Delta Annex Chapter 10 Reclamation District 563

10.1 Introduction

This Annex details the hazard mitigation planning elements specific to Reclamation District 563 (RD 563 or District), a previously participating jurisdiction to the 2016 Sacramento County Local Hazard Mitigation Plan (LHMP) Update. This Annex is not intended to be a standalone document, but appends to and supplements the information contained in the Base Plan document. As such, all sections of the Base Plan, including the planning process and other procedural requirements apply to and were met by the District. This Annex provides additional information specific to RD 563, with a focus on providing additional details on the risk assessment and mitigation strategy for this District.

10.2 Planning Process

As described above, the RD 563 followed the planning process detailed in Chapter 3 of the Base Plan. In addition to providing representation on the Sacramento County Hazard Mitigation Planning Committee (HMPC), the District formulated their own internal planning team to support the broader planning process requirements. Internal planning participants, their positions, and how they participated in the planning process are shown in Table 10-1. Additional details on plan participation and District representatives are included in Appendix A.

Table 10-1 RD 563 – Planning Team

Name	Position/Title	How Participated
Chris Neudeck, KSN, Inc	District Engineer	Attended meetings, collected data, reviewed draft docs
Bill Darcie, KSN, Inc.	Project Manager	Attended meetings, collected data, reviewed draft docs

Coordination with other community planning efforts is paramount to the successful implementation of this LHMP Update. This section provides information on how the District integrated the previously approved 2016 Plan into existing planning mechanisms and programs. Specifically, the District incorporated into or implemented the 2016 LHMP through other plans and programs shown in Table 10-2.

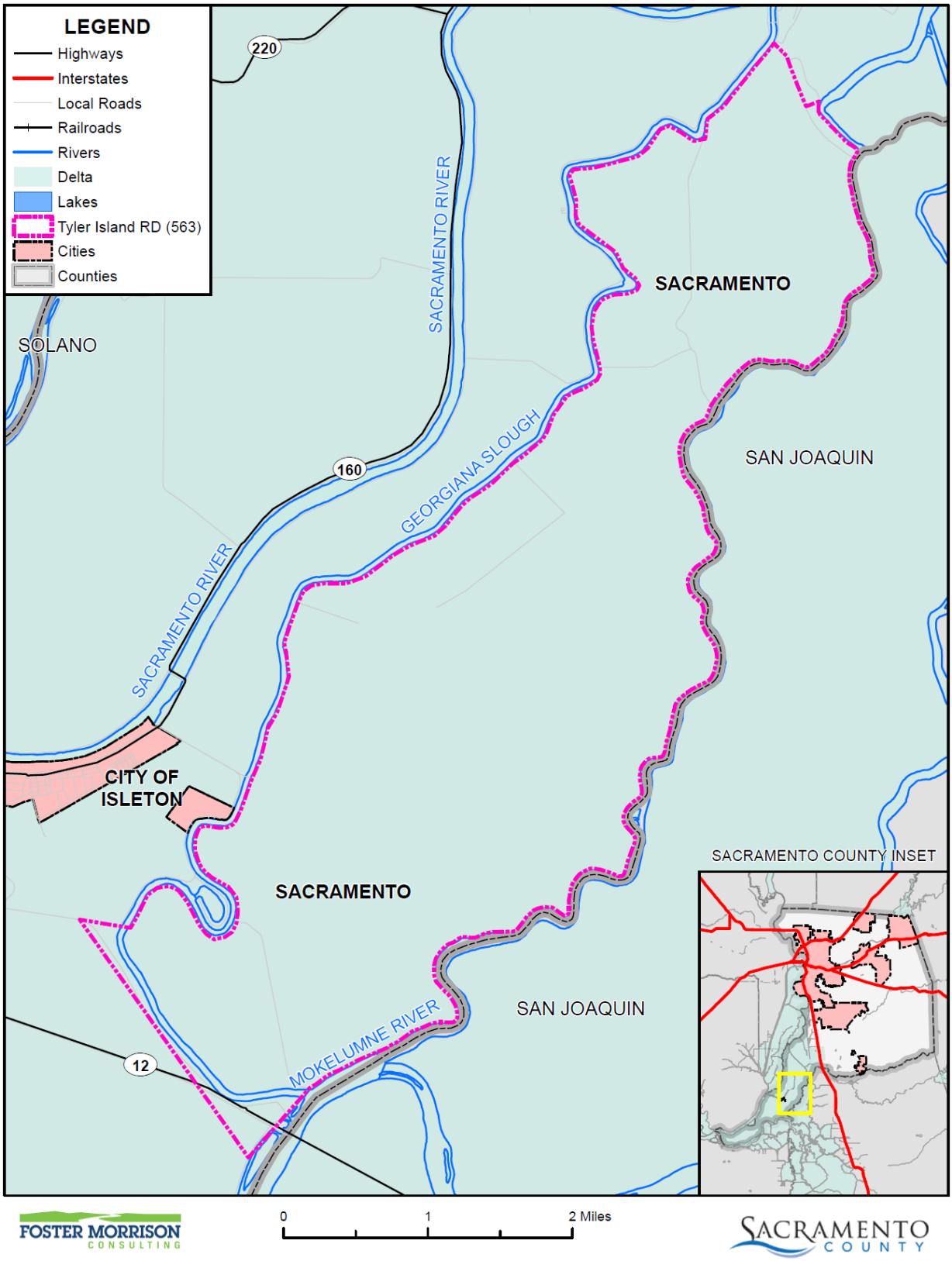
Table 10-2 2016 LHMP Incorporation

Planning Mechanism 2016 LHMP Was Incorporated/Implemented In.	Details: How was it incorporated?
Development of RD 563 Flood Safety Plan	Elements in the Hazard Assessment used in the development of the Flood Safety Plan, which includes an Emergency Operations Plan – Basic Plan (EOP), and hazard specific annex (the Flood Contingency Map).

10.3 District Profile

The District profile for RD 563 is detailed in the following sections. Figure 10-1 displays a map and the location of the District within Sacramento County.

Figure 10-1 RD 563



Data Source: Tyler Island Reclamation District, Sacramento County GIS, Cal-Atlas; Map Date: 09/2020.

10.3.1. Overview and Background

Reclamation District No. 563, also known as Tyler Island, is responsible for maintaining the levee and drainage system that provides flood protection for primarily agricultural land, along with a small portion of infrastructure, residential, commercial, industrial, and governmental land use. Tyler Island is located in the Northern Delta between the Walnut Grove to the north, Staten Island to the east, Bouldin Island to the south, and Andrus Island to the West. The Island is surrounded by three major waterways, Snodgrass Slough to the north, the Mokelumne River to the east, and Georgiana Slough to the west. The segment of levee along Georgiana Slough is considered a Project Levee, while the segment along the North Mokelumne is considered a Non-Project Levee. There are three land access points onto the island including Walnut Grove Road to the north, the Walnut Grove bridge crossing of the Mokelumne River in the northeast, and the Tyler Island Road bridge crossing of Georgiana Slough in the southwest. Much of the District's levees are topped with paved or gravel Sacramento County roads including Walnut Grove Road to the north, Tyler Island Road which wraps around the southern two-thirds of the District, and Race Track Road to the northwest. The remainder of the District's levees are topped with a minimum 16' wide all-weather gravel road surface.

Reclamation District No. 364 (Upper Tyler Island) was formed on August 6, 1880, and Reclamation District No. 532 (Lower Tyler Island) was formed on February 11, 1891. On May 7, 1894, a petition was filed with the Sacramento County Board of Supervisors to form the current Reclamation District No. 563, which included the lands within the existing Reclamation District Nos. 364 and 532, along with lands that up to that time did not fall within the boundaries of an organized Reclamation District. Upon the formation of Reclamation District No. 563, District Nos. 364 and 532 ceased. Today Reclamation District No. 563 encompasses a total area of 8,990 acres, surrounded by 22.9 miles of levee, all located within Sacramento County.

The District's Board of Trustees is made up of three Trustees who meet regularly on a quarterly basis.

10.4 Hazard Identification

RD 563 identified the hazards that affect the District and summarized their location, extent, frequency of occurrence, potential magnitude, and significance specific to District (see Table 10-3).

Table 10-3 RD 563—Hazard Identification Assessment

Hazard	Geographic Extent	Likelihood of Future Occurrences	Magnitude/ Severity	Significance	Climate Change Influence
Climate Change	Extensive	Occasional	Limited	Low	–
Dam Failure	Limited	Unlikely	Negligible	Low	Medium
Drought & Water Shortage	Extensive	Occasional	Critical	Low	High
Earthquake	Extensive	Occasional	Limited	Medium	Low
Earthquake Liquefaction	Significant	Occasional	Limited	Medium	Low
Floods: 1%/0.2% annual chance	Extensive	Occasional	Catastrophic	High	Medium
Floods: Localized Stormwater	Extensive	Occasional	Critical	High	Medium
Landslides, Mudslides, and Debris Flow	Limited	Unlikely	Negligible	Low	Medium
Levee Failure	Extensive	Occasional	Catastrophic	High	Medium
Pandemic	Extensive	Likely	Limited	Low	Medium
Severe Weather: Extreme Cold and Freeze	Limited	Unlikely	Limited	Low	Medium
Severe Weather: Extreme Heat	Extensive	Likely	Limited	Low	High
Severe Weather: Heavy Rains and Storms	Extensive	Likely	Critical	Medium	Medium
Severe Weather: Wind and Tornado	Extensive	Likely	Critical	High	Low
Subsidence	Extensive	Likely	Critical	Medium	Medium
Volcano	Limited	Unlikely	Negligible	Low	Low
Wildfire	Limited	Unlikely	Negligible	Low	High

Geographic Extent
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

Likelihood of Future Occurrences
Highly Likely: Near 100% chance of occurrence in next year, or happens every year.
Likely: Between 10 and 100% chance of occurrence in next year, or has a recurrence interval of 10 years or less.
Occasional: Between 1 and 10% chance of occurrence in the next year, or has a recurrence interval of 11 to 100 years.
Unlikely: Less than 1% chance of occurrence in next 100 years, or has a recurrence interval of greater than every 100 years.

Magnitude/Severity
Catastrophic—More than 50 percent of property severely damaged; shutdown of facilities for more than 30 days; and/or multiple deaths
Critical—25-50 percent of property severely damaged; shutdown of facilities for at least two weeks; and/or injuries and/or illnesses result in permanent disability
Limited—10-25 percent of property severely damaged; shutdown of facilities for more than a week; and/or injuries/illnesses treatable do not result in permanent disability
Negligible—Less than 10 percent of property severely damaged, shutdown of facilities and services for less than 24 hours; and/or injuries/illnesses treatable with first aid

Significance
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

Climate Change Influence
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

10.5 Hazard Profile and Vulnerability Assessment

The intent of this section is to profile the District's hazards and assess the District's vulnerability separate from that of the Sacramento County Planning Area as a whole, which has already been assessed in Section 4.3 Hazard Profiles and Vulnerability Assessment in the Base Plan. The hazard profiles in the Base Plan discuss overall impacts to the Sacramento County Planning Area and describes the hazard problem description, hazard location and extent, magnitude/severity, previous occurrences of hazard events and the likelihood of future occurrences. Hazard profile information specific to the District is included in this Annex. This vulnerability assessment analyzes the property and other assets at risk to hazards ranked of medium or high significance specific to the District. For more information about how hazards affect the County as a whole, see Chapter 4 Risk Assessment in the Base Plan.

10.5.1. Hazard Profiles

Each hazard vulnerability assessment in Section 10.5.3, includes a hazard profile/problem description as to how each medium or high significant hazard (as shown in Table 10-3) affects the District and includes information on past hazard occurrences and the likelihood of future hazard occurrence. The intent of this section is to provide jurisdictional specific information on hazards and further describes how the hazards and risks differ across the Sacramento County Planning Area.

10.5.2. Vulnerability Assessment and Assets at Risk

This section identifies the District's total assets at risk, including values at risk, populations at risk, critical facilities and infrastructure, natural resources, and historic and cultural resources. Growth and development trends are also presented for the District. This data is not hazard specific, but is representative of total assets at risk within the District.

Assets at Risk and Critical Facilities

This section considers RD 563's assets at risk, with a focus on key District assets such as critical facilities, infrastructure, and other District assets and their values. With respect to District assets, the majority of these assets are considered critical facilities as defined for this LHMP. Critical facilities are defined for this Plan as:

> ***Any facility, including without limitation, a structure, infrastructure, property, equipment or service, that if adversely affected during a hazard event may result in severe consequences to public health and safety or interrupt essential services and operations for the community at any time before, during and after the hazard event.***

A critical facility is classified by the following categories: (1) Essential Services Facilities, (2) At-risk Populations Facilities, (3) Hazardous Materials and Solid Waste Facilities.

Table 10-4 lists critical facilities and other District assets identified by the District Planning Team as important to protect in the event of a disaster. RD 563's physical assets, valued at over $8.0 million, consist of the buildings and infrastructure to support District's operations.

Table 10-4 RD 563 Critical Facilities, Infrastructure, and Other District Assets

Name of Asset	Facility Type	Replacement Value	Which Hazards Pose Risk
Drainage Conveyances (92,650 ft.)	Essential Services	$2.0 mil	Flood, Levee Failure, Liquefaction
Pump Station #1 (including all station components)	Essential Services	$2.0 mil	Flood, Levee Failure, Liquefaction
Pump Station #2 (including all station components)	Essential Services	$2.0 mil	Flood, Levee Failure, Liquefaction
Pump Station #3 (including all station components)	Essential Services	–*	Flood, Levee Failure, Liquefaction
West Thornton-Walnut Grove Gas Field	Essential Services	$2.0 mil	Flood, Levee Failure, Liquefaction
Total		**$8,000,000**	

Source: RD 563

* The gas field is not owned by the District, but is protected by its levees. No replacement value was available to the District Planning Team.

The Delta Risk Management Strategy Phase 1 report estimates the total assets within Reclamation District No. 563 to be $91,184,000, and does not include the value of the land. The Public Policy Institute estimates the land value to be $33,202,759, and the asset value to be $92,866,000. Recent land sales of similar properties and soil types in the region indicate the current land values are approximately $62,930,000. The value of other assets including homes, buildings, irrigation, drainage and appurtenant structures have been estimated to be 10% of the land value, for a total of approximately $6,293,000. This does not take into account two bridges on the Island which are collectively valued at approximately $50,000,000. The total value of land and assets is approximately $119,223,000. Given that this is a unique property is in a very desirable location with many opportunities for other uses, the value could be in excess of the stated amount.

