

12.1 Introduction

This Annex details the hazard mitigation planning elements specific to the Reclamation District 1601 (RD 1601 or District), a previously participating jurisdiction to the 2021 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 the District, with a focus on providing additional details on the planning process, risk assessment, and mitigation strategy for this jurisdiction.

12.2 Planning Process

As described above, the RD 1601 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 12-1. Additional details on Plan participation and District representatives are included in Appendix A.

Table 12-1 RD 1601 – Internal Planning Team

Name	Position/Title	How Participated
Christopher Neudeck	District Engineer KSN, Inc. President	District Engineer coordinates with the internal planning team on draft development and review, provides input on hazards, past occurrences, local concerns of district, and mitigation strategies and plan maintenance.
Brenna Howell	Emergency Manager, Howell Consulting consultant to KSN, Inc. for RD 1601	Participated in planning team meeting and coordination with Sacramento County, coordinates with the internal planning team on draft development and review, provides input on hazards, past occurrences, local concerns of district, and mitigation strategies and plan maintenance.
Rick Carter	District General Manager	Coordinates with the internal planning team on draft development and review, provides input on hazards, past occurrences, local concerns of district

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 FEMA-approved 2021 LHMP into existing planning mechanisms and programs. Specifically, the District incorporated into or implemented the 2021 LHMP through other plans and programs shown in Table 12-2.

Table 12-2 2021 LHMP Incorporation

Planning Mechanism 2021 LHMP Was Incorporated/Implemented In.	Details: How was it incorporated?
RD 1601 Emergency Operations Plan and Flood Contingency Map	Plan provided a useful reference for the EOP/FCM update in 2025

12.3 Community Profile

The community profile for the RD 1601 is detailed in the following sections. Figure 12-1 displays a District map and the location of RD 1601 within Sacramento County.

LEGEND

- Interstates
- Major Roads
- Local Roads
- Railroads
- Rivers
- Lakes
- Delta
- Cities
- Counties

Elevation (ft)

- 0 - 100
- 101 - 250
- 251 - 400
- 401 - 831

RECLAMATION DISTRICT 1601

SACRAMENTO COUNTY

SACRAMENTO COUNTY INSET

YOLO
SOLANO
SACRAMENTO COUNTY
AMADOR
CALAVERA
SAN JOAQUIN
CONTRA COSTA
STANISLA

W. TWITCHELL ISLAND RD
SACRAMENTO SLough
BRANNAN ISLAND RD
JACKSON SLough RD
SHERMAN ISLAND EAST LEVEE RD
TWITCHELL ISLAND FERRY RD
San Joaquin River
CONTRA COSTA

0 1 2 Miles

FOSTER MORRISON CONSULTING

SACRAMENTO COUNTY

Data Source: Sacramento County, Cal-Atlas; Map Date: 6/16/2026.

12.3.1. Overview and Background

RD 1601, also known as Twitchell Island, maintains 11.9 miles of levee made up of 2.5 miles of Federal Flood Control Project levee and 9.4 miles of non-project levee. Like other reclamation districts, RD 1601 sits around sea level in elevation as seen on Figure 12-1. The District is bordered by Sevenmile Slough, Threemile Slough and the San Joaquin River. Sacramento County maintains a paved road along Sevenmile Slough from levee station 127+50 to 303+00. The county road provides access and emergency evacuation to the East via Brannan-Andrus Island and State Highway 12 or to the West via State Highway 160.

The lands within the District were privately owned up until 1991 when the State of California purchased the majority of the property within the island. The State's interest in the island is primarily to ensure that the levees would be improved to protect against flooding of the island. Flooding in the Western Delta could severely degrade water quality within the Delta and impact the operations of the State and Federal water projects due to salt intrusion from areas downstream. Following the State's purchase of property on the island, the State, being the largest landowner, appointed the majority of the Trustee positions on the District's Board.

Continuous routine maintenance activities have occurred on the levees throughout the history of the island and include smaller projects not listed here. Types of work performed on a routine basis include erosion repairs, road repairs, debris removal, minor core trenching, ditch cleaning, pump repair and maintenance, vegetation control, and rodent control.

12.4 Risk Assessment

As defined by FEMA, risk is a combination of hazard, vulnerability, and exposure. "It is the impact that a hazard would have on people, services, facilities, and structures in a community and refers to the likelihood of a hazard event resulting in an adverse condition that causes injury or damage."

The RD 1601 risk assessment identifies and profiles relevant hazards and assesses the exposure of lives, property, infrastructure, and the environment to these hazards. The process allows for a better understanding of the District's potential risk and vulnerability to hazards and provides a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events.

Building on the District Profile above, a risk assessment was performed for the District utilizing the existing District boundaries. This includes the following sections:

- 12.4.1 Assets Inventory and Growth and Development Trends
- 12.4.2 Hazard Identification
- 12.4.3 Hazard Profiles and Vulnerability to Specific Hazards

12.4.1. Assets Inventory and Growth and Development Trends

This section provides an inventory of the RD 1601's total assets potentially at risk to hazards and an overview of growth and development trends. This section is broken into two parts:

- **Asset Inventory** – The assets inventory identifies the RD 1601’s total assets, including the people and populations; structures; critical facilities and infrastructure; community lifelines; natural, historic, and cultural resources; and economic assets and community activities of value. This data is not hazard specific, but is representative of total assets within the District, potentially at risk to identified hazards as discussed in Section 12.4.3 Hazard Profiles and Vulnerability to Specific Hazards.
- **Growth and Development Trends** – A discussion of growth and development trends in the District, both current and future, is presented.

Assets Inventory

The District’s asset inventory is detailed in the following sections:

- People and Populations
- District Assets and Critical Facilities and Infrastructure
- Community Lifelines
- Natural, Historic, and Cultural Resources
- Economic Assets and Community Activities of Value

A discussion of each of these assets follows and serves as the template for the asset discussion for each hazard in Section 12.4.3.

People and Populations

The most important asset within any community are the people and populations that reside in the community. People and populations in the District include both District staff and workers as well as those populations located within District boundaries and are served by the District. This section includes an inventory of past and current populations of the District and also discusses vulnerable populations and underserved communities as a subsection of people and populations located within the District and potentially at risk to hazards. Information from the District and other sources as detailed below form the basis of this discussion.

Historic Population Trends and Current Population

The most important asset within any community are the people and populations that both work and reside in the District. For special districts, this generally includes District staff and contractors as well as those populations located within its boundaries. The District has limited staff and District levees protect about 115 residents, 79 residential homes, 40 gas wells, and two gas transmission pipelines that transport gas off the island.

District Assets and Critical Facilities and Infrastructure

This section considers the RD 1601’s assets at risk, with a focus on key District assets such as structures, critical facilities and 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 Plan. 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 Facilities.

Most of the District assets are considered Category 1 critical facilities, specifically essential services facilities. Table 12-3 lists critical facilities and other District assets identified by the District Planning Team as important to protect in the event of a disaster. RD 1601's physical assets, valued at over \$2.3 million, consist of structures, critical facilities and infrastructure, and other District assets to support the District's operations.

Table 12-3 RD 1601 Assets: Structures, Critical Facilities and Infrastructure, and Other Facilities.

Name of Asset	Facility Type	Replacement Value	Which Hazards Pose Risk
Pump Station #1 (including all station components)	Essential Services	\$2,000,000	Flood, Levee Failure,
Pump Station #2 (including all station components)	Essential Services	\$2,000,000	Flood, Levee Failure,
Drainage Conveyances	Essential Services	\$350,000	Flood, Levee Failure,
Underground Electric Crossing*	Essential Services	–	Flood, Levee Failure,
Overhead Electric Crossings*	Essential Services	–	Flood, Levee Failure,
Siphons*	Essential Services	–	Flood, Levee Failure,
Electric Pullbox Underground Docs	Essential Services	–	Flood, Levee Failure,
Total		\$2,350,000	

Source: RD 1601

The 2020 5-year plan noted that the total estimated value of the 3,634.88 acres of land within the District is \$16,338,771.

There are several levee geometry standards and criteria that are recognized within the Delta. Twitchell Island uses the Hazard Mitigation Plan (HMP) Criteria and the Bulletin 192-82 Standard. HMP level is the 100-year Base Flood Elevation plus an additional foot of freeboard for agricultural Districts. The goal is to reach the 192-82 level of flood protection, which is the 300-year surface elevation plus 1.5-ft freeboard for agricultural Districts.

The Level of Protection assessment below is based on the DWR 2017 Light Detection and Ranging (LiDAR) Survey. It should be noted that LiDAR survey data is generally suitable for high-level assessments and planning efforts such as this Plan, but it has limitations for more refined analyses due to

accuracy thresholds, data gaps underneath vegetation and/or structure cover, and lack of identification of planimetric surface features.

The DWR 2017 LiDAR survey data indicates that the District’s levee meets the following standards and criteria as shown in Table 12-4.

Table 12-4 - Current Levee Assessment

Delta Agricultural Levee Standard/Criteria	Length of Levee that Meets Standard/Criteria	Percentage of Levee that Meets Standard/Criteria
Total Levee Length	62,255 feet	---
HMP Criteria	38,016 feet	61.1 %
Bulletin 192-82	7,000 feet	11.2 %

Approximately 35 producing gas wells are located within the District. Gas wells come in and out of production regularly, so to establish a firm number at any given time is difficult. The estimated value of these wells is \$27,074,352, as of June 10, 2010. A network of collection pipelines connects the wells throughout the island, and two gas transmission pipelines transport gas off the island, transecting the District’s levee at approximately Station 161+00 and Station 265+00. The 8-inch high-pressure pipeline crossing at Station 161+00 was installed in 2002 using horizontal directional drilling, and is located at a depth of 60 feet below the levee crown. The crossing at Station 265+00 utilizes a previously abandoned 8-inch PG&E pipeline that was capped in 2000. The capped 8-inch PG&E pipeline is located approximately 2 to 3 feet below the levee crown, as shown in the historic drawings produced by PG&E in 1953. Currently, the pipeline is approximately 4 feet below the levee crown. In 2002, PG&E abandoned the pipeline by cutting and capping the lines in the concrete containment bulkhead located on the landside levee slope. In 2007, Rosetta Resources reconnected a new 6-inch line to a sleeve that was installed inside the previously abandoned 8-inch pipeline running through the levee. All of the pipeline crossings were permitted by the District.

The total estimated value of the 3634.88 acres of land within the District is \$16,338,771. The value is derived from the price per acre of \$4,500 as stated in the Appraisal performed by Sean Hardin, California Department of Water Resources, Division of Engineering titled “Twitchell Island, West Delta Wildlife Management Plan, Parcel No. ND-1, Sacramento County,” dated April 17, 2008, included in the appendices of this Plan. Additional research was completed and for hazard mitigation planning purposes, the estimated value of the 3,634.88 acres within RD 1601 is now approximately \$37.1 million. This planning-level estimate is based on a regional Delta agricultural land value of approximately \$10,220 per acre. The estimate is intended to provide a reasonable measure of land exposure for the Local Hazard Mitigation Plan and does not constitute a formal real-property appraisal.

Community Lifelines

Assessing the vulnerability of the RD 1601 to natural hazards and disasters also involves reviewing and inventorying the community lifelines in place that could be affected. It is important to include these items in hazard discussions as the continuous operation of critical government and business functions is essential

to human health and safety, property protection, and economic security. The importance of community lifelines is discussed below:

- Lifelines are the most fundamental services in the community that, when stabilized, enable all other aspects of society to function.
- FEMA has developed a method for objectives-based response that prioritizes the rapid stabilization of Community Lifelines after a disaster.
- The integrated network of assets, services, and capabilities that provide lifeline services are used day-to-day to support the recurring needs of the community and enable all other aspects of society to function.
- When disrupted, decisive intervention (e.g., rapid re-establishment or employment of contingency response solutions) is required to stabilize the incident.

Community lifelines, as defined by FEMA, include the following:

- **Safety and Security** – Law Enforcement/Security, Fire Service, Search and Rescue, Government Service, Community Safety
- **Food, Hydration, Shelter** – Food, Water, Shelter, Agriculture
- **Health and Medical** – Medical Care, Public Health, Patient Movement, Medical Supply Chain, Fatality Management
- **Energy** – Power Grid, Fuel
- **Communications** – Infrastructure, Responder Communications, Alerts Warnings and Messages, Finance, 911 and Dispatch
- **Transportation** – Highway/Roadway/Motor Vehicle, Mass Transit, Railway, Aviation, Maritime
- **Hazardous Material** – Facilities, HAZMAT, Pollutants, Contaminants
- **Water Systems** – Potable Water Infrastructure, Wastewater Management

It should be noted that these community lifelines are all in place and functional as part of regular government operations in the Sacramento County Planning Area serving as a partnership between the cities, local special districts and agencies, and Sacramento County. Most all of the District's community lifelines overlap with the Planning Area's and include many of the critical facilities and infrastructure assets inventoried for this LHMP. As such, specific information on these community lifelines in the District and how they may be affected by a hazard event or disaster are discussed collectively for all jurisdictions in the Base Plan and in the Delta annex.

Natural, Historic, and Cultural Resources

Natural Resources

RD 1601 has a variety of natural resources of value to the District. Twitchell Island has established a total of 15.12 acres of valuable permanent habitat and mitigation sites. Much of the habitat provided is riverine or palustrine, providing essential habitat for flora and fauna native to the Delta. The habitat areas provide a permanent, undisturbed environment for sensitive Delta species, as well as providing habitat, food and resting areas for migratory wildlife. The value of these habitat areas is undefined, but the loss of these areas could greatly impact the species that depend upon these valuable ecosystem components.

