pressure as the supporting soil on the landside of the levee sinks. Because peat soils oxidize when exposed to the air, subsidence is expected to continue. Peat soils bacterial oxidation and subsidence are not uniform throughout the Delta but nevertheless pose a major challenge to the sustainability of the Delta under current and projected conditions. The California Department of Water Resources (DWR) has long recognized this concern. One of the key impacts of climate change on California's water resources is expected to be storms that produce more rain and less snow. Water that is now held in frozen reserve until summer will fall as rain and flow into streams and rivers, increasing flood risk and flood flows through the Delta. In the future, reservoirs may fill earlier due to changing runoff patterns, and operators will need to release water earlier in the season to make space for flood storage. Sea level rise, which is currently occurring at the rate of about 0.7 foot per century, is expected to accelerate, adding to the stress and need for levee strengthening and raising. Although a body of legislation has been

enacted over many decades to address several of these issues, securing necessary funding to sustain and improve the Delta has continued to be a challenge for local agencies and the State.

Levee failures and flooding have been common occurrences over the years although the frequency of flooding has been reduced as levees have been improved (Figure 1). Since many of the lands protected are near or below sea level, when a levee fails and lands are flooded, recovery can be very difficult, time-consuming, and expensive. In some past instances, the cost of recovery efforts exceeded the total value of assets on the island. For example, the Jones Tract flood recovery costs in 2004 totaled nearly $90 million—substantially more than the value of the assets on the island. Through its programs, DWR plays an important role in protecting and enhancing the Delta, responding to the need for investments in flood risk management, and prioritizing maintenance, repair and improvements to the levees that make the Delta what it is today and increasing its resiliency for the future.

**Figure 1: Cumulative Delta Levee Failures (Source: DWR Delta Levees Program)**



# TABLE OF CONTENTS



# FIGURES AND TABLES

# EXECUTIVE SUMMARY

This report is DWR's first annual report to the Delta Stewardship Council (DSC) pursuant to *The Delta Plan: Ensuring a Reliable Water Supply for California, a Healthy Delta Ecosystem, and a Place of Enduring Value* (*Delta Plan*), associated proposed regulations, and the Memorandum of Understanding (MOU) on priorities for State investments in the Delta that was signed by DWR, the DSC, and the Central Valley Flood Protection Board (CVFPB) in 2017. DWR has prepared this report to describe fiscal year 2018/2019 (FY 18/19 is July 1, 2018, through June 30, 2019) Delta levee funding decisions. DWR has sixteen programs or significant efforts with specific objectives in the legal Delta, and five of them made funding decisions regarding levee improvements and/or levee rehabilitation projects in FY 18/19. Through these decisions DWR approved funding for 23 projects on 19 islands/tracts. Of these, three islands are identified as very high priority by the DSC; four are considered high priority; and, twelve are considered other priority. A total of $123,547,222 in State funds was awarded by DWR during FY 18/19 to programs and projects with levee improvement or rehabilitation components (these figures do not include expenditures for levee maintenance in the Delta) consistent with the DSC's proposed definitions.

# 1. Purpose

The purpose of this report is to inform the DSC of DWR's decisions to award State funds for Delta levee improvements and rehabilitation projects in FY 18/19 pursuant to the 2017 MOU, the *Delta Plan*, and associated proposed regulations.

# 2. DWR's Mission

To sustainably manage the water resources of California, in cooperation with other agencies, to benefit the state's people and protect, restore, and enhance the natural and human environments.

DWR manages California's water resources, systems, and infrastructure, including the State Water Project (SWP). Our specific responsibilities and duties include:

- Preventing and responding to floods, droughts, and catastrophic events
- Informing and educating the public on water issues
- Developing scientific solutions
- Restoring habitats
- Planning for future water needs, climate change impacts, and flood protection
- Constructing and maintaining facilities
- Generating power
- Ensuring public safety
- Providing recreational opportunities

# 3. DWR's Investment Role in the Delta

The State of California has significant, broad interests in the Delta. Over time, many policies have been enacted with the goal of preserving the Delta in its current configuration to the extent possible. More recently, new policies have recognized that the Delta is in a state of transition and most State actions must account for that change. While DWR seeks to implement authorized programs in the context of its mission described above, individual programs and their funding sources are typically tied to specific legislative language and subsequent enacted regulations.

DWR's investments in the Delta are varied, reflecting the varied needs of Delta communities including rural, small communities, and urban areas. DWR has been implementing the Delta Levees Subventions and Delta Levees Special Flood Control Projects programs (described below) to cost-share Delta levee maintenance and levee improvements in the Delta. DWR also is cost-sharing with local agencies and the Unites States Army Corps of Engineers (USACE) to

reduce flood risk in urban communities as well as administering and funding a program to assist small communities achieve a higher level of flood protection. These expenditures in flood risk management have contributed to preservation of ecosystem functions and water supply reliability of the Delta. Expenditures in improving emergency response, conducting scientific research, updating hydraulic and hydrologic models, and gathering new geotechnical and topographic data have also been considerable. DWR's investments support the State's goal of creating a resilient and sustainable water management system for all Californians while protecting and enhancing natural habitat for native species. As large-scale planning efforts, such as Delta Conveyance, California EcoRestore, the *Delta Plan*, and Central Valley Flood Protection Plan (CVFPP) proceed, DWR will continue to use available resources strategically to improve integrated water management and help preserve the unique characteristics of the Delta.

# 4. Types of Levees and Terminology

Levees by definition are structures that direct the flow of water and hold it back from flowing to adjacent floodplains. Over time, there have been various standards established for the Delta which define levee geometry and maintenance requirements. These levee standards include those governed by federal flood control regulations, specifically Title 33 of the Code of Federal Regulations, Section 208.10, and the USACE's Rehabilitation and Inspection Program established under Public Law 84-99 (PL 84-99). General characteristics (see Figure 2), standards, and existing requirements for Delta levees are discussed below:

a) **Hazard Mitigation Plan (HMP):** This local levee configuration has been widely used in the Delta since the flood of 1986. It is only a geometric standard, under which a levee must have a crest width of at least 16 feet, a waterside slope of 1.5 horizontal to 1.0 vertical (1.5H:1V) landside slope of 2H:1V or less, and at least 1 foot of freeboard above 100-year stage. The HMP configuration was originally established as the minimum standard of maintenance under which Delta levees would be eligible for Federal Emergency Management Agency (FEMA) emergency response and recovery assistance. FEMA no longer offers assurances of such assistance based on the HMP standard.

b) **Delta-Specific Public Law (PL) 84-99:** Most levees in the Delta meet the PL 84-99 standard. PL 84-99 guidance provides for somewhat better flood protection than the HMP standard. The PL 84-99 guidance flattens the levee side slope (3H:1V to 5H:1V landside and 2H:1V waterside) from those used for the HMP configuration and increases freeboard above the one-percent annual chance (100-year flood) water level to 1.5 feet; however, the PL 84-99 freeboard is still less than that required for FEMA accreditation.

