Delta Annex Chapter 2 Brannan Andrus Levee Maintenance District; Reclamation Districts 317, 407, 2067

2.1 Introduction

This Annex details the hazard mitigation planning elements specific to Brannan-Andrus Levee Maintenance District (BALMD or District) and Reclamation Districts (RD or District) 317, 407, and 2067, a previously participating jurisdiction to the 2016 Sacramento County Local Hazard Mitigation Plan (LHMP) Update. This Annex is not intended to be a standalone document, but appends to and supplements the information contained in the Base Plan document. As such, all sections of the Base Plan, including the planning process and other procedural requirements apply to and were met by the District. This Annex provides additional information specific to BALMD and RDs 317, 407, and 2067, with a focus on providing additional details on the risk assessment and mitigation strategy for the District.

2.2 Planning Process

As described above, the District followed the planning process detailed in Chapter 3 of the Base Plan. In addition to providing representation on the Sacramento County Hazard Mitigation Planning Committee (HMPC), the District formulated their own internal planning team to support the broader planning process requirements. Internal planning participants, their positions, and how they participated in the planning process are shown in Table 2-1. Additional details on plan participation and District representatives are included in Appendix A. FILL OUT TABLE WITH NAMES, TITLES, AND HOW EACH PERSON PARTICIPATED.

Table 2-1 BALMD and RDs 317, 407, and 2067 – Planning Team

Name	Position/Title	How Participated

Coordination with other community planning efforts is paramount to the successful implementation of this LHMP Update. This section provides information on how the District integrated the previously approved 2016 Plan into existing planning mechanisms and programs. Specifically, the District incorporated into or implemented the 2016 LHMP through other plans and programs shown in Table 2-2. FILL OUT TABLE – IF THERE WAS NO PLANNING DONE, SIMPLY PUT N/A IN THE FIRST COLUMN AND STATE THAT NO MITIGATION RELATED PLANNING MECHANISMS HAVE BEEN COMPLETED SINCE 2016. LOOKS LIKE THERE IS A FLOOD SAFETY PLAN IN PROGRESS. SMALL COMMUNITIES PLANNING?

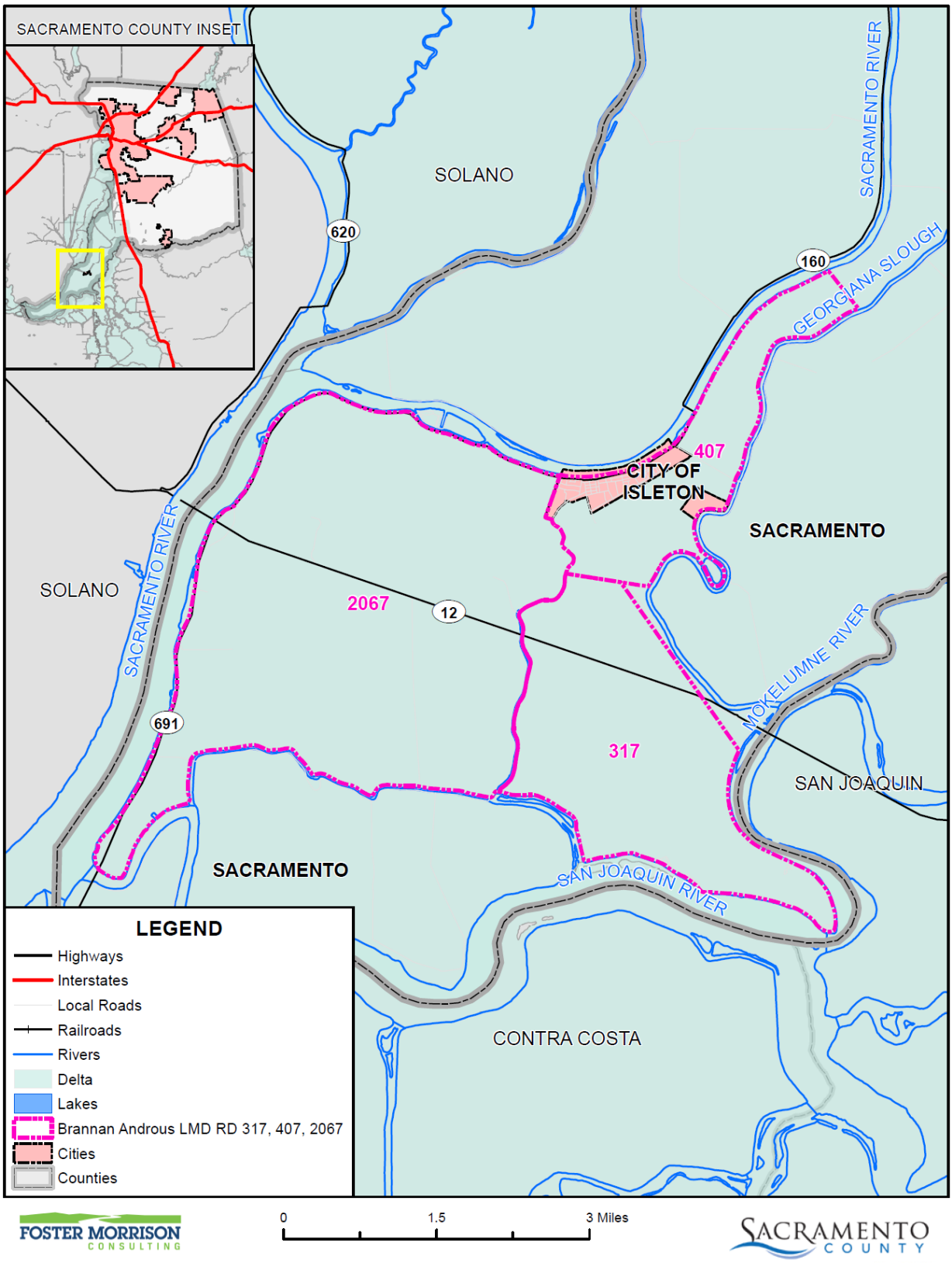
Table 2-2 2016 LHMP Incorporation

Planning Mechanism 2016 LHMP Was Incorporated/Implemented In.	Details: How was it incorporated?

2.3 District Profile

The District profile for the BALMD and RDs 317, 407, and 2067 is detailed in the following sections. Figure 2-1 displays a map and the location of the District within Sacramento County.

Figure 2-1 BALMD and RDs 317, 407, and 2067



Data Source: Brannan Androus Levee Maintenance District, Sacramento County GIS, Cal-Atlas; Map Date: 09/2020.

2.3.1. Overview and Background

Brannan-Andrus Island is surrounded by 26.2 miles of levee, excluding the Brannan Island State Park, that protects about 13,000 acres of land, which is primarily in agricultural/rural use. It is bordered by the Sacramento River, Georgiana Slough, Mokelumne River, San Joaquin River, and Sevenmile Slough. The levees along the Sacramento River and Georgiana Slough are designated as project levees (16.2 miles). The remaining levees along the Mokelumne River, San Joaquin River and Sevenmile Slough are considered non-project levees (10.0 miles). Out of the 10 miles of non-project levee, 3.3 miles border the non-tidal, controlled section of Sevenmile Slough.

The BALMD monitors and maintains the levees on the island. Reclamation Districts 317, 407, and 2067 and maintain and control the operations of the seven pumping stations to keep the island dry. Five pumping stations are located along Sevenmile Slough, another is on Georgiana Slough, and a lift station is located on the main drainage canal in the northern part of the island.

The BALMD levee system protects an island population of approximately 1,837. This figure includes a major recreation contingent and the City of Isleton, with close to 900 residents. Approximately 379 acres are urbanized, with about 187 acres incorporated by the City of Isleton.

ANYTHING TO UPDATE?

2.4 Hazard Identification

BALMD and RDs 317, 407, and 2067 identified the hazards that affect the District and summarized their location, extent, frequency of occurrence, potential magnitude, and significance specific to District (see Table 2-3). FOSTER MORRISON USED THE 2016 TABLE. VERIFY THE RANKINGS AND CHANGE ACCORDINGLY.

Table 2-3 BALMD and RDs 317, 407, and 2067—Hazard Identification Assessment

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

2.5 Hazard Profile and Vulnerability Assessment

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

2.5.1. Hazard Profiles

Each hazard vulnerability assessment in Section 2.5.3, includes a hazard profile/problem description as to how each medium or high significant hazard (as shown in Table 2-3) affects the District and includes information on past hazard occurrences and the likelihood of future hazard occurrence. The intent of this section is to provide jurisdictional specific information on hazards and further describes how the hazards and risks differ across the Sacramento County Planning Area.

2.5.2. Vulnerability Assessment and Assets at Risk

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

Assets at Risk and Critical Facilities

This section considers the BALMD and RDs 317, 407, and 2067's assets at risk, with a focus on key District assets such as critical facilities, infrastructure, and other District assets and their values. With respect to District assets, the majority of these assets are considered critical facilities as defined for this LHMP. Critical facilities are defined for this Plan as:

> ***Any facility (a structure, infrastructure, equipment or service), that is adversely affected during a hazardous event may result in interruption of services and operations for the District at any time before, during and after the hazard event. A critical facility is classified by the following categories: (1) Essential Services Facilities, (2) At-risk Populations Facilities, (3) Hazardous Materials Facilities.***

Table 2-4 lists critical facilities and other District assets identified by the District Planning Team as important to protect in the event of a disaster. BALMD and RDs 317, 407, and 2067's physical assets, valued at over $245 million, consist of the buildings and infrastructure to support the District's operations. VERIFY VALUES AND ADD TO TABLE WITH DISTRICT ASSETS. ADD ANY OTHER DISTRICT

FACILITIES AND ASSETS. FILL OUT LAST COLUMN OF TABLE – WHAT ARE THEY AT RISK FROM?

Table 2-4 BALMD and RDs 317, 407, and 2067 Critical Facilities, Infrastructure, and Other District Assets

Name of Asset	Facility Type	Replacement Value	Which Hazards Pose Risk
BALMD			
District Levees	Infrastructure	$235,000,000	
Cross Levee	Infrastructure	$5,000,000	
RD 317			
150 HP Pump	Infrastructure	$500,000	
50 HP Pump	Infrastructure	$250,000	
75 HP Pump	Infrastructure	$250,000	
RD 407			
60 HP Pump Station	Infrastructure	$250,000	
60 HP Pump Station	Infrastructure	$250,000	
RD 2067			
100 HP Pump	Infrastructure	$500,000	
60 HP Pump	Infrastructure	$250,000	
60 HP Pump	Infrastructure	$250,000	
60 HP Pump	Infrastructure	$250,000	
60 HP Pump	Infrastructure	$250,000	
100 HP Pump	Infrastructure	$500,000	
75 HP Pump	Infrastructure	$250,000	
75 HP Pump	Infrastructure	$250,000	

