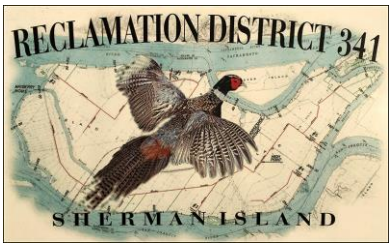


Delta Annex Chapter 4 Reclamation District 341

4.1 Introduction

This Annex details the hazard mitigation planning elements specific to Reclamation District 341 (RD341), 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 341 with a focus on providing additional details on the risk assessment and mitigation strategy for this District.

4.2 Planning Process

As described above, the District 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 4-1. Additional details on plan participation and District representatives are included in Appendix A.

Table 4-1 RD 341 – Planning Team

Name	Position/Title	How Participated
Robert C. Wagner, P.E.	District Engineer	Reviewed draft documents
Patrick W. Ervin, P.E.	Engineer	Collected data, drafted text

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 4-2.

Table 4-2 2016 LHMP Incorporation

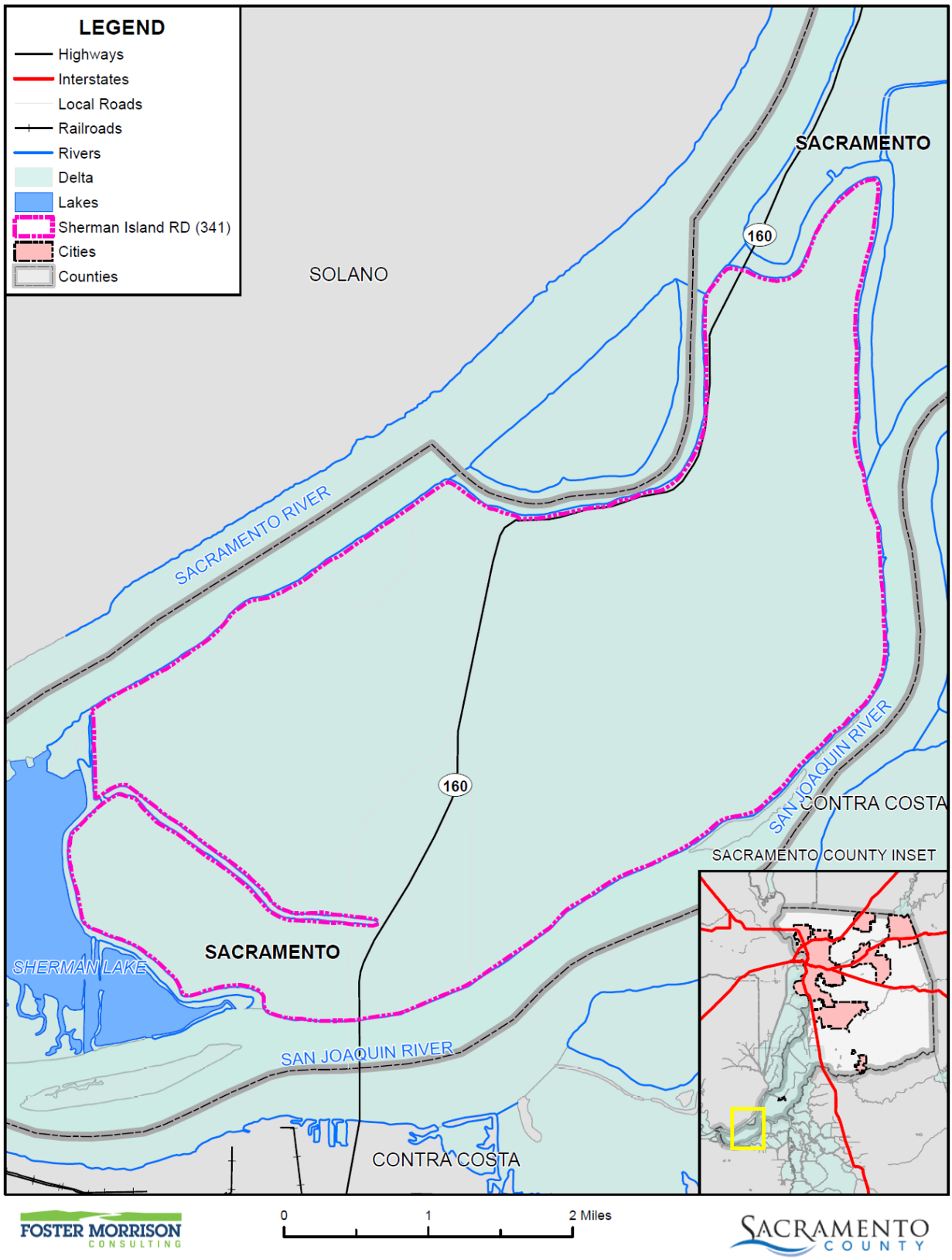
Planning Mechanism 2016 LHMP Was Incorporated/Implemented In.	Details: How was it incorporated?
None	See below text

The District Planning Team noted that they did not directly incorporate or implement the LHMP document into any planning mechanisms. The District did however complete projects that were part of our strategy to improving mitigation and have ongoing projects as well. For example, the Scour Lake Habitat Restoration Project has been completed and the District is working on the long term maintenance plan for the habitat. The Sherman Island Levee Improvement Project for "Little Baja" and "Manzo Ranch" Fish Release Sites Project (SH-14-DCP) and the Sherman Island PL 84-99 Levee Repair Project – Phase 2 (SH-10-1.0) have also been completed

4.3 District Profile

The District profile for the RD 341 is detailed in the following sections. Figure 4-1 displays a map and the location of the District within Sacramento County.

Figure 4-1 RD 341



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

4.3.1. Overview and Background

In the Delta, for the last 5,000 years to the 1850s, relative sea-level rise was balanced by vertical marsh growth through biomass accumulation and sediment deposition. A transition from deposition of organic silt-clay to peat formation in the Delta largely reflects the decline in inundation frequency and the maturation of the marsh plain towards mean higher high water elevations. The resulting freshwater tidal marshes developed because a relatively large freshwater inflow compared to the size of the tidal prism sustained a low salinity, which supported highly productive organic peat formation through tule growth. The large roots of the tule created an organic fabric that supported and aided rapid vertical growth. The living surface was maintained within the intertidal zone (natural habitat), and marsh organic accretion (injection of roots and rhizomes, and incorporation of surface litter) was able to sustain vertical growth at rates in excess of relative sea-level rise. The gradual accumulation of the organic and inorganic sediment must have also offset the loss and compaction of existing peat.

The development of today's Delta began in late 1850 when the Swamp and Overflow Land Act conveyed ownership of tall swamp and overflow land, including Delta marshes from the federal government to the State of California. Reclamation of Sherman Island began shortly thereafter, and by 1859, local property owners had constructed small peat levees of three to four feet in height, with a base width of about eight feet, along the banks of the Sacramento River and Mayberry Slough.

Today, Sherman Island is protected by approximately 18-miles of levee which encompass approximately 9,937 acres of land, according to the 1995 Sacramento Delta San Joaquin Atlas. Approximately 9 miles of levee are project levees, constructed by the US Army Corps of Engineers, and approximately 9 miles of levee are non-project levees. The entire levee system is maintained by RD 341. RD 341 maintains and operates five modern pumping stations on Sherman Island: three on the San Joaquin River (south) side; one on the Sacramento River (north) side; and one on Sherman Island's northwest corner. The pumps are part of a larger system of pumps, siphons irrigation ditches and canals used to circulate water and drain the Island.

4.4 Hazard Identification

RD 341 identified the hazards that affect the District and summarized their location, extent, frequency of occurrence, potential magnitude, and significance specific to District (see Table 4-3).

Table 4-3 RD 341—Hazard Identification Assessment

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

4.5 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.

4.5.1. Hazard Profiles

Each hazard vulnerability assessment in Section 4.5.3, includes a hazard profile/problem description as to how each medium or high significant hazard (as shown in Table 4-3) 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.

4.5.2. 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 the RD 341'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 (a structure, infrastructure, equipment or service), that is adversely affected during a hazardous event may result in interruption of services and operations for the District 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 Facilities.***

Table 4-4 lists critical facilities and other District assets identified by the District Planning Team as important to protect in the event of a disaster. RD 341's physical assets, valued at over $65 million, consist of the buildings and infrastructure to support the District's operations.

Table 4-4 RD 341 Critical Facilities, Infrastructure, and Other District Assets

Name of Asset	Facility Type	Replacement Value	Which Hazards Pose Risk
District Levees	District Infrastructure	$54,000,000	Flood, Levee Failure
District Drain Ditches	District Infrastructure	$5,000,000	Flood, Levee Failure
Pump Stations (5 Stations)	Critical Facility	$3,000,000	Flood, Levee Failure
District Equipment (backhoe, tractors, pickups, etc.)	District Asset	$1,000,000	Flood, Levee Failure
District Office/Workshops	District Asset	$2,000,000	Flood, Levee Failure
Total		**$65,000,000**	

Source: RD 341

In addition to assets owned by RD 341, the District noted the following assets that are protected by RD 341 levees, but are owned by others. According to the 2010 census, Sherman Island has a population of 190 people, with 100 occupied dwelling units. The County General Plan designates approximately 500 acres of recreational land and about 10,000 acres of agricultural cropland/resource conservation area. Sherman Lake is designated as natural preserve.