c) **DWR Bulletin 192-82:** Bulletin 192-82 levee guidance was developed and recommended for major central Delta islands that protect significant State interests. This standard is appropriate where tides are the major consideration for establishing design flood elevations. Bulletin 192-82 recommendations produce a levee that is like one built per the PL 84-99 guidelines, except that the design water level has a 0.33-percent (1 in 300) annual chance of occurrence. Under Bulletin 192-82 standards, freeboard for levees

protecting rural areas is 1.5 feet and freeboard for levees protecting urban areas is 3 feet. For much of the Delta, there is little difference (a few inches) between the 1.0-percent (1 in 100) and the 0.33-percent annual chance of occurrence.

d) **Rural State Plan of Flood Control (SPFC) Levees:** SPFC levees generally provide 3 feet of freeboard above the design water surface (USACE 1957 profiles from in the Sacramento River basin and 1955 profiles for the San Joaquin River basin) and 6 feet of freeboard above the design water surface for bypasses. Some rural levees generally do not meet FEMA accreditation standards, which affects the eligibility of landowners for flood insurance.

e) **Urban SPFC Levees:** Urban SPFC levees fall under DWR's *Urban Levee Design Criteria* (ULDC) developed pursuant to Senate Bill 5 (i.e., Government Code [GC] §65007(l)), which provides criteria and guidance for design, evaluation, operation, and maintenance of levees and floodwalls in urban and urbanizing areas (population over 10,000), providing a 1-in-200 chance of occurrence in any given year. The ULDC provides criteria for two types of levees: 1) intermittently loaded, and 2) frequently loaded. A frequently loaded levee is defined as a levee that experiences a water surface elevation of one foot or higher above the elevation of the landside levee toe at least once a day for more than 36 days per year, on average. More stringent requirements apply to the design of frequently loaded levees, with regards to slope stability and seismic vulnerability. The ULDC establishes criteria for levee resilience by requiring factors of safety for slope stability and under-seepage for a water surface elevation that is higher than the 200-year design water surface elevation.

f) **FEMA Accredited Levees:** These levees provide three feet of freeboard above water levels expected with a one percent chance of occurrence event (100-year flood). These levees include geotechnical designs to control through-seepage and under-seepage.

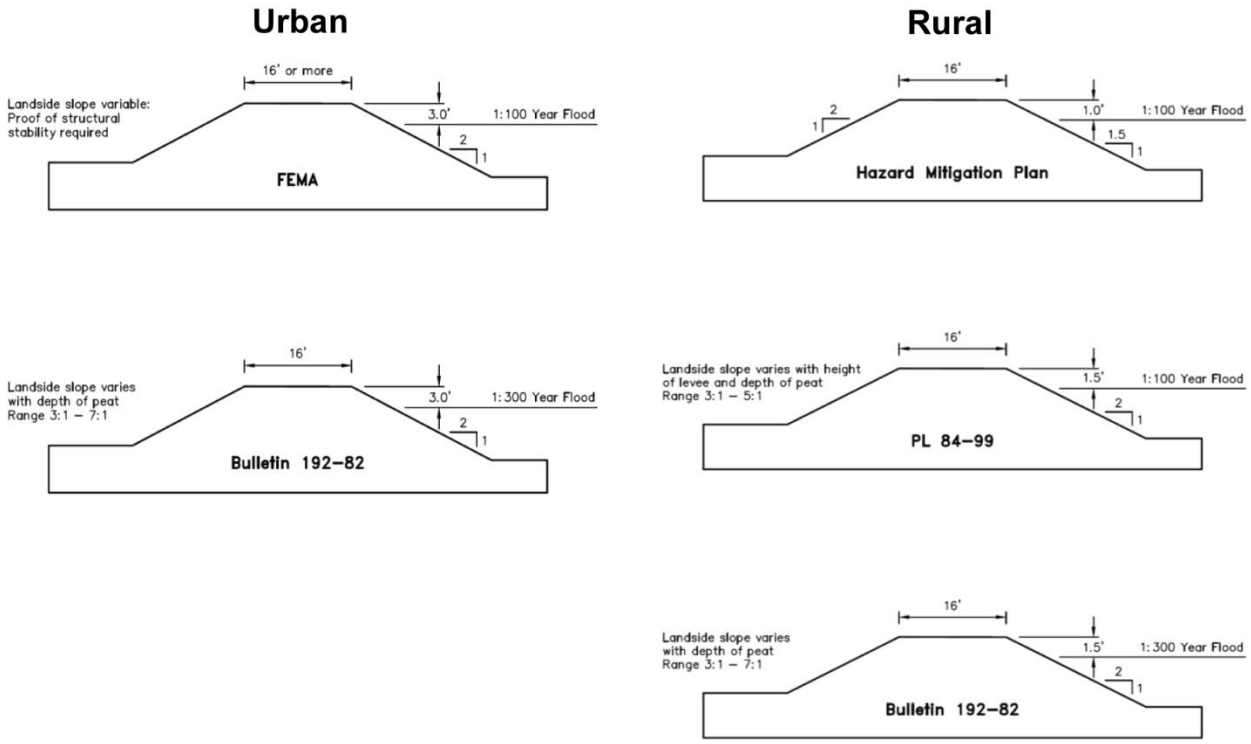
g) **Small Communities:** Small communities are defined by DWR as cities and towns with a population of less than 10,000. Some small communities are protected by SPFC levees (Figure 3). DWR intends to assist local agencies with flood control projects for small communities consistent with the CVFPP. The CVFPP identifies the 100-year flood event as the targeted level of flood protection for small communities, where feasible.

h) **Urban Levees:** Urban levees are referred to in DWR Bulletin 192-82 as protecting urban development associated with Andrus-Brannan, Bethel, Byron, Hotchkiss and New Hope. Delta urban areas currently receive various levels of protection. The goal for urban area levees protecting 10,000 or more people is to provide a minimum of 200-year level of protection, which is now mandated in California under the Central Valley Flood Protection Act of 2008.

i) **Project Levees:** Project levee as defined by CWC §9110(e) means any levee that is part of the facilities of the SPFC as defined by CWC §9110(F). These are levees for which the State has given assurances to the federal government that we will operate and maintain. Because the State provided assurances to the federal government regarding the standard

to which Project levees would be maintained, Project levees will always be a priority for DWR.

**Figure 2: Delta Levee Protection Levels**




# 5. Legal Delta

The definition of the legal Delta is contained in Water Code §12220 (Delta Protection Act, 1959). Figure 3 illustrates the extent of Delta boundaries, island names, and location of SPFC (Project) and non-SPFC levees (non-Project).

# 6. The *Delta Plan* Priority Islands

Water Code §85306 directs that the DSC shall recommend in the *Delta Plan* priorities for State investments in levee operation, maintenance, and improvements in the Delta. Table 1 is DSC's island priority list. Figure 4 illustrates the DSC ranking of Delta Islands into "Very High", "High" and "Other" priority categories.