Source: BALMD and RDs 317, 407, and 2067

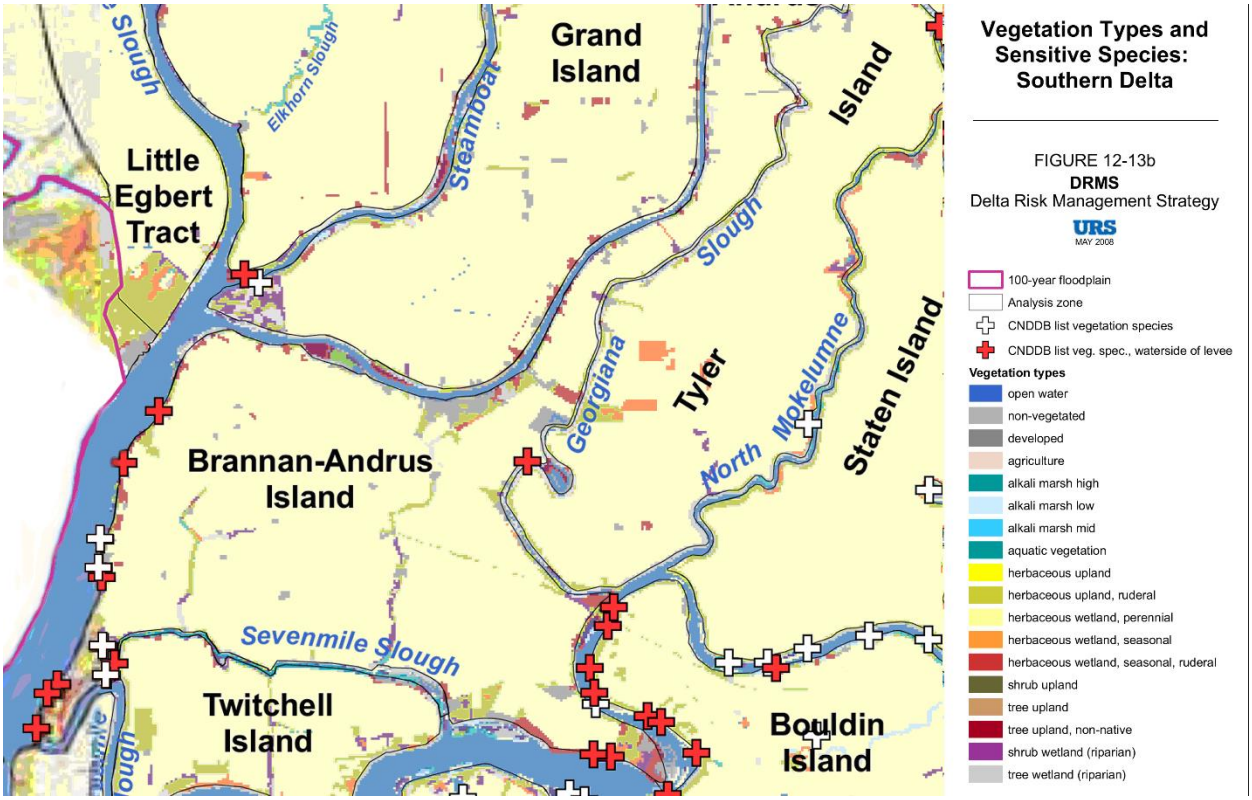
CAN THE DISTRICT ALSO PROVIDE A LIST OR TABLE THAT DETAILS BY LEVEE SEGMENT OR SYSTEM THE CURRENT STATUS OF THE LEVEE AND IF IT IS UNDERGOING ANY IMPROVEMENTS AND WHAT THAT LEVEL OF PROTECTION WILL INCREASE TO?

Natural Resources

BALMD and RDs 317, 407, and 2067 has a variety of natural resources of value to the District. The 5-Year Plan noted that in terms of natural resources, Brannan-Andrus Island has freshwater wetland, upland, and riparian habitats. Within the freshwater wetland category, there are 12.36 acres of herbaceous perennial wetland and 26.63 acres of herbaceous seasonal/ruderal wetland. Upland habitat consists of 724.74 acres of herbaceous ruderal, 10.13 acres of shrub, 47.61 acres of tree, and 292.56 of non-native tree upland. There is also approximately 142.31 acres of riparian habitat, with 96.88 acres of shrub wetland, and 45.43 acres of tree wetland.

Two small sloughs, Tomato Slough and Jackson Slough, in the interior of the island provide some riparian habitat. Refer to Figure 2-2 for specific habitat areas. According to the California Natural Diversity Database the sensitive species found on Brannan-Andrus Island are: Northern California Black Walnut, Swainson Hawk, Northwestern Pond Turtle, Delta Tule Pea, Suisun Marsh Aster, Mason Lilaeopsis, and Delta Mudwort.

Figure 2-2 BALMD and RDs 317, 407, and 2067 Vegetation Types and Sensitive Species



Source: BALMD 2012 5-Year Plan

Historic and Cultural Resources

BALMD and RDs 317, 407, and 2067 has a variety of historic and cultural resources of value to the District. The 5-Year Plan noted that BALMD, RD 317, RD 407, and RD 2067 protect the City of Isleton. The City has two nationally registered historic districts, the Isleton Chinese and the Japanese Commercial Districts.

Growth and Development Trends

The BALMD 2012 5-Year Plan noted that the standard island elevation is about -14' with a minimum elevation of -22' and a maximum of +9' per the 2007-2008 DWR Lidar Survey. With the adoption of the Delta Protection Act in 1992, about 40% of Brannan-Andrus Island was designated as a Secondary Zone of the legal Delta, extending from the northern edge of Highway 12 to Tyler Island Bridge Road, east of Isleton. The remainder of the island is in the Primary Zone, which was established to protect the area for agriculture, wildlife habitat, and recreation uses within the Delta. The BALMD levee system protects an island population of approximately 1,837. This figure includes a major recreation contingent and the City

of Isleton, with close to 900 residents. Approximately 379 acres are urbanized, with about 187 acres incorporated by the City of Isleton.

Beyond the city limits of Isleton, Sacramento County zoning designates approximately 1,200 acres to recreational use along the southeast corner of Andrus Island. Scattered around Brannan-Andrus Island are a large contingent of the Delta resorts, including RV parks, boat launches, and marinas for local and public use. A majority of these recreational uses are located along the Delta Loop, a 7.2-mile drive with 40 recreational attractions bordering the Mokelumne and San Joaquin Rivers, and Sevenmile Slough. Overall, there are 5 large marinas (over 200 berths), 5 medium marinas (50 to 200 berths), and 8 small marinas (less than 50 berths) that account for a total of 2400 berths and 6 boat launching facilities. Twelve of the resorts also have RV/camping grounds totaling about 800 sites overall. Five of the resorts have cabins (approx. 300 total). About 40 acres total of dry storage is provided at eleven resorts. Four resorts are on their own island that bridges to Brannan-Andrus and may not be inundated by a flood, but access could be compromised. Including marinas and resorts, there are approximately 148 businesses on the island.

There was a development of approximately 650 homes that failed in the housing crash of 2008. It is still developable land but many projects to revive the development have also failed. Development of that size is possible in the future given Isleton is in the Secondary Zone of the Delta which allows for some development. One hindrance is the levees are not certified by FEMA to protect against the 100-year flood. Thus homes will have to be elevated to protect from flooding. The failed development had accounted for that and designed the homes to be elevated with garages on the first story. ANY UPDATE ON THIS?

Development since 2016

No District facilities have been constructed since 2016. TRUE? HAVE ANY BEEN IMPROVED? SEEN A DECLINE? IF ANY FACILITIES HAVE BEEN CONSTRUCTED SINCE 2016 - WERE THEY IN ANY IDENTIFIABLE HAZARD AREAS?

Future Development

DOES THE DISTRICT HAVE ANY PLANS FOR DEVELOPMENT OF NEW DISTRICT FACILITIES? INCLUDE ANY INFORMATION ON PLANNED OR ONGOING LEVEE IMPROVEMENTS.

2.5.3. Vulnerability to Specific Hazards

This section provides the vulnerability assessment, including any quantifiable loss estimates, for those hazards identified above in Table 2-3 as high or medium significance hazards. Impacts of past events and vulnerability of the District to specific hazards are further discussed below (see Section 4.1 Hazard Identification in the Base Plan for more detailed information about these hazards and their impacts on the Sacramento County Planning Area). Methodologies for evaluating vulnerabilities and calculating loss estimates are the same as those described in Section 4.3 of the Base Plan.

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

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

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

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

Power Outage/Power Failure

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

Public Safety Power Shutoff (PSPS)

A new intentional disruption type of power outage/failure event has recently occurred in California. In recent years, several wildfires have started as a result of downed power lines or electrical equipment. This was the case for the Camp Fire in 2018. As a result, California's three largest energy companies (including PG&E), at the direction of the California Public Utilities Commission (CPUC), are coordinating to prepare all Californians for the threat of wildfires and power outages during times of extreme weather. To help protect customers and communities during extreme weather events, electric power may be shut off for public safety in an effort to prevent a wildfire. This is called a PSPS. More information on PSPS criteria can be found in Section 4.3.2 of the Base Plan. The Districts' have not been affected by a PSPS event in the past, and given the low potential for a significant wildfire event in the Delta area, a PSPS event, while possible, is unlikely.

Dam Failure

Likelihood of Future Occurrence–Unlikely
Vulnerability–Medium

Hazard Profile and Problem Description

Dams are manmade structures built for a variety of uses including flood protection, power generation, agriculture, water supply, and recreation. When dams are constructed for flood protection, they are usually engineered to withstand a flood with a computed risk of occurrence. For example, a dam may be designed to contain a flood at a location on a stream that has a certain probability of occurring in any one year. If prolonged periods of rainfall and flooding occur that exceed the design requirements, that structure may be overtopped or fail. Overtopping is the primary cause of earthen dam failure in the United States.

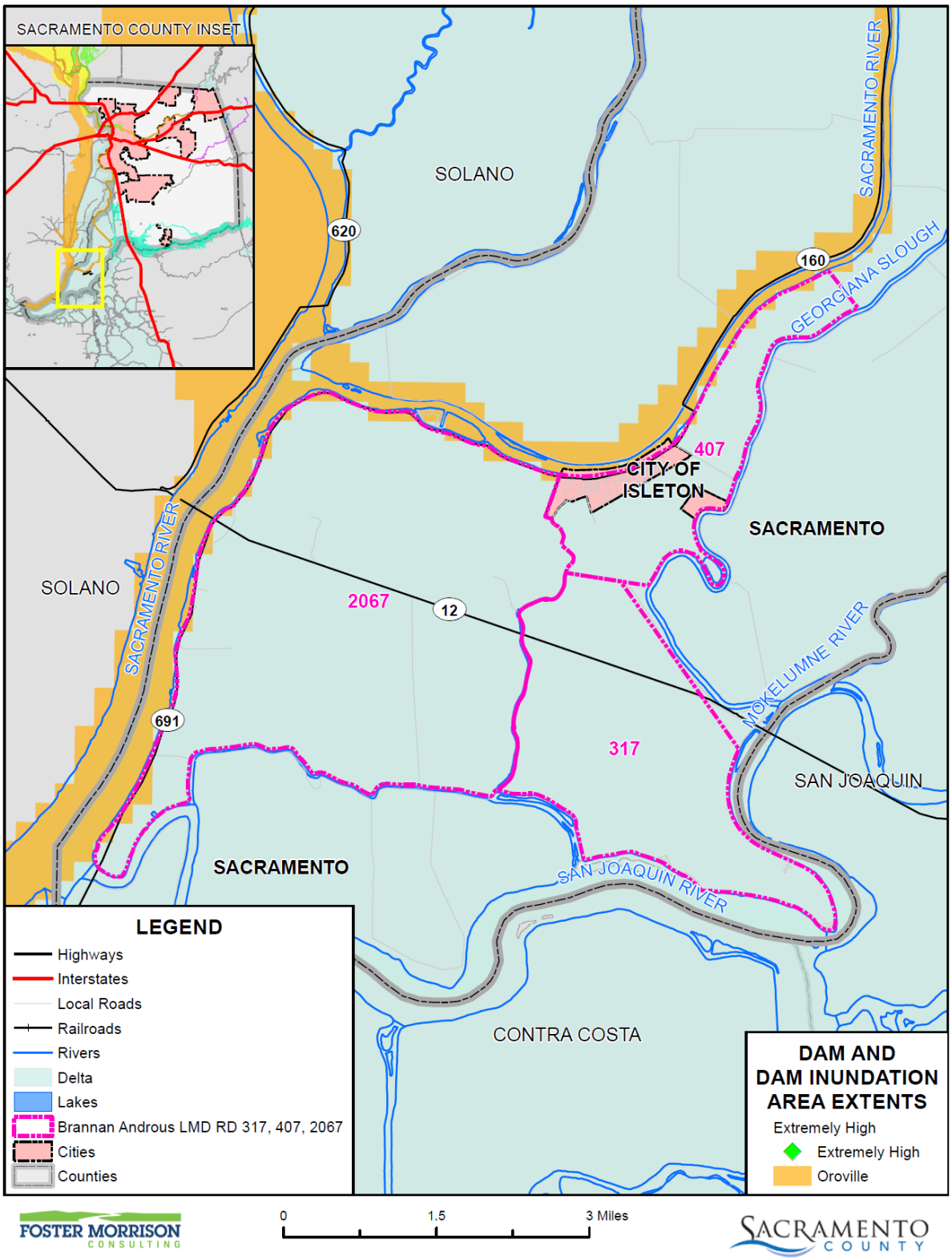
Location and Extent

Dam failure is a natural disaster from two perspectives. First, the inundation from released waters resulting from dam failure is related to naturally occurring floodwaters. Second, a total dam failure would most probably happen as a consequence of the natural disaster triggering the event, such as an earthquake. There is no scale with which to measure dam failure. However, Cal DWR Division of Safety of Dams (DOSD) assigns hazard ratings to dams within the State that provides information on the potential impact should a dam fail. The following two factors are considered when assigning hazard ratings: existing land use and land use controls (zoning) downstream of the dam. Dams are classified in four categories that identify the potential hazard to life and property: Low, Significant, High, and Extremely High. These were discussed in more detail in Section 4.3.7 of the Base Plan.