In addition to agricultural uses, several recreational vehicle parks and marinas for local and public use are located on Sherman Island including Rio Viento on the Sacramento River side, Eddos Harbor and RV park which includes a 70 berth marina on the San Joaquin River side, Sherman Lake Marina on Sherman Lake, and the Outrigger Marina located on the Island's northeast corner. In total, the Island provides 368 marina berths, a boat launch maintained by the County and one fishing access site.

According to the DRMS, the Sherman Island levee system protects approximately $110,416,000 in local assets. Accounting for inflation, the levee system currently protects approximately $138,000,000 in local assets.

Natural Resources

RD 341 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.

Historic and Cultural Resources

RD 341 has a variety of historic and cultural resources of value to the District. These historic and cultural resources parallels that of Sacramento County as a whole. Information can be found in Section 4.3.1 of the Base Plan.

Growth and Development Trends

General growth in the District parallels that of the Sacramento County Planning Area as a whole. Information can be found in Section 4.3.1 of the Base Plan.

Sherman Island has seen little to no growth since 2011. The State of California owns a large portion of the island, limiting potential development, and there are very few economic drivers on-island.

Development since 2016

Since 2016, the District has completed the following projects:

- Sherman Island Levee Improvement Project for "Little Baja" and "Manzo Ranch" Fish Release Sites. Significantly improved the stability of approximately 4,000 linear feet of Project Levee.
- Sherman Island PL 84-99 Levee Repair Project – Phase 2. Improved 7,800 linear feet of levee to meet PL 84-99 standard.
- Sherman Island Flood System Repair Project STA 945+50 to 951+00. Repaired approximately 550 linear feet of severe waterside erosion of Project Levee along HWY 160.
- Sherman Island Pump Station #2 Repair and Rehabilitation. Replaced existing pump and motor, improved pump platform, replaced wooden piles with steel piles, replaced trash rack and trash rack platform.

The District noted it has not seen any steep or sudden declines in facilities. It has seen basic wear and tear of District facilities and ongoing erosion.

Future Development

Future development in these areas generally parallels that of the Sacramento County Planning Area. More general information on growth and development in Sacramento County as a whole can be found in "Growth and Development Trends" in Section 4.3.1 Sacramento County Vulnerability and Assets at Risk of the Base Plan.

The District proposes to construct the following projects over the next five years:

- San Joaquin River PL 84-99 Rehabilitation Project. Rehabilitate San Joaquin River levee from Sta. 330+00 – 368+00 to the PL 84-99 Standard and reconstruct Sherman Island East Levee Road to County Rural Road Standards.
- San Joaquin River Multi-Benefit Project – Phase II. Rehabilitate San Joaquin River levee from Sta. 199+00 – 368+00 to the PL 84-99 Standard and reconstruct Sherman Island East Levee Road to County Rural Road Standards.
- Flood System Repair Project (FSRP) Repair erosion along the Highway 160 levee at various sections from STA 875+00 to 990+00.
- Highway 160 Levee Seepage Repair Project. Construction of a levee drain system from STA 870+00 to 940+00.

4.5.3. Vulnerability to Specific Hazards

This section provides the vulnerability assessment, including any quantifiable loss estimates, for those hazards identified above in Table 4-3 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.

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.

According to the District Superintendent, the District has experienced a PSPS one time. We can't say for sure how likely they are to happen in the future. High winds are a regular occurrence on and near Sherman Island, but the terrain surrounding the island is not typical of areas where PSPS's are regularly issued. The District office is the only District facility with backup power.

Climate Change

Likelihood of Future Occurrence–Likely
Vulnerability–Medium

Hazard Profile and Problem Description

Climate change adaptation is a key priority of the State of California. The 2018 State of California Multi-Hazard Mitigation Plan stated that climate change is already affecting California. Sea levels have risen by as much as seven inches along the California coast over the last century, increasing erosion and pressure on the state's infrastructure, water supplies, and natural resources. The State has also seen increased average temperatures, more extreme hot days, fewer cold nights, a lengthening of the growing season, shifts in the water cycle with less winter precipitation falling as snow, and earlier runoff of both snowmelt and rainwater in the year. In addition to changes in average temperatures, sea level, and precipitation patterns, the intensity of extreme weather events is also changing.

Sea level rise and increased storm intensities are of particular concern to the District moving forward. Sea level rise reduces levee freeboard, (the distance between the water surface and the levee crest) while increased storm intensities resulting in heavy precipitation over short periods of time cause rapid rises in river stage. Both of these events have a direct effect on the levee's ability to prevent flooding, especially when happening concurrently. In the future, Sherman Island levees will need to be built to a higher flood standard to combat the effects of climate change.

Location and Extent

Climate change is a global phenomenon. It is expected to affect the whole of the District, Sacramento County, and State of California. There is no scale to measure the extent of climate change. Climate change exacerbates other hazards, such as drought, extreme heat, flooding, wildfire, and others. The speed of onset of climate change is very slow. The duration of climate change is not yet known, but is feared to be tens to hundreds of years.

Past Occurrences

Climate change has never been directly linked to any declared disasters. While the District noted that climate change is of concern, no specific impacts of climate change could be recalled. The District and HMPC members did, however, note that in Sacramento County, the strength of storms does seem to be increasing and the temperatures seem to be getting hotter.

Vulnerability to and Impacts from Climate Change

The 2014 California Adaptation Planning Guide (APG) prepared by California OES and CNRA was developed to provide guidance and support for local governments and regional collaboratives to address the unavoidable consequences of climate change. California's APG: Understanding Regional Characteristics has divided California into 11 different regions based on political boundaries, projected climate impacts, existing environmental setting, socioeconomic factors and regional designations. Sacramento County falls within the North Sierra Region characterized as a sparsely settled mountainous region where the region's economy is primarily tourism-based. The region is rich in natural resources, biodiversity, and is the source for the majority of water used by the state. This information can be used to guide climate adaptation planning in the District and Sacramento County Planning Area.

The California APG: Understanding Regional Characteristics identified the following impacts specific to the North Sierra region in which the Sacramento County Planning Area is part of:

- Temperature increases
- Decreased precipitation
- Reduced snowpack
- Reduced tourism
- Ecosystem change
- Sensitive species stress
- Increased wildfire

Long term, the biggest impact of climate change to Sherman Island is an increased risk of levee failure for the reasons mentioned above in Hazard Profile and Problem Description. Average precipitation may decrease, but storm duration and intensity are projected to increase. Levee improvement projects (and the required funding) that raise levee crest elevations will need to keep pace with rising sea levels.

District operations include, but are not limited to, daily inspections of the levees, pump station maintenance, vegetation and rodent management, drainage ditch maintenance, etc. Climate change should not affect these day-to-day operations. District concerns with climate change are more related to long term sea level rise as mentioned above.

Assets at Risk

All District assets are at risk from a levee failure caused by climate change with the least vulnerable being the fish release facilities and pump stations. The fish release facilities are all located on the levee crest and a failure would have to happen at, or directly adjacent to, their location to cause serious damage. Most of the District pump stations are built on piles at the approximately the same elevation as the levee crest. However, if levee failures or severe storms cause widespread power outages, the pump stations may be disabled, as they are powered by electric motors.

Earthquake

Likelihood of Future Occurrence–Likely
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 a 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. 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. The District is located in an area where few earthquakes of significant magnitude occur, so both magnitude and intensity of earthquakes are expected to remain low. 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 be 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.

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. None of these exist in the District.

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. The RD 341 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 infrastructure, critical facilities, residential and commercial properties, and possible injuries or loss of life.

The most significant vulnerability of RD 341 to earthquake is potential damage to or failure of the levees, including overtopping of levees, erosion, boils, seepage, and other damage to the levees compromising its function. This can result in significant inundation of areas protected by the levees creating life safety issues and damaging property, infrastructure and crops.

Assets at Risk

District levees are at-risk from a seismic event, although the level of risk is still being studied. The District owns two steel buildings that are used as workshops, storage of materials and equipment, and equipment maintenance. Retrofitting of these buildings likely is not necessary do their low risk categorization as low-occupancy agriculture buildings. The District office sits adjacent to the main workshop at the toe of the levee. The office is a converted shipping container and since it is essentially a steel box, retrofitting would not be required. The largest risk to the District shops and office are likely flooding due to a levee failure caused by an earthquake, not the structural failure of the buildings themselves. The District pump stations are also at risk, however two of the stations have been rehabilitated using seismically designed steel piles that should protect the pump stations during a seismic event.

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. Flooding has occurred within the 1% annual chance floodplains and in other localized areas.