**Table 1: DSC Island Priority List (Source: *The Delta Plan*, 2018)**

| Priority Level | Delta Islands by Priority Level |
|---|---|
| **Very High Priority** | Bethel Island, Bishop/DLIS-14 (North Stockton), Brannan-Andrus, Byron Tract, Central Stockton, Dutch Slough, Grand Island, Jersey Island, Maintenance Area 9 North, Maintenance Area 9 South, McCormack-Williamson Tract, North Stockton, Reclamation District 17, Sherman Island, Twitchell Island, Upper Andrus Island, West Sacramento |
| **High Priority** | Bacon Island, Bouldin Island, Bradford Island, Clifton Court Forebay, DLIS-08 (Discovery Bay Area), DLIS-20 (Yolo Bypass), DLIS-22 (Rio Vista), DLIS-63 (Grizzly Island Area), Drexler Tract, Glanville, Hastings Tract, Holland Tract, Honker Bay, Honker Lake Tract, Hotchkiss Tract, Jones Tract (Lower And Upper), Little Egbert Tract, Mandeville Island, McDonald Island, Middle & Upper Roberts Island, Mossdale Island, New Hope Tract, Palm-Orwood, Paradise Cut, Paradise Junction, Pescadero District, Staten Island, Stewart Tract, Terminous Tract, Tyler Island, Union Island West, Victoria Island, Webb Tract, Woodward Island |
| **Other Priority** | Atlas Tract, Bixler Tract, Brack Tract, Cache Haas Area, Canal Ranch Tract Chipps Island, Coney Island, Dead Horse Island, DLIS-01 (Pittsburg Area), DLIS-06 (Oakley Area), DLIS-07 (Knightsen Area), DLIS-10, DLIS-15, DLIS-17, DLIS-18, DLIS-19 (Grizzly Slough Area), DLIS-25, DLIS-26 (Morrow Island), DLIS-27, DLIS-28, DLIS-29, DLIS-30, DLIS-31 (Garabaldi Unit), DLIS-32, DLIS-33, DLIS-34, DLIS-35, DLIS-36, DLIS-37 (Chadbourne Area), DLIS-39, DLIS-40, DLIS-41 (Joice Island Area), DLIS-43 (Potrero Hills Area), DLIS-44 (Hill Slough Unit),DLIS-46, DLIS-47, DLIS-48, DLIS-49, DLIS-50, DLIS-51, DLIS-52, DLIS-53, DLIS-54, DLIS-55, DLIS-56, DLIS-57, DLIS-59, DLIS-62, Drexler Pocket, Egbert Tract, Ehrheardt Club, Empire Tract, Fabian Tract, Fay Island, Glide District, Holt Station, Kasson District, King Island, Libby Mcneil, Lisbon District, Lower Roberts Island, Mcmullin Ranch, Medford Island, Mein's Landing, Merritt Island, Netherlands, Pearson District, Peters Pocket, Pico-Naglee, Prospect Island, Quimby Island, Randall Island, Rindge Tract, Rio Blanco Tract, River Junction, Rough And Ready Island, Ryer Island, Shima Tract, Shin Kee Tract, Stark Tract, Sunrise Club, Sutter Island, Union Island East, Veale Tract, Venice Island, Walnut Grove, Walthall, Wetherbee Lake, Winter Island, Wright-Elmwood Tract, Yolano |

**Figure 3: Delta Boundaries and Levees**

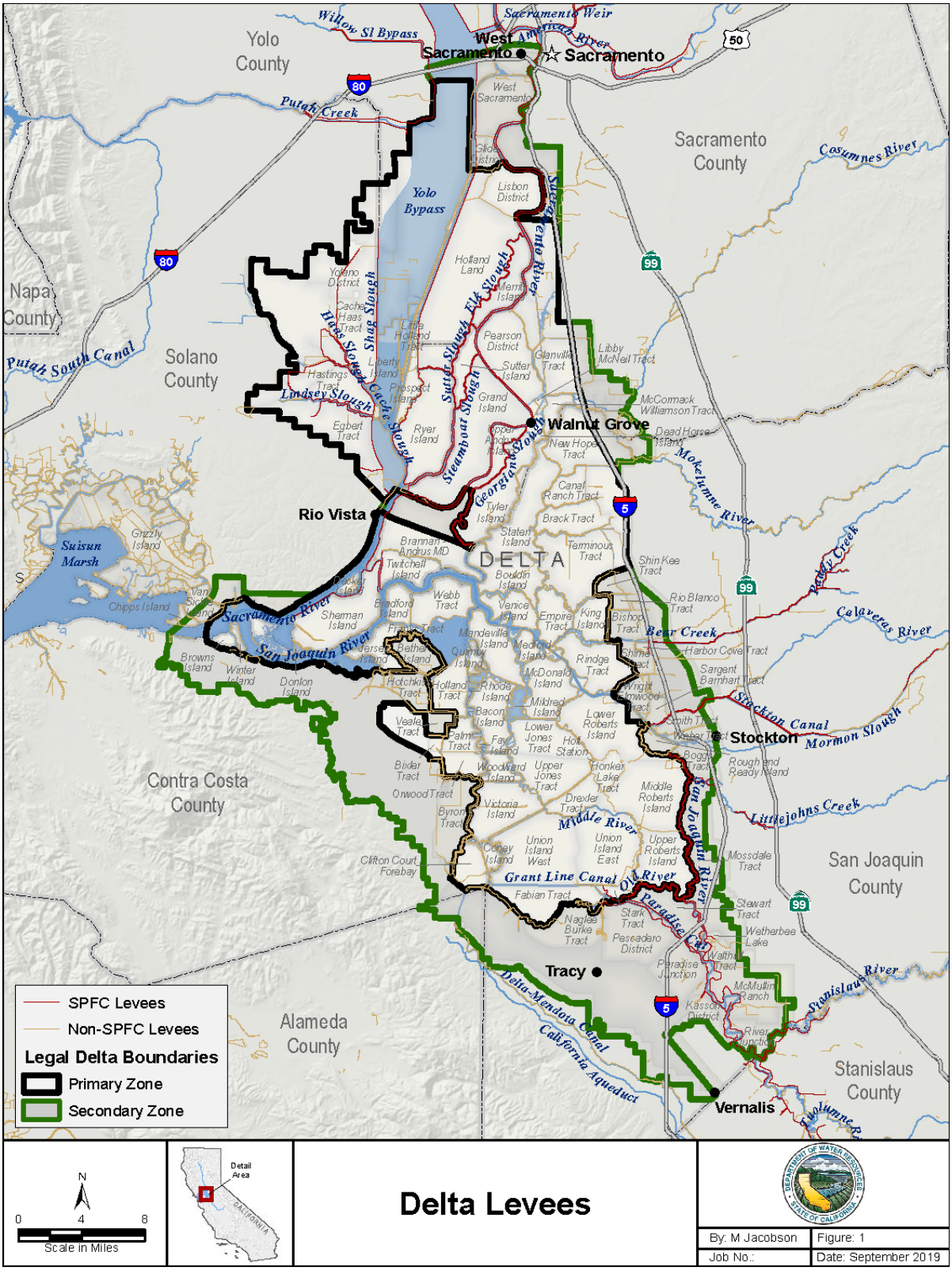
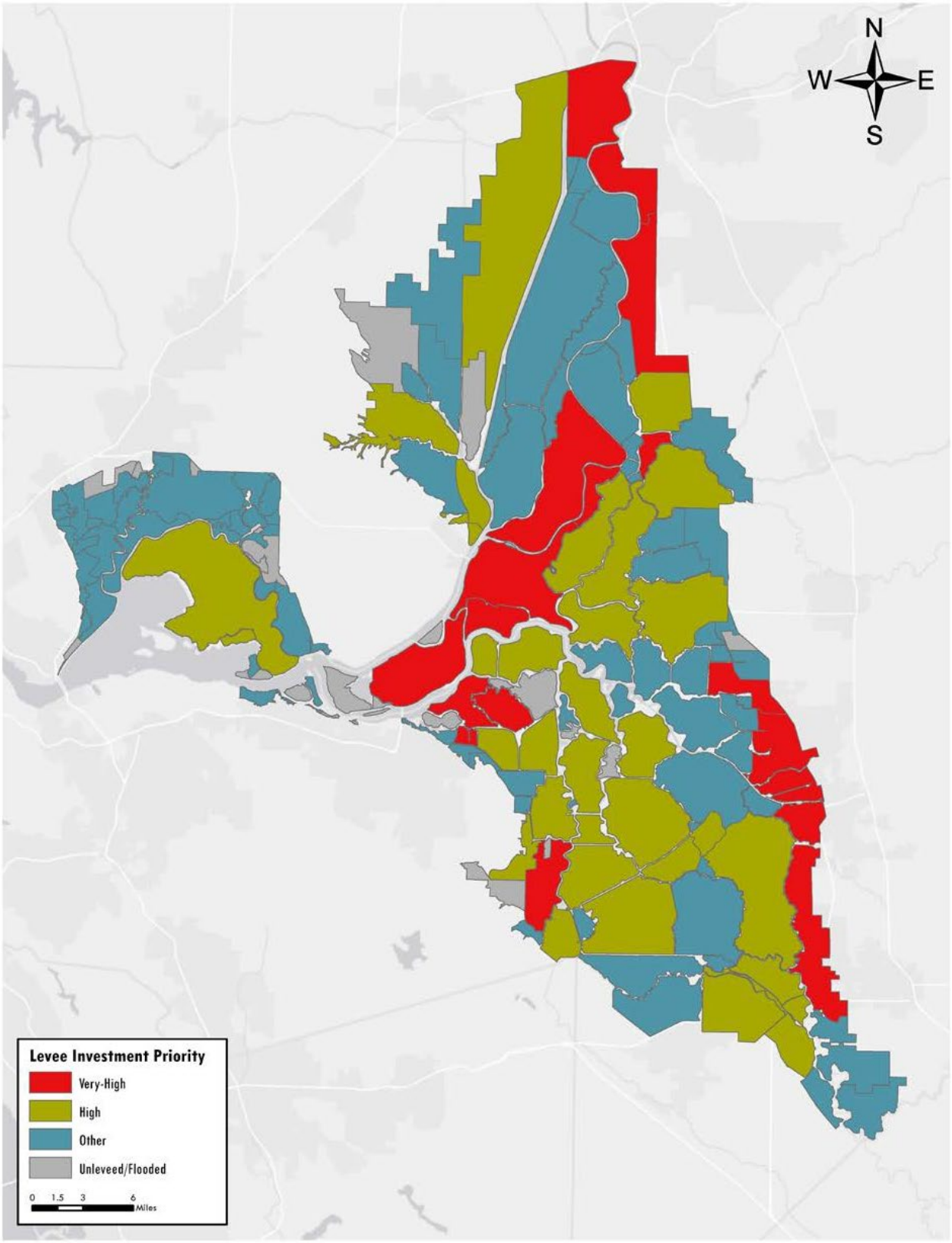