General Infrastructure

According to the Delta Protection Commission's Economic Sustainability Plan for the Sacramento-San Joaquin Delta, there are over a dozen natural gas transmission and petroleum oil pipelines that cross Tyler Island from companies such as Stream Energy, Towne Exploration, Pacific Gas and Electric, Lodi Gas, and Royale. The District is also situated in the middle of the West Thornton-Walnut Grove Gas Field. This gas field is part of a significant series of oil/gas fields that ranges from Sherman Island at its southwest-most point to Glanville Tract at its northeast-most point and includes the Rio Vista Gas Field, the largest natural gas field in California.

According to the State of California Department of Conservation Division of Oil, Gas & Geothermal Resources, there are fifty-four plugged and abandoned gas wells, thirty-three plugged and abandoned dry holes, twenty-five completed gas wells, and two active drilling gas wells located on Tyler Island. The island retains significant value as a component of the State's gas production and transmission network through this portion of the Delta.

Electrical service to the island residents and District pump stations is provided by Pacific Gas and Electric (PG&E). The transmission lines are fed from the town of Walnut Grove to the north, Staten Island to the east, and Brannan-Andrus to the west. Loss of this power supply would render the District drainage pumps useless, as well as cut power to the residences on the island. There are also many local telephones lines located within the District.

The District is located just south of the town of Walnut Grove and contains the bridge crossings of Walnut Grove Road, also called Sacramento County Road J11, across the North and South forks of the Mokelumne River, and Tyler Island Bridge Road across Georgiana Slough. While there has not historically been a problem with access being impeded at these bridges directly due to flooding at Reclamation District No. 563, these, and several other roads on the District, are major egress routes for the towns of Walnut Grove, Isleton, and Ryde, and provide access to Staten Island and Andrus Island specifically, and through much of the Delta in general. Boats have broken loose from local marinas and floated up against bridges in high water events which have threatened to destroy bridges in this area in the past. Destruction of these egress routes could severely impede flood control operations for multiple reclamation districts in the area, as well as limit evacuation capabilities in the region.

Local Assets

The District's levee system protects over 8,990 acres of prime farmland, approximately one dozen residences and several non-residential, government, commercial, industrial, and agriculture related structures. The Delta Risk Management Strategy (DRMS) Phase 1 report estimates the total assets within the District to be $91,184,000, and does not include the value of the land. The Public Policy Institute (PPIC) estimates the land value to be $33,202,759, and the asset value to be $92,866,000. Recent land sales of similar properties and soil types in the region indicate the current land values are approximately $62,930,000. The value of other assets including homes, buildings, irrigation, drainage and appurtenant structures have been estimated to be 10 percent of the land value, for a total of approximately $6,293,000. This does not take into account two bridges on the Island which are collectively valued at approximately $50,000,000. The total value of land and assets is approximately $119,223,000. Given that this is a unique property is in a very desirable location with many opportunities for other uses, the value could be in excess of the stated amount.

For the purposes of this report, no economic value has been placed on the environmental benefits provided by the interior lands within the island and protected by the levees. The costs of replacing these environmental benefits are likely substantial, and the costs to mitigate for environmental or habitat losses currently range from $65,000 to $145,000 per acre.

Natural Resources

RD 563 has a variety of natural resources of value to the District. These natural resources parallels that of Sacramento County as a whole. Information can be found in Section 4.3.1 of the Base Plan.

The Reclamation District No. 563 levee provides protection for valuable habitat essential for many threatened and endangered species. In general, Delta lands, including those protected by the District's levees, provide forage and cover for local and migratory populations of birds and terrestrial wildlife

including many special status species. The levees also provide important waterside habitat and shoreline for various fisheries that includes several special status species. Flooding of Delta islands destroys habitat and kills most terrestrial species present.

In the District, according to a survey done in 2002, a total of 53.0 acres of levee-associated habitat and 38,997 linear feet of SRA habitat exist. Most of the levee-associated vegetation recorded on Tyler Island (44.7 acres) was riparian forest (trees greater than 20ft.tall). Riparian forest stands with Willow, Alder, and/or Oregon Ash consisted of 29.2 acres. Stands with Oak and/or Cottonwood accounted for 10.7 acres (24.0% of all RF). Additionally, Walnut trees totaled 2.5 acres. Other species accounted for 2.3 acres and associated with Tyler levees include: Box Elder, Black locust, Elderberry, Sycamore, Pine, and Button Bush. Most of the above habitat was recorded along Georgiana slough.

The second most common habitat type was shrub/scrub (7.8 acres). Observations involved individual plants from 5 to 19 feet tall. Over half (4.6 acres) of all shrub/scrub included Himalayan Blackberry and/or California Wild Rose. Both species can serve as forage and cover for birds and small mammals. Willow and Alder were also well represented (2.8 acres or 36%). All other shrub/scrub species only accounted for 0.37 acres or 5.0% of the total.

Freshwater marsh species were not very prevalent on Tyler Island (0.5-acre total). Tule species made up the vast majority of all freshwater marsh species recorded here. Cattail was only observed in one area and represents a negligible amount of freshwater marsh on Tyler.

Special Status Species identified on Tyler Island include three Western Pond Turtles (*Clemmys marmorata*) and a single Swainson Hawk (*Buteo swainsoni*). The Western Pond Turtles were identified at two separate locations (two individuals at one and a single turtle at the other). A Swainson Hawk was also identified on Tyler Island. "Special status" refers only to nesting populations of Swainson Hawks.

Historic and Cultural Resources

The District Planning Team noted that there are no known sites in the District.

Information on Historic and Cultural Resources for Sacramento County can be found in Section 4.3.1 of the Base Plan.

Growth and Development Trends

Reclamation District No. 563 is zoned almost entirely (96%) as agricultural land. The remainder of the District is zoned as Industrial, Miscellaneous, Pipeline, Residential, Roadway, and Gas Well. The land on the District is owned by more than fifty different entities ranging from private landowners and utility companies to the local county government.

Development since 2016

The District Planning Team noted that there has been no growth and or development in the District during the last planning period.

Future Development

Planned levee improvements will help regain PL84-99 eligibility for the Project levee section, but won't remove the island from a flood zone (i.e. flood related permits/development requirements will remain the same). As such, a change in vulnerability is unlikely.

Rock Slope Protection Project

The District's first priority is to ensure the protection of the existing levee by adding quarry stone riprap above the existing riprap to any portions of the waterside slope of the levee requiring additional rock slope protection. This will prevent erosion and reduce future erosion repairs. Prior to submitting a project proposal, a thorough riprap inventory of the District must be completed to determine where additional riprap may be necessary and determine more definitive quantities and costs required to complete the project. The quantities and costs provided in this Plan are planning level estimates based on input from the District and from the District's most recent survey.

The anticipated planning-level costs of the Rock Slope Protection Project consisting of additional riprap as needed is approximately $1.6 million. Costs are provided in this Plan as planning level estimates based on input from the District and from the District's most recent survey and inspection. A thorough riprap inventory of the District must be completed prior to submitting a project proposal to determine where additional riprap may be necessary and determine more definitive quantities and costs required to complete the project. Bulletin 192-82 Levee Project

The District will then bring those portions of levee below the Bulletin 192-82 Standard to six inches above the Bulletin 192-82 Standard with a District minimum crown width of 24 feet to allow for future levee raises to address climate change and sea level rise. This work will likely be divided into several phases or projects, depending on the funding available. A more detailed description of the proposed Bulletin 192-82 Project is included in District's 5-year plan.

The Bulletin 192-82 Project sites are proposed to be limited to the following locations as shown in Table 10-5.

Table 10-5 Bulletin 192-82 Project Sites

Start Station	End Station	Length in Feet
22+00	331+13	30,913
336+46	342+15	569
345+59	349+40	381
350+32	353+02	270
362+30	372+79	1,049
377+50	382+50	500
402+50	417+50	1,500
422+50	447+50	2,500
452+50	457+50	500

Start Station	End Station	Length in Feet
462+50	492+50	3,000
502+50	532+50	3,000
537+50	552+50	1,500
558+67	560+17	150
563+22	577+50	1,428
597+18	607+50	1,032
622+50	627+50	500
662+54	663+25	71
687+50	732+75	4,525
767+14	778+36	1,122
822+01	836+88	1,487
878+69	888+56	987
892+78	920+59	2,781
957+50	1192+50	23,500
1197+50	1202+00	450

Source: RD 563

The cost estimate provided in this report treats all Bulletin 192-82 project sites as a single project.

The costs involved with constructing a minimum 16-foot wide crown in accordance with the Bulletin 192-82 Standard is approximately $101 million. The incremental costs involved with widening the crown to 24 feet to allow for future raises in freeboard to address climate change and sea level rise is approximately $32 million. A more detailed cost estimate breakdown is included in District's 5-year plan. Costs provided are planning level estimates based on input from the District and from the District's most recent survey and inspection. A design-level survey and inspection of the District must be completed prior to submitting a project proposal to determine more definitive quantities and costs required to complete the project.

Levee Failure Repair Project

In 2017, a large series of storm events generating high winds and heavy rain caused rivers to rise above flood stage. Between Station 403+00 and Station 450+00 along the North Fork of the Mokelumne River, the District's levee experienced a significant landside slope failure due to under and through seepage. Emergency and temporary repair included placing a rock berm extending landward around the failure and then adding fill material to the damaged levee prism to fill the void. An engineered long-term repair strategy has been developed and submitted to FEMA for Federal Disaster Assistance, yet it remains in appeal for FEMA funding at the time of this report. A more detailed description of the proposed Levee Failure Repair Project is included in District's 5-year plan.

The Levee Failure Repair Project sites are proposed to be limited to the following locations as shown in Table 10-6.

Table 10-6 – Levee Failure Repair Project Sites

Start Station	End Station	Length in Feet
410+00	425+00	1,500

The anticipated planning-level costs of the Levee Failure Repair Project are approximately $3.6 million. A more detailed cost estimate breakdown is included in District's 5-year plan. Cost provided is a planning level estimate based on input from the District and from the District's most recent survey and inspection. A design-level survey and inspection of the District must be completed prior to submitting a project proposal to determine more definitive quantities and costs required to complete the project. Levee Seepage Repair Project.

In 2014, DWR issued to the District a Notice of Eligibility for Funding of Critical Repairs through its Flood System Repair Project (FSRP) Program. The critical levee reach that was identified has historically experienced significant under and through seepage. A more detailed description of the proposed Levee Seepage Repair Project is included in the District's 5-year plan.

The Levee Seepage Repair Project sites are proposed to be limited to the following locations as shown in Table 10-7.

Table 10-7 – Levee Seepage Repair Project Sites

Start Station	End Station	Length in Feet
700+00	724+40	2,440

Source: RD 563

The anticipated planning-level costs of the Levee Seepage Repair Project is approximately $6.8 million. The cost provided is a planning level estimate based on input from the District and from the District's most recent survey and inspection. A design-level survey and inspection of the District must be completed prior to submitting a project proposal to determine more definitive quantities and costs required to complete the project.

10.5.3. Vulnerability to Specific Hazards

This section provides the vulnerability assessment, including any quantifiable loss estimates, for those hazards identified above in Table 10-3 as high or medium significance hazards. Impacts of past events and vulnerability of the District to specific hazards are further discussed below (see Section 4.1 Hazard Identification in the Base Plan for more detailed information about these hazards and their impacts on the Sacramento County Planning Area). Methodologies for evaluating vulnerabilities and calculating loss estimates are the same as those described in Section 4.3 of the Base Plan.

An estimate of the vulnerability of the District to each identified priority hazard, in addition to the estimate of likelihood of future occurrence, is provided in each of the hazard-specific sections that follow. Vulnerability is measured in general, qualitative terms and is a summary of the potential impact based on

past occurrences, spatial extent, and damage and casualty potential. It is categorized into the following classifications:

- **Extremely Low**—The occurrence and potential cost of damage to life and property is very minimal to nonexistent.
- **Low**—Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.
- **Medium**—Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **High**—Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread. Hazards in this category may have occurred in the past.
- **Extremely High**—Very widespread with catastrophic impact.

Depending on the hazard and availability of data for analysis, this hazard specific vulnerability assessment also includes information on values at risk, critical facilities and infrastructure, populations at risk, and future development.

In general, the most vulnerable District assets include the levees and supporting structures that the District owns.

Power Outage/Power Failure

An impact of almost all hazards below relates to power outage and/or power failures. The US power grid crisscrosses the country, bringing electricity to homes, offices, factories, warehouses, farms, traffic lights and even campgrounds. According to statistics gathered by the Department of Energy, major blackouts are on the upswing. Incredibly, over the past two decades, blackouts impacting at least 50,000 customers have increased 124 percent. The electric power industry does not have a universal agreement for classifying disruptions. Nevertheless, it is important to recognize that different types of outages are possible so that plans may be made to handle them effectively. In addition to blackouts, brownouts can occur. A brownout is an intentional or unintentional drop in voltage in an electrical power supply system. Intentional brownouts are used for load reduction in an emergency. Electric power disruptions can be generally grouped into two categories: intentional and unintentional. More information on types of power disruptions can be found in Section 4.3.2 of the Base Plan.

Public Safety Power Shutoff (PSPS)

A new intentional disruption type of power outage/failure event has recently occurred in California. In recent years, several wildfires have started as a result of downed power lines or electrical equipment. This was the case for the Camp Fire in 2018. As a result, California's three largest energy companies (including PG&E), at the direction of the California Public Utilities Commission (CPUC), are coordinating to prepare all Californians for the threat of wildfires and power outages during times of extreme weather. To help protect customers and communities during extreme weather events, electric power may be shut off for public safety in an effort to prevent a wildfire. This is called a PSPS. More information on PSPS criteria can be found in Section 4.3.2 of the Base Plan.

District pump stations and drainage conveyances are at risk to power outages and/or power failure. In the absence of power, localized flooding can occur because existing pump stations currently do not have backup power systems. In addition, if power outages occur near the end of the flood, it will hinder dewatering operations.

Earthquake

Likelihood of Future Occurrence–Occasional
Vulnerability–Medium

Hazard Profile and Problem Description

An earthquake is caused by a sudden slip on a fault. Stresses in the earth's outer layer push the sides of the fault together. Stress builds up, and the rocks slip suddenly, releasing energy in waves that travel through the earth's crust and cause the shaking that is felt during an earthquake. Earthquakes can cause structural damage, injury, and loss of life, as well as damage to infrastructure networks, such as water, power, gas, communication, and transportation. Earthquakes may also cause collateral emergencies including dam and levee failures, seiches, hazmat incidents, fires, avalanches, and landslides. The degree of damage depends on many interrelated factors. Among these are: the magnitude, focal depth, distance from the causative fault, source mechanism, duration of shaking, high rock accelerations, type of surface deposits or bedrock, degree of consolidation of surface deposits, presence of high groundwater, topography, and the design, type, and quality of building construction.