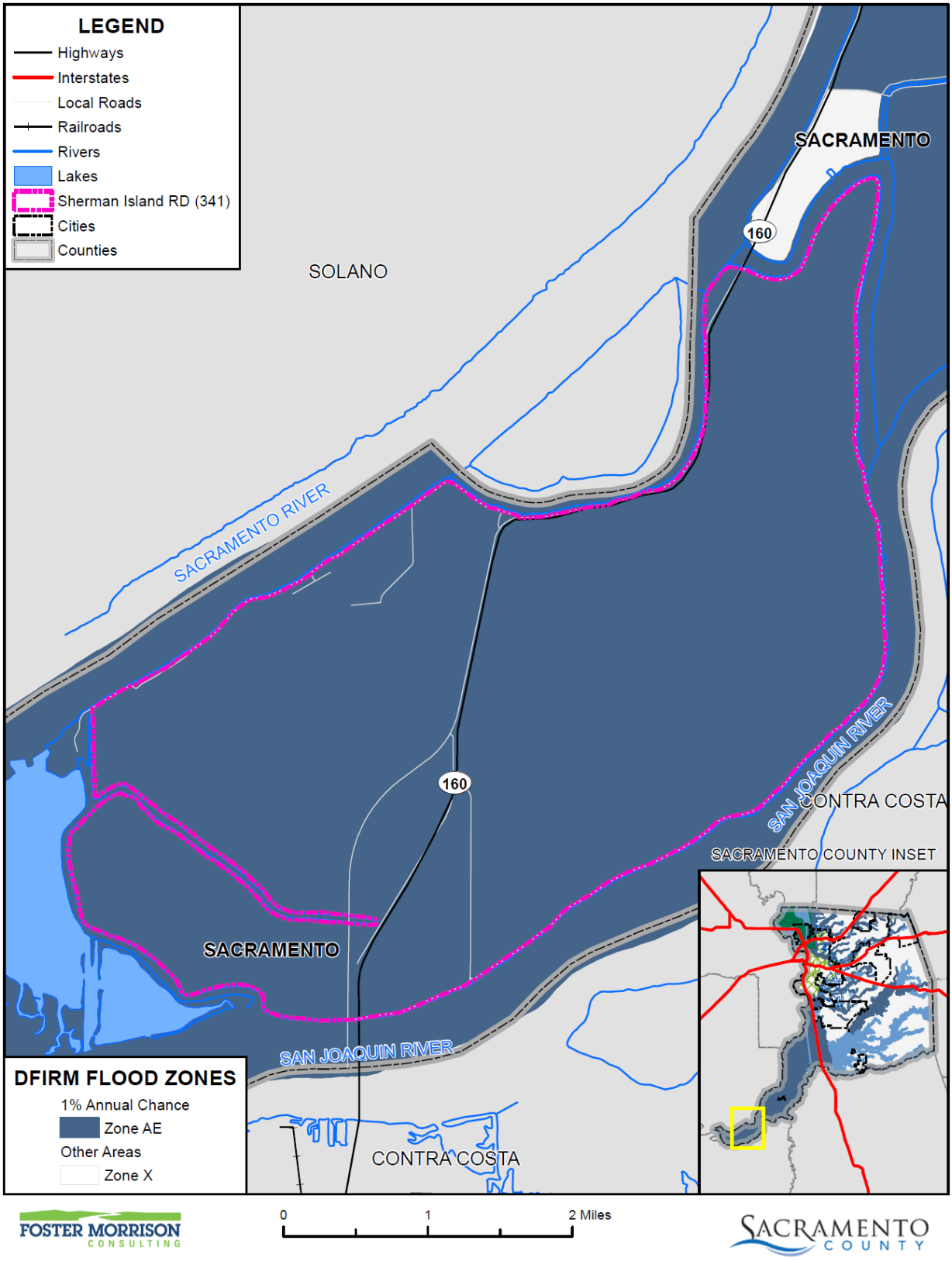
Through discussion of the visual inspections, the District Board members, District superintendent and District engineer have determined that Sherman Island levees are most vulnerable to failure cause by flooding.

As previously described in Section 4.3.11 of the Base Plan, the Sacramento County Planning Area and the RD 341 have been subject to historical flooding.

Location and Extent

The RD 341 has areas located in the 1% annual chance floodplain. This is seen in Figure 4-2.

Figure 4-2 RD 341 – FEMA DFIRM Flood Zones



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

Table 4-5 details the DFIRM mapped flood zones within the 1% annual chance flood zone as well as other flood zones located within the District.

Table 4-5 RD 341– 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. 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. Flooding in the District tends to have a shorter speed of onset, due to the amount of water that flows through the District.

Past Occurrences

A list of state and federal disaster declarations for Sacramento County from flooding is shown on Table 4-6. These events also likely affected the District to some degree.

Table 4-6 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 first significant flooding affecting Sherman Island agriculture occurred during the 1861/62 season and caused wide-spread damage throughout the delta's river islands, and Sherman Island farmers lost most of

their livestock as a result when the Sacramento River breached the low levees constructed along its banks. After completion of the levee system in 1869, Sherman Island suffered several floods. Sherman Island levees failed during the winters of 1871/72, 1874/75, 1876, and 1878. Several crevasses cut through the north and south levees west of Mayberry Slough in the 1874 levee failure, resulting in the loss of all but 100 acres of cropland in the western portion of the island. The subsequent levee reconstruction featured a 12-foot high peat levee with 120 feet widths at the base. Even so, the 1876 flood covered the western portion of the island again. The flood of 1878 devastated the entire island.

Subsequent levee breaks on the San Joaquin River submerged most of the land and Sherman Island's 700 inhabitants fled to higher ground. The beleaguered reclamation districts were faced with underwriting thousands of dollars in assessments to replace most of the levee system. Landowners regrouped, and in March 1878, Reclamation District 252 formed out of a portion of RD 54. Sherman Island landowners reorganized again, and RD 54 and RD 252 combined to form Reclamation District No. 341 (RD 341) on June 17, 1879. Although reclamation efforts continued in RD 50 west of Mayberry Slough for several years after the 1879 floods, landowners eventually dropped reclamation efforts, and after the land flooded during the 1940s, ownership of the land reverted to the State for taxes.

By spring 1880, most of the new RD 341 was again under cultivation until high waters collapsed levee sections again in August later that year. Although an assessment of $13,141 was made for levee repair following the 1880 break, most of the land remained under water until 1894 when reclamation efforts were renewed.

In 1894, RD 341 encompassed 10,303.71 acres of land east of Mayberry Slough and the 3,000-foot cross-levee between Sacramento River and Mayberry Slough. The Sacramento and San Joaquin rivers are connected by Threemile Slough, which forms the eastern and northern boundary of the Island. The district included 24.76 miles of levee, much of it at the time destroyed by previous floods. At the time, much of Sherman Island had been underwater for fifteen years. Although some stretches of levee were intact, much of the levee had had sunk to the ground level of the island or below. The Horse Shoe Bend area of the Sacramento River had several breaks; one about 500 feet in width, with resulting scar holes measuring about 75 feet deep. The San Joaquin River levees on the south side of the island were essentially destroyed from Gallagher Slough, near the modern day location of Eddo's Resort, to the mouth of Mayberry Slough.

During the first decade of the twentieth century, RD 341 conducted frequent levee upgrading and restoration projects on Sherman Island. RD 341 leased four dredges in 1900 that worked in tandem around Sherman Island. Flooding occurred in some section of the Delta almost annually during the period from 1900 to 1910, and serious levee breaks and major flooding of RD 341 occurred during 1904 when a crevasse opened on Mayberry Slough, and in 1906 and 1909, when water again inundated the island. RD 341 trustees contracted with Franks Dredging Company for levee construction and repair work between 1908 and 1920.

The southern levee on the San Joaquin River side failed and flooded the Island on January 20, 1969 at approximate levee station 520+00. Upon finding the break, a large quantity of rock was placed on the upstream and downstream ends of the levee to protect against further erosion from high velocities into and out of the break due to tide. Without placement of the rock, the break which was approximately 275 feet wide and about 45 feet below mean sea level, would have been greatly enlarged. After the break, the water inside the island and in the San Joaquin River was at the same level. The flooding created a deep hole in

the channel on the waterside and a deep lake on the landside toe of the levee at the site of the break. Pumps to dewater the Island were rented (District pumps were entirely submerged). Pumping with the rented equipment commenced February 28, 1969 and continued through August 9, 1969, at which point District pumps continued to remove the remaining water from the Island. All 93,000 feet of District drainage ditches were cleaned and/or excavated, primarily by drag line and ditcher operations before District ditches were operable. The Corps of Engineers spent approximately $600,000 in emergency funds to repair, reslope, and regrade the levee break area after the 1969 break. Seepage and settlement in the area of the break have been ongoing issues requiring constant levee improvements.

There have been no recent floods on Sherman Island. The only issues were the boils on the levee toe during Jan 2017.