**Figure 4: DSC Delta Levee Investment Strategy Priority Map (Source: *The Delta Plan*, 2018)**



# 7. DWR's Delta Programs

DWR has developed various programs to support its mission to sustainably manage the water resources of California, in cooperation with other agencies, to benefit the state's people and protect, restore, and enhance the natural and human environments. The programs and efforts listed and described below have responsibilities and/or interests, in whole or in part, associated with levees that are within the legal Delta.

- Delta Conveyance
- EcoRestore
- Urban Flood Risk Reduction
- Small Communities Flood Risk Reduction Program (SCFRRP)
- State Plan of Flood Control System Improvements
- Delta Levees Maintenance Subventions
- Delta Levees Special Flood Control Projects
- Emergency Response
- West Delta
- North Delta Projects
- Flood System Repair Project (FSRP)
- Sacramento River Bank Protection Project
- Levee Repairs cost shared under Public Law 84-99
- Flood Maintenance Assistance Program (FMAP)
- Storm Damage DWR Emergency Rehabilitation
- DWR Flood System Maintenance

**Delta Conveyance** – The Delta is vulnerable to climate change and earthquake risk. As sea levels continue to rise, the Delta will face increasing water levels and increased risk of salt water intrusion.

As directed by Governor Newsom, DWR is pursuing a new environmental review and planning process for a single tunnel solution to modernize SWP infrastructure in the Delta. As the owner and operator of the SWP, DWR is leading the environmental review and permitting for the renewed Delta conveyance project. Under the direct supervision of DWR, the Delta Conveyance Design and Construction Authority (DCA) is conducting engineering work and field investigations to support the environmental review. DWR intends to build on work that has already been done and do additional design and engineering to avoid or minimize the project's

local impacts. This process will include significant engagement with the public, especially Delta communities. DWR anticipates the formal environmental review process will begin with the Notice of Preparation (NOP) under the California Environmental Quality Act (CEQA) near the end of 2019.

**EcoRestore** – This is a multi-agency initiative led by the California Natural Resources Agency. DWR is a partner on 28 of the 30 projects which seek to restore at least 30,000 acres of Delta habitat by 2020. EcoRestore projects are driven by current scientific understanding and guided by adaptive management. These projects support the long-term health of the Delta and its native fish, plant and wildlife species. The types of habitat targeted include: tidal wetlands, floodplain, upland, riparian, fish passage improvements and others.

**Urban Flood Risk Reduction** – This program provides funding for projects that contribute to achieving an urban level of flood protection (200-year, 0.5% annual chance) by improving SPFC facilities in the Central Valley. Urban areas are defined in statute as "…any contiguous area in which more than 10,000 residents are protected by project levees" (PRC 5096.805). While primarily focused outside the Delta, this program funds some urban areas with at least a portion of their footprints within the Delta. These include Sacramento, West Sacramento, Stockton, and Reclamation District 17 (Lathrop area). Urban flood protection investments are generally shared among USACE, the State, and local agencies in accordance with federal and State law. Because of the high cost and the rigor of the federal-State-local flood project implementation process, investments in this category are projected for periods up to 30 years.

**Small Communities Flood Risk Reduction –** Following adoption of the 2012 CVFPP, DWR initiated this program to help communities having fewer than 10,000 residents protected by the SPFC achieve a 100-year level of protection, where feasible. The program currently supports actions for the continued viability of small communities within the SPFC Planning Area to preserve cultural and historical continuity and important social, economic, and public services to rural agricultural populations, agricultural enterprises, and commercial operations. This will help preserve small community development opportunities within specific boundaries without providing urban level of protection and encouraging broader urban development.