A habitat assessment was done in 2001 for the District. Findings from that were:

- One special-status plant (Blue Elderberry) was observed along the levee during the field survey.
- No special status animals were observed during field work;
- The Shaded Riverine Aquatic Habitat was found to total 1,642 lineal feet;
- The Riparian Forest habitat on the waterside of the levee consisted of individual trees or extensive reaches of continuous canopy. The Riparian Forest was found to total 3,285 lineal feet;
- The Shrub/Scrub habitat consists of willow, and blackberry on the waterside of the levee. The Shrub/Scrub was found to total 7,917 lineal feet;
- The Freshwater Marsh habitat of tules along the levee waterside toe was found to total 7,781 lineal feet;
- The landside levee slopes consisted of bare ground, ruderal vegetation, urbanized environment with cultivated plants, small areas of Shrub/Scrub habitat, and Riparian Forest of individual trees or continuous canopy with varying amounts of understory;
- The landside Riparian Forest along the levee was found to cover 465 lineal feet. The majority of this habitat was found along levee station 38+959 to 39+396 in the toe ditch;
- The landside Shrub Scrub habitat along the levee was found to cover 177 lineal feet.

In 1993, a 4.04 acre habitat mitigation site was established and planted from Stations 545+00 to 560+00 and Stations 570+00 to 600+00, with a Conservation Easement established specifically for the mitigation site between stations 545+00 and 560+00. The overall mitigation site was designed to consist of 1.12 acres of palustrine emergent (freshwater marsh) habitat, 1.92 acres of lacustrine (open water) habitat, 2.3 acres of palustrine forest (riparian woodland) habitat, and 0.65 acres of annual grassland habitat. The flora planted were predominantly tule and cattail in the freshwater marsh, and white alder, red willow and sandbar willow in the riparian woodland. Two ponds totaling 1.92 acres were excavated to approximately 6 feet deep with approximately 1:1 side slopes to provide the open water habitat. The open water and annual grassland did not require plantings.

In 1999, an 8.08 acre habitat mitigation site was transferred to the Department of Fish and Game via a Transfer of Control and Possession and Conservation Agreement. The site runs parallel to the drainage canal at the District Pump station, reaching 5,440 feet northward along the canal from approximately Station 585+00, and provides various types of protected habitats, including palustrine shrub and scrub, palustrine forest, and freshwater marsh habitats. The site was initially established to mitigate 5.78 acres of palustrine emergent habitat lost due to levee repairs and rehabilitation at Stations 0+00 to 127+00 and 360+00 to 396+00. Much of the mitigation site was originally planted with feed corn). The site was enhanced in 2007 when 35 black willow trees were planted along the canal.

In 2000, a 3.0 acre habitat site was planted between levee Stations 570+00 and 600+00 that provides 1.4 acres of emergent tidal marsh habitat and 1.6 acres of shaded riverine aquatic habitat. This habitat area was created between the original levee and a new setback levee.

Openings were cut into the original levee, allowing water to circulate between the levees. The levee crown and landside slope of the old levee was re-vegetated, and the tidal bench and waterside slope of the setback levee were planted with native woody and herbaceous vegetation. Woody plants included willows, ash, box elder, alder, cottonwood, valley oak, dogwood, button willow, wild rose, wild blackberry, blue elderberry, and wild grape. Herbaceous plants included California hibiscus, grasses, sedges, rushes, and tules. The setback levee slope was planted with grasses only for maintenance purposes.

The habitat mitigation sites on Twitchell Island provide a variety of protected habitats. In general, Delta lands 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.

Historic and Cultural Resources

RD 1601 has a variety of historic and cultural resources of value to the District. These historic and cultural resources parallel that of Sacramento County as a whole. Information can be found in Section 4.2.1 of the Base Plan.

Economic Assets and Community Activities of Value

Assessing the vulnerability of the RD 1601 to natural hazards and disasters also involves inventorying the economic assets and community activities of value in the District.

Economic Assets

After a disaster, economic resiliency is one of the major drivers of a speedy recovery. Each community has specific economic drivers. Economic assets for the County were discussed in Section 4.2.1 of the Base Plan and are assumed to be the same or similar for the District.

The maintenance of the levee system is critical to the economy supported by over 3,635 acres of prime agricultural land & wetlands. District levees protect about 115 residents, 79 residential homes, 40 gas wells, and two gas transmission pipelines that transport gas off the island. Alfalfa, corn, and rice, are the primary crops grown on the island; there is also a significant amount of irrigated pasture for cattle and goats. The large acreage of agricultural lands and wetlands provides a large source of food and habitat for local and migratory species throughout the year.

Community Activities of Value

Inventorying economic assets in the District and their vulnerability to natural hazards and disasters also involves inventorying activities that have value to the community. This includes activities that are important to a community, like long-standing traditions such as a festival or fair or other activities that bring money into the communities such as sports tournaments and other recreational activities. Community Activities of Value for the County were discussed in Section 4.2.1 of the Base Plan and are assumed to be the same or similar for the District.

Growth and Development Trends

As part of the planning process, the District looked at changes in growth and development, both current and future, and examined these changes in the context of hazard-prone areas, and how the changes in growth and development affect loss estimates and vulnerability over time. This inventory section details future development/redevelopment projects that are likely to occur over the next five years covered by this 2026 LHMP. For Districts, this generally includes the following:

- Construction/development projects related to adding new District facilities, infrastructure, land acquisition, etc.
- Plans for expansion or build out of the District’s service area, including new service hookups, and other District functions related to where the District will be expanding services.

Population Trends and Projections

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

Development since 2021 Plan

No District facilities have been constructed since 2021. As such, a change in vulnerability is unlikely.

Future Development Areas

It is important to review future development plans for the District. Future development should be sited in areas that are away from known hazard risks. If this is not possible, mitigation should be done to ensure that future development is protected against future hazards. The District noted that no future development is expected in the area protected by District levees.

12.4.2. Hazard Identification

The RD 1601 identified the hazards that affect the District and summarized their location, extent, likelihood of future occurrence, potential magnitude, and significance (or priority of a hazard) specific to the District (see Table 12-5). Those hazards identified as a high or medium significance in Table 12-5 are considered District priority hazards for mitigation planning. Those hazards that occur infrequently or have little or no impact in the District were determined to be of low significance and not considered a priority hazard. Significance was determined based on the hazard profile, focusing on key criteria such as frequency, extent, and resulting damage, including deaths/injuries and property, natural and cultural resources, and economic damage. The ability of a jurisdiction to reduce losses through implementation of existing and new mitigation measures was also considered as to the significance of a hazard. This assessment was used to prioritize those hazards of greatest significance, enabling the District to focus resources where they are most needed.

Table 12-5 RD 1601—Hazard Identification Assessment

Hazard	Geographic Extent	Likelihood of Future Occurrences	Magnitude/Severity	Significance	Climate Change Influence
Aquatic Nuisance Species (plant/animal)	Limited	Unlikely	Limited	Low	Low
Climate Change	Extensive	Occasional	Limited	Low	–
Dam Failure	Limited	Unlikely	Negligible	Low	Medium
Drought & Water Shortage (w/tree mortality)	Extensive	Occasional	Critical	Low	High
Earthquake (w/subhazards)	Extensive	Occasional	Limited	Low	Low
Flood: 1%/0.5%/0.2% annual chance	Extensive	Unlikely	Catastrophic	High	Medium
Flood: Localized Stormwater	Extensive	Occasional	Critical	High	Medium
Landslides, Mudslides, and Debris Flow	Limited	Unlikely	Negligible	Low	Medium
Levee Failure	Extensive	Occasional	Catastrophic	High	Medium
Sea Level Rise	Limited	Likely	Limited	Low	High
Severe Weather: Extreme Cold and Freeze	Extensive	Likely	Limited	Low	Medium
Severe Weather: Extreme Heat	Limited	Unlikely	Limited	Low	High
Severe Weather: Heavy Rains and Storms (Hail, Lightning, Wind)	Extensive	Likely	Limited	Low	Medium
Severe Weather: High Winds and Tornadoes	Extensive	Likely	Critical	Low	Low
Subsidence	Extensive	Likely	Critical	Medium	Medium
Wildfire (with smoke and air quality)	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					

12.4.3. Hazard Profiles and Vulnerability to Specific Hazards

This section includes the hazard profiles and vulnerability assessment for the RD 1601's priority hazards (i.e., those ranked of medium or high significance specific to the District as identified in the Significance column of Table 12-5). This section focuses on where and how the District is affected by their priority hazards. Chapter 4 of the Base Plan provides 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 4.2 of the Base Plan.

Hazard Profiles and Vulnerability Assessment

Each hazard is profiled in the following format:

- **Hazard Profile** – A hazard profile is included for each hazard. This includes information on:
 - ✓ **Hazard Overview** – A general discussion of the hazard and related issues is detailed here.
 - ✓ **Location and Extent** – Location is the geographic area within the District that is affected by the hazard. Extent is the expected range of intensity for each hazard. These are discussed in specific detail for mapped hazards, and in more general detail for those hazards that do not have discrete mapped hazard areas.
 - ✓ **Past Occurrences** – Past occurrences are discussed for each hazard. A discussion of disaster declarations is included in each hazard section. NCEM events are also discussed. Other past occurrences data specific to the District follow the disaster declarations and NCEM events for each hazard.
 - ✓ **Climate Change** – This section contains the effects of climate change (as applicable). The possible influence of climate change on the hazard is discussed.

After the hazard profile, a vulnerability assessment is presented. As part of the vulnerability assessment, an estimate of the vulnerability of the District to each identified hazard, in addition to the estimate of risk of future occurrence, is provided in each of the hazard-specific sections. 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.

After this classification, a general discussion of hazard vulnerabilities occurs. This is done in the following format:

- **Vulnerability Overview** – A general discussion of the hazard vulnerability and related issues is detailed here.
- **Local Concerns** – This includes District provided information on how the District is uniquely affected by or vulnerable to each hazard.
- **Assets at Risk** – A discussion of the assets at risk follows, presented in the same order as in Section 12.4.1 above, with a few exceptions. This includes sections on: People and Populations; District Assets and Critical Facilities and Infrastructure; and Natural, Historic, and Cultural Resources. These are discussed in specific terms for mapped hazards, and in more general terms for those hazards that are unmapped. Sections on Community Lifelines and Economic Assets and Community Activities of Value are not included in the Sections below, as they are common to all jurisdictions and are fully covered in Section 12.4.1 above and in Chapter 4 of the Base Plan.
- **Impacts** – A discussion on hazard impacts follows. Impacts describe how each hazard can affect the District and its assets. The type and severity of impacts reflect both the potential magnitude of the hazard and the vulnerability of the asset.
- **Future Conditions/Future Development** – A discussion of how future conditions and future development may affect the hazard is also included. This considers both new District assets and improvements as well as any changes with the District’s boundaries.

Power Interruption/Power Failure: A Common Vulnerability of all Hazards

An impact of almost all hazards evaluated as part of this LHMP Update relates to power shortage 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 U.S. 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. Much of the Sacramento County Planning Area is served by Pacific Gas & Electric (PG&E) and Sacramento Municipal Utility District (SMUD). More information on types of power disruptions can be found in Section 4.3 of the Base Plan.

Public Safety Power Shutoff (PSPS)

An intentional disruption type of power shortage/failure event has been implemented in California as a result of wildfires starting 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 preparing all Californians for the threat of wildfires and power outages during times of extreme (fire) weather. To help protect customers and communities during extreme fire weather events, electric power may be shut off for public safety in an effort to proactively prevent wildfire. This is called a PSPS. More information on PSPS criteria can be found in Section 4.3 of the Base Plan. PG&E noted no PSPS events in the Sacramento County Planning Area since the 2021 LHMP. SMUD noted that it has had no PSPS events for its service territories since 2021.

Local Concerns

There have been no intentional (including PSPS events) or unintentional power outage issues associated with hazard events affecting the District since 2021. However, with an increase in climate change related issues (e.g., extreme heat conditions, atmospheric river storms) occurring in the Sacramento County Planning Area, the potential for future hazard related power outages remain a concern.

Hazard Profiles and Vulnerability Assessment by Hazards

The following sections provide the hazard profile and vulnerability assessments for each of the hazards identified in Section 12.4.2 Hazard Identification.

Flood: 1%/0.5%/0.2% Annual Chance

Likelihood of Future Occurrence—Occasional (1%)/Unlikely (0.5/0.2%)

Vulnerability—Extremely High

Hazard Profile

This hazard discusses the FEMA DFIRM 1%, 0.5%, and 0.2% annual chance floods. These tend to be the larger floods that can occur in the District and have caused damage in the past. Flooding can be a significant problem in the District. Historically, the District has been at risk to flooding primarily during the winter and spring months when river systems in the District swell with heavy rainfall and snowmelt runoff. The District has also been at risk during atmospheric river flood events. Normally, storm floodwaters are kept within defined limits by a variety of storm drainage and flood control measures located throughout the Sacramento County Planning Area and the RD 1601. 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 in the District.

Location and Extent

The RD 1601 has areas located in the 1% annual chance flood zones. This is seen in Figure 12-2.