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. Loss of power is usually a precursor to closure of governmental offices and community businesses. 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

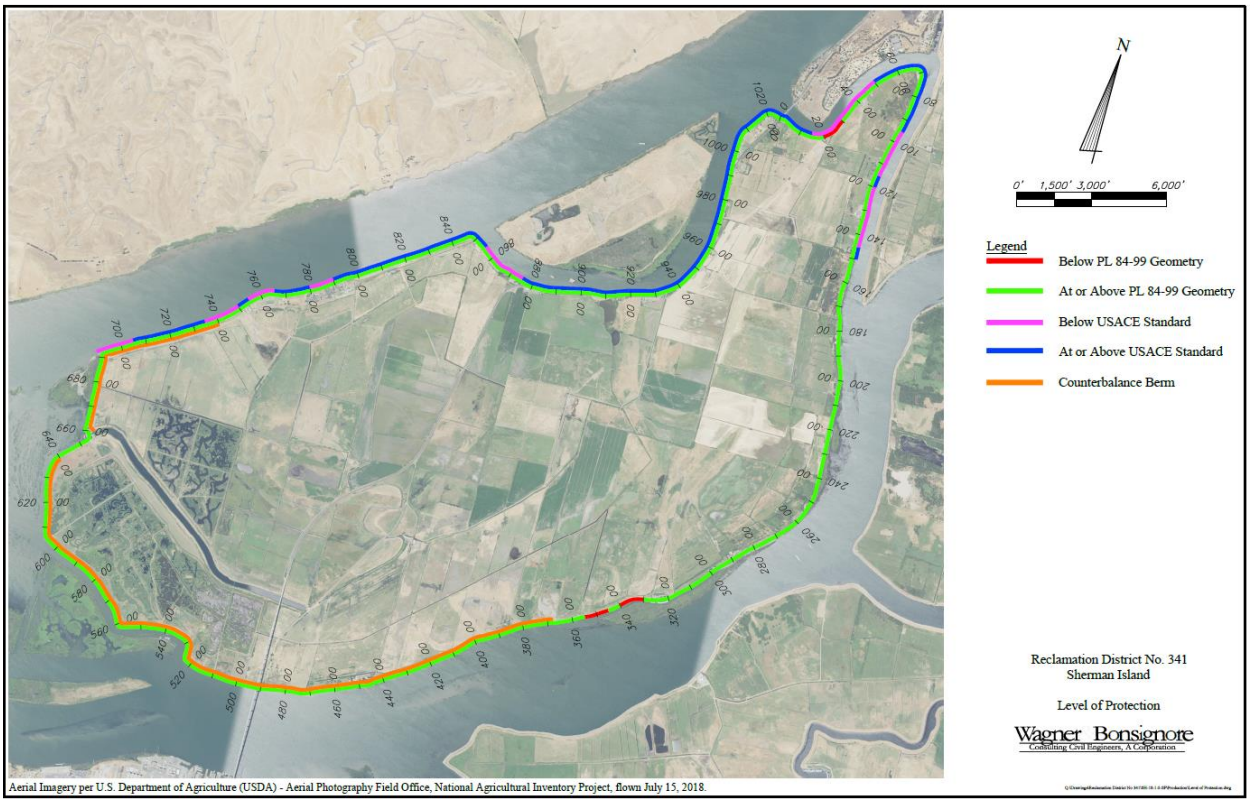
Should a high water flood event cause levees to collapse, Sherman Island would be fully inundated, risking the $12.7 million in district assets discussed in **Error! Reference source not found.**.

Areas of the existing levee system most susceptible to overtopping are those which do not meet the PL 84-99 height standard. An inventory of levee sections and their respective heights is maintained by the District. Analysis of this inventory shows that the levee along the San Joaquin River from about levee station 330+00

to 350+00, and Three Mile Slough from about 20+00 to 40+00 contains stretches which are below the PL 84-99 height standard (1.5 feet above 1:100 year flood event) and therefore are susceptible to overtopping. Figure 4-3 depicts levee flood protection levels for each individual section of the Sherman Island levees.

While future development may occur in the areas protected by levee, the District does not control this development. The District only can control whether the levees meet certification standards and can protect against floods. The District Planning Team noted that the State of California has purchased the majority of the land on Sherman Island over the last several years with the intent of not developing the island. It's leased as grazing land or being converted back to natural habitat.

Figure 4-3 Level of Levee Flood Protection in Reclamation District 341



Source: Reclamation District 341

Levee Failure

Likelihood of Future Occurrence–Occasional
Vulnerability–Extremely 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.

Floods can threaten the District from several sources. Usually, the possibility of flooding can be anticipated from eight to twenty hours before the "Emergency Period" is reached. However, as demonstrated in Linda, California, in February 1986, it is possible for a levee to collapse with little or no warning when there are still four or more feet of freeboard available.

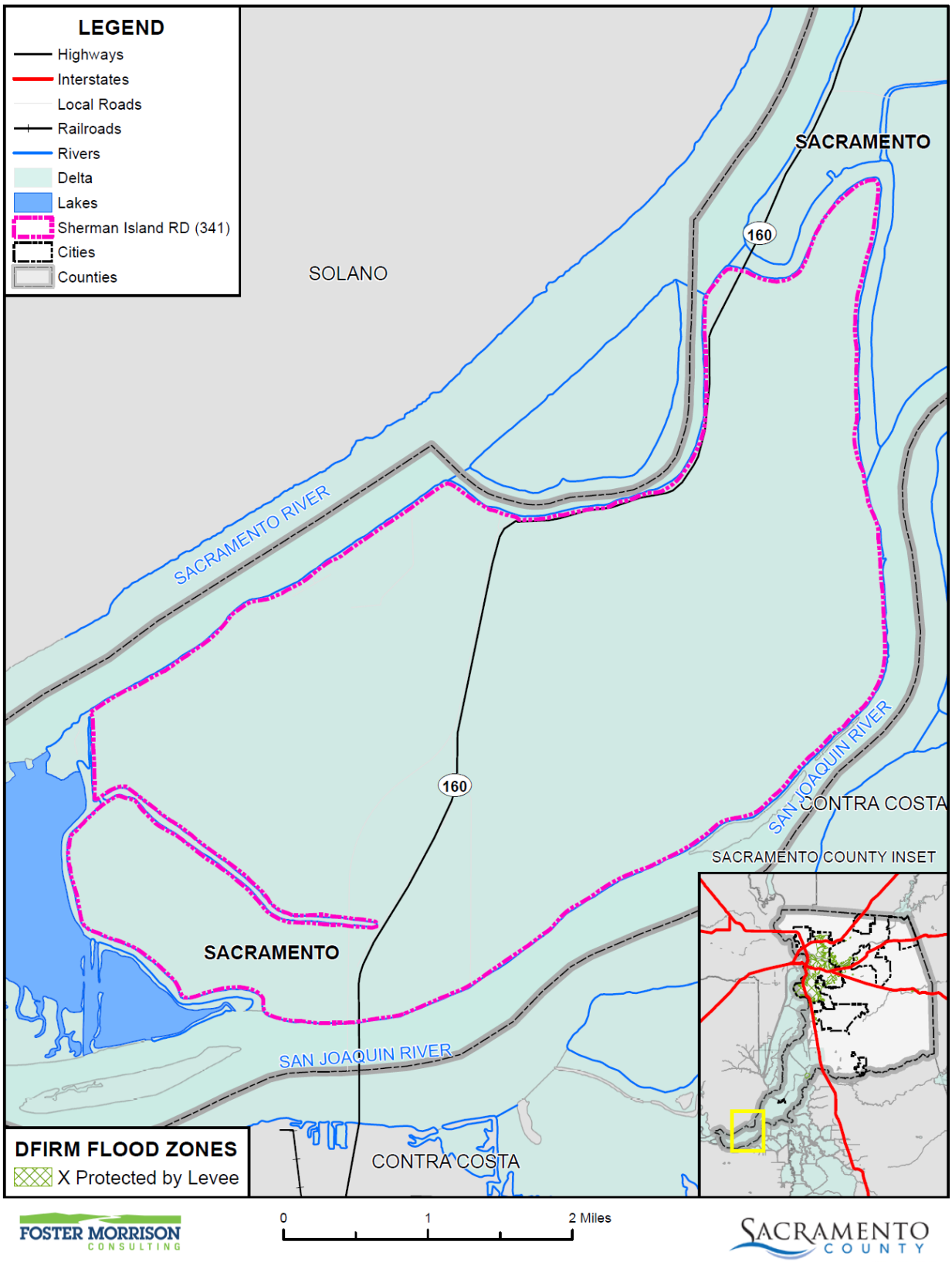
Generally, levees fail due to overtopping or collapse. A catastrophic levee failure resulting from collapse probably will occur very quickly with relatively little warning. Such a failure would occur where the levee is saturated and the high hydrostatic water pressure on the river side, coupled with erosion of the levee from high water flows or an inherent defect in the levee, causes an almost instant collapse of a portion of the levee. Under such circumstances, structures located relatively near the break will suffer immediate and extensive damage. Several hundred yards away from the break the energy of the flood waters will be dispersed sufficiently to reduce, but not eliminate, flooding damage to structures in its path. The flood water will flow in a relatively shallow path toward any low point in the affected area. Flood water will collect in these low areas and the levels will rise as the flow continues. When the rivers are high, it is not possible to close or repair a levee break until the water surface in the river and the flooded area equalize.

A major overtopping of a levee, if flow persists, will result in severe erosion of the levee crowns on the landward side and cause levee failure over a period of minutes to several hours. A severe levee overtopping can, therefore, be considered as a levee break for the purpose of determining the extent of flooding that any area will suffer. Generally, overtopping can be predicted based on river stages and the warning given depending on the source of the flood waters.

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 4-4. As shown, the levees in the District are not currently shown as certified on the FEMA DFIRMS.