Like urban areas, small communities located in floodplains contain a degree of risk to human life, and the density of existing development somewhat limits the types of management actions available within the small community footprints. However, unlike urban areas, the smaller scale of development and openness of the surrounding landscape often allows for a more diverse and resilient approach to flood management that holistically addresses all components of risk and contains more multi-benefit opportunities. Many small communities in the Central Valley are disadvantaged communities with limited resources to plan or implement flood management system repairs, rehabilitation, or improvements without greater assistance from the State and other partners.

For Phase 1 of this program (studies), up to $500,000 for each study was provided as a DWR fully-funded grant. Costs beyond this threshold were cost-shared 50/50 (State/local). Phase 2 of this program (design and implementation) will be cost-shared 50/50. However, for projects that

are multi-benefit, improve State facilities, or are improving flood risk for a disadvantaged community there are cost-share enhancements – i.e., cost-share will range between 50/50 – 100/0, depending on availability of funds.

**State Plan of Flood Control System Improvements –** In the Central Valley, the CVFPB and DWR are partnering to lead formulation of systemwide improvements to the SPFC. "Systemwide improvements" are distinct improvements that positively impact how the entire system functions – e.g., improving the Yolo Bypass can reduce stress on upstream levees. These improvements are intended to reduce flood risks while achieving multiple benefits, as described in the CVFPP. The State is proceeding with planning and implementing certain systemwide features to achieve greater system sustainability, resiliency, and multiple resource benefits. The opportunity to incorporate riparian and floodplain habitat features into systemwide improvements is also important because it may enhance sustainability and potentially reduce long-term operation and maintenance costs.

**Delta Levees Maintenance Subventions** – Through reimbursements to local levee maintaining agencies, this program leverages State and local funds to support the maintenance of eligible levees, which helps preserve the Delta essentially in its present configuration. Non-SPFC levees, which account for about 65 percent of the Delta levee system, were the historical focus of the program. However, since 1996, maintenance costs for SPFC levees in the Primary Zone of the Delta are also eligible for reimbursement under the program when the majority of the acreage protected by the maintenance area falls within the Primary Zone of the Delta, per AB 360 of 1996. Guidelines governing distribution of Subventions program funds, drafted by DWR and adopted by the CVFPB, are designed to facilitate the distribution of funds to achieve at least a minimum standard of levee maintenance for as much of the Delta as possible. Maintenance of the existing Delta levee system is essential for both conveying the water supply for 27 million Californians through the Delta and conveying flood waters from the Sacramento and San Joaquin rivers through the Delta and into San Pablo Bay. The Subventions program has been continuously administered by DWR since 1973 and supported by various State funding sources over the years. Program administrative procedures and guidelines have been refined over time, such that it has achieved a high degree of efficiency and effectiveness. Types of activities funded by this program include:

- Vegetation control
- Rodent control
- Erosion control
- Erosion repair
- Access road repairs
- Levee rehabilitation
- Rip rap replacement
- Clearing drains and toe ditches
- Encroachment removal
- Levee crown repairs
- Seepage control
- Debris removal
- Regular inspection
- Levee crown raise to compensate for subsidence

**Delta Levees Special Flood Control Projects** –To ensure protection of statewide interests in the Delta, this program was established in 1988 by the California State Legislature under SB 34 and later revised under SB 1065 (1991) and AB 360 (1996). The Program was originally authorized to address flooding on the eight western Delta islands, as well as the communities of Thornton, New Hope and Walnut Grove. It was expanded in 1996 to the entire Delta and to portions of the Suisun Marsh, and new language was added that requires achieving net long-term improvement in aquatic habitat (Water Code §12311). DWR disburses funds to local agency projects on a competitive basis. The guidelines governing distribution of Program funds focus on levee work with statewide benefit while giving DWR the ability to select the most effective projects to cost-share. This program also provides the opportunity to construct critically important habitat projects, and the program's restoration sites are proving grounds that advance the science needed to accomplish projects on a larger scale. Types of activities funded by this program include:

- **Five-Year Plan** – The Five-Year Plan assesses the current conditions of a local agency's levees and sets out a strategy for rehabilitation, repair, and/or improvement of its facilities to meet a desired levee standard and/or level of protection. Anticipated funding assistance, required permitting, expected mitigation, and potential habitat enhancement may also be included in the Five-Year Plan.
- **HMP Levee Improvement** – Levee improvement work to achieve Hazard Mitigation Plan requirements.
- **Levee Improvement** – Projects that reduce the probability of flooding of the land protected by the local agency's levees. Work may include adding fill to the landside, waterside, and/or crest of the levee. Work may also include drainage or stability berms, erosion protection, or other geotechnical work.
- **Programmatic Habitat Improvement Projects** – Large scale habitat improvement and/or enhancement projects within the Delta that contribute to meeting the Water Code §12311 requirement to provide for a net improvement in aquatic habitat.
- **Multi-Benefit Projects** – Combined levee improvement and habitat enhancement projects that can help simultaneously improve the environment, flood management, and water supply reliability.

**Delta Emergency Response** – As the State's lead agency for flood management, DWR has broad authority to collect and disseminate hydrologic data, issue flood and water supply forecasts, stockpile and deploy flood fighting equipment and supplies, conduct flood response operations, offer assistance to other agencies, and participate in post-flood recovery operations among other activities. These activities are collectively referred to as "flood emergency preparedness, response, and recovery activities." Although DWR responsibilities are statewide, the Delta warrants greater attention due to its critical importance and vulnerability to flooding. This program maintains a high degree of readiness to respond quickly and effectively to threatening levee conditions and levee failures in the Delta, including potential simultaneous failures affecting multiple islands. DWR has, in recent years, invested in facilities for stockpiling flood-fight materials and annually replenishes supplies and equipment needed for flood fighting

in the Delta. The program supports local agencies by offering grant funding to improve emergency response capabilities in the Delta including enhancing local emergency response plans, stockpiling flood fight materials and equipment, training and exercises, and additional critical improvements. While the focus of this program is the legal Delta, it currently does not specifically fund levee improvements or rehabilitation as defined by the DSC.

**West Delta**– Continuing subsidence not only makes the Delta more susceptible to flooding due to increased hydrostatic pressure on the levee walls resulting in levee failure, but also makes farming more difficult and expensive, while threatening public safety, infrastructure, water supply, and water quality. It is in the State's interest to curtail subsidence in the Delta by initiating mitigation studies and actions that will result in neutralizing subsidence and possibly help in the accretion of soils. Under this program, in collaboration with other agencies for more than 20 years, DWR has conducted scientific experiments on Sherman and Twitchell islands to develop a better understanding of subsidence processes and how to slow or reverse them. Historically, this program is focused on work within the island and landside of the levee prism. Various regimes of soil cultivation, plantings, and inundation have been studied to formulate practical approaches to subsidence reversal, habitat creation, and carbon sequestration. Sufficient understanding has been achieved to justify a major expansion in this program.