Figure 12-2 RD 1601 – FEMA DFIRM Flood Zones

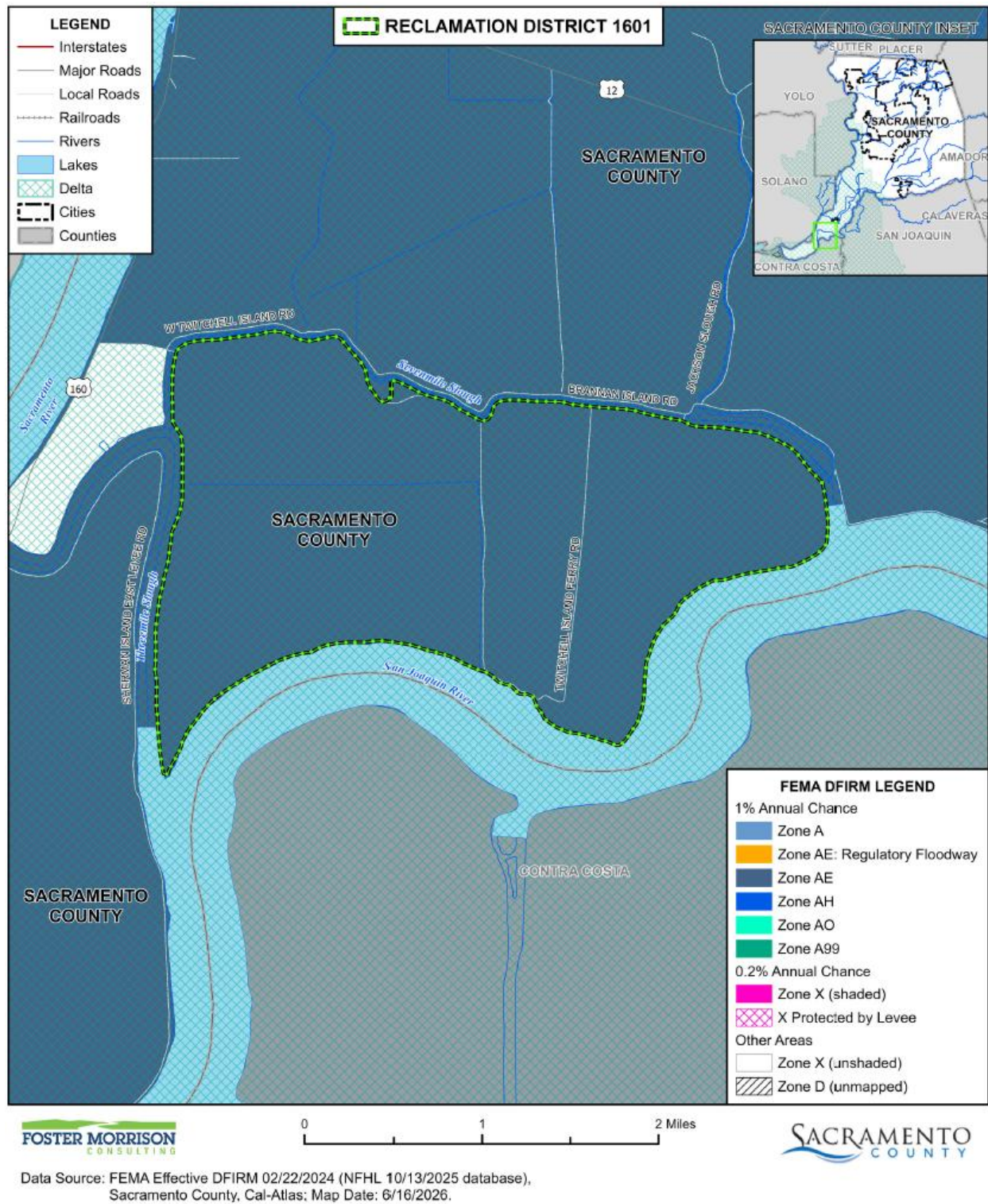


Table 12-6 details the DFIRM mapped flood zones located within the District.

Table 12-6 RD 1601– DFIRM Flood Hazard Zones

Flood Zone	Description	Present in District
A	1% annual chance flooding; No base flood elevations provided	
AE Regulatory Floodway	1% annual chance flood: Regulatory floodway; Base flood elevations provided	
AE	1% annual chance flooding; Base flood elevations provided	X
AH	1% annual chance flood areas of shallow flooding between one to three feet deep. Regulatory floodway; Base flood elevations provided	
AO	Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between one and three feet. Average flood depths derived from detailed hydraulic analyses are shown in this zone.	
A99	Areas subject to inundation by the 1-percent-annual-chance flood event, but which will ultimately be protected upon completion of an under-construction Federal flood protection system.. No Base Flood Elevations (BFEs) or depths are shown.	
Shaded X	0.2% annual chance flooding: 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	Areas protected by levees from 1% annual chance flood event. Levee protection places these areas in the 0.2% annual chance flood zone. Flood insurance is not mandatory but is available.	
X (unshaded)	No flood hazard	

Source: FEMA DFIRM 02/22/2024

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.

Geographical flood extents for the District from the FEMA DFIRMs are shown in Table 12-7.

Table 12-7 RD 1601 – Geographical DFIRM Flood Zone Extents

Flood Zone	Total Acres	% of Total Acres	Improved Acres	% of Total Improved Acres	Unimproved Acres	% of Total Unimproved Acres
1% Annual Chance Flood Hazard	3,565	100%	77	100%	3,488	100%
0.2% Annual Chance Flood Hazard	0	0%	0	0%	0	0%
Other Areas	0	0%	0	0%	0	0%
RD 1601 Total	3,565	100%	77	100%	3,488	100%

Source: FEMA DFIRM 02/22/2024

Past Occurrences

Disaster Declaration History

A list of state and federal disaster declarations for Sacramento County from flooding is shown on Table 12-8. These events also likely affected the District to some degree.

Table 12-8 Sacramento County – State and Federal Disaster Declarations from Flood 1950-2025

Disaster Type	State Declarations		Federal Declarations	
	Count	Years	Count	Years
Flood (including heavy rains and storms)	26	1950, 1955, 1958 (twice), 1963, 1969, 1982 (twice), 1983, 1986, 1995 (twice), 1996, 1997, 1998, 2008, 2017 (three times), 2022*, 2023 (three), 2024 (twice)	18	1955, 1958, 1964, 1969, 1983, 1986, 1995 (twice), 1997, 1998, 2006, 2017 (three times), 2023 (three times)*, 2024*

Source: Cal OES, FEMA

*included a landslide component.

NCDC Events

The NCDC tracks flood events for the County. Events have been tracked for flooding since 1993. Sacramento County has seen 174 events. These events most likely had some impact on the District.

RD 1601 Events

The 5-Year Plan for RD 1601 included a history of flooding in the District.

- **1986** Flood event. Poor levee performance, with several instances of boils that were treated with sandbag coffer dams. Individual boils were sandbagged on the landward levee slope at Stations 361+81, 365+50, 373+98, 405+87, 406+39, 408+49, 414+83, and 502+22, and groups of boils were sandbagged on the landward levee slope at Stations 500+64 to 501+69 and 534+94 to 536+52. Dredged fill material was placed on the waterward levee slope and the bottom of the slough in an attempt to seal a boil at Station 363+39 to 366+56. The State of California updated its flood Hazard Mitigation Plan (HMP), establishing both short-term and long-term guidelines for levee rehabilitation, including minimum requirements for levee geometry that were required to be met by 1991 in order to receive future federal disaster assistance.
- **1997** Flood Event. USACE made emergency repairs by placing a 250 foot long gravel blanket extending 60 feet past the landside levee toe at approximately Station 59+00. Further emergency repairs were made by the District by pulling rock up from the waterside toe of the levee to form two berms on the levee crown at the juncture of Sevenmile Slough and the San Joaquin River, and on the PL 84-99 levee along Threemile Slough, approximately Station 380+00 to 385+00.
- **1998** Flood Event. During the flood event of 1998, riprap was placed on waterside slopes to mitigate damage by high water and high winds,
- **2005 to 2006** Flood Event. A storm event starting on December 30, 2005, required emergency action beginning on January 1, 2006. Four long reach excavators were used to restore the rock slope protection at Stations 363+74 to 565+00 and 580+00 to 628+74 that was lost as a result of the extreme high water

and winds along the San Joaquin River. The construction involved pulling the slipped rock up along the waterside slope from the waterside levee toe. Two angle blade bulldozers were used to clear debris on the levee crown and restore eroded sections of levee due to the high water and wind-generated waves splashing over the levee to the landside slope, including portions of the levee road that were no longer passable. The San Joaquin reach of the Twitchell Island levee was nearly overtopped. 25,000 feet of existing riprap was repositioned to form a break wall by Dutra Construction in 40 consecutive hours to protect the levee from extreme wind and wave wash.

- **2017 Flood Event.** A large series of storm events generating high winds and heavy rain caused rivers to rise above flood stage. Emergency flood fight and repairs, rodent hole repairs, and emergency response patrols and labor occurred during the event. The District had well organized flood fight response, and was able to immediately address problems. The District's levees and sustained only minor damage and performed well. The total 2017 Event claims to FEMA was \$118,691.

The District noted that there have been no events since the last LHMP.

Climate Change and Flood

It is likely that climate change will increase the chance of future occurrence as well as future impacts associated with flood. More information on future impacts to the District can be found in the Future Conditions/Future Development section of the Vulnerability Assessment below.

According to the 2024 CAS, climate change may affect flooding in California, the Sacramento County Planning Area, and the District. While average annual rainfall may increase or decrease slightly, the intensity of individual rainfall events is likely to increase during the 21st century. It is possible that average soil moisture and runoff could decline, however, due to increasing temperature, evapotranspiration rates, and spacing between rainfall events. Reduced snowpack and increased number of intense rainfall events are likely to put additional pressure on water infrastructure which could increase the chance of flooding associated with breaches or failures of flood control structures such as levees and dams.

Cal Adapt future precipitation projections were shown in Section 4.3.4.

The 2024 Sacramento County CAP noted that climate change is likely to lead to changes in the frequency, intensity, and duration of extreme weather events, such as sustained periods of heavy precipitation, increased rainfall intensity during precipitation events, and increased risk of rain-on-snow events. Further, more winter-time precipitation that falls as rain instead of snow, and higher temperatures that will cause earlier snowmelt, which could produce substantial surface water flows over a short period of time and may potentially affect dams and spillways and overwhelm levee systems designed for historical precipitation patterns. Historically, the County experienced an average of four extreme precipitation events per year (as shown in Section 4.3.4 of the Base Plan). Under the medium and high emissions scenarios, the County is expected to experience five to six extreme precipitation events per year by mid-century and six to seven extreme precipitation events per year by the late century.

The 2026 American, Bear, and Cosumnes Watersheds Resilience Plan noted that a key driver of climate vulnerability, adaptive capacity, and implementation readiness in the watershed group is flooding. An equity analysis was performed as part of this Plan. An Equity Analysis Technical Appendix demonstrates how social vulnerability aligns with the physical hazard environment across the watershed. It noted that

flooding impacts are most severe downstream, where rising flows increasingly stress Sacramento's levee system; a modeled levee-breach scenario affects 12.5% of the watershed population, and 59% of those affected fall into the highest flood-sensitivity category.

Future flooding exacerbated by climate change will result in a range of potential impacts across the County. For populations, there is an array of social vulnerability factors that exacerbate flood-related risks, and those residing in floodplains are especially vulnerable to the direct impacts of flooding. Floodwaters can interact with sources of pollution and distribute hazardous pollutants locally and regionally, which may result in water contamination and a range of human health impacts. Additionally, flooding can disrupt transportation networks, cause economic losses through business and government facility closures, disrupt communications, disrupt the provision of utilities, and cause significant damage to buildings and critical infrastructure. Further, flooding may also threaten ecosystems and agricultural resources; unlike natural flooding regimes that deposit useful sediment resulting in increased soil fertility as well as groundwater recharge, catastrophic flooding from levee overtopping could lead to soil erosion and loss of viable cropland. It could also release sewage and hazardous materials into the environment if wastewater treatment plants are inundated, storage tanks are damaged, and pipelines are severed.

The June 2025 Delta Adapts Adaptation Plan noted that climate change will affect flooding in the Delta. Located at the confluence of the Sacramento and San Joaquin Rivers and San Francisco Bay, the Delta is a complex system whose water levels are influenced by riverine inflows, tides, storm surge, and in some locations, flood hazard management and water supply infrastructure. Climate change will affect many of these factors, increasing the risk of flooding. Riverine flows are the primary driver of high-water levels in the north and south Delta, where more frequent and stronger watershed precipitation events and a shift in winter precipitation from snow to rain will drive flood vulnerabilities. In contrast, higher sea levels will increase the likelihood of flooding in Suisun Marsh and the western and central Delta. Climate change is expected to increase the frequency of large runoff events across the Delta watershed. Most of the Delta's flood management infrastructure, including 1,100 miles of levees and upstream reservoirs, were designed to operate under historical conditions that did not consider climate change. Climate change will place greater stress on the flood management system, and Delta levees will become increasingly vulnerable to breaches, overtopping, or other types of failure if no action is taken.

Vulnerability to Flood: 1%, 0.5%, and 0.2% Annual Chance

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 damage and potential loss of life and injury. Predominantly, the effects of 1% annual chance flooding are generally confined to areas near the waterways of the District. As waterways grow in size from local drainages, so grows the threat of flood and dimensions of the threat.

The whole of the District is at some measure of vulnerability to floods. An assessment of a community's vulnerability to flood begins with an understanding of local exposure to flood. This is included in the Local Concerns section below followed by a discussion of the District's Assets at Risk to this hazard.