Figure 4-4 RD 341 – Levee Protected Areas



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

Past Occurrences

Commencing January 6, 2017, Reclamation District #341 was notified of a potential flood emergency as the Sacramento River stage measured at Rio Vista Bridge rose above the flood monitoring level of 7.4 feet. The river level continued to rise over the next six days. Possible dangers to the levee system protecting Sherman Island, due to the high river level, were seepage, boils, erosion, and potential for levee overtopping.

On January 12, during the peak of the tide which occurred around 2:30 p.m., the levee section between Sta. 335+00 –445+00 had spots where the remaining freeboard at the top of the levee appeared to be less than 1 foot.

On January 13, at approximately 3:00 pm, the District Superintendent, Joel McElroy, received a call from Caltrans (California Department of Transportation) regarding the sighting of two (2) boils on the portion of the levee system that supports Highway 160. The boils were located behind the District Office at approximately Sta. 960+00. At approximately 8:00 pm, the situation was worsening. The section of levee was becoming more saturated, the boils were not stabilizing and a third boil was developing near the existing boils. On the morning of January 14, the third boil that had developed in close proximity to the others was identified by District personnel, but it was not seeping water.

On January 15, District Engineer Robert C. Wagner, P.E., Henry Matsunaga, District President Juan Mercado, Mr. McElroy and Patrick W. Ervin, P.E., met at the District office to inspect the seepage area. It was determined that, as a result of the precipitation events, high river stage and high tides during January, and the forecast for additional rainfall, there was potential for levee failure in this section.

Catastrophic levee failure would result in an immediate threat to life, public health and safety, and significant damage to improved public and private property.

A trench drain was installed properly and by the end of the fourth day of construction, all cover material was in place, with water flowing from the drain as expected. The following day, Asta placed jute mesh rolls over all exposed soil to prevent erosion, which completed the Project

Additional information is referenced in the flood section of this document for a history of flooding and levee failure.

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.

According to the 2010 census, Sherman Island has a population of 190 people, with 100 occupied dwelling units. The County General Plan designates approximately 500 acres of recreational land and about 10,000 acres of agricultural cropland/resource conservation area. Sherman Lake is designated as natural preserve. In addition to agricultural uses, several recreational vehicle parks and marinas for local and public use are located on Sherman Island including Rio Viento on the Sacramento River side, Eddos Harbor and RV park which includes a 70 berth marina on the San Joaquin River side, Sherman Lake Marina on Sherman Lake, and the Outrigger Marina located on the Island's northeast corner. In total, the Island provides 368 marina berths, a boat launch maintained by the County and one fishing access site.

The Sherman Island levee system also protects non-local assets which provide a public benefit, including infrastructure, utilities, water quality and water supply reliability. Below is a list of the non-local assets protected by the levee system:

- Water Delivery System
  - ✓ State Water Project
  - ✓ Federal Central Valley Water Project (CVP)
  - ✓ Miscellaneous Diversions Directly from the Delta
- Infrastructure
  - ✓ State Route 160
  - ✓ Highway 160 Draw Bridge
  - ✓ Dam (Forms Mayberry Canal)
- Utilities
  - ✓ Major 500kV Transmission Lines
  - ✓ Natural Gas Resources
  - ✓ Telecommunication and fiber optic lines
  - ✓ US Geological Survey accelerometers

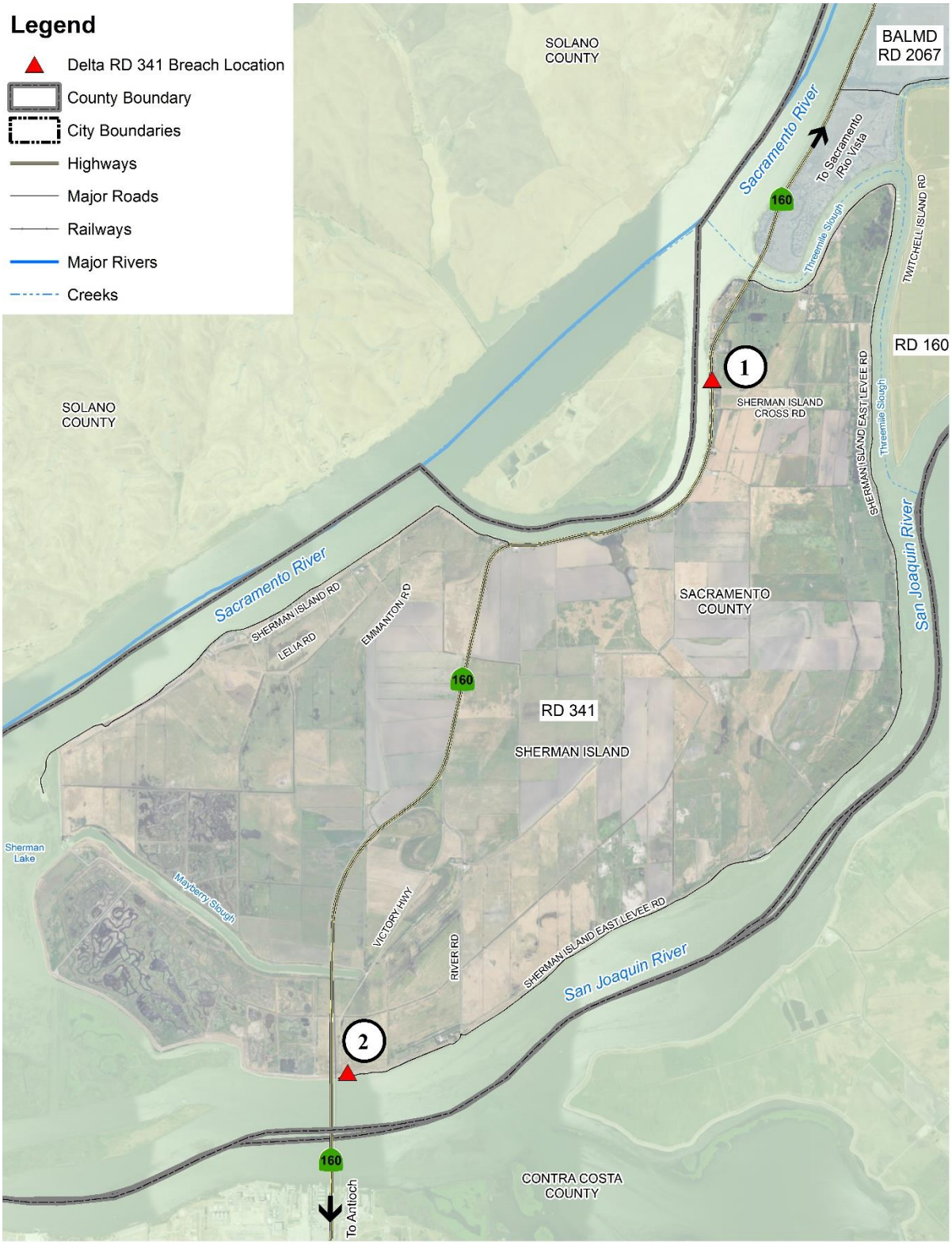
StormReady Flood Scenarios and Evacuation Routes

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 341, Figure 4-5 details the locations in the Delta within Reclamation District 341 where flooding could occur. The red triangles denote potential levee breach locations. RD 341 has two potential levee break scenarios. Maps for Scenario 1 regarding time to one foot inundation (Figure 4-6), estimated flood

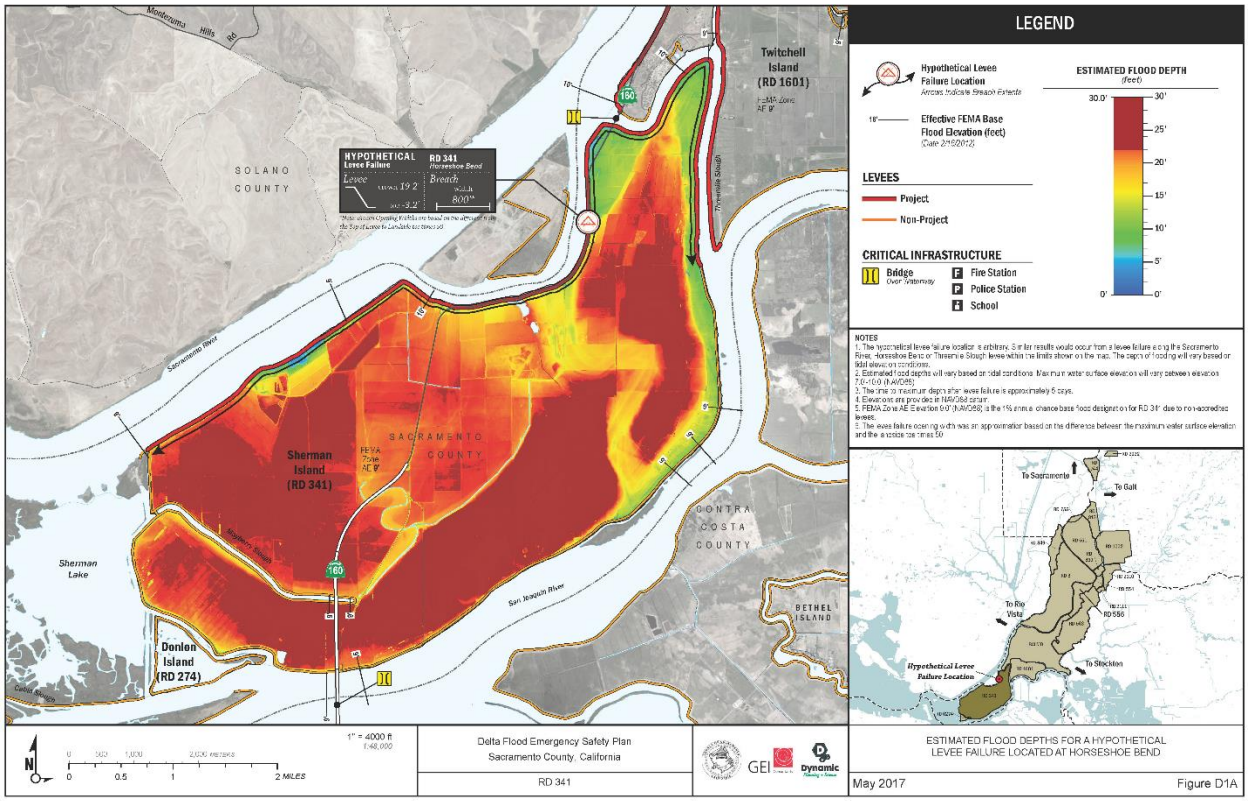
depths (Figure 4-7), and suggested evacuation routes (Figure 4-8) are displayed below. Maps for Scenario 2 can be found on the Sacramento County stormready.org website.