**North Delta Projects–** These projects implement flood management improvements principally on and around McCormack Williamson Tract, Dead Horse Island, and Grizzly Slough in a manner that benefits habitats, species, and ecological processes. By breaching levees, the projects attenuate floods in surrounding areas and provide aquatic and floodplain habitat along the downstream portion of the Cosumnes Preserve along the Cosumnes and Mokelumne rivers. The North Delta Projects are being conducted within the Division of Multi-Benefit Initiatives in partnership with the Cosumnes Preserve, including The Nature Conservancy, Bureau of Land Management, and Sacramento County. They are also included in the California EcoRestore Program. In addition to flood management benefits, these projects enhance Delta productivity, provide habitat for native fish including Splittail and salmonids, and various wildlife and provide recreation opportunities. Knowledge gained through these projects will lead to more practical Delta restoration approaches.

**Flood System Repairs Project (FSRP) –** A bond-funded program that supports repairs to rural SPFC facilities of the Sacramento and San Joaquin River systems under State and local maintaining agency (LMA) cost-share agreements. On an annual basis, DWR compiles and updates a list of all potential repair sites from a variety of sources including USACE inspection and evaluation data, DWR maintenance and evaluation program data, and input from LMAs. For each site that meets FSRP screening criteria, DWR works with LMAs to assess the funding and remediation options and prioritizes sites to maximize flood risk reduction for implementation. For participating LMAs, a project agreement is developed allowing for DWR to provide funding for the LMA to implement and complete all phases of the project.

**Sacramento River Bank Protection Project** – The goal of this USACE program is to evaluate the levees and embankments of the Sacramento River and tributaries to reduce stream bank erosion and minimize the threat of flooding. While the original 1960 authorization approved the

rehabilitation of 430,000 linear feet of levee, the 1974 Water Resources Development Act added 405,000 linear feet to the authorization and a 2007 bill authorized another 80,000 linear feet for a total of 915,000 linear feet of project. The CVFPB is the local project sponsor who works with DWR to provide the non-federal cost-share and manage the State interests (Land Easements, Relocations, Rights of Way and Disposal, or LERRDs) in these projects.

**Levee Repairs cost shared under PL 84-99** – Established in Section 5 of the Flood Control Act of 1941, PL 84-99 gives USACE emergency management authority. Under PL 84-99, USACE may undertake a variety of activities, including emergency response and storm damage rehabilitation. The CVFPB is the local project sponsor who works with DWR to manage the State interests (Land Easements, Relocations, Rights of Way and Disposal, or LERRDs) in these projects. Levee systems that are eligible for rehabilitation assistance under PL 84-99 following flood or storm damage include those federally authorized, operated and maintained by a non-federal sponsor or non-federally built, operated and maintained by a non-federal sponsor. These levees remain eligible if operated and maintained to acceptable or minimally acceptable standards. Federal government cost-share policy regarding repairs to levee systems and flood control projects damaged by floods includes:

- Federally constructed or enhanced, locally maintained systems (in PL 84-99 program): Will be repaired by the federal government at 100 percent federal cost. Pending letter of request by maintaining authority and funding by Congress.
- Non-federally constructed, locally maintained systems (in PL 84-99 program): Will be repaired by the federal government at 80 percent federal/20 percent local cost share. Pending letter of request by maintaining authority and funding by Congress.

**Flood Maintenance Assistance Program (FMAP) –** Established in 2018 as a result of the increased awareness that operation and maintenance (O&M) of the SPFC facilities (levees, channels, and structures) has been chronically underfunded and ever evolving and often conflicting regulatory constraints have hampered efficient and timely O&M. Though new State appropriations, FMAP provides funds to LMAs and State-managed maintenance areas (MAs) for eligible maintenance activities. This program will help ensure SPFC facilities are properly maintained and LMAs have sufficient funding resources to meet applicable federal regulations and O&M manual requirements.

**Storm Damage DWR Emergency Rehabilitation** – Consistent with the Office of Emergency Services and the State Emergency Plan, DWR works to restore all flood protection facilities under our jurisdiction. The 2017 atmospheric river storms that occurred in the months of January and February caused flooding in the Central Valley and the Sacramento-San Joaquin Delta, resulting in multiple damage sites. Field reconnaissance classified sites as 1) critical, 2) serious, and 3) areas of concern in which a site has problems that need periodic monitoring. A catastrophic failure at one of the sites would have disastrous results, including possible loss of human life, significant property damage, negative environmental impacts and threats to water supply. This State-led emergency rehabilitation program evaluates, designs, permits, and constructs the levee repair projects based on site prioritization and available funding. Through

discussions with USACE 408 personnel, DWR determined that implementation of the rehabilitation projects would fall under the Section 408 definition of maintenance and therefore not require a 408 permit, which would have greatly extended the timeframe of the repairs. DWR presented the projects as maintenance actions which was acceptable to USACE.

**DWR Flood System Levee Maintenance** – As described in California Water Code §8361, some Central Valley levees are to be maintained and operated by DWR on behalf of and paid by the State. DWR has also assumed responsibility of some SPFC levees by the formation of State Maintenance Areas through authority provided by Water Code §12878. Maintenance Area work performed by DWR is reimbursed by beneficiaries of the maintained area. Altogether, DWR is responsible for maintaining over 300 miles of SPFC levees in California's Central Valley. Of these 300 miles, DWR is responsible for maintaining 22 miles of levees in the legal Delta. Although Delta levee work beyond the scope of maintenance, such as levee improvements and rehabilitation, may be performed by the DWR Sacramento Maintenance Yard, it would most likely be funded under one of the other programs listed above.

# 8. FY 18/19 Awarded Funds

Pursuant to the programs listed and described above, DWR has awarded funds to Delta levee rehabilitation and improvement projects in FY 18/19. Table 2 lists programs that received these funds, total amounts awarded within each program, individual project cost, Delta island where project is located, project type, and the Delta Levee Investment Strategy (DLIS) priority. Table 3 lists programs that did not award any funding in FY 18/19 and a description of why that is the case.

**Table 2: FY 18/19 Awarded Funds**

| Program | Total FY 18/19 Funds Awarded | Individual Project Costs | Delta Island | Project Type | DLIS Priority |
|---|---|---|---|---|---|
| **State Plan of Flood Control System Improvements** | $118,865,000 | $118,865,000 | Cache Haas Area (Lookout Slough) | Improvement | **Other** |
| **Delta Levees Maintenance Subventions** | $1,876,885 | $159,654 | Terminous Tract | Rehabilitation | **High** |
| | | $1,002,692 | Mandeville Island | Rehabilitation | **High** |
| | | $56,833 | Bradford Island | Rehabilitation | **High** |
| | | $107,843 | Deadhorse Island | Rehabilitation | **Other** |
| | | $549,863 | Brannan-Andrus | Rehabilitation | **Very-High** |
| **Flood System Repair Project (FSRP)** | $881,337 | $616,469 | Kasson Tract | Rehabilitation | **Other** |
| **-** | **-** | $264,868 | Yolano | Rehabilitation | **Other** |
| **Levee Repairs cost shared under Public Law 84-99** | $769,000 | $241,000 | McMullin Ranch | Rehabilitation | **Other** |
| | | $61,000 | McMullin Ranch | Rehabilitation | **Other** |
| | | $231,000 | McMullin Ranch | Rehabilitation | **Other** |
| | | $120,000 | McMullin Ranch | Rehabilitation | **Other** |
| | | $116,000 | McMullin Ranch | Rehabilitation | **Other** |
| **Flood Maintenance Assistance Program (FMAP)** | $1,155,000 | $40,000 | Lisbon | Rehabilitation | **Other** |
| | | $40,000 | Sutter Island | Rehabilitation | **Other** |
| | | $40,000 | Ryer island | Rehabilitation | **Other** |
| | | $40,000 | Pearson | Rehabilitation | **Other** |
| | | $40,000 | Tyler Island | Rehabilitation | **High** |
| | | $40,000 | Randall | Rehabilitation | **Other** |
| | | $40,000 | Glide | Rehabilitation | **Other** |
| | | $490,000 | West Sacramento | Rehabilitation | **Very-High** |

| | | | | | |
|---|---|---|---|---|---|
| | | $40,000 | Netherlands | Rehabilitation | **Other** |
| | | $345,000 | Maintenance Area 9 | Rehabilitation | **Very-High** |
| **Total** | **$123,547,222** | | | | |