While a dam may fill slowly with runoff from winter storms, a dam break has a very quick speed of onset. The duration of dam failure is generally not long – only as long as it takes to empty the reservoir of water the dam held back. The District would be affected for as long as the flood waters from the dam failure took to drain downstream.

There are no dam inundation areas from dams inside the County that can affect the District. Dams outside the County that can affect the District can be seen on Figure 2-3.

Figure 2-3 BALMD and RDs 317, 407, and 2067 – Dam Inundation Areas from Dams Outside the County



Data Source: DWR DSOD Data 2020 and Cal OES Dam Status 10/2017, Brannan Androus Levee Maintenance District, Sacramento County GIS, Cal-Atlas; Map Date: 9/2020.

Past Occurrences

There has been no federal or state disaster declarations for dam failure in the County. The District noted no other dam failure occurrences that have affected the District. TRUE?

Vulnerability to and Impacts from Dam Failure

Dam failure flooding would vary by community depending on which dam fails and the nature and extent of the dam failure and associated flooding. Impacts to the District from a dam failure flood could include loss of life and injury, flooding and damage to property and structures, damage to critical facilities and infrastructure, loss of natural resources, and all other flood related impacts. Additionally, mass evacuations and associated economic losses can also be significant.

Riparian habitats that border the channel can be lost due to erosive forces of high flows from dam failure. The City has two nationally registered historic districts, the Isleton Chinese and the Japanese Commercial Districts that could be lost in the event of a flood due to dam failure.

Assets at Risk

As shown in the figures above, the levees and all District facilities in Table 2-4 could be at risk to dam failure, depending on the dam that fails and the nature of its failure.

Drought & Water Shortage

Likelihood of Future Occurrence–Likely
Vulnerability–Medium

Hazard Profile and Problem Description

Drought is a complex issue involving many factors—it occurs when a normal amount of precipitation and snow is not available to satisfy an area's usual water-consuming activities. Drought can often be defined regionally based on its effects. Drought is different than many of the other natural hazards in that it is not a distinct event and usually has a slow onset. Drought can severely impact a region both physically and economically. Drought affects different sectors in different ways and with varying intensities. Adequate water is the most critical issue and is critical for agriculture, manufacturing, tourism, recreation, and commercial and domestic use. As the population in the area continues to grow, so will the demand for water.

Location and Extent

Drought and water shortage are regional phenomenon. The whole of the County, as well as the whole of the District, is at risk. The US Drought Monitor categorizes drought conditions with the following scale:

- None
- D0 – Abnormally dry
- D1 – Moderate Drought
- D2 – Severe Drought

- D3 – Extreme drought
- D4 – Exceptional drought

Drought has a slow speed of onset and a variable duration. Drought can last for a short period of time, which does not usually affect water shortages and for longer periods. Should a drought last for a long period of time, water shortage becomes a larger issue. Current drought conditions in the District and the County are shown in Section 4.3.8 of the Base Plan.

Past Occurrences

There has been two state and one federal disaster declaration due to drought since 1950. This can be seen in Table 2-5.

Table 2-5 Sacramento County – State and Federal Disaster Declarations Summary 1950-2020

Disaster Type	State Declarations		Federal Declarations	
	Count	Years	Count	Years
Drought	2	2008, 2014	1	1977

Source: Cal OES, FEMA

Since drought is a regional phenomenon, past occurrences of drought for the District are the same as those for the County and includes 5 multi-year droughts over an 85-year period. Details on past drought occurrences can be found in Section 4.3.8 of the Base Plan.

Although California did recently experience an extended drought, agriculture in this District remained largely unaffected due to senior water rights and riparian water rights. Some farmers voluntarily cut water use by 25% in the Delta in response to the drought in the Summer of 2015.

ANY SPECIFIC DAMAGES FROM DROUGHTS IN THE PAST? TALK ABOUT DATES, DAMAGES, ETC HERE

Vulnerability to and Impacts from Drought and Water Shortage

Based on historical information, the occurrence of drought in California, including the District, is cyclical, driven by weather patterns. Drought has occurred in the past and will occur in the future. Periods of actual drought with adverse impacts can vary in duration, and the period between droughts can be extended. Although an area may be under an extended dry period, determining when it becomes a drought is based on impacts to individual water users. Drought impacts are wide-reaching and may be economic, environmental, and/or societal. Tracking drought impacts can be difficult.

The most significant qualitative impacts associated with drought in the Sacramento County Planning Area are those related to water intensive activities such as agriculture, wildfire protection, municipal usage, commerce, tourism, recreation, and wildlife preservation. Mandatory conservation measures are typically implemented during extended droughts. Drought conditions can also cause soil to compact and not absorb water well, potentially making an area more susceptible to flooding. With a reduction in water, water supply issues based on water rights becomes more evident. Climate change may create additional impacts to drought and water shortage in the County and the District.

During periods of drought, vegetation can also dry out which increases fire risk.

SPECIFIC VULNERABILITIES AND IMPACTS TO THE DISTRICT?

Assets at Risk

The District Planning Team noted no facilities at risk to drought.

Earthquake: Liquefaction

Likelihood of Future Occurrence–Occasional
Vulnerability–Medium

Hazard Profile and Problem Description

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

Location and Extent

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

Past Occurrences

There have be no past federal or state disaster declarations from this hazard. According to the Delta Risk Management Strategy, Brannan-Andrus Island levees have an estimated annual frequency of failure rating of 3% from flood risk and 5% from seismic risk. The annual frequency failure for a 100-year levee is 1%.

However, there is no record of a levee failure caused by a seismic event in the entire Delta region. ANYTHING TO ADD?

Vulnerability to and Impacts from Liquefaction

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

In the event an earthquake is intense enough to result in shaking that could cause the sandy soils to liquefy, the levees could resettle, move off their foundations and possibly fail. Failure could compromise the levee system and result in flooding.

WHAT ARE THE DISTRICT'S MOST SIGNIFICANT VULNERABILITIES/IMPACTS/CONCERNS FROM AN EARTHQUAKE EVENT? LIQUEFACTION?

Assets at Risk

WHAT DISTRICT ASSETS (FROM Table 2-4) ARE AT RISK FROM THIS HAZARD?

Flood: 1%/0.2% Annual Chance

Likelihood of Future Occurrence–Occasional
Vulnerability–High

Hazard Profile and Problem Description

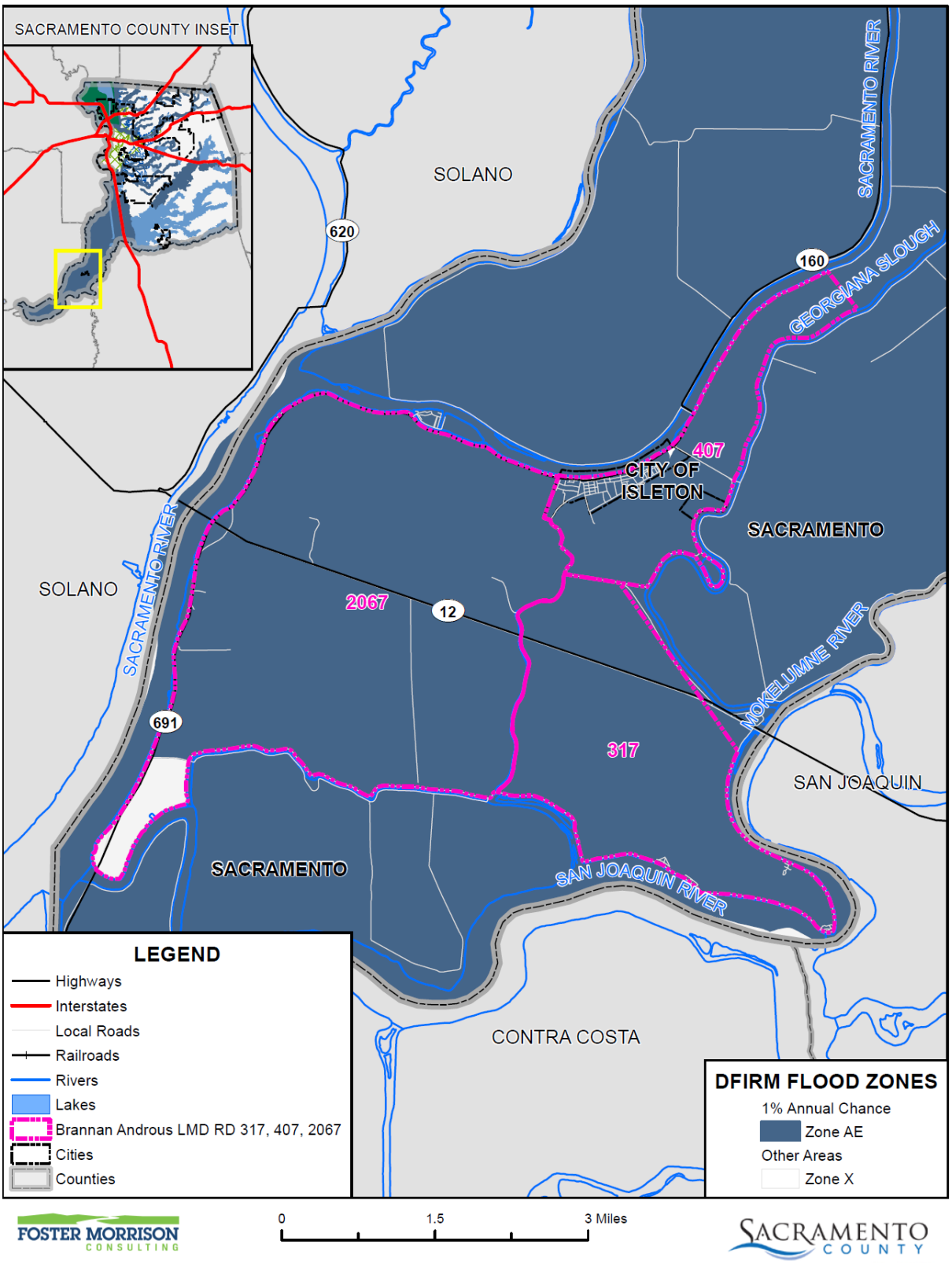
This hazard analyzes the FEMA DFIRM 1% and 0.2% annual chance floods. These tend to be the larger floods that can occur in the County or in the District, and have caused damages in the past. Flooding is a significant problem in Sacramento County and the District. Historically, the District has been at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

As previously described in Section 4.3.11 of the Base Plan, the Sacramento County Planning Area and the BALMD and RDs 317, 407, and 2067 have been subject to historical flooding.

Location and Extent

The BALMD and RDs 317, 407, and 2067 is mostly located in the 1% annual chance floodplain. This is seen in Figure 2-4.

Figure 2-4 BALMD and RDs 317, 407, and 2067 – FEMA DFIRM Flood Zones



Data Source: FEMA NFHL 07/19/2018, Brannan Androus Levee Maintenance District, Sacramento County GIS, Cal-Atlas; Map Date: 09/2020.