Figure 4-5 RD 341 – Potential Levee Breach Location



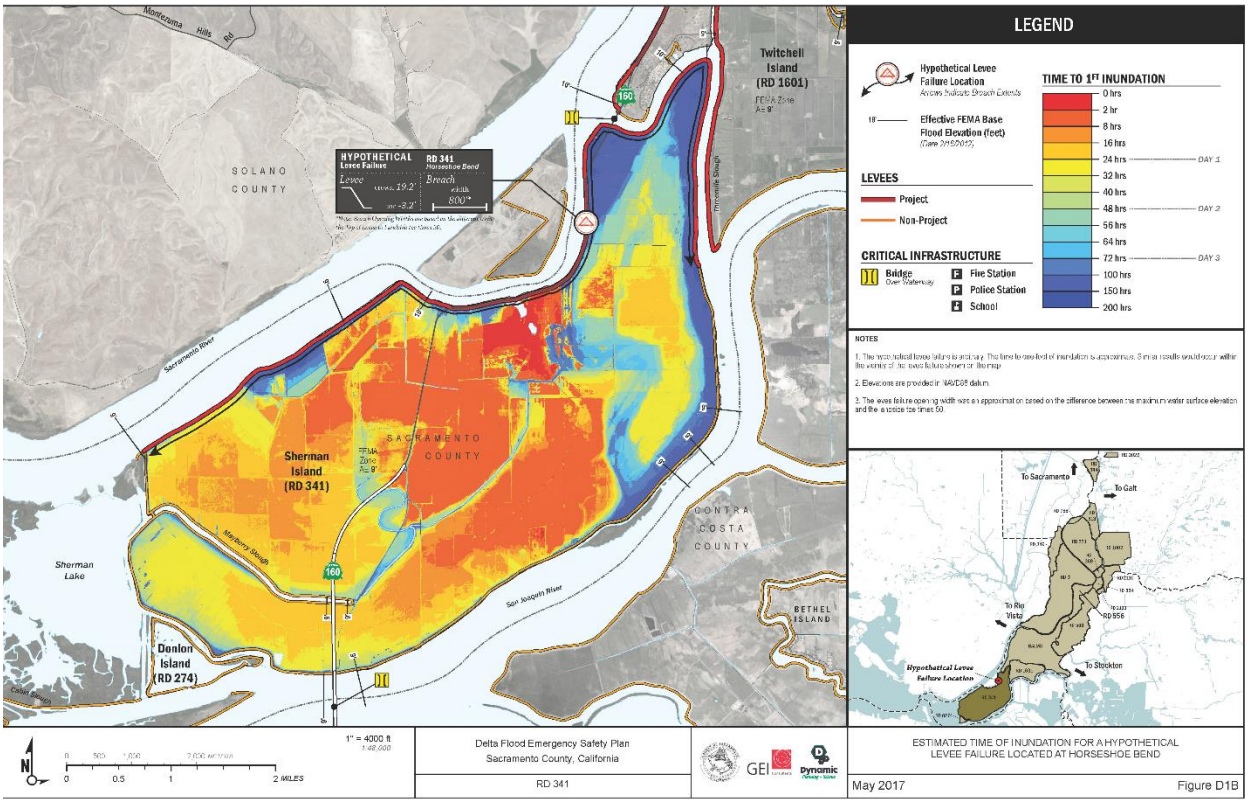
Source: Sacramento County Storm Ready – retrieved March 24, 2021

Figure 4-6 RD 341 – Time to One Foot Inundation after Levee Breach



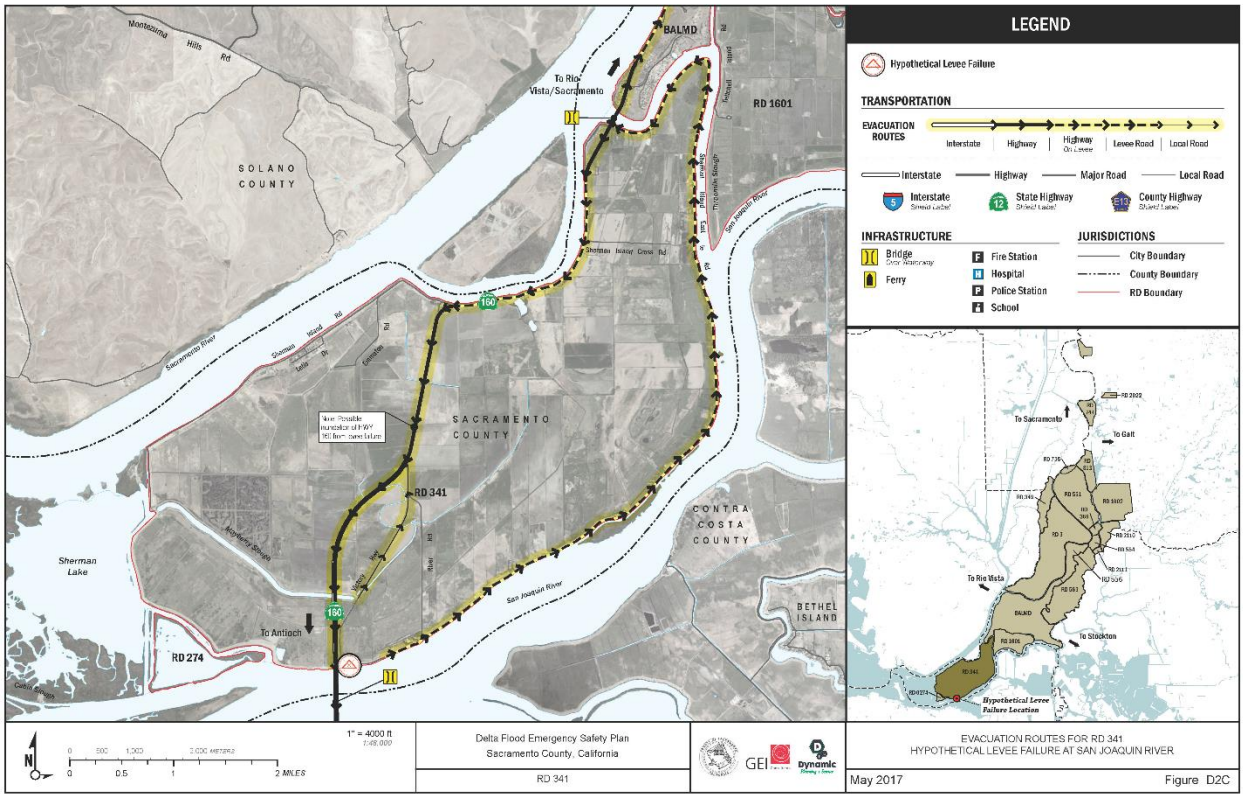
Source: Sacramento County Storm Ready – retrieved March 24, 2021

Figure 4-7 RD 341 – Estimated Flood Depth from Levee Breach Scenario



Source: Sacramento County Storm Ready – retrieved March 24, 2021

Figure 4-8 RD 341 – Levee Breach Scenario Evacuation Routes



Source: Sacramento County Storm Ready – retrieved March 24, 2021

Assets at Risk

All District assets are at risk from a levee failure with the least vulnerable being the fish release facilities and pump stations. The fish release facilities are all located on the levee crest and a failure would have to happen at, or directly adjacent to, their location to cause serious damage. Most of the District pump stations are built on piles at the approximately the same elevation as the levee crest. However, if levee failures or severe storms cause widespread power outages, the pump stations may be disabled, as they are powered by electric motors.