Local Concerns

The District has specific concerns and unique vulnerabilities regarding this hazard. These concerns form a portion of the basis for the mitigation strategy and mitigation actions that seek to reduce risk and vulnerability to this hazard.

RD 1601 (Twitchell Island) is one of the eight western islands, which collectively form a crucial group of islands which, if breached, could each individually greatly degrade water quality in the Delta from the transportation of tidal salt water through the major Delta channels where fresh and salt waters mix. Additionally, if the island did flood, the evaporative losses from the flooded island would have an additional detrimental impact to the overall water quality in the surrounding Delta waterways. The District also noted that there is a Flood Response Plan (EOP) that can be utilized during an event.

Assets at Risk

Assets at risk from flood include people and populations; District assets and critical facilities and infrastructure); and natural, historic, and cultural resources. These are discussed in the following sections.

People and Populations

All people and populations located in the 1% annual chance floodplains within the District (including both District staff and the population within District boundaries) are at some risk to flooding. Certain vulnerable populations located within areas prone to flooding may be at increased risk to this hazard, especially during a large event with minimal advance notice. These vulnerable populations include: the unsheltered, those with limited mobility, and those that lack the resources to leave the area.

Populations within District boundaries can be the most vulnerable. Not only are the residents at risk, but their homes and contents are all at risk, compounding the impacts associated with significant hazard events.

District Assets and Critical Facilities and Infrastructure

The District noted that all structures are at risk of DFIRM flooding and primarily include those structures located within the 1% and 0.2% annual chance floodplains. Flooding presents a threat to both critical facilities and infrastructure, as well as community lifelines. Critical infrastructure plays an immensely important role in the District and surrounding communities. District assets listed in Table 12-9 would be at risk to flooding.

Table 12-9 RD 1601 Assets: Structures, Critical Facilities and Infrastructure, and Other Facilities at Risk to Flood

Name of Asset	Facility Type	Replacement Value
Pump Station #1 (including all station components)	Essential Services	\$2,000,000
Pump Station #2 (including all station components)	Essential Services	\$2,000,000
Drainage Conveyances	Essential Services	\$350,000

Name of Asset	Facility Type	Replacement Value
Underground Electric Crossing*	Essential Services	—
Overhead Electric Crossings*	Essential Services	—
Siphons*	Essential Services	—
Electric Pullbox Underground Docs	Essential Services	—
Total		\$2,350,000

Source: RD 1601

Natural, Historic, and Cultural Resources

Large flood events can affect natural, historic, and cultural resources. There are a number of ways floodwaters can impact natural resources and the environment. Wildlife habitats can be destroyed by floodwaters. Contaminated floodwater can pollute rivers and habitats. Silt and sediment can destroy natural areas. Riverbanks and natural levees can be eliminated as rivers reach bankfull capacity. Rivers can be widened, and deposition can increase downstream. Trees can be uprooted by high-velocity water flow. Plants that survived the initial flood may die due to being inundated with water. Historic and cultural resources may also be affected. Generally, the impacts are associated with damage to structures within the flooded areas, but other cultural resources such as those associated with Native Americans and old tribal areas can also be disturbed, damaged and lost during extreme flood events. Any of these that fall in the flood zones shown on Figure 12-2 would be vulnerable.

Impacts from Flood: 1%, 0.5%, and 0.2% Annual Chance

Floods are among the costliest natural disasters in terms of human hardship and economic loss nationwide. Large flood events, including those associated with 1% annual chance floods, can cause substantial damage to structures, landscapes, and utilities as well as life safety issues. People may be swept away in floodwaters, causing injuries or deaths. 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. Direct impacts, such as drowning, can be limited with adequate warning and public education about what to do during floods. Floodwaters can transport large objects downstream which can damage or remove stationary structures. Structures can be damaged directly from floodwaters and can also be damaged from trees falling as a result of water-saturated soils. 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 causing power outages. The interruption of power causes major problems and can result in the closure of governmental offices and community businesses. Public schools may also be required to close or be placed on a delayed start schedule. Roads can be damaged and closed, causing safety and evacuation issues.

Standing water can cause damage to crops, roads, foundations, and electrical circuits. Other problems connected with flooding and stormwater runoff include erosion, sedimentation, degradation of water quality, loss of environmental resources, and economic impacts.

Impacts to identified assets at risk to this hazard and the overall vulnerability of the District may be affected in the future by climate change (which was discussed in the hazard profile discussion above), changes in

population patterns (migration, density, or the makeup of socially vulnerable populations), and changes in land use and development. These are discussed below.

Future Conditions/Future Development

This section provides a discussion of how future conditions will influence or affect the hazard over time and also discusses future development relative to each hazard.

Future Conditions

Future conditions may be affected by climate change, changes in population patterns (migration, density, or the makeup of socially vulnerable populations), and changes in land use and development. Findings on this for RD 1601 include the following:

- Climate change is likely to exacerbate future flood conditions and associated impacts and vulnerability of the District to 1% and 0.2% annual chance flooding. This was discussed in greater detail in the Climate Change and Flood section of the Hazard Profile above.
- Population projections within the jurisdictional boundaries of the District show the population to be flat or slightly declining. It is unknown how population patterns and demographics will change in the near future. The District may add staff, but this number would be small. The District noted that it has no control over population changes within its jurisdictional boundaries. With no notable changes in populations numbers and makeup, the vulnerability of the District to this hazard is unlikely to change.
- Changes in land use and development in the District are expected to be limited in the near future and thus are not likely to affect flooding and associated impacts to the District. Additional development traditionally leads to additional flooding. In addition, adherence to protective building codes for new development will assist in limiting future impacts and associated vulnerabilities of the District to this hazard.

Future Development

Future development in the District may be built in the floodplain, as long as it conforms to the standards of the floodplain ordinance. The County enforces their floodplain management ordinance on areas inside the District. More detail on the specifics of the floodplain ordinance can be found in Section 4.4.1 of the Base Plan. New District facilities and assets will be sited in such a way as to reduce the risk from flooding to District structures and assets.

Flood: Localized Stormwater Flooding

Likelihood of Future Occurrence—Occasional

Vulnerability—High

Hazard Profile

Flooding occurs in areas other than the FEMA mapped 1%, 0.5%, 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 District, during the rainy

season from November through April. Prolonged heavy rainfall (including that from atmospheric river events) contributes to a large volume of runoff resulting in high peak flows of moderate duration.

Location and Extent

The RD 1601 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.

Past Occurrences

Disaster Declaration History

There have been no state or federal disaster declarations from localized floods. There would most likely have been localized flood events during the disaster declarations from flood as shown in the previous 1%/0.2% annual chance flood section.

NCDC Events

The NCDC occurrences of localized flooding are included in the 1% and 0.2% annual chance flood hazard profile above where past flood events were noted.

RD 1601 Events

The District noted that localized flooding generally occurs during periods of heavy rain and storms and often occurs in conjunction with the larger, more significant flood events. Many of these were discussed in the Past Occurrences Section of the Flood:1% and 0.2% annual chance flood section above.

Climate Change and Localized Flood

It is likely that climate change will increase the chance of future occurrence as well as future impacts from localized flood. More information on future impacts to the District can be found in the Future Conditions/Future Development section of the Vulnerability Assessment below.

Even if average annual rainfall may decrease slightly, the intensity of individual rainfall events is likely to increase during the 21st century, increasing the likelihood of overwhelming stormwater systems built to historical rainfall averages. This makes localized flooding more likely.

Vulnerability to Localized Flood

Flood vulnerability and their impacts vary by location and severity of any given flood event and will likely only affect certain areas of the District during specific times. Based on the risk assessment, it is evident that floods will continue to have potentially significant impacts to certain areas of the District. However, while flooding can cause significant impacts, depending on the duration and volume of precipitation and

the drainage in any given area, many of the floods in the District are minor, localized flood events that are more of a nuisance than a disaster.

Many areas of the District are at some measure of vulnerability to localized flooding. An assessment of a community's vulnerability to localized flooding begins with an understanding of local exposure to localized flooding. This is included in the Local Concerns section below followed by a discussion of the District's Assets at Risk to this hazard.

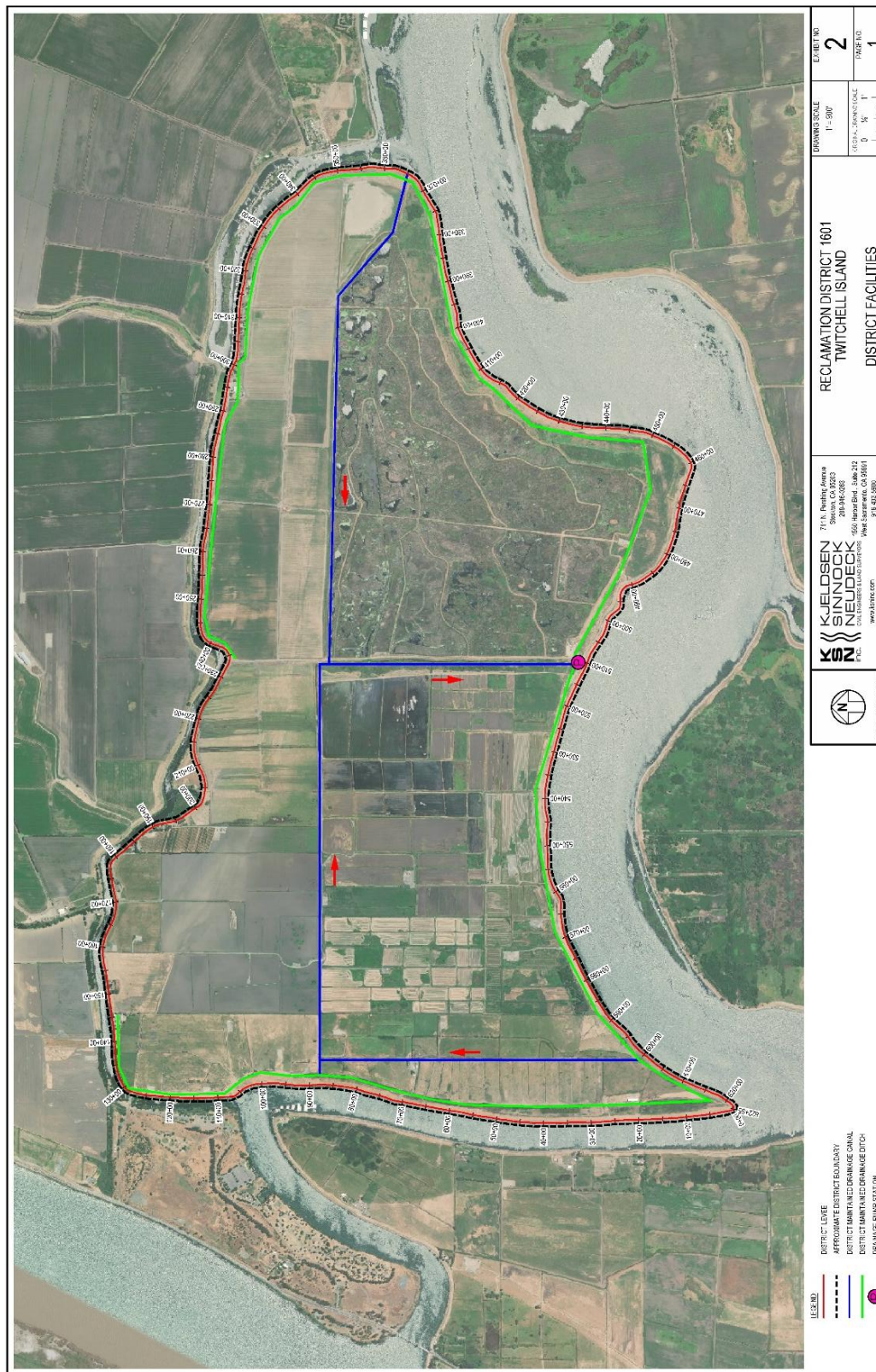
Local Concerns

The District has specific concerns and unique vulnerabilities regarding this hazard. These concerns form a portion of the basis for the mitigation strategy and mitigation actions that seek to reduce risk and vulnerability to this hazard.

Historically, the District has been affected by flooding of rivers, streams and creeks occurring during heavy rain and storm (including atmospheric river) events. Additional development in the District and in the watersheds of these streams affects both the frequency and duration of damaging floods through an increase in stormwater runoff and contributes to localized flooding occurring in areas throughout the District. The lack of or inadequate drainage infrastructure in the District contributes to localized flooding issues.

The District has a drainage system set up deal with localized flooding. A map of this system can be seen on Figure 12-3

Figure 12-3 RD 1601 Drainage System



Source: RD 1601

Water for irrigation is supplied from the surrounding waterways via landowner and District owned siphons, and is routed through irrigation ditches located on the high end of the fields. Drainage of irrigation tail-water, storm drainage runoff, and subsurface seepage occurs through earth-lined drainage canals through the farmed portion of the island, draining toward the District pump station. The drainage canals are maintained regularly to remove accumulated debris and vegetation from the channels.

Excess water from the canal drainage collection system is conveyed to the District pump station located at Station 510+00. This pump station discharges into the San Joaquin River and has three 100-horsepower pumps that have a combined flow rate of approximately 22,000 gallons per minute.

The flow rates listed above are based on pump performance during conditions at the time of the pump test. These conditions are assumed to be indicative of normal operations of the pump stations. Pump capacities for any pump with a given motor vary, depending on the total dynamic head, impeller size, and efficiency.

The District's pump station is powered by electricity provided by Pacific Gas and Electric (PG&E). If the power supply to the island is disrupted, there is no backup power supply immediately available to the pumps, and it would be necessary to bring in backup generators to operate the pumps.

Assets at Risk

Assets at risk from localized flood include people and populations; District assets and critical facilities and infrastructure); and natural, historic, and cultural resources. These are discussed in the following sections.

People and Populations

People and populations (including both District staff and the population within District boundaries) are traditionally not highly vulnerable to localized flooding, but their structures and contents can be at risk. Likewise, most vulnerable populations are not uniquely vulnerable to localized flooding. Localized flooding may cause transportation issues as roads and bridges are impacted or closed and affect the ability for people to travel throughout the District.

District Assets and Critical Facilities and Infrastructure

District assets and critical facilities and infrastructure in areas with localized flooding can be affected if floodwaters intrude into the structure. Structures and critical facilities in low lying areas, can be at greater risk. Buildings with older foundations that are prone to water intrusion are also at greater risk. Once water finds its way into a structure, it tends to continue to do so until the path that brings water into a structure is mitigated. Structures can also be damaged by trees that have become uprooted and fall during rain and storm events. Large trees falling onto structures can cause significant damage. 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.

Natural, Historic, and Cultural Resources

Natural resource assets may have some vulnerabilities to localized flood during major storm events, but can benefit from floodwaters, often by design. Many parks and green spaces are designed to take overflow

water and release it into the underlying soils and natural areas. Wetland areas in the District actually help reduce the risk of flooding, as they can absorb excess rainfall that would have to be drained away from impervious surfaces. Flooding can provide many benefits to the natural environment, including recharging wetlands and groundwater, increasing fish production, creating wildlife habitat, and rejuvenating soil fertility. Flooding of Delta islands destroys habitat, kills most species present, and can entrain and strand large populations of native and non-native fish species. These smaller localized flooding events often provide more benefits to the environment in comparison to negative impacts associated with large flood events. Historic and cultural resources may be at some measure of vulnerability if they are located in areas subject to repeated localized flooding.

Impacts from Localized Flood

Primary concerns associated with localized stormwater flooding include impacts to infrastructure that provide 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.

Life safety issues from localized flooding would be more limited. The amount and type of damage or flooding that occurs varies from year to year and from storm to storm, depending on the quantity of precipitation and runoff.

Impacts to identified assets at risk to this hazard and the overall vulnerability of the District may be affected in the future by climate change (which was discussed in the Likelihood of Future Occurrence discussion above), changes in population patterns (migration, density, or the makeup of socially vulnerable populations), and changes in land use and development. These are discussed below.

Future Conditions/Future Development

This section provides a discussion of how future conditions will influence or affect the hazard over time and also discusses future development relative to each hazard.

Future Conditions

Future conditions may be affected by climate change, changes in population patterns (migration, density, or the makeup of socially vulnerable populations), and changes in land use and development. Findings on this for the RD 1601 include the following:

- Climate change is likely to exacerbate future heavy rain conditions and associated impacts and vulnerability of the District to localized flood. This was discussed in greater detail in the Climate Change and Localized Flood section of the Hazard Profile above.
- Population projections within the jurisdictional boundaries of the District show the population to be flat or slightly declining. It is unknown how population patterns and demographics will change in the near future. The District may add staff, but this number would be small. The District noted that it has no

control over population changes within its jurisdictional boundaries. With no notable changes in populations numbers and makeup, the vulnerability of the District to this hazard is unlikely to change.

- Changes in land use and development in the District are expected to be limited in the near future and thus are not likely to affect flooding and associated impacts to the District. Additional development traditionally leads to additional localized flooding. However, adherence to protective building codes for new development will assist in limiting future impacts and associated vulnerabilities of the District to this hazard.

Future Development

The District will need to be proactive to ensure that increased development has proper siting and drainage for stormwater. The risk of localized flooding to future development can also be minimized by accurate recordkeeping of repetitive localized storm activity. Mitigating the root causes of the localized stormwater flooding can reduce future flood losses.

Levee Failure

Likelihood of Future Occurrence—Occasional

Vulnerability—Extremely High

Hazard Profile

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 stream channel, levees can also increase the speed of the water. Levees can be natural or man-made. A natural levee is formed when sediment settles on the streambank, raising the level of the land around the stream.

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 a release from or failure of a dam. 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. It is important to remember that 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.

Over 518 miles of levees are located throughout the Sacramento County Planning Area. These include both accredited and unaccredited levees, as discussed in Section 4.3.14 of the Base Plan, all which pose a risk to adjacent communities should a levee fail or overtop. While the levee analysis included in this section focuses on the accredited levees and those with improvements in process based on the DFIRM A99 and X-Protected by Levee Flood Zones, there are many older, unaccredited levees located throughout the County Planning Area, including the District, that may have a greater potential for overtopping or breaching and pose a significant risk to communities should they fail.

Location and Extent

The entire District are at risk to levee failure flooding. The District is entirely protected by levees on all sides. There is not a scientific scale or measurement system in place for levee failure. It is usually measured in area covered and depth of flooding. A map of levees located in the Sacramento County Planning Area is shown in Section 4.3.14 of the Base Plan. Note, not all levees and levee inundation depths are depicted on these maps. The speed of onset is slow as the river rises, but if a levee fails the warning times are 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. Those levees accredited as providing protection against the 1% or greater annual chance flood and those in levees in the certification process are identified in the FEMA DFIRMs which also include those areas protected by the levees.

There are no DFIRM levee protected areas in the District, as the District sits outside of accredited levee areas. As such no mapping is shown and no tabular analysis is performed. While this gives the initial appearance of limited levee failure risk, it should be noted that these unaccredited levees may have a greater potential for failure or breach and can pose even a greater risk to those communities in which they are located.

Past Occurrences

Disaster Declaration History

There have been two state and two federal disasters declarations directly related to levee failure in Sacramento County, as shown on Table 12-10. Also, it is important to note that many of the flood disaster declarations included in Section 4.3.11 of the Base Plan (like the December 31, 2022 event near Wilton) also may include flooding associated with levee breach or failure events.

Table 12-10 Sacramento County – State and Federal Disaster Declarations Summary 1950-2025

Disaster Type	State Declarations		Federal Declarations	
	Count	Years	Count	Years
Levee Break	2	1972, 1980	2	1972, 1980

Source: Cal OES, FEMA

NCDC Events

There have been no NCDC levee failure events in Sacramento County, as the NCDC does not track levee failure flooding as a stand-alone hazard.

RD 1601 Events

The 5-Year Plan documented the history of levee failures in RD 1601.

- **1906, 1907 & 1909:** Flooding of entire island occurred from levee failure or overtopping.
- **1964:** Levee at approximately Station 390+00 cracked and/or dropped in December 1964, requiring immediate repair.

- **1980:** A large settlement crack occurred in the levee crown at Station 376+00 to 380+00, arcing from the landward to the center of the crown and back to the landward. Crack width was from 1 to 4 inches, with a vertical settlement of 3 to 6 inches. Rock revetment was added to the waterward levee slope. Dredged material was placed on the landward levee slope as the crack gradually opened further and settlement increased. The dredge material was moved off the slope to create a 25 foot wide by 1.5 foot high stability berm at the landward toe of the levee. A core trench was constructed at Station 415+00 to 421+00 to cut off seepage. Riprap placement and dredging occurred in response to a high water and wind event, and was funded by the Federal Disaster Assistance Administration (FDAA) in the amount of \$100,550. The levee crown in was low at Station 530+00 to 532+00, and required sandbags to be placed along the waterward shoulder during high tides and high winds from the south in February. A crack occurred near the landward toe of the levee, with a width of 3 inches and length of 150 feet. Dredged material was placed in the low areas on the landside of the levee, on the landward slope, and in limited amounts on the levee crown. Boils occurred on the landward levee slope at Station 415+00 to 421+00, located 5 to 6 feet below the crown. High tides at this time were 5 feet below the levee crown. A backhoe was brought in to dig a core trench in the levee crown between 6 and 7 feet deep and 18 inches wide. The trench was dug in 8 to 10 foot segments, with each segment being inspected, backfilled in layers, and tamped with the backhoe bucket before digging the next trench segment. A crack approximately 5 feet below the levee crown was discovered opposite two of the boils, and appeared to extend through the levee on a diagonal. The crack was 6 to 8 inches wide, and 1/2 inch high.
- **2006:** Seepage at Stations 445+00 to 450+00, 480+00, 500+00 to 510+00, 530+00 to 540+00, and 600+00 was stopped by coring and sealing the levee with a Bentonite mix after a failed attempt at Stations 535+00 to 540+00 to stop seepage using a vibratory wall by DWR.
- **2016-2014:** Supplementation of existing riprap at several locations throughout the District due to erosion.
- **2017-2018:** Construction of all-weather road on San Joaquin River levee toe from Station 360+00 to Station 622+55. This reach of levee is highly susceptible to extreme wave wash under high wind conditions along with seepage and landside slope deformation. Flood fighting relies heavily on access to the levee at all times by use of all-weather roads.

The District noted that there have been no other recent events since the previous LHMP.

Climate Change and Levee Failure

The 2024 Sacramento County CAP noted that climate change is likely to lead to changes in the frequency, intensity, and duration of extreme weather events. The County is projected to experience a steady increase in average annual precipitation through the end of the century, with much of that precipitation likely to occur during extreme precipitation events, which can lead to flood impacts. According to Cal-Adapt, the historic average annual precipitation in Sacramento County is 18.3 inches, and the historic average annual number of extreme precipitation events is four. The average annual precipitation across the County may rise upwards of 22 inches, with the number of extreme precipitation events potentially exceeding 7 per year by the end of the century, depending on the level of current and future GHG emissions.

In general, California exhibits “booms and busts,” which refers to the existence of both very wet years and very dry years. The amount of precipitation that falls in any particular year is largely influenced by occurrences of large, discrete winter storms, also known as atmospheric rivers, which often provide a substantial fraction of the region’s annual precipitation, inclusive of the county. In California, atmospheric

rivers vary in intensity; some are beneficial for water supply and replenish snowpack that naturally melts during the summer, serving as the water supply for people and agriculture, while others are responsible for widespread and adverse impacts (NOAA 2023). Extreme precipitation from these atmospheric rivers in the future may prove to be more variable, volatile, and potentially more severe. These extremes are most likely to occur during storm events, leading to more severe damage from waves and floods, thus possibly leading to more levee failure events.

The June 2025 Delta Adapts Adaptation Plan noted that climate change will affect levee failure flooding in the Delta. The Delta's 1,300 miles of levees protect more than 800,000 acres of land and play a critical role in conveying water supply through the Delta. By mid-century, overtopping of Delta levees by an event with a 1-percent annual chance of occurrence may result in the exposure of over \$1.8 billion in annual agricultural and commercial economic activity and \$10.5 billion in agricultural, residential, commercial, and infrastructure assets. Most of the Delta's flood management infrastructure, including levees and upstream reservoirs, are designed to operate under historical sea level and hydrologic conditions that do not consider potential future climate change. Changing climatic conditions will place greater stress on the flood management system in the future.

Vulnerability to Levee Failure

According to historical hazard data and levee mapping, levee failures can occur in or near the District. Portions of the District are at a high measure of vulnerability to levee failure floods, including failure or breach of accredited levees, those in the certification process, and unaccredited levees. An assessment of a community's vulnerability to levee failure flooding begins with an understanding of local exposure to levees. This is included in the Local Concerns section below followed by a discussion of the District's Assets at Risk to this hazard.

Local Concerns

The District has specific concerns and unique vulnerabilities regarding this hazard. These concerns form a portion of the basis for the mitigation strategy and mitigation actions that seek to reduce risk and vulnerability to this hazard.

General Concerns

The two primary vulnerabilities that threaten the levee system on Twitchell Island involve levee stability and levee geometry.

The Twitchell Island levee system has a long history of levee stability problems including settlement, movement, seepage, and slope failure. Documentation of the levee's performance is extensive. GEI Consultants, a geotechnical, environmental and water resources engineering firm, obtained information from the California Department of Water Resources documenting these problems as far back as 1955 during the course of research for the January 2009 "Geotechnical Investigation and Evaluation Report" performed for the San Joaquin River portion of the levees. The San Joaquin river levee reach has historically shown more problems relative to Stability. Deep organic soils and sands in conjunction with deep water and high winds cause this reach of levee to be extremely vulnerable to failure during high water and storm events. It should also be noted that the investigations did not locate an acceptable on-island borrow material suitable

for levee projects. As of the last complete profile survey of the island in 2008, and taking into account completed projects through fiscal year ending June 30, 2010, there remain several locations along Sevenmile Slough that do not meet the Hazard Mitigation Plan (HMP) standard for geometry.

This standard requires the levee to be one foot above base flood elevation, and 1.5:1 waterside and 2:1 Landside slopes. There is approximately 3000' (5%) District levee below the HMP Standard and approximately 28,000' (45%) below the PL84 Standard. These values were calculated by analyzing a combination of the most current District surveys, including the 2009 District Aerial Survey for the San Joaquin River levee and the 2006 KSN GPS Survey for the Threemile Slough and Sevenmile Slough levees. Levee centerline profiles were cut through each of the modeled survey surfaces and compared to water surface elevation profiles from the US Army Corps of Engineers' 1992 Sacramento-San Joaquin Delta Special Hydrology Study.

Sevenmile Slough is isolated from tidal waters by water control structures that, along with the balance of the levee system, meet the HMP standard. Up until 2006, the District was considered to have met the HMP standard; however, in 2006 the FEMA determined that because the entire Sevenmile slough levee did not meet the geometry required in HMP, thus the District was not eligible for Federal Disaster Assistance. Thus, the vulnerability to the District is both a flood threat due to overtopping caused by low levee crown elevations and a financial threat because no Federal Disaster Assistance would be available for damages resulting from a declared disaster event.

Five-Year Plan Concerns and Costs

A failure or breach of the District's levee system could result in flooding of the District to depths of approximately 20 feet on average. Projected costs associated with such an event have been calculated using actual costs from the 2004 Jones Tract flood event. 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.

In order to establish the unit costs for an anticipated flood cost model for Delta reclamation districts, the costs from the 2004 Jones Tract flood event were broken into component costs that can be applied to other districts using characteristic data for each district. The data used for the District includes the following:

- 3,560 acres of land
- 11.8 levee miles
- 20 feet average depth of District relative to BFE
- 82,600 linear feet of District maintained canals
- 71,200 acre-feet of floodwater to be evacuated from District

For the District, the estimated cost of a flood event resulting from a single levee failure would be approximately \$32.1 million based on the costs from the 2004 Jones Tract flood event.

The cost analysis does not include damage to privately owned property and improvements. The actual financial impact to those properties and facilities would depend greatly on the replacement costs, the

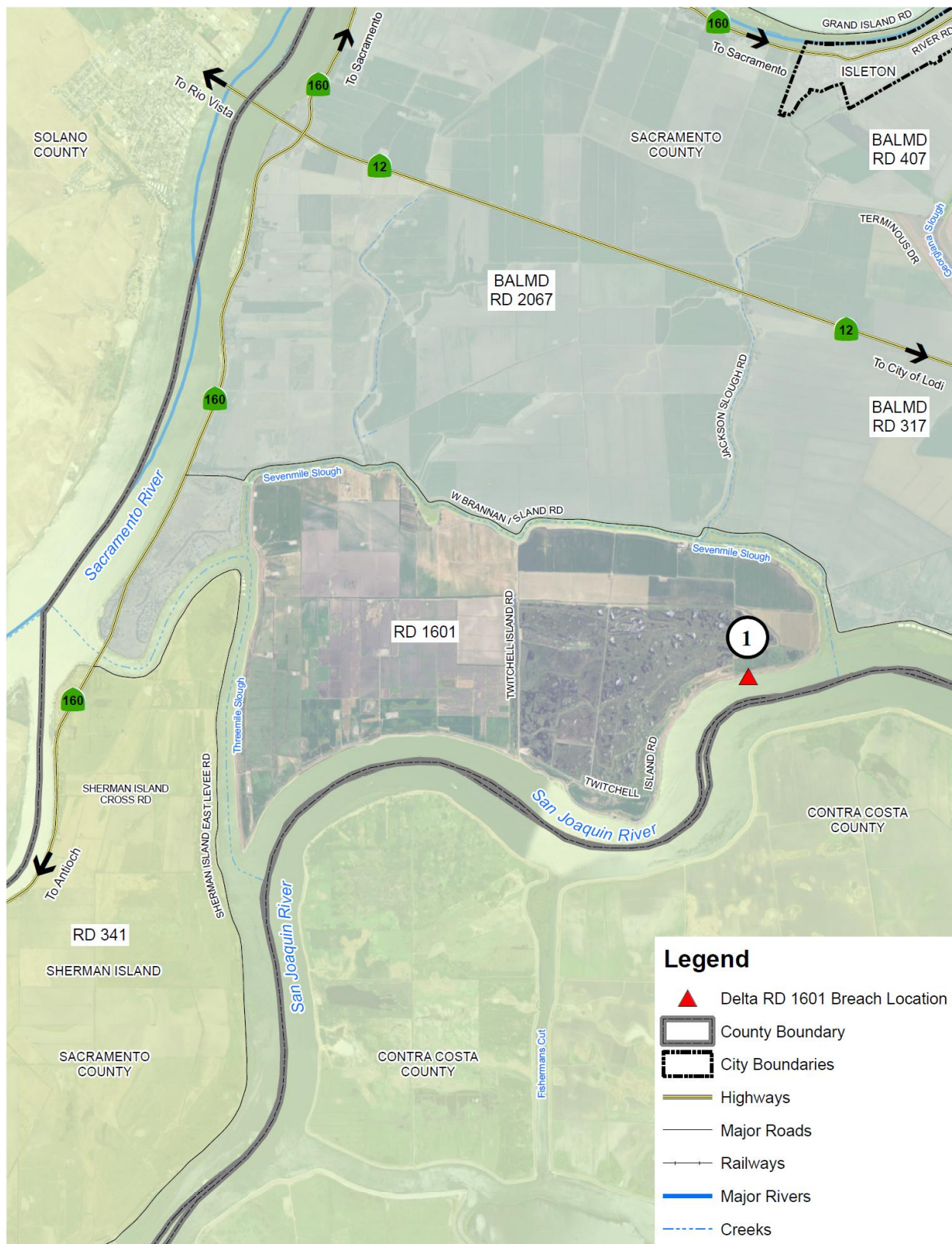
amount of insurance those properties might have, and where they are located relative to the location of the levee breach and depth of water at those locations. It should also be noted that a flood could potentially eliminate a cropping season.

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.

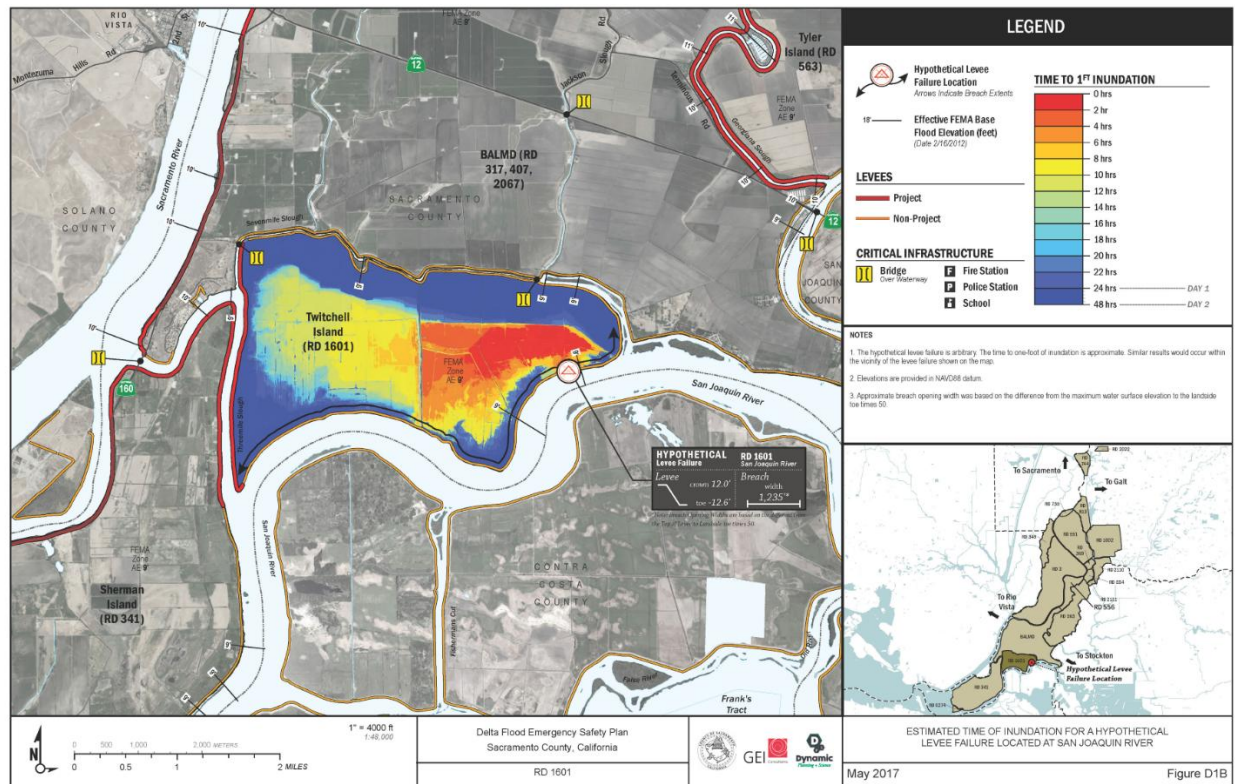
For RD 1601, Figure 12-4 details the locations in the Delta within Reclamation District 1601 where flooding could occur. The red triangles denote potential levee breach locations. RD 1601 has a hypothetical potential levee break scenario. Maps for the levee breach scenario regarding time to one foot inundation (Figure 12-5), estimated flood depths (Figure 12-6), and suggested evacuation routes (Figure 12-7) are displayed below.

Figure 12-4 RD 1601 – Potential Levee Breach Location



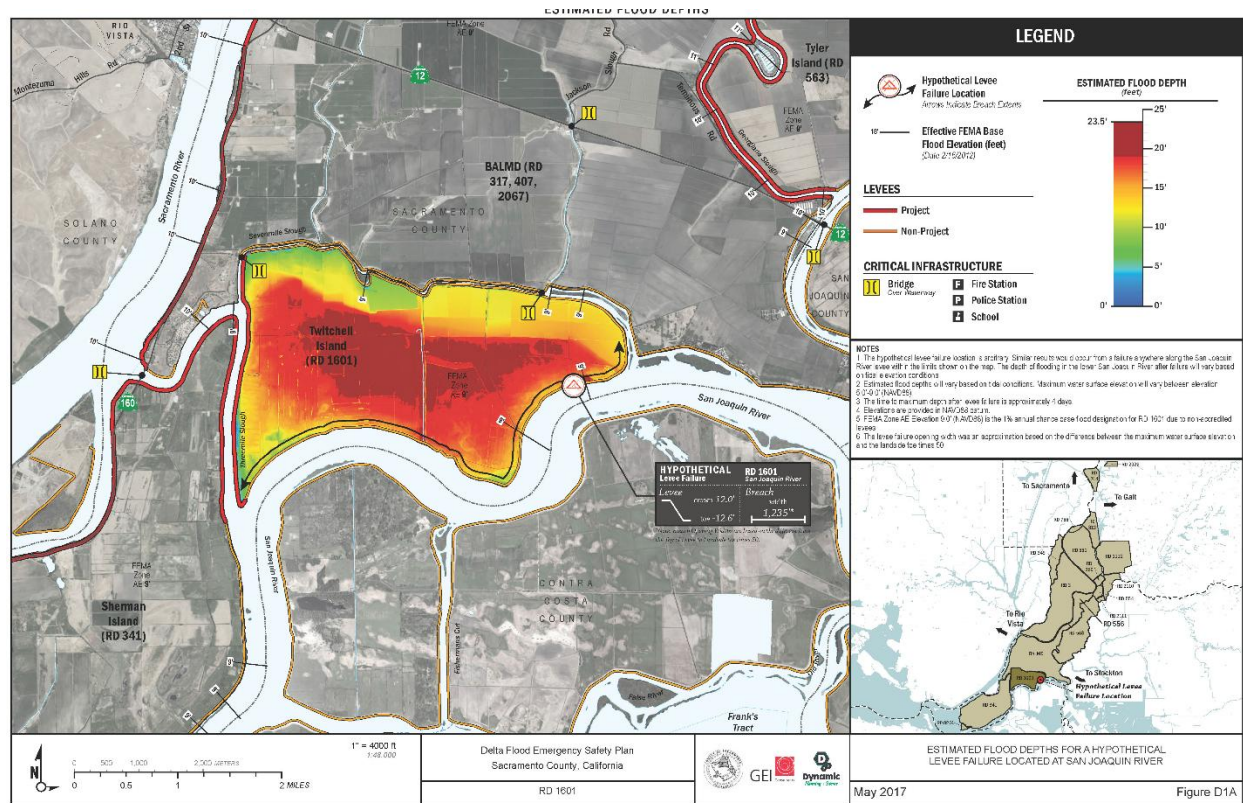
Source: Sacramento County Storm Ready – retrieved August 5, 2026

Figure 12-5 RD 1601 – Time to One Foot Inundation after Levee Breach



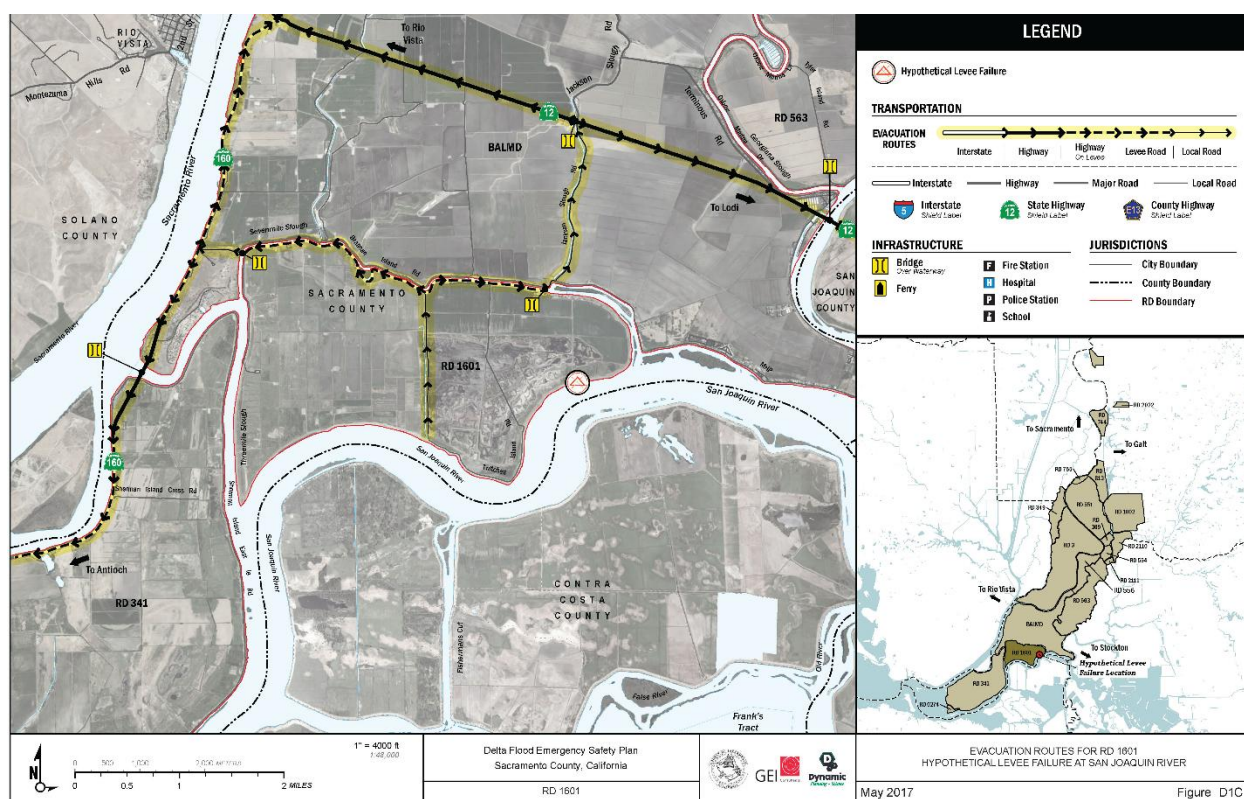
Source: Sacramento County Storm Ready – retrieved August 5, 2026

Figure 12-6 RD 1601 – Estimated Flood Depth from Levee Breach Scenario



Source: Sacramento County Storm Ready – retrieved August 5, 2026

Figure 12-7 RD 1601 – Levee Breach Scenario Evacuation Routes



Source: Sacramento County Storm Ready – retrieved August 5, 2026

Assets at Risk

Assets at risk from levee failure include people and populations; District assets and critical facilities and infrastructure); and natural, historic, and cultural resources. These are discussed in the following sections.

People and Populations

All people and populations (including both District staff and the population within District boundaries) located in leveed areas are at some risk to levee failure flooding. Certain vulnerable populations located within areas prone to levee failure flooding may be at increased risk to this hazard, especially during a large event with minimal advance notice. These vulnerable populations include: the unsheltered, those with limited mobility, and those that lack the resources to leave the area.

District Assets and Critical Facilities and Infrastructure

Should the levees fail, all District assets would be at risk. District assets listed in Table 12-11 would be at risk to flooding from a levee failure.

Table 12-11 RD 1601 Assets: Structures, Critical Facilities and Infrastructure, and Other Facilities at Risk to Levee Failure

Name of Asset	Facility Type	Replacement Value
Pump Station #1 (including all station components)	Essential Services	\$2,000,000
Pump Station #2 (including all station components)	Essential Services	\$2,000,000
Drainage Conveyances	Essential Services	\$350,000
Underground Electric Crossing*	Essential Services	—
Overhead Electric Crossings*	Essential Services	—
Siphons*	Essential Services	—
Electric Pullbox Underground Docs	Essential Services	—
Total		\$2,350,000

Source: RD 1601

Natural, Historic, and Cultural Resources

Large flood events, such as those occurring as a result of a levee failure, can affect natural, historic, and cultural resources. There are a number of ways floodwaters can impact natural resources and the environment. Wildlife habitats can be destroyed by floodwaters. Contaminated floodwater can pollute rivers and habitats. Silt and sediment can destroy natural areas. Riverbanks and natural levees can be eliminated as rivers reach bankfull capacity. Rivers can be widened, and deposition can increase downstream. Trees can be uprooted by high-velocity water flow. Plants that survived the initial flood may die due to being inundated with water. Historic and cultural resources may also be affected. Generally, the impacts are associated with damage to structures within the flooded areas, but other cultural resources such as those associated with Native Americans and old tribal areas can also be disturbed, damaged and lost during extreme flood events.

Impacts from Levee Failure

Floods and their impacts vary by location, including impacts associated with a levee failure flood event, and will only affect certain areas of the District that are in areas protected by levees. Based on the areas of the District surrounded by levees, it is evident that levee failure floods could potentially have significant impacts to the District, depending on the location, timing, and severity of the event. Impacts that are not quantified, but could be anticipated in large levee failure event, include:

- Injury and loss of life
- Structural and property damage
- Crop damage
- Disruption of and damage to public critical infrastructure and services
- Health hazards associated with mold and mildew, contamination of drinking water, etc.
- Impacts to natural resource areas, including stream bank erosion
- Damage to roads/bridges resulting in loss of mobility

In addition to flood related levee failures, the levees in the District are potentially at risk to failure during an earthquake event. Levee failure flooding could accompany an earthquake and could be compounded further if a dam or storage reservoir fails. Channels and water courses with earthen banks and levees are particularly vulnerable and could collapse in a major earthquake resulting in partial or complete blockage of channels causing flooding upstream of the impoundment. Levees are especially susceptible to rapid settlement due to liquefaction or horizontal spreading of underlying soils.

Impacts to identified assets at risk to this hazard and the overall vulnerability of the District may be affected in the future by climate change (which was discussed in the hazard profile section above), changes in population patterns, and changes in land use and development. The influencing effects of these factors on this hazard are discussed further in the Future Conditions/Future Development discussion below.

Future Conditions/Future Development

This section provides a discussion of how future conditions will influence or affect the hazard over time and also discusses future development relative to each hazard.

Future Conditions

Future conditions may be affected by climate change, changes in population patterns (migration, density, or the makeup of socially vulnerable populations), and changes in land use and development. Findings on this for RD 1601 include the following:

- Climate change is likely to exacerbate future flood and levee failure conditions and associated impacts and vulnerability of the District to levee failure flooding. This was discussed in greater detail in the Climate Change and Levee Failure section of the Hazard Profile above.
- Population projections within the jurisdictional boundaries of the District show the population to be flat or slightly declining. It is unknown how population patterns and demographics will change in the near future. The District may add staff, but this number would be small. The District noted that it has no control over population changes within its jurisdictional boundaries. With no notable changes in populations numbers and makeup, the vulnerability of the District to this hazard is unlikely to change.
- Changes in land use and development in the District are expected to be limited in the near future and thus are not likely to affect levee failure flooding and associated impacts to the District. Additional development traditionally leads to additional flooding, especially in levee protected areas. However, adherence to protective building codes for new development will assist in limiting future impacts and associated vulnerabilities of the District to this hazard.

Future Development

Future development considerations should be ongoing and proactive. Ensuring that comprehensive land use planning is conducted, regulatory requirements, such as building codes and the floodplain ordinance, are followed, and levee improvements, inspections, and maintenance is ongoing will help reduce impacts to future development.

Subsidence

Likelihood of Future Occurrence–Likely

Vulnerability–Medium

Hazard Profile

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. According to the Sacramento County 2022 General Plan Background Report, Sacramento County is affected by five types of subsidence: liquefaction caused by earthquake shaking, compaction by heavy structures, the erosion of peat soils, peat oxidation, and fluid withdrawal. Groundwater extraction for residential, commercial and agricultural uses causes the greatest amount of subsidence in Sacramento County.

Location and Extent

In Sacramento County, the western and southwestern portions of the County are prone to some level of subsidence, with the Delta area at high risk of subsidence. These areas were shown in the Section 4.3.16 of the Base Plan. There is no scientific scale used to measure subsidence. Subsidence is measured in inches or feet of elevation over time. Speed of onset of subsidence is slow, with rates of change of often less than 1" to 2" per year. The duration of subsidence is long, as it is rare for subsidence to be reversed.

Past Occurrences

Disaster Declaration History

There have been no state or federal disaster declarations for subsidence in Sacramento County.

NCDC Events

The NCDC does not contain any subsidence events for Sacramento County.

Rd 1601 Events

The 5-Year Plan documented the history of subsidence in RD 1601.

- **1982-1983:** The flood event FEMA 677 DR caused waterside erosion, multiple cracks on the landside slope along with sinkholes, subsidence areas, and seepage areas. The levee was found to have problems with subsidence and seepage, and had cracks in the landward slope at Stations 374+00 to 378+00, 384+00 to 387+00, 405+00 to 409+00, 419+00 to 436+00, 526+00 to 530+00, 550+00 to 554+00, and 567+00 to 569+50. Import fill material was placed on the landward levee slope to flatten the slope, and a landside berm fill was constructed, with Mirafi fabric placed under the berm fill, except at Stations 384+00 to 387+00, 534+00 to 536+25, and 567+00 to 569+50. Sink holes were located at the landward toe of the levee at Stations 448+00, 550+00, and were filled with import fill material.
- **1985 to 1986:** The levee was found to have problems with subsidence and seepage, and had cracks in the landward slope at Stations 363+39 to 367+00 and 582+00 to 588+34.

The District Planning Team noted that, in addition to the 5-Year Plan history, a **2006** storm event caused subsidence in the District. An area on the west side of Pump Station #1 suffered from subsidence.

No events have occurred since 2021.

Climate Change and Earthquake

Changes in precipitation, reduced snowpack, and more frequent droughts are likely to increase the demand on groundwater sources, risking overdraft, ground subsidence, and decreased water quality. Climate change may further contribute to subsidence in the County, by increasing evapotranspiration rates for agriculture and other vegetation and by increasing periods of drought, both of which can increase demand for water, accelerate groundwater pumping and the drilling of new groundwater wells and lead to further lowering of the groundwater table and increasing subsidence.

Vulnerability to Subsidence

Historically, the District has been at risk from subsidence. Subsidence in the District, City of Isleton, and larger Delta is an ongoing concern. According to the Sacramento County 2022 General Plan Background Report, subsidence has created major problems for flood control, particularly in the Delta. As levees sink under their own weight and are weakened by the erosive force of water, expensive periodic rebuilding is necessary. According to the California Department of Water Resources, the Sacramento-San Joaquin Delta's peat soils are subsiding at an estimated 0.4 to 0.6 inches per year. However, according to USGS estimates, developed islands in the Central and Western Delta are subsiding at 1-2 inches per year on average. Many islands in the Delta that, at one time, were at or above sea level are now between 10 and 25 feet below sea level.

Historically, the whole of the District is at some measure of vulnerability to 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

At the most local level, individual farmers or reclamation districts must maintain drainage networks on the islands and pump the agricultural drainage back into waterways. These costs increase gradually as subsidence progresses.

Local Concerns

The District has specific concerns and unique vulnerabilities regarding this hazard. These concerns form a portion of the basis for the mitigation strategy and mitigation actions that seek to reduce risk and vulnerability to this hazard.

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

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 assets in the District are at risk to ground shaking and other earthquake related impacts. Assets at risk from earthquake include people and populations; District assets and critical facilities and infrastructure); and natural, historic, and cultural resources. These are discussed in the following sections.

People and Populations

People and populations in the District boundaries are at limited risk from direct effects of subsidence. However, subsidence that affects levees surrounding the District could have secondary impacts if levees overtop or fail due to subsidence. All people and populations located in the levee protected areas are at some risk to flooding. Certain vulnerable populations located within areas prone to flooding may be at increased risk to this hazard, especially during a large event with minimal advance notice. These vulnerable populations include: the unhoused, those with limited mobility, and those that lack the resources to leave the area.

District Assets and Critical Facilities and Infrastructure

Certain District assets and critical facilities are at risk of levee failure flooding and primarily include those structures located adjacent to levee protected areas. District assets listed in Table 12-12 would be at risk to flooding.

Table 12-12 RD 1601 Assets: Structures, Critical Facilities and Infrastructure, and Other Facilities at Risk to Subsidence

Name of Asset	Facility Type	Replacement Value
Drainage Conveyances (92,650 ft.)	Essential Services	\$2.0 mil
Pump Station #1 (including all station components)	Essential Services	\$2.0 mil
Pump Station #2 (including all station components)	Essential Services	\$2.0 mil
Pump Station #3 (including all station components)	Essential Services	—*
West Thornton-Walnut Grove Gas Field	Essential Services	\$2.0 mil
Total		\$8,000,000

Natural, Historic, and Cultural Resources

The largest of California's drinking water sources is the Sacramento-San Joaquin Delta and its tributaries. Land subsidence of Delta islands indirectly affects the north-to-south water transfer system, which is predicated on the available water supply (annual inflows to the Delta), the viability of aquatic species populations, and acceptable water quality in the southern Delta. The statewide water-transfer system in California is so interdependent that decreased water quality in the Delta, whether due to droughts or levee failures, might lead to accelerated subsidence in areas dependent on imported water from the Delta.

The Delta provides at least a portion of the water supply for about two-thirds of California's population, and provides a migratory pathway for four fish that are listed as endangered or threatened pursuant to the federal Endangered Species Act. Subsidence causing saltwater intrusion could affect this water supply. Any historic or cultural resources located in or near a leveed area at risk to subsidence would be at risk to flood related damages should a levee overtop or fail due to subsidence.

Impacts from Subsidence

The District is perpetually at risk of flooding in the event of levee breaks or overtopping and many have flooded in the past, causing millions of dollars in damage. As subsidence progresses, the levees must be regularly maintained and periodically raised and strengthened to support the increasing stresses on their banks. Delta island flooding can also interfere with freshwater exports from the Delta.

Subsidence has caused impacts on critical water infrastructure, including reduced conveyance capacity in local, State, and federal conveyance facilities, reduced levee heights, and damaged well casings. Throughout California, subsidence has damaged buildings, aqueducts, well casings, bridges, and highways.

As the land sinks, it can experience increased flooding and adverse impacts on sewer lines and stormwater drainage. As subsidence progresses, areas protected by levees are impacted. The levees in the Sacramento-San Joaquin Delta must be regularly maintained and periodically raised and strengthened to support the increasing stresses on them that result when the Delta islands subside. Compaction of the aquifer system may permanently decrease its capacity to store water. Subsidence can lead to damage to critical infrastructure and facilities.

Impacts to identified assets at risk to this hazard and the overall vulnerability of the District may be affected in the future by climate change (which was discussed in the hazard profile section above), changes in population patterns, and changes in land use and development. The influencing effects of these factors on this hazard are discussed further in the Future Conditions/Future Development discussion below.

Future Conditions/Future Development

This section provides a discussion of how future conditions will influence or affect the hazard over time and also discusses future development relative to each hazard.

Future Conditions

Future conditions may be affected by climate change, changes in population patterns (migration, density, or the makeup of socially vulnerable populations), and changes in land use and development. Findings on this for the District include the following:

- Climate change is likely to exacerbate future sea level rise conditions and associated impacts and vulnerability of the County. This was discussed in greater detail in the Climate Change and Subsidence section of the Hazard Profile above
- Population projections within the jurisdictional boundaries of the District show the population to be flat or slightly declining. It is unknown how population patterns and demographics will change in the near future. The District may add staff, but this number would be small. The District noted that it has no control over population changes within its jurisdictional boundaries. With no notable changes in populations numbers and makeup, the vulnerability of the District to this hazard is unlikely to change.
- Changes in land use and development in the District are expected to be limited in the near future and thus are not likely to affect subsidence and associated impacts to the District. Additional development in known subsidence areas traditionally leads to additional problems. However, adherence to protective building codes for new development will assist in limiting future impacts and associated vulnerabilities of the District to this hazard.

Future Development

The District owns no buildings and has no plans to acquire or develop new properties or add structures to support District objectives. Further, the District noted that it has no control over future development within its boundaries. Responsibility for growth and development within District boundaries resides with the City of Isleton. The City will need to ensure that comprehensive land use planning is conducted, regulatory requirements, such as building codes, are followed, and varying needs for different demographic groups with intersecting identities that reside within the County are considered can help to make for a more resilient community.

12.5 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.

12.5.1. Regulatory Mitigation Capabilities

Table 12-13 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 1601.

Note: The District does not have the authority to regulate land use and development within its jurisdiction. Authority for promulgating and enforcing zoning, land use, and development requirements falls to counties and incorporated communities. As such development within the District’s jurisdictional boundaries will

conform to the zoning and land use development ordinances and building codes of the county or incorporated community in which the District is located.

Table 12-13 RD 1601's Regulatory Mitigation Capabilities

Plans	In Place Y/N	Does the plan address hazards? Can the plan be used to carry out mitigation actions? When was it last updated??
Capital Improvements Plan	N	
Climate Change Adaptation Plan	N	
Community Wildfire Protection Plan	N	
General Plan/Comprehensive Plan/Master Plan	Y 2020	5 Year Plan identifies hazards that may affect RD 1601. Some mitigation strategies are proposed. Yes, the plan can be used to implement mitigation actions.
Continuity of Operations Plan	N	
Economic Development Plan	N	
Land Use Plan	N	
Local Emergency Operations Plan	Y	A District-specific Flood Safety Plan, composed of an Emergency Operations Plan and an Annex – A Flood (the Flood Contingency Map) was completed in 2019 for RD1601.
Stormwater Management Plan	N	
Transportation Plan	N	
Other		
Land Use Planning and Ordinances	Y/N	Is the ordinance an effective way to reduce hazard impacts? Is the ordinance adequately administered and enforced?
Acquisition of land for open space and public recreation use	N	
Building code	N	
Flood insurance rate maps	N	
Floodplain ordinance	N	
Natural hazard-specific ordinance (stormwater, steep slope, wildfire)	N	
Subdivision ordinance	N	
Zoning ordinance	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 1601

12.5.2. Administrative/Technical Mitigation Capabilities

Table 12-14 identifies the District department(s) responsible for activities related to mitigation and loss prevention in the RD 1601.

Table 12-14 RD 1601's Administrative and Technical Mitigation Capabilities

Administration	In Place Y/N	Describe capability Is coordination effective?
Staff Is staffing adequate to enforce regulations? Is staff trained on hazards and mitigation? Is coordination between agencies and staff effective?		
Chief Building Official	N	
Civil Engineer, including dam and levee safety	Y	KSN, Inc.
Community Planner	N	
Emergency Manager	Y	KSN, Inc.
Floodplain Administrator	N	
GIS Coordinator	Y	KSN, Inc.
Planning Commission	N	
Other		
Technical	Y/N	Has capability been used to assess/mitigate risk in the past?
Grant writing	Y	KSN, Inc.
Hazard data and information	Y	KSN, Inc.
GIS analysis	Y	KSN, Inc.
Mutual aid agreements	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 1601

12.5.3. Fiscal Mitigation Capabilities

Table 12-15 identifies financial tools or resources that the District could potentially use to help fund mitigation activities.

Table 12-15 RD 1601's Fiscal Mitigation Capabilities

Funding Resource	In Place 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	
Community Development Block Grant	N	
Federal funding programs (non-FEMA)	N	
Fees for water, sewer, gas, or electric services	N	
Impact fees for new development	N	
State funding programs	Y	DWR Levee Subventions and Special Projects Program (used for O&M activities), Statewide Emergency Response Program – Delta
Stormwater utility fee	Y	Part of our Levee Assessment Program
Other		Levy Assessment Program but not taxes
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 1601

12.5.4. Mitigation Education, Outreach, and Partnerships

Table 12-16 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 12-16 RD 1601's Mitigation Education, Outreach, and Partnerships

Program/Organization	In Place Y/N	How widespread are each of these in your community?
Community newsletters	N	
Hazard awareness campaigns (such as Firewise, Storm Ready, Severe Weather Awareness Week, school programs, public events)	N	
Local news	N	
Organizations that interact with underserved and vulnerable communities	N	
Social media	N	
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 1601

12.5.5. Other Mitigation Efforts

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

The entire Twitchell Island levee system consists of 2.5 miles of Federal Project Levee and 9.4 miles of Non-Project levee and is inspected daily by District staff who are familiar with all aspects of its function. The District engineer typically performs an inspection once a month or more frequently when warranted. The Federal Project Levee along Threemile Slough 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. During high water or severe weather events, inspection frequency is increased to meet the demand. The entire levee is inspected continuously at one hour intervals.

12.6 Mitigation Strategy

12.6.1. Mitigation Goals and Objectives

The RD 1601 adopts the hazard mitigation goals and objectives developed by the HMPC and described in Chapter 5 Mitigation Strategy.

12.6.2. NFIP Mitigation Strategy

The District does not participate in the NFIP, as it is not an eligible participant. Many of the District's projects work to reduce impacts from flooding thus furthering the objectives of the NFIP.

12.6.3. Mitigation Actions

The Planning Team for the RD 1601 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, and timeline are also included. The following hazards were considered a priority for purposes of mitigation action planning:

- Flood: 1%/0.5%/0.2% annual chance
- Flood: Localized Stormwater
- Levee Failure
- Sea Level Rise
- Subsidence

Low priority hazards for mitigation planning include:

- Climate Change
- Dam Failure
- Drought & Water Shortage (w/tree mortality)
- Earthquake (w/subhazards)
- Aquatic Nuisance Species (plant/animal)
- Landslide, Mudslide, Debris Flow

- Severe Weather: Extreme Cold and Freeze
- Severe Weather: Extreme Heat
- Severe Weather: Heavy Rains and Storms (Hail, Lightning, Wind)
- Severe Weather: High Winds and Tornadoes
- Wildfire (with smoke and air quality)

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 and jurisdictions regardless of hazard priority. Collectively, this LHMP's 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 each jurisdiction has focused on identifying those mitigation actions and projects to address their priority hazards, which are both realistic and reasonable for them to implement for this 5-year planning process, and would like to preserve their right to modify hazard priorities should future projects be identified where the implementing jurisdiction has the future capacity to implement. The participating jurisdictions are not obligated by this document to implement any or all of these projects. Rather this mitigation strategy represents the desires of the jurisdictions to mitigate the risks and vulnerabilities from identified hazards. The actual selection, prioritization, and implementation of these actions will also be further evaluated in accordance with the mitigation categories and criteria contained in Appendix C.

Mitigation Actions

The District has put forward the actions as shown in Table 12-17. Details of the actions can be found below the table.

Table 12-17 RD 1601 Mitigation Actions

Action Title	New Action/ Previous Action	Address Current Development	Address Future Development	Continued NFIP Compliance	Mitigation Type
Action 1. Levee Improvement Project	Previous Action	X	X	X	Prevention Property Protection Structural Projects Natural Resource Protection
Action 2. Rock Slope Protection Project	Previous Action	X	X	X	Prevention Property Protection Natural Resource Protection
Action 3. San Joaquin River Setback Levee	Previous Action	X	X	X	Prevention Property Protection Structural Projects Natural Resource Protection

Action Title	New Action/ Previous Action	Address Current Development	Address Future Development	Continued NFIP Compliance	Mitigation Type
Action 4. Backup Power Project	Previous Action	X	X	X	Prevention Property Protection Emergency Services

Action 1. Levee Improvement Project

Hazards Addressed: Earthquake, Earthquake: Liquefaction, Flood: 100/200/500-year, Flood: Localized Stormwater Flooding, Levee Failure, Severe Weather: Heavy Rains and Storms, Severe Weather: Wind and Tornadoes, and Subsidence

Goals Addressed: 1, 2, 3, 5, 6

Issue/Background: The goal of this Mitigation Action is to improve the Twitchell Island levees over the next five years to a level of protection that meets, or exceeds, the Bulletin 192-82 standard.

Project Description: The District will bring those portions of levee along Threemile Slough and Sevenmile Slough currently 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 project will also include addressing levee crown elevations where levee embankment settlement has occurred. This work will likely be divided into several phases or projects, depending on the funding available.

Other Alternatives: None

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

Responsible Office/Partners: RD 1601

Cost Estimate: \$90 -100 million

Project Priority: High

Benefits (Losses Avoided): Preservation of 1601 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 and funding

Action 2. Rock Slope Protection Project

Hazards Addressed: Earthquake; Earthquake: Liquefaction; Flood: 100/200/500-year, Localized Stormwater Flooding, Levee Failure; Severe Weather: Heavy Rains and Storms, Wind and Tornadoes; and Subsidence

Goals Addressed: 1, 2, 3, 5

Issue/Background: The goal of this Mitigation Action is to provide additional protection to the levee by installing additional riprap.

Project Description: The District plans 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.

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: District 5-Year Plan and Delta Levees Program

Responsible Office/Partners: RD 1601

Cost Estimate: \$4 million

Project Priority: High

Benefits (Losses Avoided): Preservation of 1601 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 and funding

Action 3. San Joaquin River Setback Levee

Hazards Addressed: Earthquake; Earthquake: Liquefaction; Flood: 100/200/500-year, Localized Stormwater Flooding, Levee Failure; Severe Weather: Heavy Rains and Storms, Wind and Tornadoes; and Subsidence

Goals Addressed: 1, 2, 3, 5, 6

Issue/Background: The goal of this Mitigation Action is to provide “fish friendly” levees and additional flood conveyance.

Project Description: The District would like to implement the levee improvement recommendations along the San Joaquin River in accordance with the 2009 GEI geotechnical report by constructing a toe berm and setback levee. The setback levee along the San Joaquin River also includes a channel margin habitat component that will provide approximately four miles of much needed “fish friendly” levees in this part of the Delta. This work would likely be divided into several phases or projects, depending on the funding available.

Other Alternatives: none

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

Responsible Office/Partners: RD 1601

Cost Estimate: \$153 million

Project Priority: High

Benefits (Losses Avoided): Preservation of 1601 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: HMGP Grant Programs, seeking cost sharing partners for project.

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

Action 4. *Backup Power Project*

Hazards Addressed: Climate Change, Earthquake; Earthquake: Liquefaction; Flood: 100/200/500-year, Localized Stormwater Flooding, Levee Failure; Severe Weather: Heavy Rains and Storms, Wind and Tornadoes; and Subsidence

Goals Addressed: 1, 2, 3, 5, 6

Issue/Background: The goal of this Mitigation Action is to provide backup power to Reclamation District 1601 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, quick connects, and associated electrical improvements. The project would design and install main disconnect systems to allow for safe use of generators as needed during a power shutoff or power failure. The project would include one generator per district and improvements for a disconnect systems for each pump station.

Other Alternatives: none

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

Responsible Office/Partners: RD 1601

Project Priority: High

Cost Estimate: \$200,000

Benefits (Losses Avoided): Preservation of 1601 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