Location and Extent

The amount of energy released during an earthquake is usually expressed as a magnitude and is measured directly from the earthquake as recorded on seismographs. An earthquake's magnitude is expressed in whole numbers and decimals (e.g., 6.8). Seismologists have developed several magnitude scales, as discussed in Section 4.3.9 of the Base Plan. Geological literature indicates that no major active faults transect the County; however, there are several subsurface faults in the Delta. The Midland fault, buried under alluvium, extends north of Bethel Island in the Delta to the east of Lake Berryessa and is considered inactive but possibly capable of generating a near 7.0 (Richter Scale) earthquake. This magnitude figure is speculative based on an 1895 earthquake measuring 6.9 on the Richter Scale with an epicenter possibly in the Midland Fault vicinity. However, oil and gas companies exploring the area's energy potential have identified several subsurface faults, none of which show any recent surface rupture. A second, presumably inactive, fault is in the vicinity of Citrus Heights near Antelope Road. This fault's only exposure is along a railroad cut where offsetting geologic beds can be seen. Neither the lateral extent of the trace, the magnitude of the offset, nor the age of faulting has been determined. To the east, the Bear Mountain fault zone trends northwest-southeast through Amador and El Dorado Counties. Geologists believe this series of faults has not been active in historic time. Potential earthquakes on the Hayward, Calaveras, and San Andreas fault could also affect the Delta area.

Another measure of earthquake severity is intensity. Intensity is an expression of the amount of shaking at any given location on the ground surface. Seismic shaking is typically the greatest cause of losses to

structures during earthquakes. Seismic shaking maps for the area show Sacramento County and the District fall within a low to moderate shake risk, with most of the moderate risk in the Delta area of the County.

Past Occurrences

There have been no past federal or state disaster declarations from this hazard. The District noted no past occurrences of earthquakes or that affected the District in any meaningful way.

After the most recent 2014 Napa Earthquake, the District performed levee inspections and verified the continued operation of the pump stations around the island to check the levee integrity and ensure there was no damage to District assets as a result of the earthquake.

Vulnerability to and Impacts from Earthquake

The combination of plate tectonics and associated California coastal mountain range building geology generates earthquake as a result of the periodic release of tectonic stresses. Sacramento County lies in the center of the North American and Pacific tectonic plate activity. There have been earthquakes as a result of this activity in the historic past, and there will continue to be earthquakes in the future of the California north coastal mountain region.

Fault ruptures itself contributes very little to damage unless the structure or system element crosses the active fault; however, liquefaction can occur further from the source of the earthquake. In general, newer construction is more earthquake resistant than older construction due to enforcement of improved building codes. Manufactured buildings can be very susceptible to damage because their foundation systems are rarely braced for earthquake motions. Locally generated earthquake motions and associated liquefaction, even from very moderate events, tend to be more damaging to smaller buildings, especially those constructed of unreinforced masonry (URM) and soft story buildings.

The Uniform Building Code (UBC) identifies four seismic zones in the United States. The zones are numbered one through four, with Zone 4 representing the highest level of seismic hazard. The UBC establishes more stringent construction standards for areas within Zones 3 and 4. All of California lies within either Zone 3 or Zone 4. RD 563 is within the less hazardous Zone 3.

Impacts from earthquake in the District will vary depending on the fault that the earthquake occurs on, the depth of the earthquake strike, and the intensity of shaking. Large events could cause damages to levees, infrastructure, critical facilities, residential and commercial properties, and possible injuries or loss of life. Potential earthquakes on the Hayward, Calaveras or San Andreas faults pose the highest risk to Delta Region levees. All assets in the District are at risk to the effects of a damaging earthquake.

Other vulnerabilities to RD 563 from an earthquake event include overtopping of levees, erosion, boils and other damage to the levees compromising their function.

Assets at Risk

The levees' structures, pump stations and drainage conveyances are potentially at risk to an earthquake. All natural resources could also be affected by an earthquake causing damage to the levee structure should the island flood due to an earthquake, though no evidence of damage has been observed to date.

Earthquake: Liquefaction

Likelihood of Future Occurrence–Occasional
Vulnerability–Medium

Hazard Profile and Problem Description

Liquefaction can be defined as the loss of soil strength or stiffness due to a buildup of pore-water pressure during a seismic event and is associated primarily with relatively loose, saturated fine- to medium-grained unconsolidated soils. Seismic ground shaking of relatively loose, granular soils that are saturated or submerged can cause the soils to liquefy and temporarily behave as a dense fluid. If this layer is at the surface, its effect is much like that of quicksand for any structure located on it. If the liquefied layer is in the subsurface, the material above it may slide laterally depending on the confinement of the unstable mass. Liquefaction is caused by a sudden temporary increase in pore-water pressure due to seismic densification or other displacement of submerged granular soils. Liquefiable soil conditions are not uncommon in alluvial deposits in moderate to large canyons and could also be present in other areas of alluvial soils where the groundwater level is shallow (i.e., 50 feet below the surface). Bedrock units, due to their dense nature, are unlikely to present a liquefaction hazard.

Location and Extent

There is no scientific scale for earthquake related liquefaction. The speed of onset is short, as is the duration. The effects from liquefaction can last for days, weeks, months or even years as areas of the County are rebuilt or leveed areas are dewatered and the levees rebuilt. In Sacramento County, the Delta and areas of downtown Sacramento are at risk to liquefaction. The Delta sits atop a blind fault system on the western edge of the Central Valley. Moderate earthquakes in 1892 near Vacaville and in 1983 near Coalinga demonstrate the seismic potential of this structural belt. The increasing height of the levee system has prompted growing concern about the seismic stability of the levees. The concern is based on the proximity of faulting, the nature of the levee foundations, and the materials used to build the levees. Many levees consist of uncompacted weak local soils that may be unstable under seismic loading. The presence of sand and silt in the levees and their foundations indicates that liquefaction is also a possibility.

Past Occurrences

There have been no past federal or state disaster declarations from this hazard. The District noted no past occurrences of earthquake liquefaction. Delta levees are composed of material that contain pockets, rather than long continuous lenses, of sand. Though it has a low likelihood of future occurrence, liquefaction is a recognized potential risk.

Vulnerability to and Impacts from Liquefaction

Earthquake is discussed above, but is primarily focused on the vulnerability of buildings and people from earthquake shaking. This section deals with a secondary hazard associated with earthquake – the possible collapse of structural integrity of the ground underneath liquefaction prone areas. In Sacramento County, two of these areas have been identified: downtown Sacramento and the Delta area, which could lead to a possible collapse of delta levees and any above ground structures. While this levee failure differs from the levee failure discussion below which generally focuses on levee failure due to high water conditions or other types of structural failure, the resulting impacts would be similar and include those related to a large flood event. Potential earthquakes on the Hayward, Calaveras or San Andreas faults pose the highest risk to Delta Region levees. All assets in the District are at risk to the effects of liquefaction.

The seismic events of 1989 and 2014 did not induce liquefaction on the Delta levees.

Assets at Risk

The levees' structures, pump stations and drainage conveyances are potentially at risk to earthquake liquefaction. All natural resources in the District would be at risk to liquefaction and associated levee failures.

Flood: 1%/0.2% Annual Chance

Likelihood of Future Occurrence–Occasional
Vulnerability–High

Hazard Profile and Problem Description

This hazard analyzes the FEMA DFIRM 1% and 0.2% annual chance floods. These tend to be the larger floods that can occur in the County or in the District, and have caused damages in the past. Flooding is a significant problem in Sacramento County and the District. Historically, the District has been at risk to flooding primarily during the winter and spring months when river systems in the County swell with heavy rainfall and snowmelt runoff. Normally, storm floodwaters are kept within defined limits by a variety of storm drainage and flood control measures. Occasionally, extended heavy rains result in floodwaters that exceed normal high-water boundaries and cause damage.

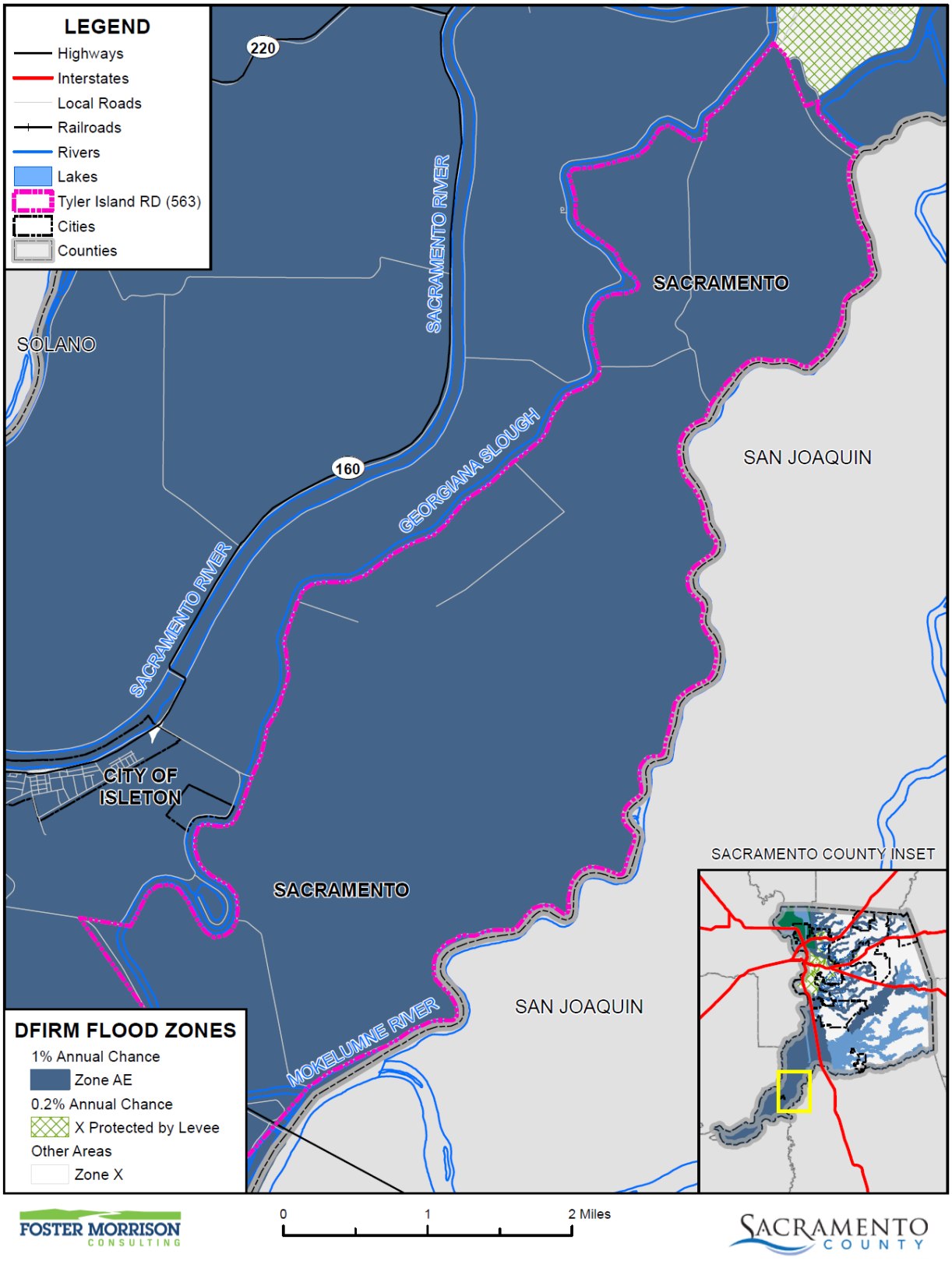
Tyler Island is located between two significant waterways, the North Fork of the Mokelumne River to the east, and Georgiana Slough to the south and west. Flooding on any of these waterways could cause problems for RD 563. Any overtoppings or other failures due to the proximity of these waterways are specifically noted below.

As previously described in Section 4.3.11 of the Base Plan, the Sacramento County Planning Area and RD 563 have been subject to historical flooding.

Location and Extent

RD 563 has areas located in the 1% annual chance floodplain. This is seen in Figure 10-2.

Figure 10-2 RD 563 – FEMA DFIRM Flood Zones



Data Source: FEMA NFHL 07/19/2018, Tyler Island Reclamation District, Sacramento County GIS, Cal-Atlas; Map Date: 09/2020.

Table 10-8 details the DFIRM mapped flood zones within the 1% annual chance flood zone as well as other flood zones located within the District.

Table 10-8 RD 563– DFIRM Flood Hazard Zones

Flood Zone	Description	Flood Zone Present in the District
A	100-year Flood: No base flood elevations provided	
AE	100-year Flood: Base flood elevations provided	X
AH	An area inundated by 1% annual chance flooding (usually an area of ponding), for which BFEs have been determined; flood depths range from 1 to 3 feet	
AO	Areas subject to inundation by 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between one and three feet	
A99	Areas with a 1% annual chance of flooding that will be protected by a Federal flood control system where construction has reached specified legal requirements. No depths or base flood elevations are shown within these zones	
Shaded X	500-year flood the areas between the limits of the 1% annual chance flood and the 0.2-percent-annual-chance (or 500-year) flood	
X Protected by Levee	An area determined to be outside the 500-year flood and protected by levee from 100-year flood	

Source: FEMA

Additionally, flood extents can generally be measured in volume, velocity, and depths of flooding. Expected flood depths in the District vary, depending on the nature and extent of a flood event; specific depths are unknown.

Past Occurrences

A list of state and federal disaster declarations for Sacramento County from flooding is shown on Table 10-9. These events also likely affected the District to some degree.

Table 10-9 Sacramento County – State and Federal Disaster Declarations from Flood 1950-2020

Disaster Type	Federal Declarations		State Declarations	
	Count	Years	Count	Years
Flood (including heavy rains and storms)	19	1950, 1955, 1958 (twice), 1963, 1969, 1982 (twice), 1983, 1986, 1995 (twice), 1996, 1997, 1998, 2008, 2017 (three times)	14	1955, 1958, 1964, 1969, 1983, 1986, 1995 (twice), 1997, 1998, 2006, 2017 (three times)

Source: Cal OES, FEMA

The 5-year plan for RD 563 included the following events of flooding in the District.