In addition to the costs incurred to repair or replace the assets destroyed by a Sherman Island levee failure, an immediate cost would be pumping out the island. To estimate the cost of restoring Sherman Island, we considered the 2004 failure of the Upper Jones Tract, an island of 6,259 acres which cost approximately $120 million to restore. This equates to about $19,100 per acre. Accounting for inflation, the per acre cost would be $23,800. Accordingly, it would cost approximately $238 million to pump out and restore Sherman Island (10,000 acres X $23,800 per/acre = $238,000,000). This estimate is conservative in that it does not account for the elevations on the interior of Sherman Island, which are up to 20 feet below sea level. Sherman Island would likely impound a greater volume of water per acre than Upper Jones Tract, and per acre restoration costs will therefore be greater.

Electrical Infrastructure Affected

In addition to the dewatering costs, three major electric transmission lines (greater then 500kV) cross Sherman Island: the California Oregon Transmission Project, operated by the Western Area Power Administration, the Pacific Gas and Electric Company (PG&E) Table Mountain-Tesla line, and the PG&E Vaca-Dixon-Tesla line. These lines work mainly to interconnect California loads and generation with loads and generation in the Pacific Northwest. The three lines through the Delta are operated as a coordinated grouping, with maximum imports or exports limited to provide some joint redundancy to help ensure reliability.

The combined load on these three lines is typically around 4,000 MW, though under some circumstances it can be as high as 4,800 MW (Mirzadeh 2006). This is approximately ten percent of statewide summer loads, which is less than the required planning reserve margin of 15 percent. However, other outages may occur at the same time as this disruption, so under some circumstances the loss of all three lines due to the failure of the Sherman Island levee system could cause operating problems.

PG&E also operates two other lines with less than 500kV capacity to provide local service to Sherman Island and nearby Delta Islands. Failure of the Sherman Island levee system would impact the ability of PG&E to serve the local delta community. The DRMS report estimates the cost of a two-month outage of two 500 kV lines to be $42,000,000, which equates to $46,300,000 in 2016 dollars.

Oil and Gas Production Affected

Sherman Island has 60 natural gas and oil wells, and approximately 1,082 acres of gas and oil production fields. In addition, the levees protect 145,514 feet of a natural gas pipeline which originates in Canada and crosses Sherman Island. Failure of the Sherman Island levee system would interrupt gas service through the pipeline and gas production and storage occurring on Sherman Island.

Civil Infrastructure Affected

Sherman Island levees also protect State Highway 160 and the drawbridge at Three Mile Slough. State Route 160 connects Sherman Island to the mainland Sacramento County on the northeast corner via Threemile Slough Bridge (Bridge 24-0121), and to Contra Costa County on the island's west side, via the Antioch Bridge (Bridge 28-0009). Failure of the Sherman Island levee system and resulting loss of State Route 160 and access to the Antioch Bridge would severely impact truck and vehicular traffic relying on this roadway. The Sherman Island Five Year Plan (2009) estimated that the closure of State Highway 160 would cost approximately $70,000 per day.

Sherman Island levees also provide a public benefit by maintaining water quality and water supply reliability for cities and farms in the San Francisco Bay area, San Joaquin Valley, and Southern California. Sherman Island is situated where fresh river water and salty bay water meet and mix. Under typical summer salinity conditions in the lower Sacramento River, salinity rises sharply in the area of Sherman Island. Consequently, the island's levees are 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 taken from the Delta for the Central Valley Project water supply, the State Water Project and the Contra Costa intake.

The presence of the western Delta islands, Sherman Island in particular, is believed to effectively inhibit the inland migration of the salinity interface between the Bay and Delta. If Sherman Island were to become permanently inundated with saline water, the water available to the massive pumping facilities near the Clifton Court Forebay might become too saline to use. The timing of levee breaks and flooding is critical in this regard. Fortunately, most flooding occurs in winter and spring, when major saltwater intrusion is less likely. However, there are occasional levee failures under low-flow conditions. These failures can cause major short-term water-quality problems, even if the flooded areas are later reclaimed. During one such incident, which occurred in summer of 1972, the Andrus Island levee failed, flooding an area slightly larger than Sherman Island. Salt concentrations in the central and western Delta quickly showed an increase up to six hundred percent. It took a large volume of extra reservoir releases to flush the salty water from the west Delta. The Andrus Island levee break may also have been a contributing factor in high mortality of juvenile bass that year. Similar impact could occur if one of Sherman Island's levees were to fail under low flow conditions.

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 District noted no events since 2016 except for the boils that showed up in Jan 2017.

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.

Heavy rains can cause localized flooding on the interior of the island. Typically, the water from localized flooding finds its way into one of the District drains where it can be pumped off-island by one of the five District pump stations. If severe weather were to cause District-wide power outages, the pump stations would be unable to pump water. Localized flooding could affect Highway 160, agriculture operations and local residents living on the interior of the island.

Assets at Risk

Localized flooding caused by heavy rains could potentially cause flooding of the District workshops and office.

Severe Weather: High Winds and Tornadoes

Likelihood of Future Occurrence–Occasional
Vulnerability–Medium

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.

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 at the beginning of Section 4.5.3 above, as well as in Section 4.3.3 of the Base Plan.

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
- Erosion impacts to levees from wave action
- Occasional building damage, primarily to roofs

The District's waterside levee slopes are protected with rock slope protection (riprap) to prevent erosion. In some areas, the levee has a "splash cap" made of riprap specifically design to protect the levee crest from overtopping waves. Severely high winds, combined with a high river stage, high tide, or both, can cause

large waves that hit the levee so hard they remove the rock slope protection and splash cap. Once the riprap is gone, the waves can cause severe erosion.

Assets at Risk

The District levees are at risk from severely high winds because of the impacts mentioned above.

4.6 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.

4.6.1. Regulatory Mitigation Capabilities

Table 4-7 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 341.

Table 4-7 RD 341 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	N	
Capital Improvements Plan	N	
Economic Development Plan	N	
Local Emergency Operations Plan	Y	Emergency Response and Evacuation Plan Plan addresses hazards, does not include projects, can be used for mitigation action. Flood Preparedness Report Plan addresses hazards, does not include projects, can be used for mitigation action.
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)	Y	5-year plan, California DWR Emergency Safety Plan Plan addresses hazards, identifies projects, can be used for mitigation actions.

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	Y	Erosion control measures on levee and canal slopes as necessary
Other		
How can these capabilities be expanded and improved to reduce risk?		
The District does not have control over most of the areas tabulated above, as they are the responsibility of other agencies. The most effective way to expand the capabilities of the District would be increased funding for levee projects, reducing flood risk.		

Source: RD 341

Emergency Response and Evacuation Plan (2006)

As part of the hazard mitigation effort, the following emergency response and evacuation plan will be implemented by Reclamation District No. 341 (RD 341) when an emergency flood event is anticipated or is imminent. An emergency flood event typically occurs in one of two ways: 1) the Federal/State Flood Center, based on weather forecasts, predict~ that high tide river stages at the Rio Vista Bridge are expected to reach Monitor Stage or Flood Stage; or 2) the RD 341 trustees, based on levee monitoring conducted by RD personnel, declare an emergency due to potential flooding of the lands within the District as a result of a combination of high tides, inclement weather, and levee conditions.

Flood Preparedness Report (2017)

Reclamation District No. 341 (District) has prepared this report to demonstrate its readiness to respond to a major flood, or any event that threatens the levee system protecting Sherman Island. This report identifies the assets on hand for flood fighting and the locations on-island, of stockpiles of rock and sand, the sections of levee considered most at-risk during a large storm event and an emergency response and evacuation plan if flooding is anticipated or imminent.

4.6.2. Administrative/Technical Mitigation Capabilities

Table 4-8 identifies the District department(s) responsible for activities related to mitigation and loss prevention in the District.

Table 4-8 RD 341's Administrative and Technical Mitigation Capabilities

Administration	Y/N	Describe capability Is coordination effective?
Planning Commission	N	
Mitigation Planning Committee	N	
Maintenance programs to reduce risk (e.g., tree trimming, clearing drainage systems)	Y	The District participated in the Delta Levee Subventions program which funds levee maintenance.
Mutual aid agreements	N	
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	N	
Community Planner	N	
Civil Engineer	Y	Yes to all.
GIS Coordinator	N	
Other		
Technical		
Warning systems/services (Reverse 911, outdoor warning signals)	N	
Hazard data and information	N	
Grant writing	N	
Hazus analysis	N	
Other		
How can these capabilities be expanded and improved to reduce risk?		
More funding.		

Source: RD 341

4.6.3. Fiscal Mitigation Capabilities

Table 4-9 identifies financial tools or resources that the District could potentially use to help fund mitigation activities.

Table 4-9 RD 341'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	N	
Authority to levy taxes for specific purposes	Y	Landowners are assessed annually, it is specifically used for mitigation.
Fees for water, sewer, gas, or electric services	N	
Impact fees for new development	N	
Storm water utility fee	N	
Incur debt through general obligation bonds and/or special tax bonds	N	
Incur debt through private activities	N	
Community Development Block Grant	N	
Other federal funding programs	N	
State funding programs	Y	The District utilizes a variety of State funding programs to fund mitigation.
Other		
How can these capabilities be expanded and improved to reduce risk?		
Additional funding.		