Table 2-6 details the DFIRM mapped flood zones within the 1% annual chance flood zone as well as other flood zones located within the District.

Table 2-6 BALMD and RDs 317, 407, and 2067– DFIRM Flood Hazard Zones

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

Source: FEMA

Additionally, flood extents can generally be measured in volume, velocity, and depths of flooding. Expected flood depths in the District vary, depending on the nature and extent of a flood event; specific depths are unknown. Flood durations in the District tend to be short to medium term, or until either the storm drainage system can catch up or flood waters move downstream. Flooding in the District tends to have a shorter speed of onset, due to the amount of water that flows through the District.

Past Occurrences

A list of state and federal disaster declarations for Sacramento County from flooding is shown on Table 2-7. These events also likely affected the District to some degree.

Table 2-7 Sacramento County – State and Federal Disaster Declarations from Flood 1950-2020

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

Source: Cal OES, FEMA

1986 was the closest the District came to experiencing a 100-year flood. The District has not experienced a 200 or 500-yr flood.

WHAT FLOOD EVENTS HAVE AFFECTED THE DISTRICT SINCE 2016? CAN THE DISTRICT PROVIDE DAMAGE AND IMPACT INFORMATION FROM ANY PA WORKSHEETS ASSOCIATED WITH THE RECENT DISASTER DECLARATIONS SINCE THE 2016 LHMP OR OTHER SOURCES?

Vulnerability to and Impacts from Flood

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

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

A 1%, 0.5%, or 0.2% annual chance flood event could cause flooding within the District. A high water event, depending on the water elevation, could cause failure due to overtopping but more realistically could increase hydraulic gradients within the levee section resulting in landside seepage or boils. Continued seepage, if left unaddressed, could erode the levee and result in failure. Heavy flows could also cause erosion and scour on the waterside bank that could undermine the levee and cause failure.

Riparian habitats that border the channel can be lost due to erosive forces of high flows from 100/200/500-year flows. The District's two nationally registered historic districts, the Isleton Chinese and the Japanese Commercial Districts could be negatively impacted from inundation due to a 100/200/500-year flood. The marinas along the Delta Loop along Georgiana Slough, Mokelumne River and the San Joaquin River could also be damaged and possibly lost as a result of high flows from a 100/200/500 year flood event.

Assets at Risk

The levee system and pumping stations are vulnerable to a 1%, 0.5%, or 0.2% annual chance flood. Higher flows from such events could exceed the capacity of both the levee system and the pumping stations that are needed to drain the island.

Flood: Localized Stormwater Flooding

Likelihood of Future Occurrence–Highly Likely
Vulnerability–High

Hazard Profile and Problem Description

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

Location and Extent

The BALMD and RDs 317, 407, and 2067 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. SPECIFIC PROBLEM AREAS?

Past Occurrences

There have been no federal or state disaster declarations in the County due to localized flooding. Some form of localized stormwater flooding occurs during most heavy rains. The most likely time this could have occurred in the past was during the wet year in 2006. BALMD and RDs 317, 407, and 2067 PAST OCCURRENCES SINCE THE 2016 LHMP

Vulnerability to and Impacts from Localized Flooding

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

Primary concerns associated with stormwater flooding include impacts to infrastructure that provides a means of ingress and egress throughout the community. Ground saturation can result in instability, collapse, or other damage to trees, structures, roadways and other critical infrastructure. Objects can also be buried or destroyed through sediment deposition. Floodwaters can break utility lines and interrupt

services. Standing water can cause damage to crops, roads, and foundations. Other problems connected with flooding and stormwater runoff include erosion, sedimentation, degradation of water quality, losses of environmental resources, and certain health hazards.

Localized stormwater flooding can occur during heavy rains or seepage events that exceed the District's drainage capabilities. Lower areas around the island may be subject to minor flooding.

Assets at Risk

Localized flooding can overtax the Districts pumping system and create a more hazardous situation involving the levee system by limiting the ability for inspection.

Levee Failure

Likelihood of Future Occurrence–Occasional
Vulnerability–Extremely High

Hazard Profile and Problem Description

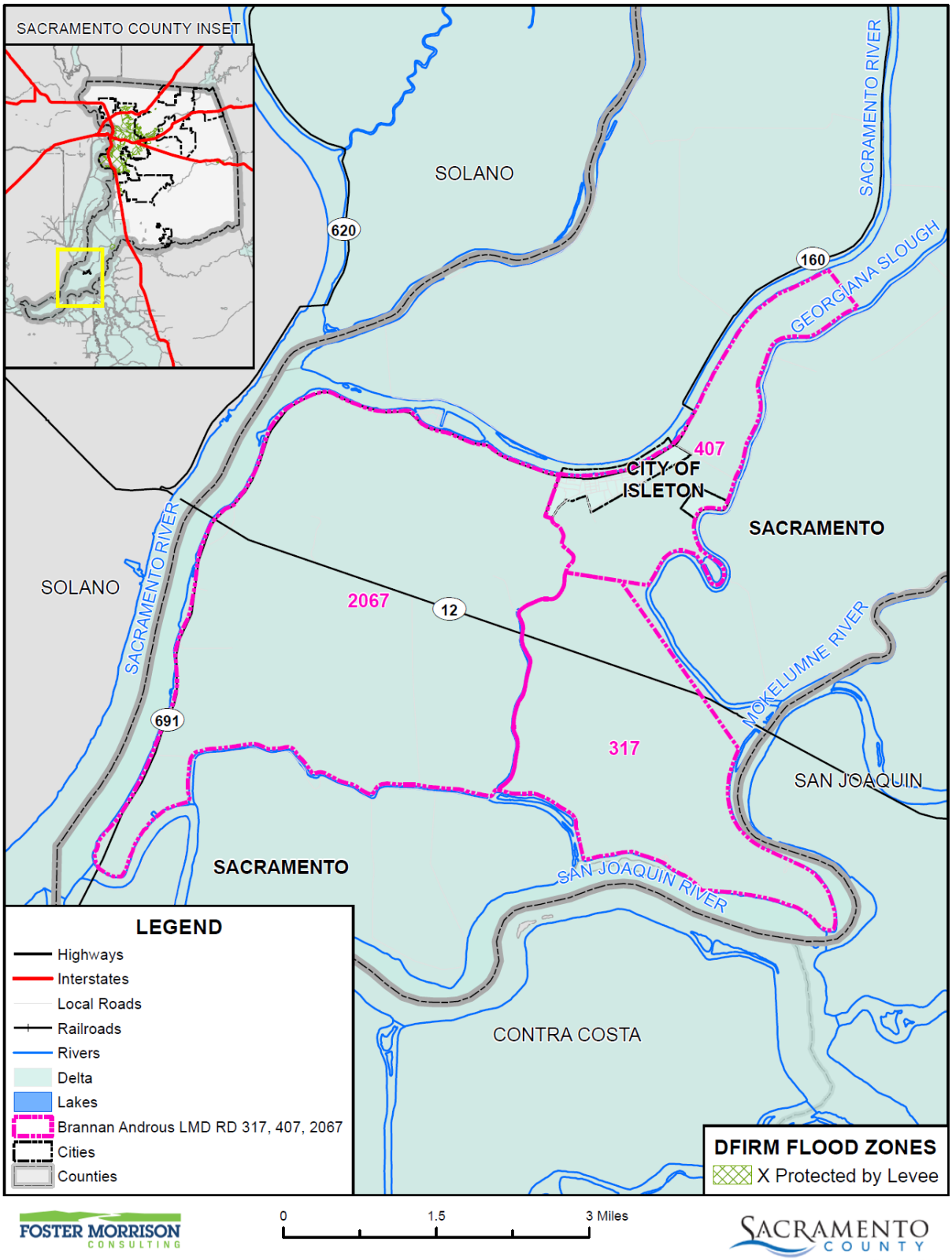
A levee is a raised area that runs along the banks of a stream or canal. Levees reinforce the banks and help prevent flooding by containing higher flow events to the main stream channel. By confining the flow to a narrower steam channel, levees can also increase the speed of the water. Levees can be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

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

Location and Extent

There is not a scientific scale or measurement system in place for levee failure. Expected flood depths from a levee failure in the District vary by event and location. The speed of onset is slow as the river rises, but if a levee fails the warning times are generally short for those in the inundation area. The duration of levee failure risk times can be hours to weeks, depending on the river flows that the levee holds back. When northern California dams and reservoirs are nearing maximum capacity, they release water through the river systems, causing additional burdens on County levees. Levee protected areas from the DFIRM in the District are shown on Figure 2-5. As shown, the levees were not certified by FEMA in the 2018 DFIRM as providing 1% annual chance flood protection.

Figure 2-5 BALMD and RDs 317, 407, and 2067 – Levee Protected Areas



Data Source: FEMA NFHL 07/19/2018, Brannan Androus Levee Maintenance District, Sacramento County GIS, Cal-Atlas; Map Date: 09/2020.

IS THERE A MAP AND TABLE OF LEVEES AND THE LOP THEY PROVIDE FOR THE DISTRICT? CAN WE ALSO GET INFORMATION ON ANY ONGOING LEVEE IMPROVEMENT PROJECTS?

Past Occurrences

There have been no federal or state disaster declarations from levee failure. The 2012 5-Year Plan reported that since the creation of the BALMD in 1967, Brannan-Andrus Island has experienced one flood event on June 22, 1972. The levee failed on the southern end of the island along the San Joaquin River. The levee breach occurred after hours during a construction effort to raise the levee and address an instability problem. The elevation of the levee crown at the time was 10.8 feet. The subsequent water level on the inundated island reached 6.2 feet. To protect the town of Isleton, a bow levee was constructed by the US Army Corps of Engineers and volunteers. The bow levee only held for 36 hours. When it failed, 35% of the Isleton community was inundated.

The flood resulted in a "big gulp" effect, where the salt water from Suisun Bay moved into the central and southern Delta, decreasing the Delta's freshwater outflow. The saltwater intrusion degraded water quality for central Delta farms and forced pumping to be cut back at the Central Valley Project pumping plant in Tracy. In order to push back the salinity gradient, a hydraulic barrier was created by increasing water releases from Folsom, Oroville, and Shasta reservoirs. Still, it took those releases several days to reach the affected Delta areas. After releasing over 150,000 acre feet of water, salinity levels were eventually restored to pre-flood levels. It took eight weeks of pumping to dewater the Brannan-Andrus Island.

The USACE spent $1.4 million to repair the breach with another $1.0 million used in federal disaster assistance totaling $2.4 million. In addition, numerous marinas and restaurants suffered from a loss of business and the flood's negative publicity. Crops were lost and intrastate commerce was disrupted. When adding up all of the flood's indirect costs, including the diversion of fresh water destined for CVP customers, it was estimated that the total economic impact of the 1972 Brannan-Andrus flood was approximately $40 million.

The BALMD became concerned about another levee failure during a high water event in 1997, when a section of the landside slope sloughed into a toe ditch along the Georgiana Slough levee. The USACE spent over $1.1 million to stabilize approximately 6,700 lineal feet of levee.

ANYTHING SINCE 2016? PROVIDE DATES AND DAMAGES.

Vulnerability to and Impacts from Levee Failure

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

Should a levee fail, some or all of the area protected by the levees would be at risk to flooding. Impacts from a levee failure include property damage, critical facility damage, and life safety issues. Business and economic losses could be large as facilities could be flooded and services interrupted. School and road closures could occur. Road closures would impede both evacuation routes and ability of first responders

to quickly respond to calls for aid. Other problems connected with levee failure flooding include erosion, sedimentation, degradation of water quality, losses of environmental resources, and certain health hazards.

Levee failure could result in inundation of the Districts and could also result in the flooding of Brannan and lower Andrus islands.

As previously stated, BALMD monitors and maintains the levees on the island. Reclamation Districts 407, 2067, and 317 maintain and control the operations of the seven pumping stations to keep the island dry. Five pumping stations are located along Sevenmile Slough, another is on Georgiana Slough, and a lift station is located on the main drainage canal in the northern part of the island.