- 1906, 1907, and 2017 - A series of regional flood events occurred. Flooding can occur with compound effects of a storm, high releases from upstream dams, snowmelt, and is influenced by tidal movement. More information can be found in the Past Occurrences Section of Levee Failure.

Vulnerability to and Impacts from Flood

Floods have been a part of the District's historical past and will continue to be so in the future. During winter months, long periods of precipitation and the timing of that precipitation are critical in determining the threat of flood, and these characteristics further dictate the potential for widespread structural and property damages. Predominantly, the effects of flooding are generally confined to areas near the waterways of the County. As waterways grow in size from local drainages, so grows the threat of flood and dimensions of the threat. This threatens structures in the floodplain. Structures can also be damaged from trees falling as a result of water-saturated soils. Electrical power outages happen, and the interruption of power causes major problems. Roads can be damaged and closed, causing safety and evacuation issues. People may be swept away in floodwaters, causing injuries or deaths.

Floods are among the costliest natural disasters in terms of human hardship and economic loss nationwide. Floods can cause substantial damage to structures, landscapes, and utilities as well as life safety issues. Floods can be extremely dangerous, and even six inches of moving water can knock over a person given a strong current. During a flood, people can also suffer heart attacks or electrocution due to electrical equipment short outs. Floodwaters can transport large objects downstream which can damage or remove stationary structures. Ground saturation can result in instability, collapse, or other damage. Objects can also be buried or destroyed through sediment deposition. Floodwaters can also break utility lines and interrupt services. Standing water can cause damage to crops, roads, foundations, and electrical circuits. Direct impacts, such as drowning, can be limited with adequate warning and public education about what to do during floods. Other problems connected with flooding and stormwater runoff include erosion, sedimentation, degradation of water quality, loss of environmental resources, and economic impacts.

Assets at Risk

Should a flood breach the levees, the entirety of the assets of RD 563 would be at risk. Levee failure is discussed later in this section. Flooding of Delta islands destroys habitat, kills most species present, and can entrain and strand large populations of native and non-native fish species.

Flood: Localized Stormwater Flooding

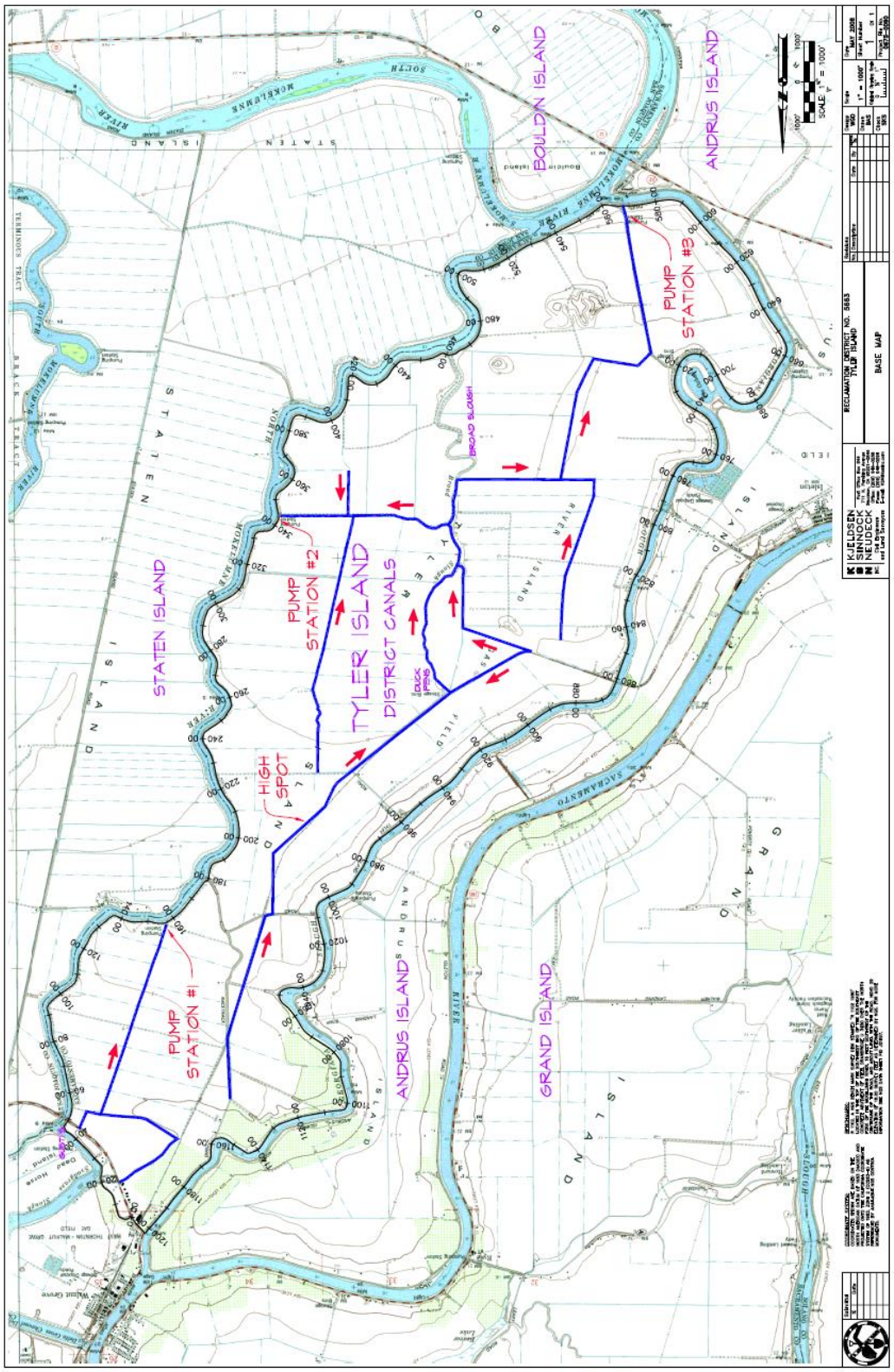
Likelihood of Future Occurrence–Occasional
Vulnerability–High

Hazard Profile and Problem Description

Flooding occurs in areas other than the FEMA mapped 1% and 0.2% annual chance floodplains. Flooding may be from drainages not studied by FEMA, lack of or inadequate drainage infrastructure, or inadequate maintenance. Localized, stormwater flooding occurs throughout the County during the rainy season from November through April. Prolonged heavy rainfall contributes to a large volume of runoff resulting in high peak flows of moderate duration.

Historically, RD 563 has been at risk to flooding primarily during the spring months when river systems in the County swell with heavy rainfall. Localized flooding also occurs throughout the Planning Area at various times throughout the year with several areas of primary concern unique to the District. The District has a drainage system set up to deal with localized flooding. This is shown on Figure 10-3.

Figure 10-3 RD 563 Drainage System



Source: RD 563 2013 5-Year Plan

Location and Extent

RD 563 is subject to localized flooding throughout the District. Flood extents are usually measured in areas affected, velocity of flooding, and depths of flooding. Expected flood depths in the District vary by location. Flood durations in the District tend to be short to medium term, or until either the storm drainage system can catch up or flood waters move downstream. Localized flooding in the District tends to have a shorter speed of onset, especially when antecedent rainfall has soaked the ground and reduced its capacity to absorb additional moisture.

The District tracks localized flooding areas, which are located throughout the District.

Past Occurrences

There have been no federal or state disaster declarations in the County due to localized flooding. However, the District could face localized flooding issues if power outage or Public Safety Power Shutoff occurs during a major storm.

Vulnerability to and Impacts from Localized Flooding

Historically, much of the growth in the District and County has occurred adjacent to streams, resulting in significant damages to property, and losses from disruption of community activities when the streams overflow. Additional development in the watersheds of these streams affects both the frequency and duration of damaging floods through an increase in stormwater runoff.

Primary concerns associated with stormwater flooding include impacts to infrastructure that provides a means of ingress and egress throughout the community. Ground saturation can result in instability, collapse, or other damage to trees, structures, roadways and other critical infrastructure. Objects can also be buried or destroyed through sediment deposition. Floodwaters can break utility lines and interrupt services. Standing water can cause damage to crops, roads, and foundations. Other problems connected with flooding and stormwater runoff include erosion, sedimentation, degradation of water quality, losses of environmental resources, and certain health hazards.

Assets at Risk

The District Planning Team noted that all District assets are at risk to localized flooding; however, this flooding is likely to be a nuisance-type of flood, and would not have lasting impacts on the District. Flooding of Delta islands destroys habitat, kills most species present, and can entrain and strand large populations of native and non-native fish species.

Levee Failure

Likelihood of Future Occurrence–Occasional
Vulnerability–High

Hazard Profile and Problem Description

A levee is a raised area that runs along the banks of a stream or canal. Levees reinforce the banks and help prevent flooding by containing higher flow events to the main stream channel. By confining the flow to a narrower steam channel, levees can also increase the speed of the water. Levees can be natural or man-made.

Levees provide strong flood protection, but they are not failsafe. Levees are designed to protect against a specific flood level and could be overtopped during severe weather events or dam failure. For example, levees can be certified to provide protection against the 1% annual chance flood. Levees reduce, not eliminate, the risk to individuals and structures located behind them. A levee system failure or overtopping can create severe flooding and high water velocities. Levee failure can occur through overtopping or from seepage issues resulting from burrowing rodents, general erosion, excessive vegetation and root systems and other factors that compromise the integrity of the levee. No levee provides protection from events for which it was not designed, and proper operation and maintenance are necessary to reduce the probability of failure.

The Tyler Island levee provides a public benefit by maintaining water quality and water supply reliability for cities and farms in the San Joaquin Valley, San Francisco Bay area, and Southern California. Tyler Island is situated upstream of where fresh river water and salty bay water meet and mix. Under typical summer salinity conditions in the lower Sacramento River, salinity rises sharply at the outlet of the river into the bay. The Tyler Island levee is critical to controlling salinity intrusion to the interior Delta. A levee break would increase the rate and area of mixing and would allow the saline bay water to move further upstream, jeopardizing the fresh water supply exported from the Delta for the Central Valley Project water supply, the State Water Project, and the Contra Costa intake.

Most flooding occurs in winter and spring when major saltwater intrusion is less likely. There are occasional levee failures under low-flow conditions, which can cause major short-term water-quality problems. For instance, the Andrus Island levee failed in the summer of 1972.

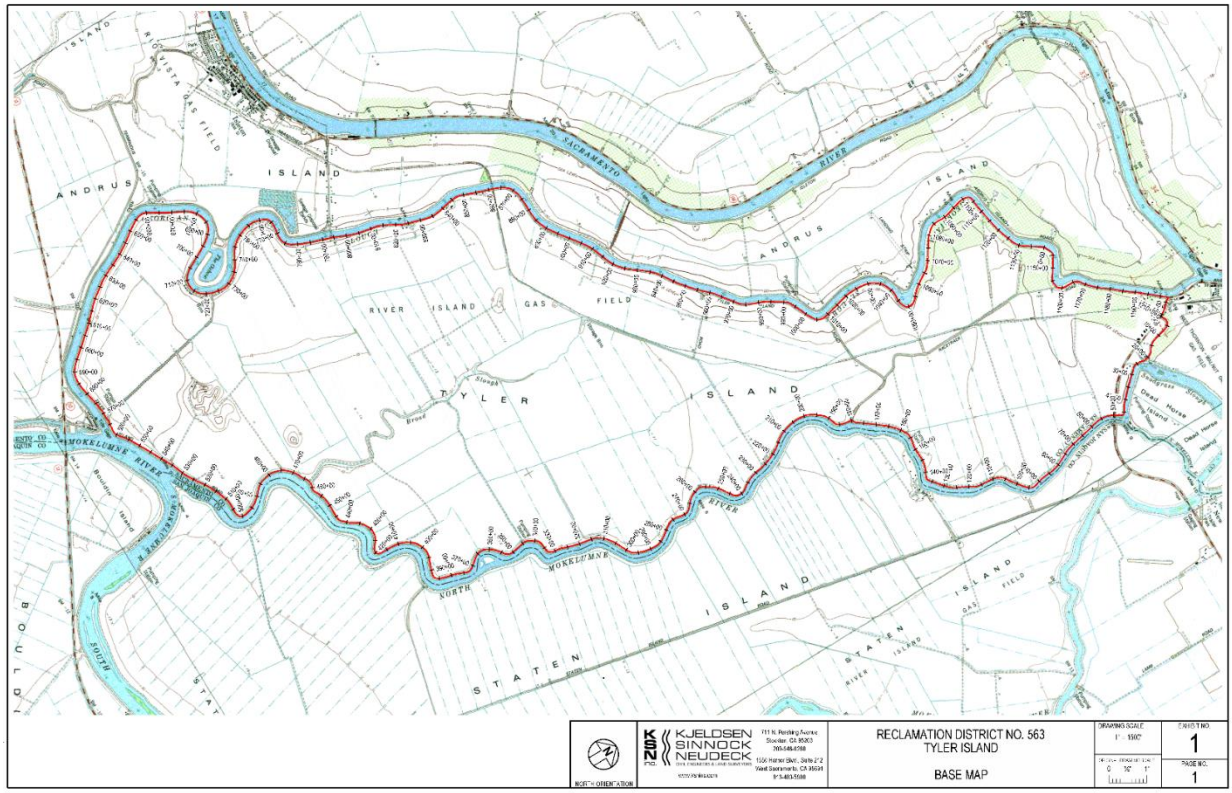
According to sources cited in the 5-Year Plan, salt concentrations in the central and western Delta quickly showed an increase up to six times their pre-failure levels, and additionally may have been a contributing factor in high mortality of juvenile bass that year. It took a large volume of extra reservoir releases to flush the salty water from the west Delta. Similar effects could occur if the Tyler Island levee was to fail under low flow conditions.

Location and Extent

There is not a scientific scale or measurement system in place for levee failure. Expected flood depths from a levee failure in the District vary by event and location. The speed of onset is slow as the river rises, but if a levee fails the warning times are generally short for those in the inundation area. The duration of levee

failure risk times can be hours to weeks, depending on the river flows that the levee holds back. When northern California dams and reservoirs are nearing maximum capacity, they release water through the river systems, causing additional burdens on County levees. Levees in the District are shown on Figure 10-4.

Figure 10-4 RD 563 – Levee Protected Areas



Source: RD 563

Table 10-10 summarizes needed and partially completed levee improvement projects on the Project Levee segment of Tyler island (along Georgiana Slough).