Source: RD 341

4.6.4. Mitigation Education, Outreach, and Partnerships

Table 4-10 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 4-10 RD 341'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	
StormReady certification	N	
Firewise Communities certification	N	
Public-private partnership initiatives addressing disaster-related issues	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?
Other		
How can these capabilities be expanded and improved to reduce risk?		
The District may choose to seek partners on mitigation education for those in the District.		

Source: RD 341

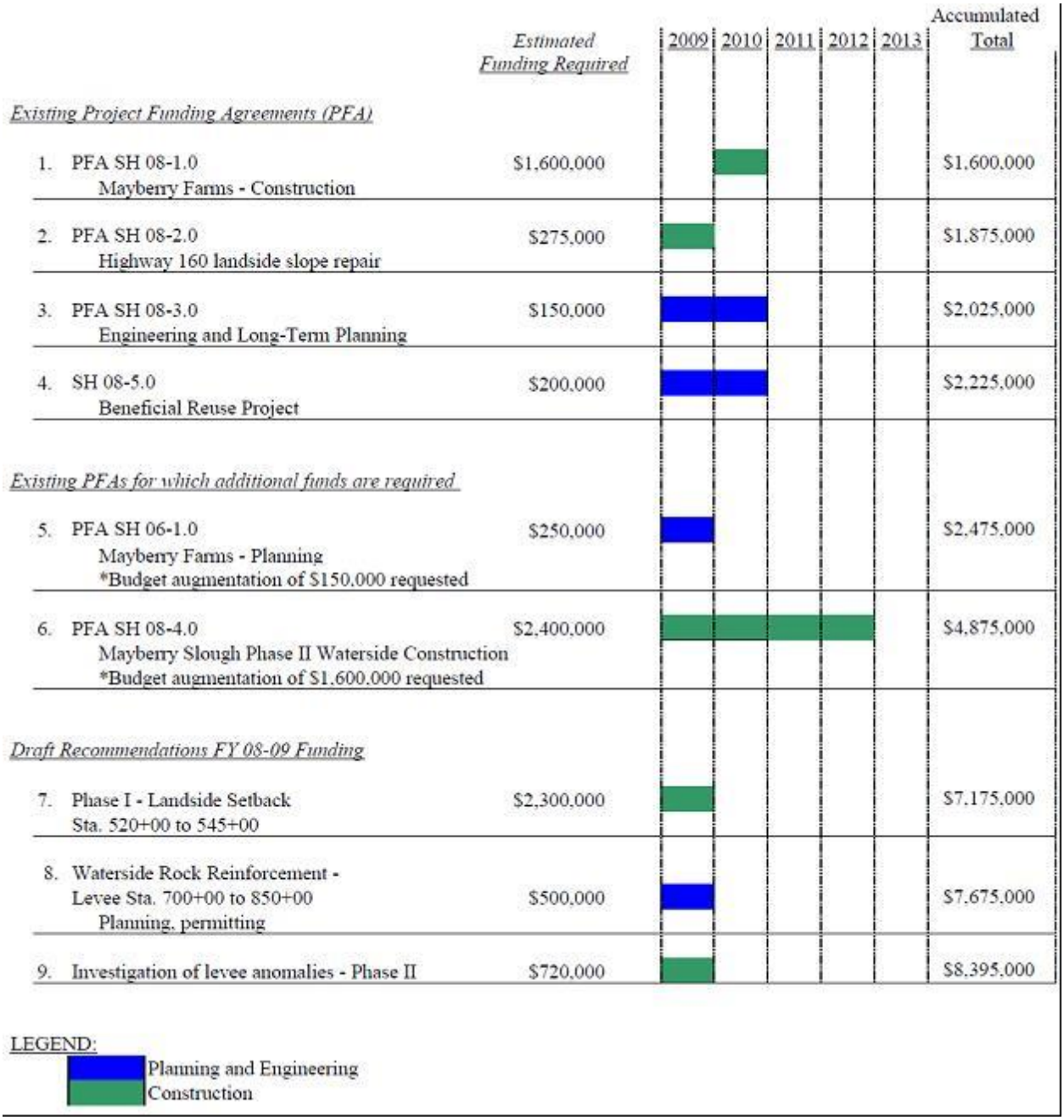
4.6.5. Other Mitigation Efforts

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

RD 341 has completed the Scour Pond Habitat Enhancement and Levee Stability Project, Mayberry Farms Construction, both part of the District's Five Year Plan. The District has also continued its Levee Stability Monitoring Program.

The Reclamation District 341 5 Year Plan (2009) lists may mitigation projects and efforts. These are shown in Figure 4-9 and Figure 4-10.

Figure 4-9 Reclamation District 341 Strategy to Meet Desired Levels of Protection



Source: RD 341 Five Year Plan (2009)

Figure 4-10 Reclamation District 341 Strategy to Meet Desired Levels of Protection (cont.)

	Estimated Funding Required	2009	2010	2011	2012	2013	Accumulated Total
Projects Proposed for Consideration - 2010 and Beyond							
(Projects listed in order of priority)							
10 Waterside Rock Reinforcement - Levee Sta. 700+00 to 850+00 Construction, identification of mitigation requirements	$3,000,000						$11,395,000
11. Scour Pond Habitat Enhancement, Levee Stability Project, Planning/Permitting	$500,000						$11,895,000
Construction	$3,000,000						$14,895,000
12. Phase II - Landside Setback Sta. 520+00 to 535+00	$2,000,000						$16,895,000
13. San Joaquin River levee improvement and waterside habitat enhancement project	$10,600,000						$27,495,000
14. Waterside Rock Reinforcement - Levee Sta. 850+00 to 1027+00 and Sherman Lake habitat island Planning/permitting	$500,000						$27,995,000
Construction	$15,000,000						$42,995,000
15. Install Cross Levee Toe Berm Levee Sta. 660+00 - 690+00	$1,000,000						$43,995,000
16. Ecosystem Restoration - Expand Parcel 11 by 30 acres	$6,000,000						$49,995,000
17. Gather additional technical information Bathymetric surveys, geotechnical studies, lidar and commercial mapping.	$1,000,000						$50,995,000
18. Borrow Material Purchase Fund	$2,200,000						$53,195,000
19. Seepage Repair Program	$250,000						$53,445,000
20. Levee Stability Monitoring Program	$1,200,000						$54,645,000

LEGEND:
Planning and Engineering
Construction

Source: RD 341 Five Year Plan (2009)

Since 2016, the District has completed the following projects:

- Sherman Island Levee Improvement Project for "Little Baja" and "Manzo Ranch" Fish Release Sites. Significantly improved the stability of approximately 4,000 linear feet of Project Levee.
- Sherman Island PL 84-99 Levee Repair Project – Phase 2. Improved 7,800 linear feet of levee to meet PL 84-99 standard.

- Sherman Island Flood System Repair Project STA 945+50 to 951+00. Repaired approximately 550 linear feet of severe waterside erosion of Project Levee along HWY 160.
- Sherman Island Pump Station #2 Repair and Rehabilitation. Replaced existing pump and motor, improved pump platform, replaced wooden piles with steel piles, replaced trash rack and trash rack platform.

4.7 Mitigation Strategy

4.7.1. Mitigation Goals and Objectives

The RD 341 adopts the hazard mitigation goals and objectives developed by the HMPC and described in Chapter 5 Mitigation Strategy.

4.7.2. Mitigation Actions

The planning team for the RD 341 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:

- Climate Change
- Earthquake
- Floods: 1%/0.2% annual chance
- Levee Failure
- Severe Weather: Heavy Rains and Storms
- Severe Weather: Wind and Tornado

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. San Joaquin River Multi-Benefit Project

Hazards Addressed: Climate Change, Earthquake, Flood, Levee Failure, Heavy Rains and Storms, Wind and Tornadoes

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

Issue/Background: The levee between stations 175+00 to 199+00 along the San Joaquin River needs to be improved to PL 84-99 standard due to stability issues.

Project Description: The Project will consist of constructing a setback levee and counterbalance berm to improve levee stability and create intertidal habitat along San Joaquin River. The Project consists of two (2) phases of work: landside levee work and waterside levee work. Generally, the work on the landside of the levee consists of the removal of the existing Sacramento County (County) road, placement of fill as compacted embankment, and construction of a new County road. The new levee roadway will incorporate two 10-foot travel lanes with two 2-foot shoulders. Generally, the work on the waterside of the levee consists of excavation of the levee section to construct a habitat bench, the placement of riprap armoring, and the planting of native species on the habitat bench and setback levee waterside slope. The Project will increase levee safety by constructing a wider levee with less porous material than the existing levee. Furthermore, a wider levee roadway will allow the passage of multi-directional flood flight equipment and provide an improved evacuation route for residents of Sherman Island.

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: N/A

Responsible Agency/ Department/Partners: Reclamation District No. 341 / CA Dept. of Water Resources

Cost Estimate: $9,600,000

Benefits (Losses Avoided): Reduces the likelihood of levee failure.

Potential Funding: Reclamation District No. 341 / CA Dept. of Water Resources

Timeline: 48 months

Project Priority (H, M, L): H