The 5-Year Plan noted that to repair a levee breach the average cost has been estimated to be approximately $25 million. But the total cost truly depends on the accessibility, size and severity of the breach, the size of the island, volume of water to be pumped out, weather conditions, etc. The $25 million figure assumes costs of $5/yd^3 of on-island replacement fill, $15/yd^3 of off-island fill, 6% per foot of engineering costs, and $5/foot for rip rap. A summer levee breach occurred on Brannan-Andrus in 1972 (discussed above). The Jones Tract failure in 2004, the most recent levee failure, provides insight into determining what a levee breach could cost today. It has been publicized that this 500 foot breach cost approximately $90 million for repair, recovery, and associated damage. However, many knowledgeable locals consider that figure inflated by as much as a factor of two.

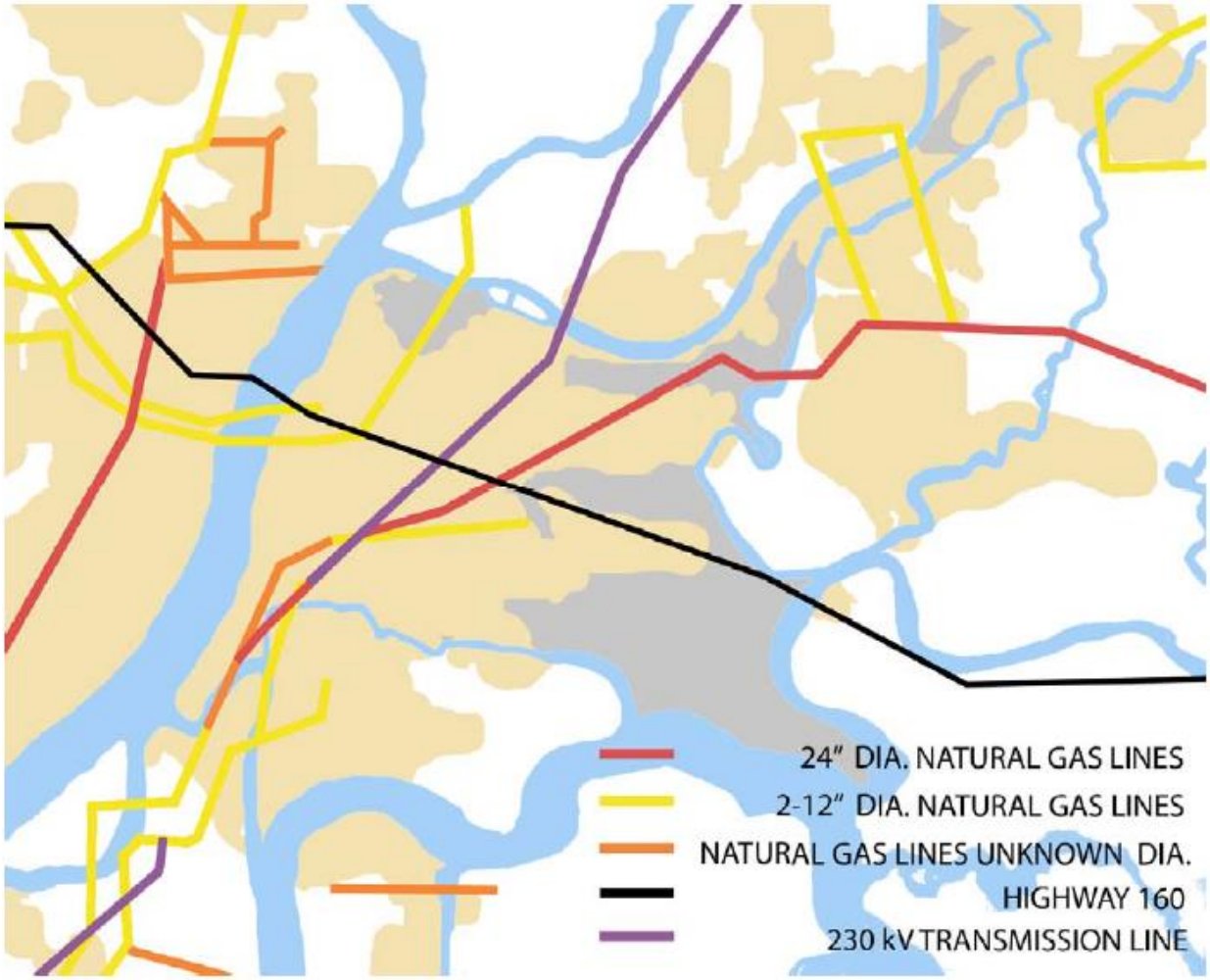
The 5-Year Plan broke down costs by land use type. ANY UPDATE TO THIS?

- **Residential** – The costs associated with inundation are taken from FEMA's method for estimating displacement. This includes a one-time cost of $500 per flooded household, a cost of $500 per month of inundation per household, and a monthly rental cost of $747. For Brannan-Andrus, it is estimated that there could be a one-time displacement cost of $182,400 for all occupied households along with an additional $15,600 per day to house these residents elsewhere. In addition to the residents, the various resorts on the island generate a transient population. To house this population in emergency shelters it could cost an estimated $85 per person per day. There are no reliable statistics covering that element of the population to determine a total cost per day for emergency housing, since the population fluctuates with the seasons. Flooding threats usually allow sufficient time to evacuate, so the costs to accommodate this unique group of part-time residents may not be significant.
- **Commercial** – Commercial structures will be adversely impacted from the time they are inundated through the time it takes to repair such damage and damage to surrounding infrastructure. For any business that is flooded FEMA assumes a one-time displacement cost of $1000, for a total of $148,000. Upon inundation, the businesses are assumed to have $77,500 of lost output value, $3,900 of lost profit, and $44,000 of lost value added per day on average. "Value added" is the sum of wages and salaries, proprietor's incomes, other property income, and indirect business taxes (URS 67). When a flood occurs, the island businesses could lose $140 million in sales for that year. Four-hundred seventy-one jobs could be lost per day over the duration of inundation. Overall, a flood could cost Brannan-Andrus Island businesses about $125,400 per day. Some businesses may be unable to recover from a flood and could possibly be lost as a result of such an event.
- **Agricultural** – Main crops grown on Brannan-Andrus Island are alfalfa, corn, wheat, pears, apples, cherries, and wine grapes. Brannan-Andrus Island has 10,517 acres of crops. Average cost for rehabilitation and field cleanup is $235 per acre. This involves the removal of debris and sediment deposits after floodwaters have receded. Silt and debris can also clog drainage and irrigation ditches adding a variable cost to rehabilitation. The estimated total one-time cost for clean-up and rehabilitation

is estimated to be $2.0 million. If inundation lasts longer than 14 days, it is assumed that the crops will be permanently lost. In 1972, it took eight weeks to pump out the island. Using that estimate, essentially all crops could be lost in a similar flood event. Any flood event that occurs between planting and harvest, could completely destroy the crops. Reestablishment of a lost crop dramatically increases economic losses. The inundation period is assumed to be five weeks on lower Tyler Island, meaning all crops on the lower end could potentially be lost in a flood event. However, due to the smaller size of RD 554 and an assumed inundation period of five days, not all crops may be lost. Not including clean-up costs, reestablishment of all crops on the island could total an estimated $23.9 million. In addition to reestablishment costs, a flood could also result in annual crop production losses. Annual crop production losses are incurred from the time of the flood and depend on how long inundation occurs, cleanup and the time required for the crops to produce a harvestable yield. If a flood occurs between planting and harvest, the crop will be lost for the year. Planting on Brannan-Andrus begins in April and harvest ends by October. This report adds two months onto the planting season since it is estimated to take two months before the soils are dry enough for planting. As a result, the critical flood season for crops really occurs between February and October. If planting cannot occur within the same year as the flood event, annual production losses from orchards and vineyards could amount to about $17 million. If an event occurs between February and October, pushing planting to the following year, annual production losses will be about $26.8 million. Degraded water quality from salinity intrusion can also reduce crop yields.

The Brannan-Andrus Island levee system also protects several critical infrastructure components. There is an approximately 18-mile network of roads that include State Highway 12 (4.21 mi.) and Highway 160 (8 mi.) which provide east-west and north-south links with interstate corridors. A power transmission line, sized at about 230kV runs about 3.6 miles down the center of the island to the south end, through Brannan Island State Park. There are approximately 9,088 acres of underground gas fields and storage areas with a total of 33 natural gas wells and 157 gas/oil wells. The areas in beige represent the natural gas fields. A Lodi Gas' natural gas pipeline (24" diameter) runs west to east across the island feeding two 2-12" diameter pipelines. In total there are about 14.3 miles of PG&E pipeline with natural gas production at about 5,117,858 mcf. These are all shown on Figure 2-6.

Figure 2-6 PG&E Natural Gas Pipelines, Gas Fields, Storage Areas, and Transmission Lines



Source: 2012 5-Year Plan

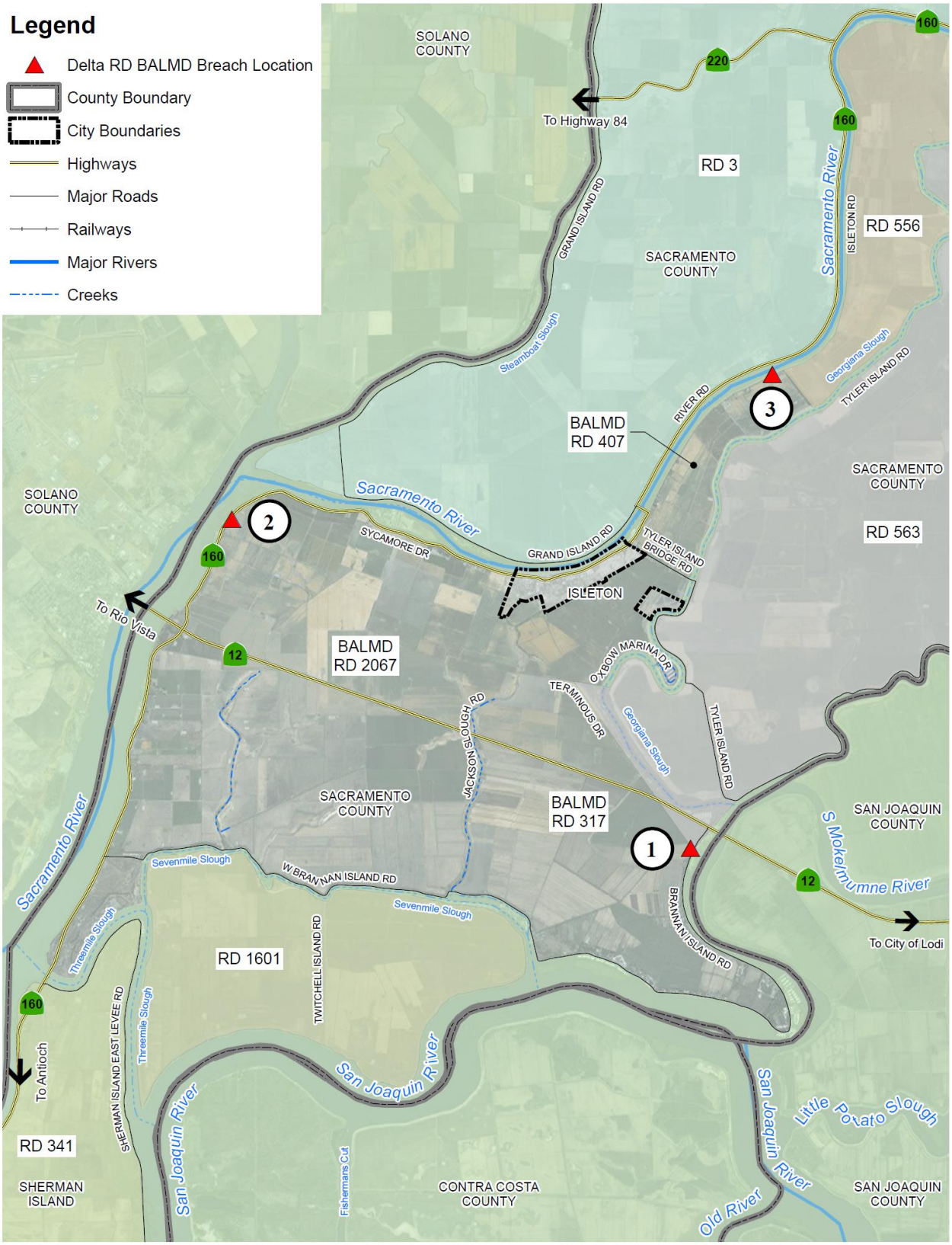
StormReady Flood Scenarios and Evacuation Routes