Table 10-10 RD 563 – Levee Improvements

Category	Item	Remarks	Station	Issue No.	Repair Complete Y/N, Date
Levee Embankments	Slope Stability	LS, Active slumping on LS slope with 16-in tall head scarp extends 25-ft. Tension crack up to 6-in deep above the slump. Animal burrow directly below slump.	1069+75	466	
Levee Embankments	Slope Stability	LS, Active slope failure. Slump at mid LS slope has up to 20-in vertical displacement and extends 50-ft. Near standing water at LS toe.	1071+80	467	Y

Category	Item	Remarks	Station	Issue No.	Repair Complete Y/N, Date
Levee Embankments	Slope Stability	LS, Active slope failure on LS slope. Tension cracking up to 6-in deep and 4-in wide. Extends 30-ft. Vertical displacement of soil mass at least 6-in.	1079+19	474	Partial Repair
Levee Embankments	Slope Stability	LS, Active slump on LS slope. Tension crack above slump is 6-in deep, 3-in wide and extends 100-ft. Vertical displacement of soil mass is at least 3-in.	1082+00	475	
Levee Embankments	Slope Stability	LS, Active slope failure on lower LS slope with vertical displacement of approximately 8-in. Tension cracking 2-in wide and 7-in deep extends 20-ft.	1084+08	476	
Levee Embankments	Slope Stability	LS, Active slope failure on LS. Nearly vertical slope, 5-ft high with minimal vertical displacement, but with shallow plane sloughing. Tension cracking 6-in deep, 15-ft long and 3-in	1188+55	568	
Levee Embankments	Erosion/Bank Caving	WS, Erosion at levee toe more than 2-ft into levee prism, extends 100-ft.	628+70	53	Y
Levee Embankments	Erosion/Bank Caving	WS, Erosion on WS slope more than 2-ft into prism. Some soil sliding near levee hinge extends 150-ft. Riprap at toe was an inadequate repair.	631+18	57	
Levee Embankments	Erosion/Bank Caving	WS, Erosion on WS slope more than 2-ft into levee prism extends 50-ft. Riprap at toe was an inadequate repair.	636+12	59	Y
Levee Embankments	Erosion/Bank Caving	WS, Erosion on WS toe more than 2-ft into levee prism, extends 30-ft.	657+90	76	
Levee Embankments	Erosion/Bank Caving	WS, Erosion on WS slope covered with riprap, 300-ft long, cuts into prism more than 2-ft. Riprap is ineffective or was an	659+73	79	Y
Levee Embankments	Erosion/Bank Caving	WS, Erosion on lower WS slope, 4-ft deep, over 2-ft into prism, extends 60-ft.	680+98	91	
Levee Embankments	Erosion/Bank Caving	WS, Erosion by pipe through levee. Large scour of 20-ft diameter and 5-ft deep. Cuts greater than 2-ft into levee prism.	772+78	201	Y
Levee Embankments	Erosion/Bank Caving	WS, Erosion at WS toe. Up to 4-ft deep and extends 20-ft. Cuts greater than 2-ft into levee prism.	778+16	207	
Levee Embankments	Erosion/Bank Caving	WS, Erosion at WS toe. Up to 5-ft deep. Extends 100-ft. Cuts greater than 2-ft into levee prism.	790+76	224	
Levee Embankments	Erosion/Bank Caving	WS, Erosion on WS slope. Up to 7-ft deep and extends 15- ft. Cuts greater than 2-ft into levee prism.	795+55	234	

Category	Item	Remarks	Station	Issue No.	Repair Complete Y/N, Date
Levee Embankments	Erosion/Bank Caving	WS, Erosion at WS toe. 3-ft deep and extends 120-ft. Cuts greater than 2-ft into levee prism.	818+75	250	
Levee Embankments	Erosion/Bank Caving	WS, Erosion on lower WS slope. Up to 4-ft deep and extends 30-ft. Cuts greater than 2-ft into levee prism.	826+98	256	
Levee Embankments	Erosion/Bank Caving	WS, Erosion on lower WS slope. 5-ft deep and extends 20- ft. Cuts greater than 2-ft into levee prism.	837+25	259	
Levee Embankments	Erosion/Bank Caving	WS, Erosion on WS slope. Up to 5-ft deep and extends 40- ft. Cuts greater than 2-ft into levee prism.	842+65	264	
Levee Embankments	Erosion/Bank Caving	WS, Erosion on WS toe. Up to 6-ft deep. Extends 20-ft. Cuts greater than 2-ft into levee prism.	862+50	286	
Levee Embankments	Erosion/Bank Caving	WS, Erosion on WS toe up to 4-ft deep. Extends 15-ft. Cuts greater than 2-ft into levee prism.	863+52	288	
Levee Embankments	Erosion/Bank Caving	WS, Erosion on WS toe by pipe. Up to 3-ft deep and extends15-ft. Cuts greater than 2-ft into levee prism.	885+12	314	
Levee Embankments	Erosion/Bank Caving	WS, Erosion on WS toe, 3-ft deep, extends 50-ft, and cuts more than 2-ft into levee prism.	896+95	328	
Levee Embankments	Erosion/Bank Caving	WS, Erosion at WS toe up to 4-ft deep, extends 20-ft. Cuts more than 2-ft into levee prism.	898+70	329	
Levee Embankments	Erosion/Bank Caving	WS, Erosion on WS near toe. 3-ft deep extends 100-ft. Cuts more than 2-ft into levee prism.	909+19	332	
Levee Embankments	Erosion/Bank Caving	WS, Erosion on WS toe, up to 5-ft deep, extends 300-ft. Cuts more than 2-ft into levee prism.	920+90	338	
Levee Embankments	Erosion/Bank Caving	WS, Erosion on WS toe up to mid-slope extends 120-ft, 5-ft deep. Cuts more than 2-ft into levee prism.	926+75	342	Y
Levee Embankments	Erosion/Bank Caving	WS, Erosion on WS mid-slope, up to 10-ft deep, extends 60- ft. Cuts more than 2-ft into levee prism.	991+40	393	Partial Repair
Levee Embankments	Erosion/Bank Caving	WS, Erosion on WS toe caused by pipe through levee, up to 3- ft deep, 10-ft wide, Cuts more than 2-ft into levee prism.	1009+25	403	Y
Levee Embankments	Erosion/Bank Caving	WS, Erosion on WS toe, 10-ft wide, up to 3-ft deep, Cuts more than 2-ft into prism.	1015+60	416	Y

Category	Item	Remarks	Station	Issue No.	Repair Complete Y/N, Date
Levee Embankments	Erosion/Bank Caving	WS, Erosion on WS slope up to 6-ft deep, extends120-ft. Cuts more than 2-ft into prism.	1061+85	454	Partial Repair
Levee Embankments	Erosion/Bank Caving	Start Point: WS, Erosion on WS toe. 4-ft deep. Greater than 2-ft cut into levee prism. End Point 0558.	1168+25	555	
Levee Embankments	Erosion/Bank Caving	End Point: WS, Erosion at WS toe. Start Point 0555.	1169+87	558	

Source: RD 563

Past Occurrences

The 5-year plan for RD 563 included the following events of levee failure in the District.

- 1906 and 1907 – A series of regional flood events caused the inundation of several islands including Reclamation District No. 563.
- **1982** – A series of large storms that produced heavy rain and high winds caused heavy runoff and high tide conditions that impacted the Districts levee, as well as the entire Sacramento – San Joaquin Delta region. The resulting impacts to the District's levee included water overtopping the levee, increased seepage through the levee, subsidence and partial failure of the levee landside slope, and severe erosion to the waterside slope including degradation of the existing rock slope erosion protection. $1.44 million in damages were sustained in this event.
- **1986** – Due to the extreme storm event, multiple days of heavy rain, strong winds from extreme low pressure gradients, high tides and runoff affecting the entire Sacramento-San Joaquin Delta, the District's levee failed in two locations along the North Fork of the Mokelumne River at approximate levee stations 228+00 and 238+00. More than $9 million in damages were sustained in this event.
- **1997** - A series of large storms that produced heavy rain and high winds caused heavy runoff and high tide conditions that impacted the Districts levee, as well as the entire Sacramento – San Joaquin Delta region. The District claimed costs for flood event related erosion repairs, emergency response – flood fight, and engineering technical assistance. Due to the improvements to the District's levee since the 1986 flood event, and well organized flood fight response, the District's levees and sustained only minor damage and performed well. $781,912 in damages were reported.
- **2006** Winter Storms. (FEMA 1628-DR) A large series of storm events generating high winds and heavy rain caused rivers to rise above flood stage. High winds during this time caused damage to the District's rock slope protection at various locations, road damage from levee patrols and repair equipment and seepage problems. Repairs were made to the rock slope protection and roads. The seepage site was stabilized with a gravel blanket. Overall the levee performance was good.
- **2017** High Water Event. A large series of storm events generating high winds and heavy rain caused rivers to rise above flood stage. Emergency erosion repairs, rodent hole repairs, deployment of muscle wall and emergency response patrols and labor occurred during the event. Between Levee Station 403+00 and 450+00 the District levee experienced a significant landside slope failure due to under and through seepage. Emergency and temporary repair included placing a rock berm extending landward around the failure and then adding fill material to the damaged levee prism to fill the void. An engineered long-term repair strategy has been developed and submitted for assistance and remains in

appeal for FEMA funding at the time of this report. The District had well organized flood fight response, and was able to immediately address the slope failure site which kept the island from flooding. Other than the slope failure site, the District's levees and sustained only minor damage and performed well.

Vulnerability to and Impacts from Levee Failure

A levee failure can range from a small, uncontrolled release to a catastrophic failure. Levee failure flooding can occur as the result of prolonged rainfall and flooding. The primary danger associated with levee failure is the high velocity flooding of those properties outside and downstream of the breach.

Should a levee fail, some or all of the area protected by the levees would be at risk to flooding. Impacts from a levee failure include property damage, critical facility damage, and life safety issues. Business and economic losses could be large as facilities could be flooded and services interrupted. School and road closures could occur. Road closures would impede both evacuation routes and ability of first responders to quickly respond to calls for aid. Other problems connected with levee failure flooding include erosion, sedimentation, degradation of water quality, losses of environmental resources, and certain health hazards.

The two primary vulnerabilities that threaten the levee system on Tyler Island involve levee stability and levee geometry. The Tyler Island levee system has a history of levee stability problems including settlement, movement, seepage, and slope failure. Documentation of the levee's performance is extensive. There are several historical seepage sites along the district due to threats ranging from foundation and structural soil deficiencies to rodent damage. Waterside erosion also continues to be a constant threat, especially along the Project Levee portion of Georgiana Slough. The levee break in 1986 and the ensuing inundation of the entire District, however, stands as the most poignant reminder of levee vulnerability. Levee improvements since that time have greatly improved the District's levee system and the levee has performed well in subsequent flood events.

Georgiana Slough which borders the District Project Levee, is a major corridor to transport Sacramento River water to the State and Federal water project pumps located in the southern Delta. Failure of the Project Levee could impact the operation of those facilities.

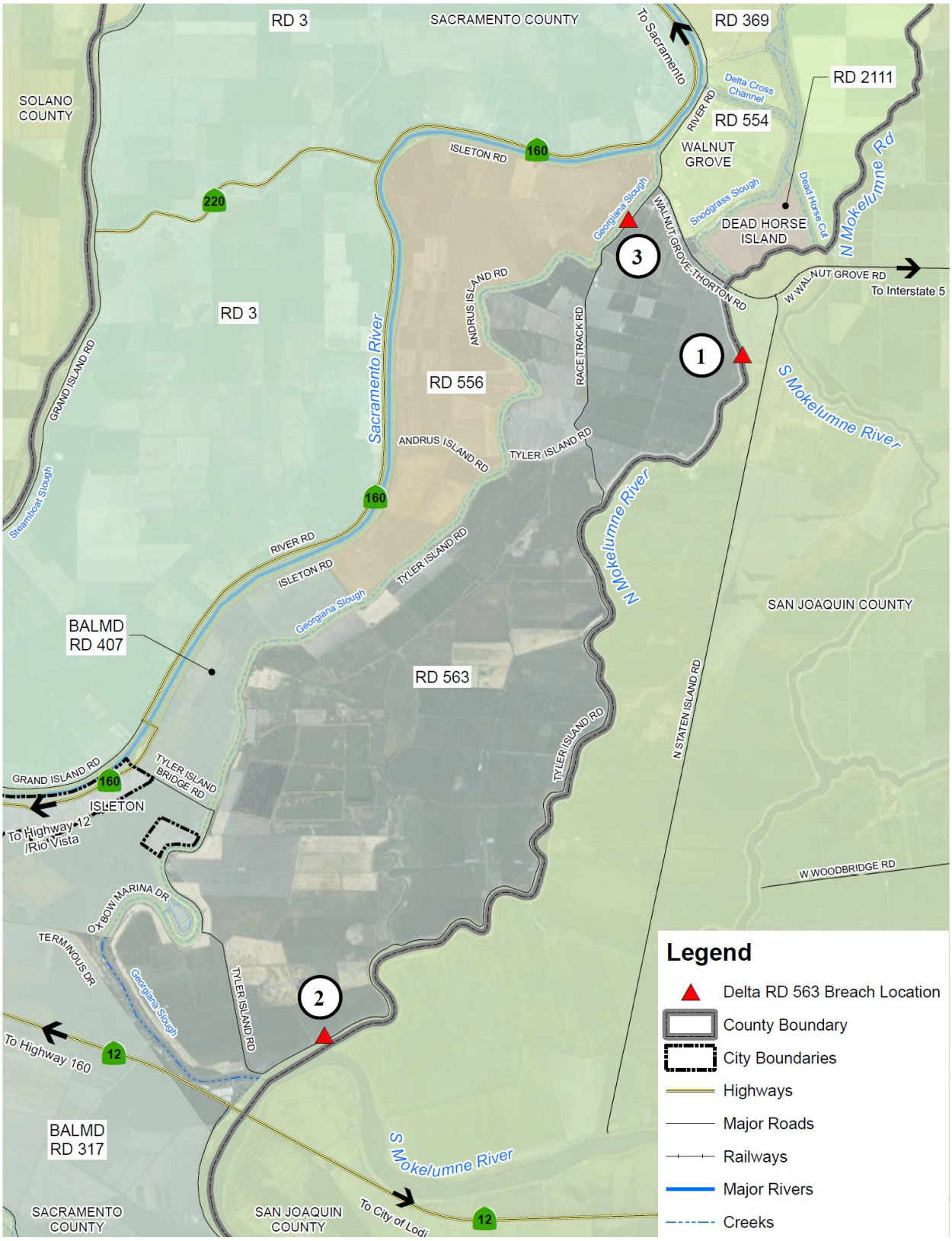
StormReady Flood Scenarios and Evacuation Routes

The County of Sacramento and the City of Sacramento have prepared various detailed maps showing hypothetical levee breaks, inundation levels and the time it would take for waters to rise in affected neighborhoods, and rescue and evacuation zones. It is important to note that these maps deal with potential scenarios. These are to help Sacramento County citizens think of how to escape before an emergency occurs. It should be noted that it would be incorrect to assume that the evacuation routes shown on the maps will necessarily be citizens only way out in a flood. Escape routes could be affected by localized flooding, traffic accidents, and different flooding situations occurring at the time. Emergency officials will monitor roads and let the public know through radio stations and other media if alternate routes should be taken.