**Table 3: FY 18/19 Unfunded Programs (No Delta levee rehabilitation or improvement)**

| Program | Explanation Why No Funding Decisions Were Made Regarding Levee Improvements or Rehabilitation During FY 18/19 |
|---|---|
| **Delta Conveyance** | Project is still in planning stages. |
| **EcoRestore** | Funding decision made for KCRA tower levee project that was constructed in FY18/19 was made in prior years. For FY18/19 no levee rehabilitation or improvement projects required funding decisions. |
| **Urban Flood Risk Reduction** | Decisions made to fund levee rehabilitation and improvements done under this program in FY18/19 were made in prior years. Program funded with Proposition 1E funds that must be committed by June 30, 2020. As a result, most funding decisions have already been made. |
| **Small Communities** | The last PSP for the feasibility study phase of the program was released in 2015. The program is currently between funding cycles for Phase 1 (studies) and Phase 2 (design and implementation). More than 30 small communities are in the process of completing Phase 1 of this program. Following the review and analysis of Phase 1 project proposal submissions, Phase I funding decisions for studies were made in 2017. The program is expecting to release a Proposal Solicitation Package (PSP) for Phase 2 in the near future. Once the PSP is released and local communities that have completed Phase 1 submit their Phase 2 proposals, additional funding decisions will be made – depending on availability of funds. |
| **Delta Levees Special Flood Control Projects** | The last PSP was released in 2016, and work is being implemented. A new PSP is being considered for this program; however, the release date is uncertain. |
| **Emergency Response** | This program coordinates with local, State and federal agencies to provide emergency response assistance in flood fight situations and does not provide levee rehabilitation or improvement funding beyond what is immediately necessary for flood fight actions. |
| **West Delta** | Dependent on funds availability, this legacy DWR program may fund levee rehabilitation or improvement projects in the future. |
| **North Delta Project** | Funding decisions for Phase A of the McCormack-Williamson Tract Project were made prior to FY 18/19, and the work is being implemented. Funding decisions for Phase B have not yet been made. Dependent on funds availability, this legacy DWR program may fund levee rehabilitation or improvement projects in the future. |
| **Sacramento River Bank Protection Project** | No funding decisions were made for levee improvements or rehabilitation during FY 18/19. |

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| **Storm Damage DWR Emergency Rehabilitation** | This program was named following federal PL 84-99 nomenclature but implements levee repairs which fall under Code of Federal Regulations Title 33, Section 408, definition of maintenance. All projects funded in FY 18/19 were undertaken as "maintenance" and paid for through re-directed Deferred Maintenance funding given to DWR through the 2016 legislative control section 6.10 appropriation process. |
| **DWR Flood System Maintenance** | This program is responsible for maintenance. Levee rehabilitation or improvements are traditionally funded under one of DWR's other programs. |

# 9. Levee Fragility

Levee performance related to probability of failure is frequently described in terms of a "levee fragility" or performance curve. Performance curves can describe the fragility of a levee due to seismic, hydraulic, or other failure modes or a combination of several. The accepted approach used to develop levee performance curves generally follows a process similar to that described in the USACE Manual Engineering Technical Letter 1110-2-556 (USACE, 1999). For the DLIS, the DSC team developed a process to create fragility curves for Delta islands and tracts where none were available. When existing curves were available that had previously been developed from the 2009 DWR Delta Risk Management Strategy report or 2012 CVFPP they were used.

The development of levee fragility curves can be a very time and labor-intensive process and somewhat subjective in nature. Frequently, a panel of experts is called upon to oversee and review the development of levee performance curves, considering a list of reasonable assumptions, expectations, and caveats for their intended use. Between 2008 and 2012 DWR developed and compiled fragility curves for urban and rural levees within the Central Valley through its Urban Levee Evaluations and Non-Urban Levee Evaluations programs. Total funds spent on these programs was over $100 million. Because DWR may make a discretionary decision to fund specific levee improvements or rehabilitation projects within the Delta performed by others, we do not necessarily require, approve, or undertake an effort to produce revised or new performance curves for each project funded.

As described in Attachment 1 of the MOU and in the DSC's proposed regulation, DWR is asked to provide estimated reduction in levee fragility for each decision to award State funds. Generally, when appropriate, new or updated fragility curves are produced during the design phase of larger projects and are not necessarily produced by the State. Updated or new levee fragility curves were not available at the time of production of this report. Currently no State funds or resources have been identified for DWR to produce new fragility curves within the Delta. The DSC has also suggested guidance for DWR to develop and report curves based on the process used by the DSC that would involve fitting characteristics of existing curves to detailed new levee geometry. In future years, funds provided to levee maintaining agencies (LMAs) through the Delta Levees Special Flood Control Projects Program to produce 5-year plans might be a reasonable mechanism to fund and require the development of updated Delta levee fragility curves at the local level.

# 10. Expected Reduction in Annual Fatalities and Damages

Flood risk is the probability of flooding combined with negative outcomes that could result when flooding occurs. Flood risk is commonly expressed as a consequence-probability function. The consequence-probability function can then be used to compute an expected annual value of the consequence. If the consequence considered is economic loss, this is called the expected annual damage (EAD). EAD reduction is often used as a standard for measuring the effectiveness of proposed flood risk management measures, both structural and non-structural. "Damages" in the context of EAD can be any of the following:

- Physical flood damage to structures, infrastructure, crops, and ecosystem resources
- Loss of functions of structures and infrastructure
- Emergency response costs
- Disruptions to water supplies and deterioration of water quality and resulting economic losses in Southern California resulting from flooding in the Delta

USACE guidance that addresses risk analysis includes the following:

- Engineer Manual (EM) 1110-2-1419 (1995a)
- Engineer Manual (EM) 1110-2-1619 (1996y)
- ER 1105-2-101 (2006)
- The US Water Resources Development Act of 1990 (Section 308, Floodplain Management)

Another important objective of DWR programs is reducing loss of life, or expected annual fatalities (EAF), which can be quantified (thus is a tangible benefit); but, currently is not monetized by DWR. Thus, it must be evaluated using methods applicable for intangible benefits. The recommended DWR approach to computing loss of life benefits is based on the flood life risk assessment for the 2012 CVFPP. There, life risk was assessed by modifying the HEC-FDA economic risk inputs in the 2012 CVFPP economic risk models to include information on the exposure and vulnerability of population within the floodplains. The advantage of this approach is that it uses the same HEC-FDA models developed for the urban inundation reduction (IR) analysis, with changes in the structural inventory (replacing economic values with persons/structure) and depth-damage information (i.e., replacing depth-damage with depth-mortality functions). The study configuration, hydrology and hydraulics (H&H), and levee failure information remains the same.