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 BALMD and RDs 317, 407, and 2067, Figure 2-7 details the locations in the Delta within BALMD and RDs 317, 407, and 2067 where flooding could occur. The red triangles denote potential levee breach locations. BALMD and RDs 317, 407, and 2067 has three potential levee break scenarios. Maps for Scenario 1 regarding time to one foot inundation (Figure 2-8), estimated flood depths (Figure 2-9), and

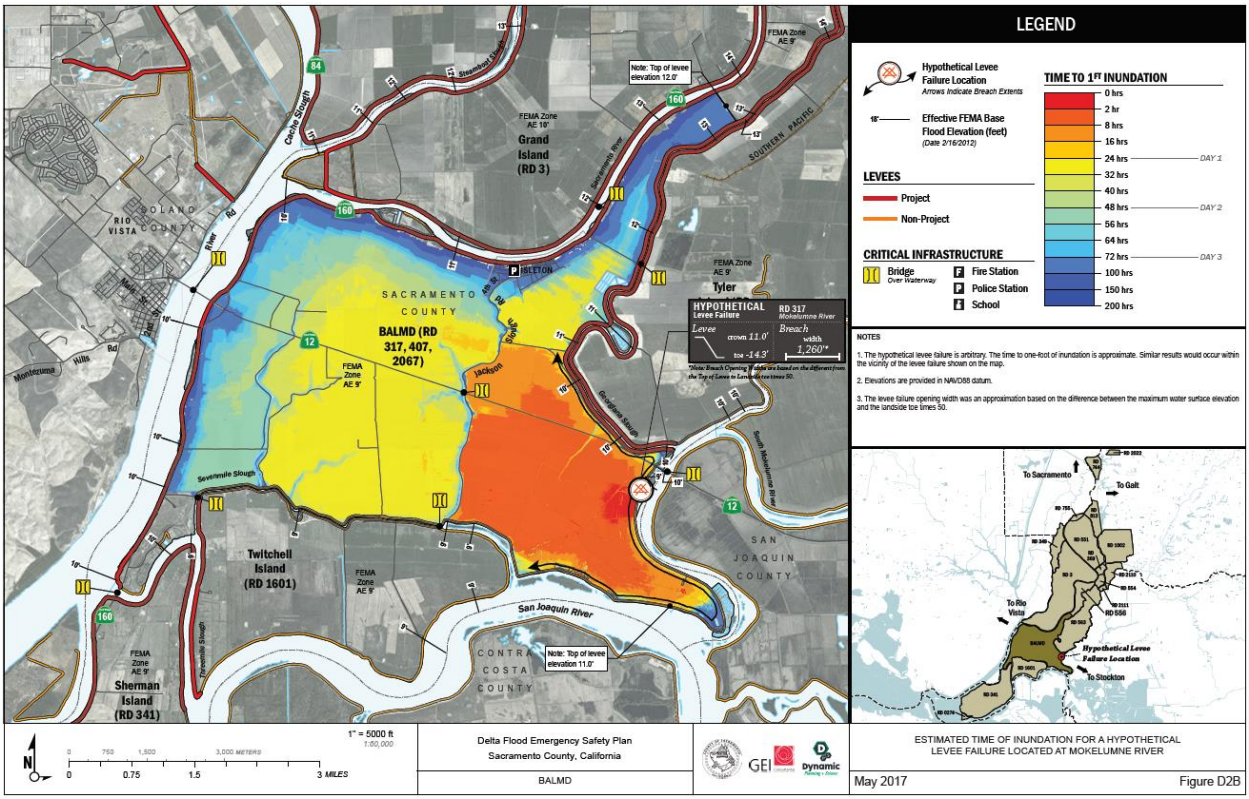
suggested evacuation routes (Figure 2-10) are displayed below. Maps for Scenario 2 and 3 can be found on the Sacramento County stormready.org website.

Figure 2-7 BALMD and RDs 317, 407, and 2067 – Potential Levee Breach Location



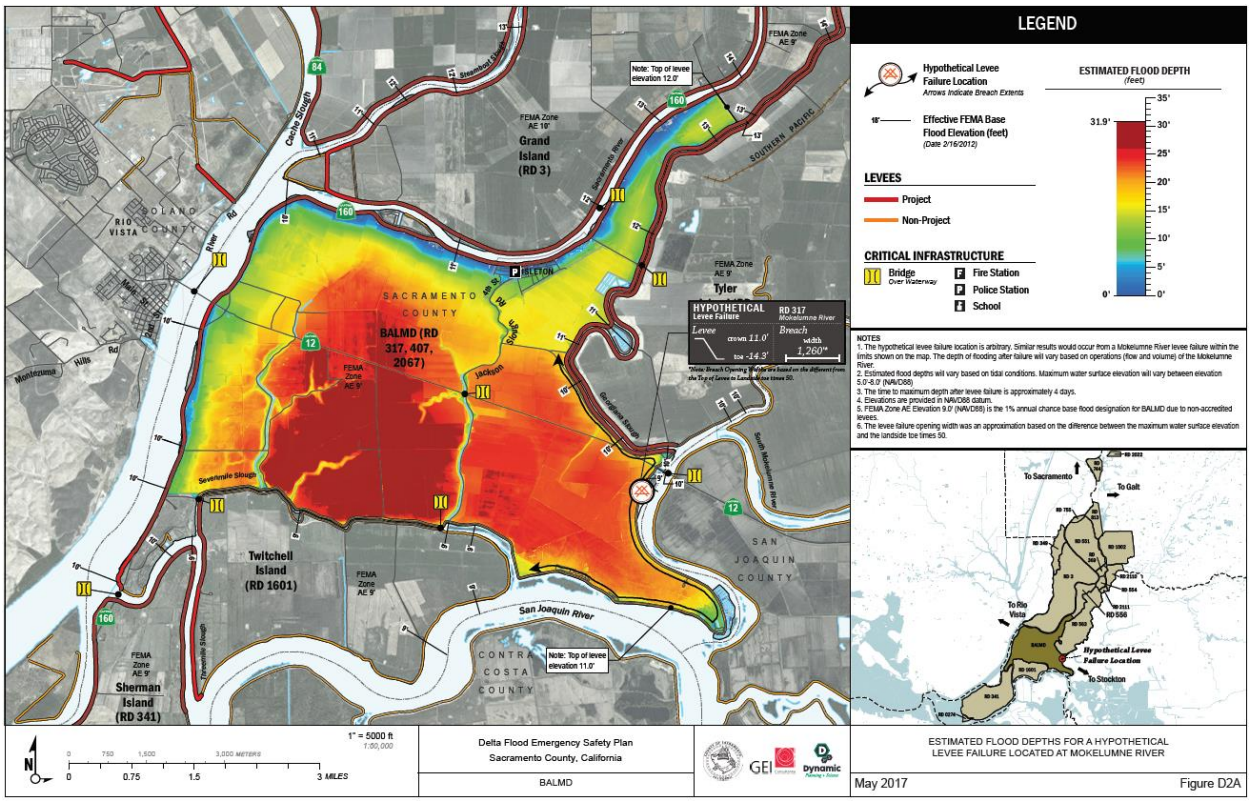
Source: Sacramento County Storm Ready – retrieved March 25, 2021

Figure 2-8 BALMD and RDs 317, 407, and 2067 – Time to One Foot Inundation after Levee Breach



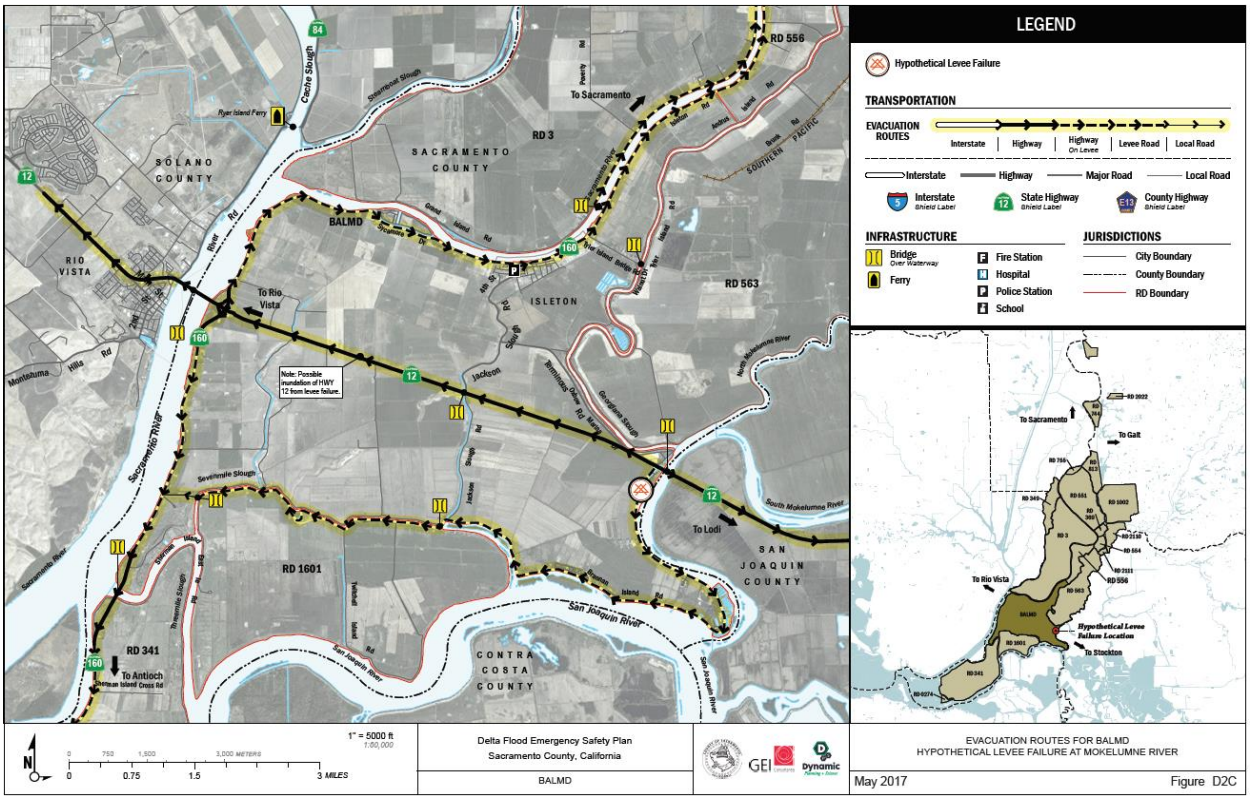
Source: Sacramento County Storm Ready – retrieved March 25, 2021

Figure 2-9 BALMD and RDs 317, 407, and 2067 – Estimated Flood Depth from Levee Breach Scenario



Source: Sacramento County Storm Ready – retrieved March 25, 2021

Figure 2-10 BALMD and RDs 317, 407, and 2067 – Levee Breach Scenario Evacuation Routes



Source: Sacramento County Storm Ready – retrieved March 25, 2021

Assets at Risk

Levees and district pumping plant. On island inundation can create an open water situation where a large fetch could develop and erode the interior of other levees within the District. Inundation of the drainage pumps and system can make them inoperable and require replacement. Other critical facilities at risk include two fire departments, Isleton city offices and an elementary school.