For RD 563, Figure 10-5 details the locations in the Delta within Reclamation District 563 where flooding could occur. The red triangle denotes hypothetical potential levee breach locations. RD 563 has three potential levee break scenarios. Maps for Scenario 1 regarding time to one foot inundation (Figure 10-6),

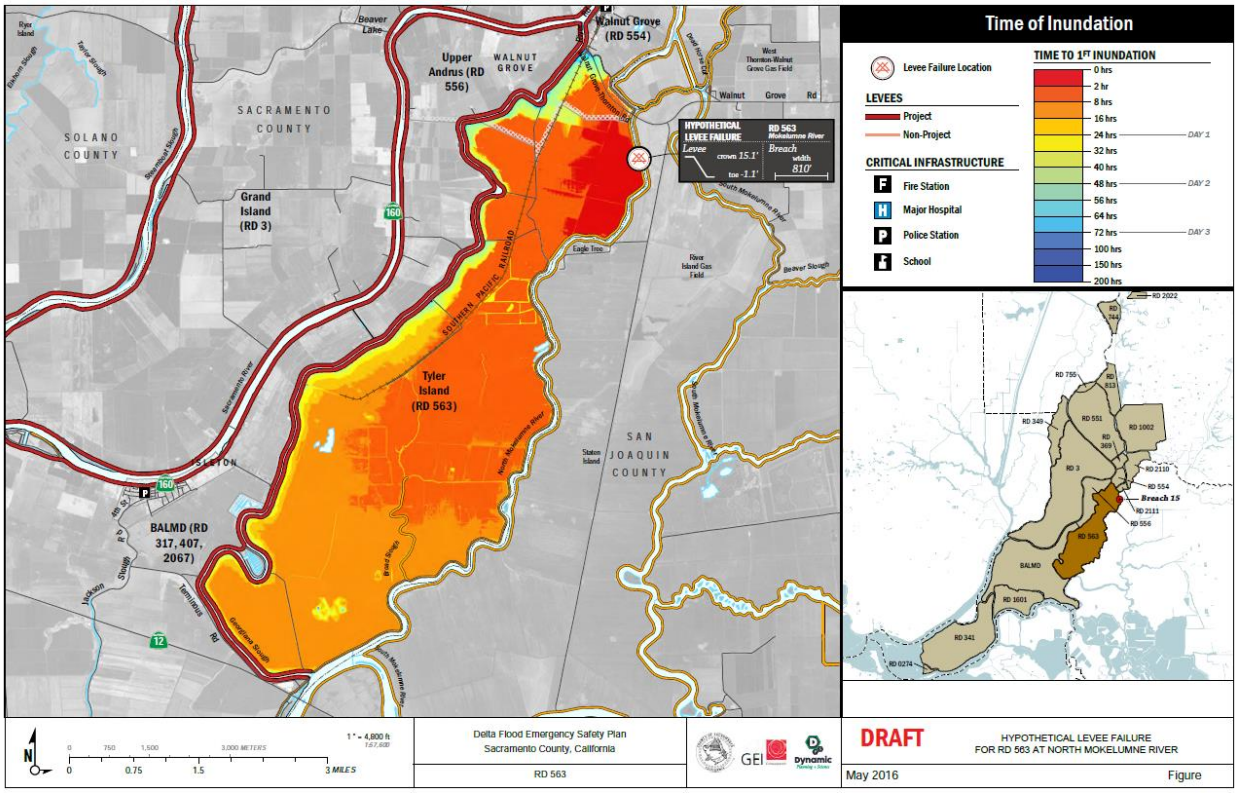
estimated flood depths (Figure 10-7), and suggested evacuation routes (Figure 10-8) are displayed below. Maps for Scenario 2 and 3 can be found on the Sacramento County stormready.org website.

Figure 10-5 RD 563 – Potential Levee Breach Location



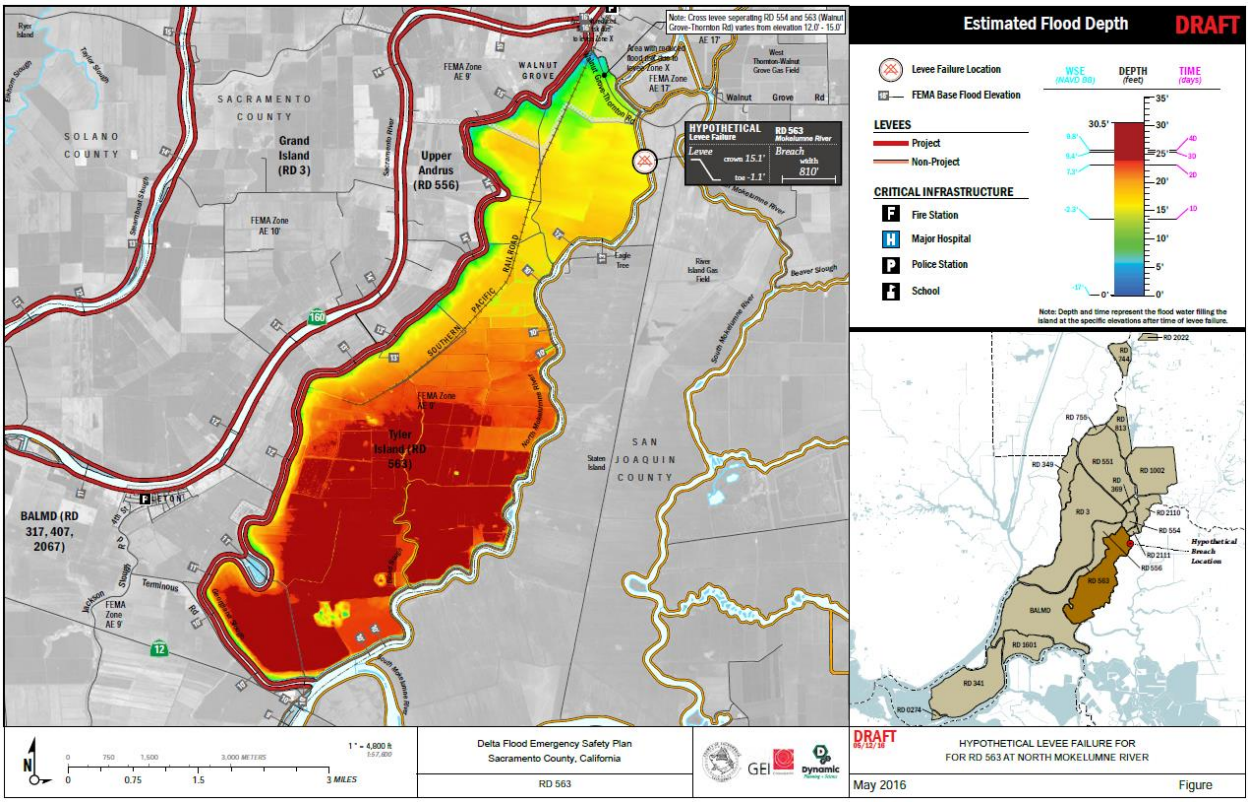
Source: Sacramento County Storm Ready – retrieved March 16, 2021

Figure 10-6 RD 563 – Time to One Foot Inundation after Levee Breach



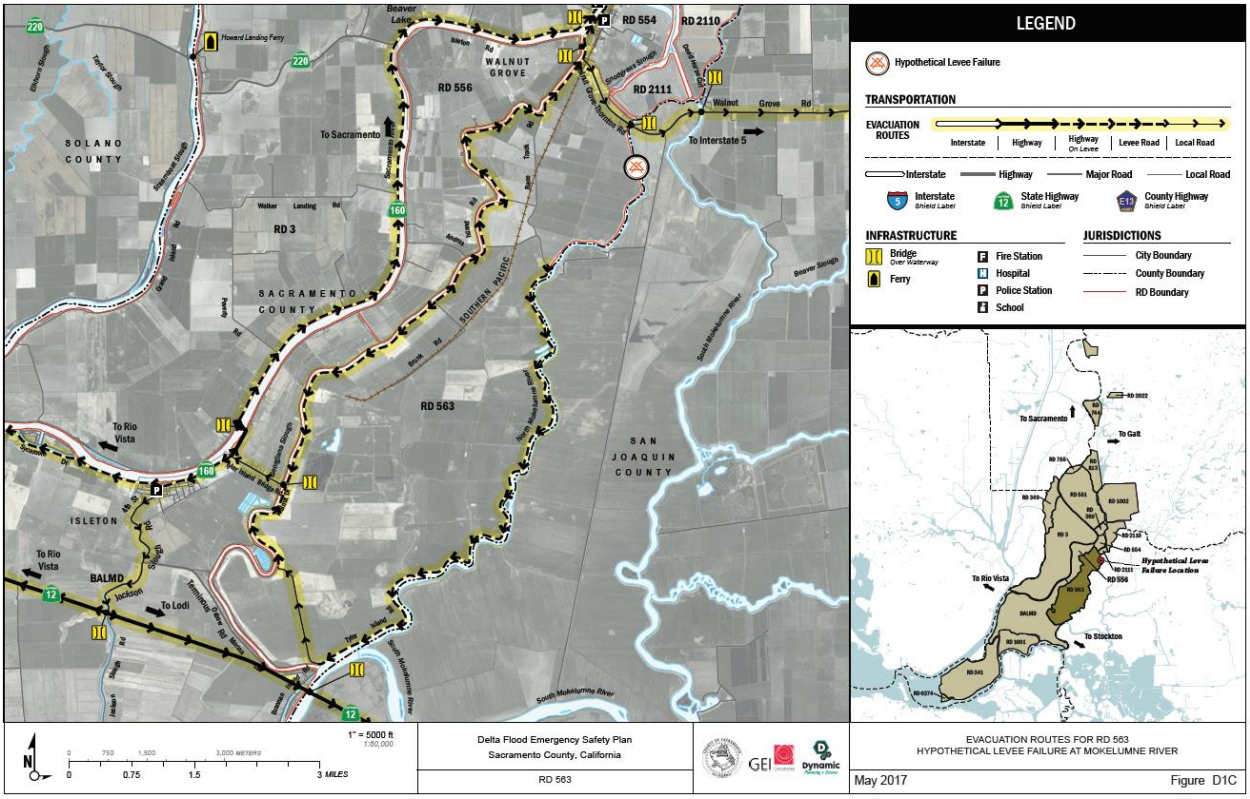
Source: Sacramento County Storm Ready – retrieved March 16, 2021

Figure 10-7 RD 563 – Estimated Flood Depth from Levee Breach Scenario



Source: Sacramento County Storm Ready – retrieved March 16, 2021

Figure 10-8 RD 563 – Levee Breach Scenario Evacuation Routes



Source: Sacramento County Storm Ready – retrieved March 16, 2021

Assets at Risk

Should the levees fail, all District assets would be at risk.

A failure or breach of the District's levee system could result in flooding of the District to depths of approximately 25 feet on average. Costs associated with such an event have been calculated using actual costs from the 2004 Jones Tract Flood. All information used was gathered from the final FEMA Project Worksheets used to close out the claims for all of the public agencies involved in the disaster event (FEMA 1529-DR). Additional costs for work not claimed to FEMA included work performed by the United States Army Corps of Engineers; these costs were established from the invoiced amount provided by the Contractor. For Reclamation District No. 563, the estimated cost of a flood event resulting from a single levee failure would be approximately $31,600,000 based on the costs from the 2004 Jones Tract flood event, with costs for distinct emergency and repair activities. The cost analysis above does not include damage to privately owned property and improvements.

Flooding of Delta islands destroys habitat, kills most species present, and can entrain and strand large populations of native and non-native fish species.

Severe Weather: Heavy Rains and Storms (Hail, Lightning)

Likelihood of Future Occurrence–Likely
Vulnerability–Medium

Hazard Profile and Problem Description

Storms in the District occur annually and are generally characterized by heavy rain often accompanied by strong winds and sometimes lightning and hail. Approximately 10 percent of the thunderstorms that occur each year in the United States are classified as severe. A thunderstorm is classified as severe when it contains one or more of the following phenomena: hail that is three-quarters of an inch or greater, winds in excess of 50 knots (57.5 mph), or a tornado. Heavy precipitation in the District falls mainly in the fall, winter, and spring months.

Location and Extent

Heavy rain events occur on a regional basis. Rains and storms can occur in any location of the District. All portions of the District are at risk to heavy rains. Most of the severe rains occur during the fall, winter, and spring months. There is no scale by which heavy rains and severe storms are measured. Magnitude of storms is measured often in rainfall and damages. The speed of onset of heavy rains can be short, but accurate weather prediction mechanisms often let the public know of upcoming events. Duration of severe storms in California, Sacramento County, and the District can range from minutes to hours to days. Information on precipitation extremes can be found in Section 4.3.4 of the Base Plan.

Past Occurrences

There have been past disaster declarations from heavy rains and storms, which were discussed in Past Occurrences of the flood section above. According to historical hazard data, severe weather, including heavy rains and storms, is an annual occurrence in the District. This is the cause of many of the federal disaster declarations related to flooding.

The 5-year plan for RD 563 included the following events of severe weather in the District.

- 1986 – Due to the extreme storm event, multiple days of heavy rain, strong winds from extreme low pressure gradients, high tides and runoff affecting the entire Sacramento-San Joaquin Delta, the District's levee failed. More information can be found in the Past Occurrences Section of Levee Failure above.
- 1997 – A series of large storms that produced heavy rain and high winds caused heavy runoff and high tide conditions that impacted the Districts levee, as well as the entire Sacramento – San Joaquin Delta region. More information can be found in the Past Occurrences Section of Levee Failure above.
- 2017 High Water Event. A large series of storm events generating high winds and heavy rain caused rivers to rise above flood stage. Emergency erosion repairs, rodent hole repairs, deployment of muscle wall and emergency response patrols and labor occurred during the event. Between Levee Station 403+00 and 450+00 the District levee experienced a significant landside slope failure due to under and through seepage. Emergency and temporary repair included placing a rock berm extending landward around the failure and then adding fill material to the damaged levee prism to fill the void. An

engineered long-term repair strategy has been developed and submitted for assistance and remains in appeal for FEMA funding at the time of this report. The District had well organized flood fight response, and was able to immediately address the slope failure site which kept the island from flooding. Other than the slope failure site, the District's levees and sustained only minor damage and performed well.

Vulnerability to and Impacts from Heavy Rain and Storms

Heavy rain and severe storms are the most frequent type of severe weather occurrences in the District. These events can cause localized flooding. Elongated events, or events that occur during times where the ground is already saturated can cause 1% and 0.2% annual chance flooding. Wind often accompanies these storms and has caused damage in the past. Hail and lightning are rare in the District.

Actual damage associated with the effects of severe weather include impacts to property, critical facilities (such as utilities), and life safety. Heavy rains and storms often result in localized flooding creating significant issues. Roads can become impassable and ground saturation can result in instability, collapse, or other damage to trees, structures, roadways and other critical infrastructure. Floodwaters and downed trees can break utilities and interrupt services.

During periods of heavy rains and storms, power outages can occur. These power outages can affect pumping stations and lift stations that help alleviate flooding. More information on power shortage and failure can be found in the Severe Weather: Extreme Heat Section above, as well as in Section 4.3.3 of the Base Plan.

However, it is the secondary effects of heavy rain and storms that are of concern to RD 563. Heavy rains can cause flooding, levee failure, and stream bank erosion.

Assets at Risk

Flooding, levee failure, and stream bank erosion can cost RD 563 million in damages. The District Planning Team noted that flooding of Delta islands destroys habitat, kills most species present, and can entrain and strand large populations of native and non-native fish species.

Severe Weather: High Winds and Tornadoes

Likelihood of Future Occurrence–Likely
Vulnerability–High

Hazard Profile and Problem Description

High winds, as defined by the NWS glossary, are sustained wind speeds of 40 mph or greater lasting for 1 hour or longer, or winds of 58 mph or greater for any duration. High winds can cause significant property and crop damage, threaten public safety, and have adverse economic impacts from business closures and power loss. High winds can also cause PSPS events.

Tornadoes are rotating columns of air marked by a funnel-shaped downward extension of a cumulonimbus cloud whirling at destructive speeds of up to 300 mph, usually accompanying a thunderstorm. Tornadoes

form when cool, dry air sits on top of warm, moist air. Tornadoes are the most powerful storms that exist. Tornadoes, though rare, are another severe weather hazard that can affect areas of the Sacramento County Planning Area, primarily during the rainy season in the late fall, winter, and early spring.

Location and Extent

The entire District is subject to significant, non-tornadic (straight-line), winds. Each area of the County is at risk to high winds. Magnitude of winds is measured often in speed and damages. These events are often part of a heavy rain and storm event, but can occur outside of storms. The speed of onset of winds can be short, but accurate weather prediction mechanisms often let the public know of upcoming events. Duration of winds in California is often short, ranging from minutes to hours. The Beaufort scale is an empirical 12 category scale that relates wind speed to observed conditions at sea or on land. Its full name is the Beaufort Wind Force Scale. The Beaufort Scale was shown in Section 4.3.5 of the Base Plan.

Tornadoes, while rare, can occur at any location in the County and District. Prior to February 1, 2007, tornado intensity was measured by the Fujita (F) scale. This scale was revised and is now the Enhanced Fujita scale. Both scales are sets of wind estimates (not measurements) based on damage. The new scale (EF) provides more damage indicators (28) and associated degrees of damage, allowing for more detailed analysis and better correlation between damage and wind speed. It is also more precise because it considers the materials affected and the construction of structures damaged by a tornado. The F Scale and EF Scale are shown in Section 4.3.5 of the Base Plan.

Past Occurrences

There has been no federal or state disaster declarations in the County for winds and tornadoes. The District noted that since high winds is a regional phenomenon, events that affected the lower elevations of the County also affected the District. Those past occurrences were shown in the Base Plan in Section 4.3.5.

The 5-year plan for RD 563 included the following events of winds and tornadoes in the District.

- 1986 – Due to the extreme storm event, multiple days of heavy rain, strong winds from extreme low-pressure gradients, high tides and runoff affecting the entire Sacramento-San Joaquin Delta, the District's levee failed. More information can be found in the Past Occurrences Section of Levee Failure above.
- 1997 Storms. A series of large storms that produced heavy rain on a heavy snowpack in the Sierras and high winds caused extraordinary heavy runoff and high tide conditions that impacted the District's levee, as well as the entire Sacramento – San Joaquin Delta region. The District claimed costs for flood event related erosion repairs, emergency response – flood fight, and engineering technical assistance. Due to the improvements to the District's levee since the 1986 flood event, and well organized flood fight response, the District's levees sustained only minor damage and performed well during this otherwise historical Flood Event.
- 2006 Flood Event. Rip rap was placed on waterside slopes to mitigate damage caused from high winds.
- 2017 High Water Event. A large series of storm events generating high winds and heavy rain caused rivers to rise above flood stage. Emergency erosion repairs, rodent hole repairs, deployment of muscle wall and emergency response patrols and labor occurred during the event. Between Levee Station 403+00 and 450+00 the District levee experienced a significant landside slope failure due to under and

through seepage. Emergency and temporary repair included placing a rock berm extending landward around the failure and then adding fill material to the damaged levee prism to fill the void. An engineered long-term repair strategy has been developed and submitted for assistance and remains in appeal for FEMA funding at the time of this report. The District had well organized flood fight response, and was able to immediately address the slope failure site which kept the island from flooding. Other than the slope failure site, the District's levees and sustained only minor damage and performed well.

Vulnerability to and Impacts from Severe Weather: Wind and Tornado

High winds are common occurrences in the District throughout the entire year. Straight line winds are primarily a public safety and economic concern. Windstorm can cause damage to structures and power lines which in turn can create hazardous conditions for people. Debris flying from high wind events can shatter windows in structures and vehicles and can harm people that are not adequately sheltered. High winds can impact critical facilities and infrastructure and can lead to power outages. Wind can also drive wildfire flames, spreading wildfires quickly During periods of high winds and dry vegetation, wildfire risk increases. High winds that occur during periods of extreme heat can cause PSPS events to be declared in the County. More information on power shortage and failure can be found in the beginning of Section 10.5.3.

Impacts from high winds in the District will vary. Future losses from straight line winds include:

- Downed trees
- Power line impacts and economic losses from power outages
- Occasional structure damage
- Erosion of levees and other areas

When paired with highwater, heavy runoff, high tide, and high wind, impacts to District levees, as well as the entire Sacramento – San Joaquin Delta region, include serious levee erosion that could result in overtopping that possibly lead to failure.

Assets at Risk

The District Planning Team noted that the entire levee structures are at risk from wind. The District Planning Team noted that all-natural resources are at risk if wind caused levee failure in the District.

Subsidence

Likelihood of Future Occurrence–Likely
Vulnerability–Medium

Hazard Profile and Problem Description

Subsidence is the gradual settling or sinking of the earth's surface over manmade or natural underground voids with little or no horizontal motion. Subsidence occurs naturally and also through man-driven or technologically exacerbated circumstances. Subsidence is worsened when groundwater drawdown exceeds the ability of the ground to naturally recharge. This is more common during periods of drought.

Location and Extent

There is no scientific scale to measure subsidence. Subsidence is measured in inches or feet of elevation change over time. Subsidence has a long speed of onset, as it occurs over many years. The duration of subsidence is long, as it is rare for subsidence to be reversed. In Sacramento County, the Delta in the southeast portion of the County is highly at risk to subsidence. In the Delta, subsidence affects the islands as well as the levees.

Past Occurrences

There have been no state or federal disasters in the County related to subsidence.

The 5-year plan for RD 563 included the following events of subsidence in the District.

- 1982 – A series of large storms that produced heavy rain and high winds causing subsidence in the District. More information can be found in the Past Occurrences Section of Levee Failure above.

Vulnerability to and Impacts from Subsidence

Historically, the County has been at risk from subsidence. Vulnerability in the County from subsidence comes from several different causes:

- Compaction of Unconsolidated Soils by Earthquake Shaking (Liquefaction)
- Compaction by Heavy Structures
- The Erosion of Peat Soils
- Fluid Withdrawal

These were discussed in detail in Section 4.3.16 of the Base Plan.

Since reclamation of the island began, elevations have fallen to as much as 20 feet below sea level, requiring protection by over 1,125 miles of man-made levees throughout the Delta. Drainage is provided by a network of ditches that collect and transport shallow groundwater, irrigation runoff, and levee seepage to pump stations that discharge back into the Delta waterways. These ditches create an unsaturated root zone for crops, and provide a more stable levee foundation.

Assets at Risk

All levee structures in RD 563 are at risk to subsidence. The District Planning Team noted that all natural resources are at risk from subsidence.

10.6 Capability Assessment

Capabilities are the programs and policies currently in use to reduce hazard impacts or that could be used to implement hazard mitigation activities. This capabilities assessment is divided into five sections: regulatory mitigation capabilities, administrative and technical mitigation capabilities, fiscal mitigation capabilities, mitigation education, outreach, and partnerships, and other mitigation efforts.

10.6.1. Regulatory Mitigation Capabilities

Table 10-11 lists regulatory mitigation capabilities, including planning and land management tools, typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in the RD 563.

Table 10-11 RD 563 Regulatory Mitigation Capabilities

Plans	Y/N Year	Does the plan/program address hazards? Does the plan identify projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?
Comprehensive/Master Plan/General Plan	Y 2020	The District's Five-Year Plan identifies hazards that may affect RD 563. Some mitigation strategies are proposed.
Capital Improvements Plan	N	
Economic Development Plan	N	
Local Emergency Operations Plan	Y	A District-specific Flood Safety Plan consisting of an Emergency Operations Plan – Basic Plan and Annex – A *Flood* (Flood Contingency Map) was completed in 2019 for the District.
Continuity of Operations Plan	N	
Transportation Plan	N	
Stormwater Management Plan/Program	N	
Engineering Studies for Streams	N	
Community Wildfire Protection Plan	N	
Other special plans (e.g., brownfields redevelopment, disaster recovery, coastal zone management, climate change adaptation)		
Building Code, Permitting, and Inspections	**Y/N**	**Are codes adequately enforced?**
Building Code	N	Version/Year:
Building Code Effectiveness Grading Schedule (BCEGS) Score	N	Score:
Fire department ISO rating:	N	Rating:
Site plan review requirements	N	
Land Use Planning and Ordinances	**Y/N**	**Is the ordinance an effective measure for reducing hazard impacts? Is the ordinance adequately administered and enforced?**
Zoning ordinance	N	
Subdivision ordinance	N	
Floodplain ordinance	N	
Natural hazard specific ordinance (stormwater, steep slope, wildfire)	N	
Flood insurance rate maps	N	
Elevation Certificates	N	

Acquisition of land for open space and public recreation uses	N	
Erosion or sediment control program	N	
Other		
How can these capabilities be expanded and improved to reduce risk?		
Pursuant to Sacramento County General Plan Safety Element Policies, SA-18a&b, written approval must be obtained from the applicable Reclamation District to build any structure or grade any soil within 300 feet of the land side toe of levee. This applies to anyone who wants to fill, excavate, or construct a structure within 50 feet of the toe of a Sacramento County river levee and anyone who wants to develop land within 300 feet of the toe. To ensure this requirement is met, every parcel located near a levee is tagged in the building department database. The Emergency Operations Plan development process alone helps to increase the capabilities of the District to respond to emergencies and disasters. Continued funding available to maintain these plans would be helpful.		

Source: RD 563

10.6.2. Administrative/Technical Mitigation Capabilities

Table 10-12 identifies the District department(s) responsible for activities related to mitigation and loss prevention in RD 563.

Table 10-12 RD 563's Administrative and Technical Mitigation Capabilities

Administration	**Y/N**	**Describe capability Is coordination effective?**
Planning Commission	N	
Mitigation Planning Committee	Y	RD 563 and KSN, Inc. staff.
Maintenance programs to reduce risk (e.g., tree trimming, clearing drainage systems)	Y	
Mutual aid agreements	Y	
Other		
Staff	**Y/N FT/PT**	**Is staffing adequate to enforce regulations? Is staff trained on hazards and mitigation? Is coordination between agencies and staff effective?**
Chief Building Official	N	
Floodplain Administrator	N	
Emergency Manager	Y	KSN, Inc.
Community Planner	N	
Civil Engineer	Y	KSN, Inc.
GIS Coordinator	Y	KSN, Inc.
Other		
Technical		
Warning systems/services (Reverse 911, outdoor warning signals)	Y	Sacramento County has an alert and warning system that covers the District.
Hazard data and information	Y	KSN, Inc.
Grant writing	Y	KSN, Inc.

Hazus analysis	N
Other	
How can these capabilities be expanded and improved to reduce risk?	
These capabilities can be expanded by utilization of additional funding opportunities to pay for the services provided by KSN, Inc. so the District can use the General Fund dollars to fund additional District priorities.	

Source: RD 563

10.6.3. Fiscal Mitigation Capabilities

Table 10-13 identifies financial tools or resources that the District could potentially use to help fund mitigation activities.

Table 10-13 RD 563's Fiscal Mitigation Capabilities

Funding Resource	Access/ Eligibility (Y/N)	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Capital improvements project funding	Y	
Authority to levy taxes for specific purposes	Y	Levy Assessment Program but not taxes
Fees for water, sewer, gas, or electric services	N	
Impact fees for new development	N	
Storm water utility fee	Y	Part of our Levee Assessment Program
Incur debt through general obligation bonds and/or special tax bonds	Y	
Incur debt through private activities	N	
Community Development Block Grant	N	
Other federal funding programs	Y	Hazard Mitigation Grant Funding – This has not been used in the past, but may be used in the future; BRIC Grant – this has not been used in the past, but may be used in the future; FEMA post-disaster recovery
State funding programs	Y	DWR Levee Subventions and Special Projects Program (used for O&M activities), Statewide Emergency Response Program – Delta
Other		
How can these capabilities be expanded and improved to reduce risk?		
Continued availability of the Delta Subventions and Special Projects funding is critical for levee health. Pursuing federal grants is generally not feasible since small, rural areas are unable to meet the required local match. Therefore, areas like RD563 are unable to apply for federal grants. If State of Federal partners could assist small, unincorporated communities to meet the local cost share, it would help agencies have access to more federal dollars.		