Calculation of EAD or EAF is highly dependent on levee performance (fragility) curves that are not always available (see previous section). EAD or EAF analysis is not always performed prior to DWR making a funding decision. For example, the Delta Levees Special Flood Control Projects uses a comprehensive approach to scoring and ranking local project proposals which does not require statistical analysis (such as the calculation of EAD or EAF) be provided by the

applicant. For larger projects completed in partnership with the USACE, calculation of EAD and/or EAF is usually performed as part of a comprehensive benefits-cost ratio analysis. When EAD has been provided by the project proponent and/or is otherwise available, it will be included in this annual reporting.

# 11. Consistency with Delta Levee Investment Strategy Priorities

As described in Attachment 1 of the MOU and the DCS proposed regulations, when DWR's funding decisions for levee improvements and levee rehabilitation vary from the priorities identified in the DLIS, DWR reports them as such. Specifically, the annual report shall identify how the funding is inconsistent with the priorities, describe why variation from the priorities is necessary, and explain how the funding nevertheless protects lives, property, and the State's interests in water supply reliability and restoration, protection, and enhancement of the Delta ecosystem while considering the Delta's unique agricultural, natural, historic, and cultural values. As shown in Table 1, funds awarded by DWR in FY 18/19 that specifically fit within the DSC's proposed definitions of "levee improvement" or "levee rehabilitation" were spread across the priorities of very high, high, and other. Table 4 below describes why certain funding decisions for various programs are inconsistent with the DSC's priorities.

**Table 4: DLIS Consistency Explanation**

| Program | Delta Island | Individual Project Costs | DLIS Priority | Description of Why Variation from DLIS Priorities is Necessary |
|---|---|---|---|---|
| **System Improvements** | Cache Haas Area (Lookout Slough) | $118,865,000 | **Other** | The Lookout Slough Tidal Habitat Restoration and Flood Improvement Project is a large-scale systemwide multi-benefit effort that was initiated to satisfy DWR's (State Water Project) obligations pursuant to the 2008 USFWS Delta Smelt BiOp and 2008 NMFS BiOp. A flood benefit component was added to leverage multi-benefit project efficiencies and be consistent with the CVFPP. |
| **Delta Levees Maintenance Subventions** | Terminous Tract | $159,654 | **High** | DWR administers the Delta Levees Maintenance Subventions Program on behalf of the CVFPB, providing funding assistance for over 70 RD/LMAs in the Delta. Each fiscal year the Program receives authorization from the CVFPB to spend a set funding amount. This funding is distributed to participating RD/LMAs in a fair and unbiased fashion based on the Program's Maintenance Priority criteria. The criteria allow up to $20,000 per levee mile to be paid for each RD/LMAs under the Program's Maintenance Priority. If funding is still available once the Maintenance Priority has been paid, the Program fairly distributes the remaining funds to those RD/LMAs that meet criteria set forth in the Program's Guidelines for Rehabilitation Priority. |
| | Mandeville Island | $1,002,692 | **High** | |
| | Bradford Island | $56,833 | **High** | |
| | Deadhorse Island | $107,843 | **Other** | |

| | | | | |
|---|---|---|---|---|
| **Flood System Repair Project** | Kasson Tract | $616,469 | **Other** | Projects are evaluated and the areas with the highest priority repairs are requested to participate in FSRP, however due to cost-share requirements, not all districts are able to participate. |
| | Yolano | $264,868 | **Other** | |

**Table 4: DLIS Consistency Explanation (continued)**

| Program | Delta Island | Individual Project Costs | DLIS Priority | Description of Why Variation from DLIS Priorities is Necessary |
|---|---|---|---|---|
| **Levee Repairs cost-shared under Public Law 84-99** | McMullin Ranch | $241,000 | Other | USACE determines repair priority based on severity of eligible requested repairs as part of the PL 84-99 rehabilitation program. |
| | McMullin Ranch | $61,000 | Other | |
| | McMullin Ranch | $231,000 | Other | |
| | McMullin Ranch | $120,000 | Other | |
| | McMullin Ranch | $116,000 | Other | |
| **Flood Maintenance Assistance Program (FMAP)** | Lisbon | $40,000 | Other | Funding is provided to all districts willing to participate (excepting levee subventions-eligible districts). Many districts do not participate due to program required Operations, Maintenance, Repair, Rehabilitation, and Repair obligations. Also, the islands/tracts where repairs were made include levees for which the State has provided assurances to USACE, making these levees a priority for the State. Additionally, these levees help protect the small communities of Courtland, Walnut Grove, Thornton, and Ryde, as well as the Stone Lakes National Wildlife Refuge and Interstate 5 from flooding. All of the above would be mapped into 100-year floodplains if not protected by these and other levees. |
| | Sutter Island | $40,000 | Other | |
| | Ryer Island | $40,000 | Other | |

| | | | | |
|---|---|---|---|---|
| | Pearson | $40,000 | **Other** | |
| | Tyler Island | $40,000 | **High** | |
| | Randall | $40,000 | **Other** | |
| | Glide | $40,000 | **Other** | |
| | Netherlands | $40,000 | **Other** | |

# 12. Looking Forward

Much of the infrastructure in California (and the U.S.) is aging and in need of repair or replacement. Because the need is so great, securing the necessary funding for levee rehabilitation and improvements remains an ongoing challenge for State, federal, and local agencies. This is especially true in the Delta where subsidence of the peat soils and the constant hydraulic loading on levees make investments in flood management infrastructure a top priority to address the impacts of sea-level rise and climate change. In April 2019 an executive order was signed directing the California Natural Resources Agency, the California Environmental Protection Agency, and the California Department of Food and Agriculture to develop a Water Resilience Portfolio to ensure healthy waterways and build a climate-resilient water system. In the Delta, this resilience portfolio will include several management actions to prevent future catastrophic losses and help secure the future of the Delta and sustainable water management in California.

In the near term, and contingent on current and future availability of funds, DWR has several projects within the legal Delta which may receive funding and be included in future DWR annual reports to the DSC. For example, the Small Communities Flood Risk Reduction Program is expecting to release a PSP in the near future, and we are also expecting a new Delta Levees Special Flood Control Projects PSP to be awarded in FY 20/21. Additionally, DWR, the CVFPB, USACE, and the San Joaquin Area Flood Control Agency are working on the design phase of the "San Joaquin River Basin, Lower San Joaquin River California Project." The project is focused on providing flood protection improvements to the north and central areas of the City of Stockton and will include several levee rehabilitation and improvement components. As DWR continues to invest in resilient solutions to long-term flood management infrastructure needs in the Central Valley, many of these efforts may include components within the Delta that involve rehabilitation or levee improvements as well as new levee segments and setbacks. Many of these rural, urban, or systemwide improvements are currently in the study or design phases and, if State funding is provided, will be described in future DWR reports to the DSC.