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

Likelihood of Future Occurrence–Highly Likely
Vulnerability–Medium

Hazard Profile and Problem Description

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

Location and Extent

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

Past Occurrences

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

There are heavy storms that occur every year. The last heavy rain and storm event that raised river levels the District experienced was in 2006, 1997 and 1986. No significant damages occurred due to these high water events. PROVIDE INFORMATION ON SPECIFIC EVENTS SINCE 2016.

Vulnerability to and Impacts from Heavy Rain and Storms

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

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

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

Heavy rains and storms can result in higher flood flows that could increase the hydraulic gradients within the levee section and result in seepage or if great enough, possibly overtopping. They can also increase flows and result in erosion of the waterside bank.

Assets at Risk

The Planning Team for the District noted that the District levees and pumping plant are at risk of damage from heavy rains and storms.

Severe Weather: High Winds and Tornadoes

Likelihood of Future Occurrence–Highly Likely
Vulnerability–Medium

Hazard Profile and Problem Description

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

Tornadoes are rotating columns of air marked by a funnel-shaped downward extension of a cumulonimbus cloud whirling at destructive speeds of up to 300 mph, usually accompanying a thunderstorm. Tornadoes form when cool, dry air sits on top of warm, moist air. Tornadoes are the most powerful storms that exist. Tornadoes, though rare, are another severe weather hazard that can affect areas of the Sacramento County Planning Area, primarily during the rainy season in the late fall, winter, and early spring.

Location and Extent

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

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

Past Occurrences

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

Wind occurs on a regular basis. The concerns come when high winds are coupled with high water creating wave actions, which happened in the winter of 2006. The District went on levee patrols during this time to monitor waves washing over the levee along the Mokelumne and San Joaquin River from the high winds coupled with high winter flows and high tide. No damages occurred as a result of the event. ANYTHING SINCE 2016?

Vulnerability to and Impacts from Severe Weather: Wind and Tornado

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

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

- Downed trees
- Power line impacts and economic losses from power outages
- Occasional building damage, primarily to roofs

In the event of high water, the biggest concern to the District are the winds that create wave action that causes erosion at the waterside bank of the District's levees.

Assets at Risk

The Planning Team for the District noted that the District levees and pumping plant are at risk of damage from high winds.

Wildfire

Likelihood of Future Occurrence–Likely
Vulnerability–Medium

Hazard Profile and Problem Description

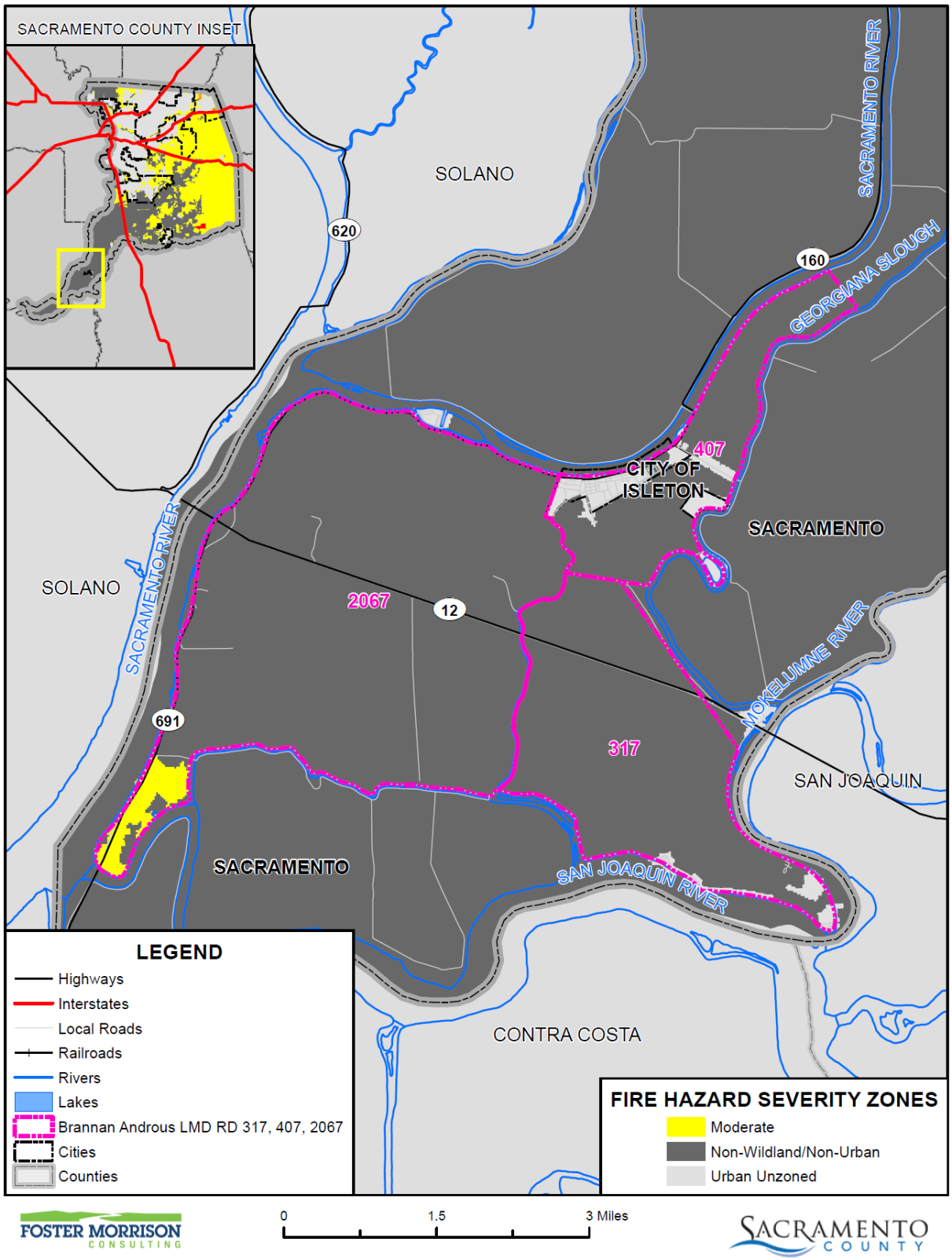
Wildland fire and the risk of a conflagration is an ongoing concern for the BALMD and RDs 317, 407, and 2067. Throughout California, communities are increasingly concerned about wildfire safety as increased development in the foothills and mountain areas and subsequent fire control practices have affected the natural cycle of the ecosystem. Wildland fires affect grass, forest, and brushlands, as well as any structures located within them. Where there is human access to wildland areas the risk of fire increases due to a greater chance for human carelessness and historical fire management practices. Historically, the fire season extends from early spring through late fall of each year during the hotter, dryer months; however, in recent years, the risk of wildfire has become a year around concern. Fire conditions arise from a combination of

high temperatures, low moisture content in the air and fuel, accumulation of vegetation, and high winds. While wildfire risk has predominantly been associated with more remote forested areas and wildland urban interface (WUI) areas, significant wildfires can also occur in more populated, urban areas.

Location and Extent

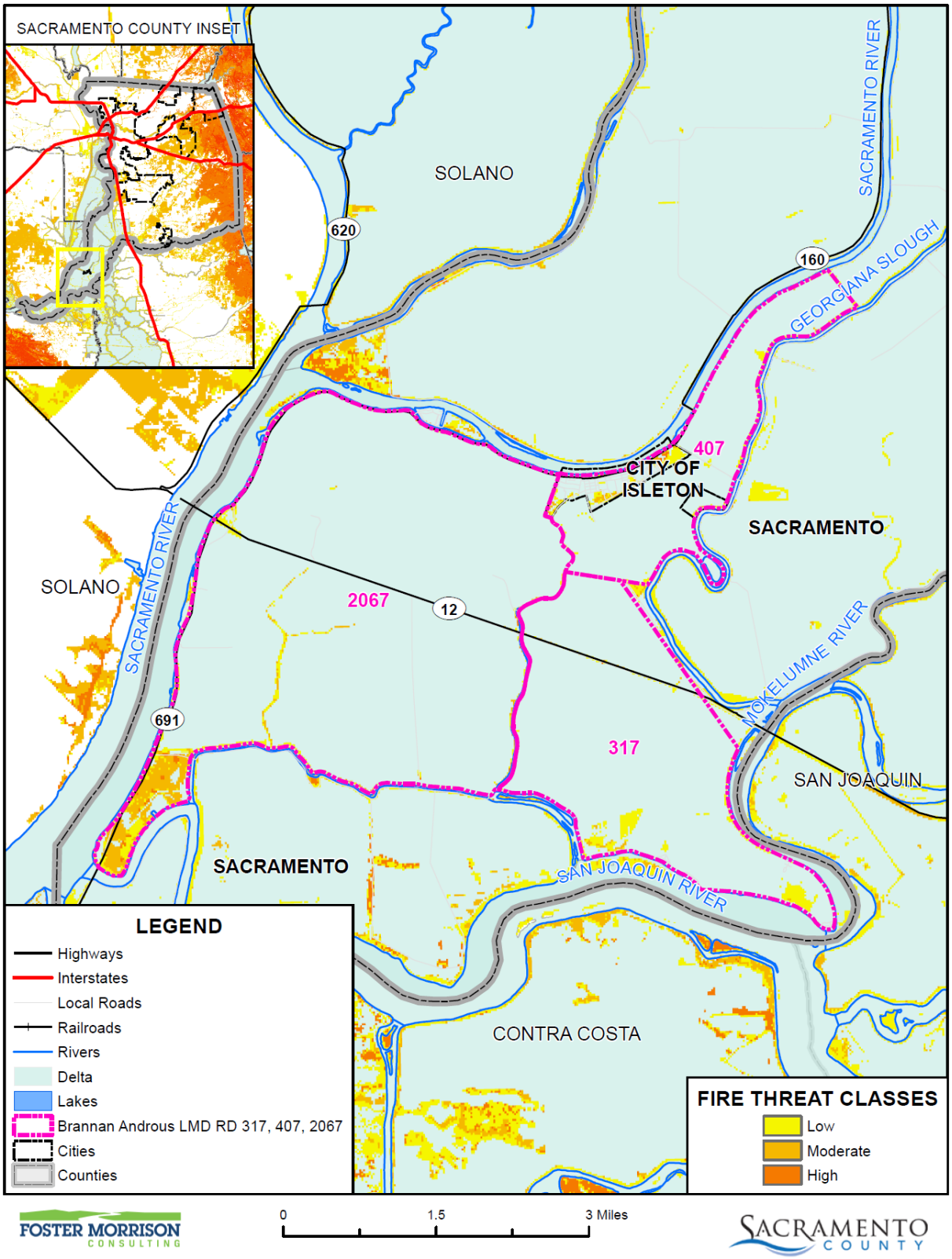
Wildfire can affect all areas of the District. CAL FIRE has estimated that the risk varies across the District and has created maps showing risk variance. Following the methodology described in Section 4.3.16 of the Base Plan, wildfire maps for the BALMD and RDs 317, 407, and 2067 were created. Figure 2-11 shows the CAL FIRE FHSZ in the District. As shown on the maps, fire hazard severity zones within the District range from Non-Wildland/Non-Urban to Moderate. Figure 2-12 shows the CAL FIRE Fire Threat areas in the District. As shown on the maps, fire hazard severity zones within the District range from No Threat to High.

Figure 2-11 BALMD and RDs 317, 407, and 2067 – Fire Hazard Severity Zones



Data Source: Cal-Fire 2017 (Draft 9/2007 - c34fhszl06_1, Adopted 11/2007 - fhsz06_3_34, Recommended 10/2008 - c34fhszl06_3), Brannan Androus Levee Maintenance District, Sacramento County GIS, Cal-Atlas; Map Date: 09/2020.

Figure 2-12 BALMD and RDs 317, 407, and 2067 – Fire Threat Areas



Data Source: Cal-Fire 2017 Fire Threat Data (fthrt14_2), Brannan Androus Levee Maintenance District, Sacramento County GIS, Cal-Atlas; Map Date: 09/2020.