Source: RD 563

Potential Cost Sharing Partners

At this time, it is unclear if cost sharing partners exist. Inquiries will be made, but it is not likely that other funding is available. At this time, it is assumed that the Delta Levees Program will be the only source of funding.

Requested Cost Sharing with the Delta Levees Special Projects Program

Based on the District's current assessment income and expenses for routine levee maintenance, drainage, flood response, and pay down of debt related to prior flood events and projects, the ability to pay by the District for new projects is limited. The District anticipates that funding from the Delta Levees Special Projects Program will be available with a 90 percent cost share ratio for typical projects identified in this Plan. The District anticipates that the remaining 10 percent of the funding for these projects will be required to be paid by the District. It is expected that not all of the recommended projects identified in this Five Year Plan will require and/or be eligible for funding from the Delta Levees Special Projects Program. The anticipated funding sources and cost share ratios through the Delta Levees Program for the recommended projects are shown below in Table 10-14.

Table 10-14 - Anticipated Delta Levees Program Funding Sources

Project	Anticipated Delta Levees Program Funding Source	Proposed State Cost Share	Proposed District Cost Share
Rock Slope Protection Project	Subventions	75%	25%
Bulletin 192-82 Levee Project	Special Projects	90%	10%
Levee Failure Repair Project	Special Projects	90%	10%
Levee Seepage Repair Project	Special Projects	90%	10%

Source: RD 563

10.6.4. Mitigation Education, Outreach, and Partnerships

Table 10-15 identifies education and outreach programs and methods already in place that could be/or are used to implement mitigation activities and communicate hazard-related information.

Table 10-15 RD 563's Mitigation Education, Outreach, and Partnerships

Program/Organization	Yes/No	Describe program/organization and how relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?
Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	N	
Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)	N	
Natural disaster or safety related school programs	N	

Program/Organization	Yes/No	Describe program/organization and how relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?
StormReady certification	N	
Firewise Communities certification	N	
Public-private partnership initiatives addressing disaster-related issues	N	
DWR Flood Methods Course and Just In Time Training Program, and SEMS/NIMS	Y	Training Policy is outlined in Attachment 1 of RD563's Emergency Operations Plan (EOP), which includes the SEMS/NIMS courses (SEMS 100, 200, 700 and/or G0402).
How can these capabilities be expanded and improved to reduce risk?		
Additional Funding to provide these types of programs. The District will look to other grant opportunities (Cal OES, FEMA, CA DWR) to fund additional mitigation efforts.		

Source: RD 563

10.6.5. Other Mitigation Efforts

The District has many other completed or ongoing mitigation efforts that include the following:

The entire Tyler Island levee system is inspected daily by the landowners, Trustees, and/or District staff who are familiar with all aspects of its functions. The District Engineer typically performs inspections at the request of the District, or more frequently when warranted. During high water or severe weather events, inspection frequency is increased to meet the demand. Like all Federal Project Levees, the Georgiana Slough Project Levee portion of the District is inspected in the fall and spring by the Department of Water Resources levee inspectors. Reports are compiled and submitted to the District. The District staff also inspects the Federal Project Levee in the winter and summer, and submits reports back to the Department of Water Resources.

10.7 Mitigation Strategy

10.7.1. Mitigation Goals and Objectives

RD 563 adopts the hazard mitigation goals and objectives developed by the HMPC and described in Chapter 5 Mitigation Strategy.

10.7.2. Mitigation Actions

The planning team for RD 563 identified and prioritized the following mitigation actions based on the risk assessment. Background information and information on how each action will be implemented and administered, such as ideas for implementation, responsible office, potential funding, estimated cost, and timeline are also included. The following hazards were considered a priority for purposes of mitigation action planning:

- Earthquake
- Earthquake: Liquefaction
- Flood: 1%/0.2% annual chance
- Flood: Localized Stormwater Flooding
- Levee Failure
- Severe Weather: Heavy Rains and Storms (Thunderstorms/Hail, Lightning)
- Severe Weather (Wind and Tornadoes)
- Subsidence

It should be noted that many of the projects submitted by each jurisdiction in Table 5-4 in the Base Plan benefit all jurisdictions whether or not they are the lead agency. Further, many of these mitigation efforts are collaborative efforts among multiple local, state, and federal agencies. In addition, the countywide public outreach action, as well as many of the emergency services actions, apply to all hazards regardless of hazard priority. Collectively, this multi-jurisdictional mitigation strategy includes only those actions and projects which reflect the actual priorities and capacity of each jurisdiction to implement over the next 5-years covered by this plan. It should further be noted, that although a jurisdiction may not have specific projects identified for each priority hazard for the five year coverage of this planning process, each jurisdiction has focused on identifying those projects which are realistic and reasonable for them to implement and would like to preserve their hazard priorities should future projects be identified where the implementing jurisdiction has the future capacity to implement.

Multi-Hazard Actions

Action 1. Rock Slope Protection Project

Hazards Addressed: Earthquake, Earthquake: Liquefaction, Flood: 100/200/500-year, Flood: Localized Stormwater Flooding, Levee Failure, River/Stream/Creek Bank Erosion, Severe Weather: Heavy Rains and Storms (Thunderstorms/Hail, Lightning), Severe Weather (Wind and Tornadoes), and Subsidence

Goals Addressed: 1, 2, 3, 4, 5

Issue/Background: The goal of this Mitigation Action is to improve the Tyler Island levees over the next five years to a level of protection that meets, or exceeds, the U.S. Army Corps of Engineers' (USACE) PL84-99 Levee Standard.

Project Description: The District would like to ensure the protection of the existing levee by adding supplementary quarry stone riprap above the existing riprap to any portions of the waterside slope of the levee requiring supplementary rock slope protection. This will prevent erosion and avoid ongoing repairs to the levee structure.

Other Alternatives: none

Existing Planning Mechanism(s) through which Action Will Be Implemented: District's 5-Year Plan

Responsible Office/Partners: RD 563

Project Priority: High

Cost Estimate: $813,000

Benefits (Losses Avoided): Preservation of 563 levee structures, Ecosystem Restoration and Habitat Enhancement Component, Reversing Land Subsidence, Ensuring Adequate and Effective Emergency Response Plans, Benefitting Water Quality, Improving Water Supply Reliability

Potential Funding: Delta Levees Programs, HMGP and BRIC Grant Programs, seeking cost sharing partners for project ongoing.

Timeline: 1-10 years depending on regulatory process and funding

Action 2. Levee Geometry Levee Improvement Project

Hazards Addressed: Earthquake: Earthquake, Liquefaction; Flood: 100/200/500-year, Levee Failure, River/Stream/Creek Bank Erosion; Severe Weather: Heavy Rains and Storms (Thunderstorms/Hail, Lightning), Wind and Tornadoes (highwater paired with high winds); and Subsidence

Goals Addressed: 1, 2, 3, 4, 5

Issue/Background: The goal of this Mitigation Action is to improve the Tyler Island levees over the next five years to a level of protection that meets, or exceeds, the U.S. Army Corps of Engineers' (USACE) PL84-99 Levee Standard. This will address the hazards listed above.

Project Description: The District would like to address the issue. If sufficient funding is available, the segments of levee improved during this phase will include portions of the levee that meet the HMP Criteria, but do not meet the design template for this project, due to the many relatively short stretches of levee that do not meet the PL 84-99 Standard in close proximity to longer stretches of levee that do not meet the HMP Standard. After the entire levee meets or exceeds the HMP Criteria, the District will bring any remaining portions of levee below the PL 84-99 Standard to six inches above the PL 84-99 Standard.

Other Alternatives: none

Existing Planning Mechanism(s) through which Action Will Be Implemented: District's Five-year Plan

Responsible Office/Partners: RD 563

Project Priority: High

Cost Estimate: $20,000,000

Benefits (Losses Avoided): Preservation of 563 levee structures, Ecosystem Restoration and Habitat Enhancement Component, Reversing Land Subsidence, Ensuring Adequate and Effective Emergency Response Plans, Benefitting Water Quality, Improving Water Supply Reliability

Potential Funding: Delta Levees Program, HMGP and BRIC Grant Programs, seeking cost sharing partners for project.

Timeline: 1-10 years depending on regulatory process and funding

Action 3. Levee Failure Repair Project

Hazards Addressed: Earthquake: Earthquake, Liquefaction; Flood: 100/200/500-year, Levee Failure, River/Stream/Creek Bank Erosion; Severe Weather: Heavy Rains and Storms (Thunderstorms/Hail, Lightning), Wind and Tornadoes (highwater paired with high winds); and Subsidence

Goals Addressed: 1, 2, 3, 4, 5

Issue/Background: The goal of this Mitigation Action is repair locations of significant slope failure on the levee as a result of the large storm.

Project Description: In 2017, a large series of storm events generating high winds and heavy rain caused rivers to rise above flood stage. The District's levee experienced a significant landside slope failure due to under and through seepage along the levee that protects against the North Fork of the Mokelumne. An engineered long-term repair strategy has been developed and submitted to FEMA for Federal Disaster Assistance, yet it remains in appeal for FEMA funding.

Other Alternatives: none

Existing Planning Mechanism(s) through which Action Will Be Implemented: Currently submitted under FEMA's Post Disaster Assistance program; District Five-year Plan

Responsible Office/Partners: RD 563

Project Priority: High

Cost Estimate: $3,600,000

Benefits (Losses Avoided): Preservation of 563 levee structures, Ecosystem Restoration and Habitat Enhancement Component, Preventing significant water quality impacts to the State's water supply, Improving Water Supply Reliability

Potential Funding: FEMA's Post-Disaster Assistance, HMGP, BRIC, and potential cost-sharing partners

Timeline: 1-10 years depending on regulatory process and funding

Action 4. Levee Seepage Repair Project

Hazards Addressed: Earthquake, Earthquake: Liquefaction, Flood: 100/200/500-year, Localized Stormwater Flooding, Levee Failure, River/Stream/Creek Bank Erosion; Severe Weather: Heavy Rains and Storms (Thunderstorms/Hail, Lightning, Wind and Tornadoes), and Subsidence

Goals Addressed: 1, 2, 3, 4, 5

Issue/Background: The goal of this Mitigation Action is to improve a portion of Tyler Island levee that historically experienced significant under and through seepage.

Project Description: Dedicated for critical levee reaches that have been identified as historically experiencing or being vulnerable to significant under and through seepage. A study is needed to determine whether a cutoff wall, seepage berm, or a combination of both are needed to address the through and under seepage experienced on this levee system.

Other Alternatives: none

Existing Planning Mechanism(s) through which Action Will Be Implemented: District Five-year Plan

Responsible Office/Partners: RD 563

Project Priority: High

Cost Estimate: $5,000,000

Benefits (Losses Avoided): Preservation of 563 levee structures, Ecosystem Restoration and Habitat Enhancement Component, Reversing Land Subsidence, Ensuring Adequate and Effective Emergency Response Plans, Benefitting Water Quality, Improving Water Supply Reliability

Potential Funding: FEMA's Post-Disaster Assistance, HMGP, BRIC, Delta Levees Program, and potential cost-sharing partners

Timeline: 1-10 years depending on regulatory process

Action 5. Backup Power Generator Project

Hazards Addressed: Climate Change, Earthquake, Earthquake: Liquefaction, Flood: 100/200/500-year, Localized Stormwater Flooding, Levee Failure, River/Stream/Creek Bank Erosion; Severe Weather: Heavy Rains and Storms (Thunderstorms/Hail, Lightning), Wind and Tornadoes, and Subsidence

Goals Addressed: 1, 2, 3, 4, 5

Issue/Background: The goal of this Mitigation Action is to provide backup power to Reclamation District 563 facilities when power goes out.

Project Description: The District would like to ensure continued operation of District infrastructure during a Public Safety Power Shutoff through obtaining backup power generators.

Other Alternatives: none

Existing Planning Mechanism(s) through which Action Will Be Implemented: District 5-year Plan

Responsible Office/Partners: RD 563

Project Priority: High

Cost Estimate: $150,000

Benefits (Losses Avoided): Preservation of 563 levee structures, Ecosystem Restoration and Habitat Enhancement Component, Reversing Land Subsidence, Ensuring Adequate and Effective Emergency Response Plans, Benefitting Water Quality, Improving Water Supply Reliability

Potential Funding: Delta Levee Subventions, Delta Levee Special Projects, HMGP Grant Programs, State Funding Opportunities, seeking cost sharing partners.

Timeline: 1-10 years depending on regulatory process

Action 6. Flood Exercise and Emergency Operations Plan Update

Hazards Addressed: Flood: 100/200/500-year, Flood: Localized Stormwater Flooding, Levee Failure, River/Stream/Creek Bank Erosion, Severe Weather: Heavy Rains and Storms (Thunderstorms/Hail, Lightning), and Severe Weather (Wind and Tornadoes)

Goals Addressed: 1, 2, 3, 4, 5

Issue/Background: The goal of this Mitigation Action is update RD 563's Emergency Operations Plan and to perform flood exercises in preparation for flood season.

Project Description: The District would like to ensure continued training of staff with regards to flood fighting and associated activities. Updating RD 563's Emergency Operations Plan is essential to continue to protect infrastructure protected by the district's levees. The Emergency Operations Plan provides guidance on how the District will organize, coordinate with outside partners, flood fight, dewater, recover, and serves as a planning document for future flood fight operations.

Other Alternatives: none

Existing Planning Mechanism(s) through which Action Will Be Implemented: California Water Code Section 9650-51 (AB156), Central Valley Flood Protection Plan's emergency preparedness priority, the District's Five-year Plan, and Districts Flood Safety Plan

Responsible Office/Partners: RD 563

Project Priority: High

Cost Estimate: $100,000

Benefits (Losses Avoided): Preservation of 563 levee structures, Ecosystem Restoration and Habitat Enhancement Component, Reversing Land Subsidence, Ensuring Adequate and Effective Emergency Response Plans, Benefitting Water Quality, Improving Water Supply Reliability

Potential Funding: State – Delta Flood Emergency Response Grant Program, HMGP Grant Programs

Timeline: 1-10 years depending on regulatory process