Wildfires tend to be measured in structure damages, injuries, and loss of life as well as on acres burned. Fires can have a quick speed of onset, especially during periods of drought or during hot dry summer months. Fires can burn for a short period of time, or may have durations lasting for a week or more.

Past Occurrences

There has been one state and no federal disaster declarations for Sacramento County from fire. It should be noted that this was from Southern Pacific Railroad Fires and Explosions (Roseville), so it was not truly a wildfire. This event did not affect the District.

Table 2-8 Sacramento County – State and Federal Disaster Declarations Summary 1950-2020

Disaster Type	State Declarations		Federal Declarations	
	Count	Years	Count	Years
Fire	1	1973	0	–

Source: Cal OES, FEMA

WILDFIRES TO AFFECT THE DISTRICT. NEED DATES, DAMAGES, ETC. INCLUDE ANY SMOKE/AIR QUALITY ISSUES

Vulnerability to and Impacts from Wildfire

Risk and vulnerability to the Sacramento County Planning Area and the District from wildfire is of significant concern, with some areas of the Planning Area being at greater risk than others as described further in this section. High fuel loads in the Planning Area, combined with a large built environment and population, create the potential for both natural and human-caused fires that can result in loss of life and property. These factors, combined with natural weather conditions common to the area, including periods of drought, high temperatures, low relative humidity, and periodic winds, can result in frequent and potentially catastrophic fires. During the May to October fire season, the dry vegetation and hot and sometimes windy weather results in an increase in the number of ignitions. Any fire, once ignited, has the potential to quickly become a large, out-of-control fire. As development continues throughout the County and the District, especially in these interface areas, the risk and vulnerability to wildfires will likely increase.

Potential impacts from wildfire include loss of life and injuries; damage to structures and other improvements, natural and cultural resources, croplands, and loss of recreational opportunities. Wildfires can cause short-term and long-term disruption to the District. Fires can have devastating effects on watersheds through loss of vegetation and soil erosion, which may impact the District by changing runoff patterns, increasing sedimentation, reducing natural and reservoir water storage capacity, and degrading water quality. Fires can also affect air quality in the District; smoke and air pollution from wildfires can be a severe health hazard.

Although the physical damages and casualties arising from large fires may be severe, it is important to recognize that they also cause significant economic impacts by resulting in a loss of function of buildings and infrastructure. Economic impacts of loss of transportation and utility services may include traffic delays/detours from road and bridge closures and loss of electric power, potable water, and wastewater services. Schools and businesses can be forced to close for extended periods of time. Recently, the threat

of wildfire, combined with the potential for high winds, heat, and low humidity, has caused PG&E to initiate PSPSs which can also significantly impact a community through loss of services, business closures, and other impacts associated with loss of power for an extended period. More information on power shortage and failure can be found at the beginning of Section 2.5.3 above, as well as in Section 4.3.3 of the Base Plan. In addition, catastrophic wildfire can create favorable conditions for other hazards such as flooding, landslides, and erosion during the rainy season.

A wildfire could destroy private property and other such structures on the island.

Assets at Risk

The District's pumping stations could be damaged in a fire. Furthermore the vegetation on the District levees could be burned leaving bare soil that could be subject to erosion. Riparian and shrub scrub vegetation could be lost in a wildfire. Wildfire has the potential to irreparably destroy the historic Chinese and the Japanese Commercial Districts.

2.6 Capability Assessment

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

2.6.1. Regulatory Mitigation Capabilities

Table 2-9 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 BALMD and RDs 317, 407, and 2067. UPDATE TABLE – THIS IS FROM THE OLD PLAN. TRY TO FILL OUT THE LAST COLUMN AS YOU ARE ABLE. MAKE SURE TO FILL OUT THE LAST CELL

Table 2-9 BALMD and RDs 317, 407, and 2067 Regulatory Mitigation Capabilities

Plans	Y/N Year	Does the plan/program address hazards? Does the plan identify projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?
Comprehensive/Master Plan/General Plan	N	
Capital Improvements Plan	N	
Economic Development Plan	N	
Local Emergency Operations Plan	Y	The plan addresses flooding hazards and can be used to implement mitigation actions
Continuity of Operations Plan	Y	
Transportation Plan	N	
Stormwater Management Plan/Program	N	

Engineering Studies for Streams	N	
Community Wildfire Protection Plan	N	
Other special plans (e.g., brownfields redevelopment, disaster recovery, coastal zone management, climate change adaptation)	N	
Building Code, Permitting, and Inspections	**Y/N**	**Are codes adequately enforced?**
Building Code	Y	Version/Year: CBC 2013
Building Code Effectiveness Grading Schedule (BCEGS) Score	N	Score:
Fire department ISO rating:	N	Rating:
Site plan review requirements	N	
Land Use Planning and Ordinances	**Y/N**	**Is the ordinance an effective measure for reducing hazard impacts? Is the ordinance adequately administered and enforced?**
Zoning ordinance	Y	Sacramento County Zoning Code
Subdivision ordinance	N	
Floodplain ordinance	Y	Yes, Sacramento County Floodplain Ordinance restricts development in the floodplain
Natural hazard specific ordinance (stormwater, steep slope, wildfire)	N	
Flood insurance rate maps	Y	AE Zone
Elevation Certificates	Y	
Acquisition of land for open space and public recreation uses	N	
Erosion or sediment control program	Y	5-YEAR PLAN
Other	N	
How can these capabilities be expanded and improved to reduce risk?		
PROVIDE SPECIFIC DETAILS OF AREAS FOR IMPROVEMENT OF THESE TYPES OF CAPABILITIES AND HOW/WHY IT WILL HELP THE DISTRICT		

Source: BALMD and RDs 317, 407, and 2067

ANY MITIGATION RELATED PLANS? CAN WE GET COPIES?

2.6.2. Administrative/Technical Mitigation Capabilities

Table 2-10 identifies the District department(s) responsible for activities related to mitigation and loss prevention in BALMD and RDs 317, 407, and 2067. UPDATE TABLE – THIS IS FROM THE OLD PLAN. TRY TO FILL OUT THE LAST COLUMN AS YOU ARE ABLE. MAKE SURE TO FILL OUT THE LAST CELL

Table 2-10 BALMD and RDs 317, 407, and 2067's Administrative and Technical Mitigation Capabilities

Administration	Y/N	Describe capability Is coordination effective?
Planning Commission	N	
Mitigation Planning Committee	N	
Maintenance programs to reduce risk (e.g., tree trimming, clearing drainage systems)	Y	Annual vegetation management
Mutual aid agreements	N	
Other	N	
Staff	**Y/N FT/PT**	**Is staffing adequate to enforce regulations? Is staff trained on hazards and mitigation? Is coordination between agencies and staff effective?**
Chief Building Official	N	
Floodplain Administrator	Y	Determined via the Emergency Operations Plan
Emergency Manager	Y	Determined via the Emergency Operations Plan
Community Planner	N	
Civil Engineer	Y, FT	Staff is trained to coordinate with agencies and perform tasks in an emergency situation
GIS Coordinator	N	
Other	N	
Technical		
Warning systems/services (Reverse 911, outdoor warning signals)	Y	Phone tree, Reverse 911
Hazard data and information	Y	
Grant writing	N	
Hazus analysis	N	
Other	N	
How can these capabilities be expanded and improved to reduce risk?		
BALMD can develop an improved warning system among trustees, public and staff. ANYTHING TO ADD?		

Source: BALMD and RDs 317, 407, and 2067

2.6.3. Fiscal Mitigation Capabilities

Table 2-11 identifies financial tools or resources that the District could potentially use to help fund mitigation activities. UPDATE TABLE – THIS IS FROM THE OLD PLAN. TRY TO FILL OUT THE LAST COLUMN AS YOU ARE ABLE. MAKE SURE TO FILL OUT THE LAST CELL

Table 2-11 BALMD and RDs 317, 407, and 2067's Fiscal Mitigation Capabilities

Funding Resource	Access/ Eligibility (Y/N)	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Capital improvements project funding	Y	Delta Levees Subventions program to maintain levee system.
Authority to levy taxes for specific purposes	Y	Proposition 218 provides the District with the ability to raise assessments through a vote
Fees for water, sewer, gas, or electric services	N	
Impact fees for new development		Unknown, would be dictated by Sacramento County
Storm water utility fee	Y	Assessments are developed for drainage
Incur debt through general obligation bonds and/or special tax bonds	N	
Incur debt through private activities	Y	Bonds are obtained from the Bank of Rio Vista
Community Development Block Grant	N	
Other federal funding programs	N	
State funding programs	Y	Delta Levee Subventions Program and Delta Levee Special Projects, Proposition 84 and 1E
Other	N	
How can these capabilities be expanded and improved to reduce risk?		
The involvement of Federal agencies funds would help in reducing risk as well as the removal of the sunset clause on the Delta Levees Subventions Program. ANYTHING TO ADD?		

Source: BALMD and RDs 317, 407, and 2067

2.6.4. Mitigation Education, Outreach, and Partnerships

Table 2-12 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. UPDATE TABLE – THIS IS FROM THE OLD PLAN. TRY TO FILL OUT THE LAST COLUMN AS YOU ARE ABLE. MAKE SURE TO FILL OUT THE LAST CELL

Table 2-12 BALMD and RDs 317, 407, and 2067's Mitigation Education, Outreach, and Partnerships

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

Program/Organization	Yes/No	Describe program/organization and how relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?
Natural disaster or safety related school programs	N	
StormReady certification	N	
Firewise Communities certification	N	
Public-private partnership initiatives addressing disaster-related issues	N	
Other	N	
How can these capabilities be expanded and improved to reduce risk?		
PROVIDE SPECIFIC DETAILS OF AREAS FOR IMPROVEMENT OF THESE TYPES OF CAPABILITIES AND HOW/WHY IT WILL HELP THE DISTRICT		

Source: BALMD and RDs 317, 407, and 2067

2.6.5. Other Mitigation Efforts

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

- The Districts do annual erosion repair and seepage abatement projects. There are currently two large projects in the planning stages that will address critical erosion sites on the Sacramento River and Georgiana Slough. The Districts are also updating their Five Year Plan with levee repair and enhancement projects to continue to maintain and improve the levee system. UPDATE THIS
- ANYTHING NOT CAPTURED ABOVE? PLEASE INCLUDE ALL LEVEE RELATED IMPROVEMENT PROJECTS AND OTHER DISTRICT MITIGATION PROJECTS, INCLUDING THOSE ONGOING AND SINCE THE 2016 LHMP,

2.7 Mitigation Strategy

2.7.1. Mitigation Goals and Objectives

The BALMD and RDs 317, 407, and 2067 adopts the hazard mitigation goals and objectives developed by the HMPC and described in Chapter 5 Mitigation Strategy.

2.7.2. Mitigation Actions

The planning team for the BALMD and RDs 317, 407, and 2067 identified and prioritized the following mitigation actions based on the risk assessment. Background information and information on how each action will be implemented and administered, such as ideas for implementation, responsible office, potential funding, estimated cost, and timeline are also included. The following hazards were considered a priority for purposes of mitigation action planning:

- Dam Failure
- Drought & Water Shortage
- Earthquake Liquefaction
- Floods: 1%/0.2% annual chance

- Floods: Localized Stormwater
- Levee Failure
- Severe Weather: Heavy Rains and Storms
- Severe Weather: Wind and Tornado
- Wildfire

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

WILL NEED MITIGATION ACTIONS FOR EACH HAZARD IN THE BULLETED LIST ON THE PREVIOUS PAGE. ONE ACTION MAY ADDRESS MORE THAN ONE HAZARD. MITIGATION ACTIONS WERE DISCUSSED AT THE 3/30/2021 LHMP MEETING

Multi-Hazard Actions

Action 1.

Hazards Addressed:

Goals Addressed:

Issue/Background:

Other Alternatives:

Existing Planning Mechanisms through which Action will be Implemented:

Responsible Office:

Priority (H, M, L):

Cost Estimate:

Potential Funding:

Benefits (avoided Losses):

Schedule: