Annex G Reclamation District 479

G.1 Introduction

This Annex details the hazard mitigation planning elements specific to the Reclamation District 479 (RD 479 or District), a new participating jurisdiction to the 2024 Colusa County Local Hazard Mitigation Plan (LHMP) Update. This Annex is not intended to be a standalone document but appends to and supplements the information contained in the Base Plan document. As such, all sections of the Base Plan, including the planning process and other procedural requirements apply to and were met by the District. This Annex provides additional information specific to RD 479, with a focus on providing additional details on the planning process, risk assessment, and mitigation strategy for this District.

G.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 Colusa 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 G-1. Additional details on Plan participation and District representatives are included in Appendix A.

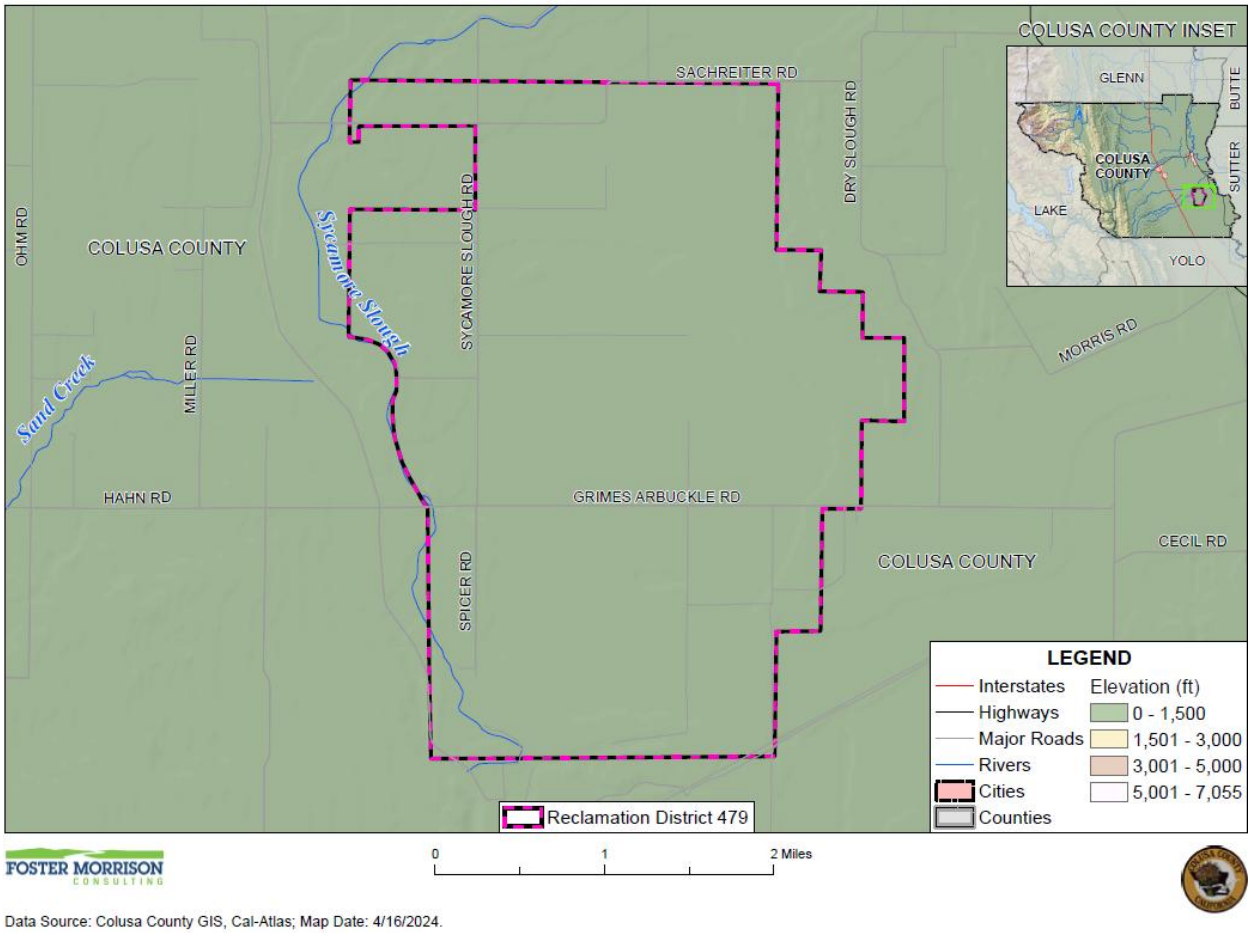
Table G-1 RD 479 – Planning Team

Name	Position/Title	How Participated
Derick Strain	President	Attended LHMP Meetings and provided all paperwork and input to Annex.

G.3 District Profile

The District profile for RD 479 is detailed in the following sections. Figure G-1 displays a map and the location of the District within Colusa County.

Figure G-1 RD 479



Data Source: Colusa County GIS, Cal-Atlas; Map Date: 4/16/2024.

G.3.1. Overview and Background

Reclamation District 479 is located south of Colusa and north of RD 108. The District is almost completely within the Sacramento River West Side Levee District with a total acreage of 5,951.97. RD 479 was formed in 1885 and covers the southern part of the Mormon Basin, a portion of the much larger Colusa Basin. The chief characteristic of these basins is that their edges or rims have been built up by alluvial deposits during flood periods so that the edges are higher than the central portion of the area.

RD 479's purpose and primary objective is to manage drainage water for over 6,000 acres in the Mormon Basin, a part of the much larger Colusa Basin. The District is primarily concerned with drain water and makes sure that all of the drain water enters the 2047 canal. Though its name does not indicate it, the District also serves as a flood control agency to keep the water in the basin, especially during wet winters, from adversely affecting public travel, namely on Grimes-Arbuckle Rd. It is very important that this district's infrastructure is properly maintained and cared for to primarily serve the needs of the farmers and their farmland, along with serving local landowners, the county, and those who travel through it.

G.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 479 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 to hazards and provides a framework for developing and prioritizing mitigation actions to reduce risk from future hazard events.

Building on the Overview and Background above, a risk assessment was performed for the District. This includes the following sections:

- G.4.1 District Assets Inventory and Growth and Development Trends
- G.4.2 Hazard Identification
- G.4.3 Hazard Profiles and Vulnerability to Specific Hazards

G.4.1. District Assets Inventory and Growth and Development Trends

This section provides an inventory of the District'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 District'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 G.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 (Populations Served)
- Structures
- 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 G.4.3.

People and Populations

The most important asset within any community are the people and populations that reside in the District. The District provides services to 25 farming entities. The District currently maintains four staff.

Special Populations and Disadvantaged Communities

The District noted very few vulnerable and underserved populations in the District. These populations are discussed in Section 4.3.1 of the Base Plan.

Structures and Critical Facilities

This section considers the RD 479'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 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.***

Table G-2 lists critical facilities and other District assets identified by the District Planning Team as important to protect in the event of a disaster. RD 479's physical assets, valued at $3.15 million, consist of the buildings and infrastructure to support the District's operations.

Table G-2 RD 479 Critical Facilities, Infrastructure, and Other District Assets

Name of Asset	Facility Type	Replacement Value	Which Hazards Pose Risk
Drain Pumps	RD Infrastructure	$450,000	Flood, Localized Flood, Levee Failure
Drain Box	RD Infrastructure	$400,000	Flood, Localized Flood, Levee Failure
Drain Pipe	RD Infrastructure	$300,000	Flood, Localized Flood, Levee Failure
Drain Ditches & Conveyance	RD Infrastructure	$2,000,000	Flood, Localized Flood, Levee Failure, Streambank Erosion
Total		**$3,150,000**	

Source: RD 479

Community Lifelines

Assessing the vulnerability of the District 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 construct 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 District as a partnership between the District, local cities, and Colusa County. Due to its rural nature, there is an interplay in community lifelines between all jurisdictions in the County. In fact, most of the District's community lifelines overlap the County's. It should also be noted that these lifelines collectively include many of the critical facilities and infrastructure assets inventoried for this LHMP. Due to this fact, specific information on these community lifelines in the District and how they may be affected by a hazard event or disaster are discussed in each hazard section; however, many of these sections refer back to the detailed lists that are captured in the Section 4.2.1 of the Base Plan.

Natural, Historic, and Cultural Resources

Assessing the vulnerability of the District to natural hazards and disasters also involves inventorying the natural, historic, and cultural assets of the area. This step is important for the following reasons:

- Environmental and natural resources add to a community's identity and quality of life. They also help the local economy through agriculture, tourism and recreation. They support ecosystem services, such as clean air and water.
- Conserving the environment may help people mitigate risk. It can also protect sensitive habitats, develop parks and trails, and build the economy.

- The community may decide that these types of resources warrant a greater degree of protection due to their unique and irreplaceable nature and contribution to the overall economy.
- If these resources are impacted by a disaster, knowing so ahead of time allows for more prudent care in the immediate aftermath, when the potential for additional impacts are higher.
- The rules for reconstruction, restoration, rehabilitation, and/or replacement are often different for these types of designated resources.
- Natural resources can have beneficial functions that reduce the impacts of natural hazards, such as wetlands and riparian habitat, which help absorb and attenuate floodwaters.

Natural Resources

RD 479 has a variety of natural resources of value to the District. The basin is rich in natural gas and contains a lot of rice acreage, which provides habitat to thousands of wintering birds in the area. These natural resources parallel that of Colusa County as a whole. Information can be found in Section 4.2.1 of the Base Plan.

Historic and Cultural Resources

RD 479 has a variety of historic and cultural resources of value to the District. These historic and cultural resources parallel that of Colusa 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 479 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.

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. 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.

Population Trends and Projections

The District does not expect there to be future growth, however, did note that the acres within the District must be maintained.

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. While agricultural developments have changed and shaped the landscape in the District, there are no major future development plans currently.

G.4.2. Hazard Identification

RD 479 identified the hazards that affect the District and summarized their location, extent, likelihood of future occurrence, potential magnitude, and significance specific to the District (see Table G-3).

Table G-3 RD 479—Hazard Identification Assessment

Hazard	Geographic Extent	Likelihood of Future Occurrences	Magnitude/ Severity	Significance	Climate Change Influence
Ag Hazards: Severe Weather/Invasive Species (Pests and Weeds)	Extensive	Occasional	Limited	Low	Medium
Climate Change	Extensive	Likely	Limited	Medium	–
Dam Failure	N/A	N/A	N/A	N/A	N/A
Drought & Water shortage	N/A	N/A	N/A	N/A	N/A
Earthquake	Extensive	Unlikely	Negligible	Low	Low
Floods: 1%/0.2% annual chance	Extensive	Occasional	Critical	Medium	Medium
Floods: Localized Stormwater	Extensive	Likely	Critical	Medium	Medium
Landslide, Mudslide, and Debris Flow	N/A	N/A	N/A	N/A	N/A
Levee Failure	Extensive	Unlikely	Catastrophic	High	Medium
Severe Weather: Extreme Cold and Freeze	N/A	N/A	N/A	N/A	N/A
Severe Weather: Extreme Heat	N/A	N/A	N/A	N/A	N/A
Severe Weather: Heavy Rain and Storms (Wind, Hail, Lightning)	N/A	N/A	N/A	N/A	N/A
Severe Weather: High Winds and Tornados	N/A	N/A	N/A	N/A	N/A
Stream Bank Erosion	Extensive	Unlikely	Catastrophic	High	Medium
Subsidence	N/A	N/A	N/A	N/A	N/A
Wildfire	N/A	N/A	N/A	N/A	N/A

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

G.4.3. Hazard Profiles and Vulnerability to Specific Hazards

This section includes the hazard profiles and vulnerability assessment for hazards ranked of medium or high significance specific to the District (as identified in the Significance column of Table G-3) and also includes a hazard profile and vulnerability assessment to the four primary hazards to the State of California: dam failure, earthquake, flood, and wildfire, regardless of the significance ranking by the District. Chapter 4 of the Base Plan provides more detailed information about these hazards and their impacts on the Colusa 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 Format

Each hazard is profiled in the following format:

- **Hazard Profile**– A hazard profile is included for each hazard. This includes information on:
  - ✓ A general discussion of the hazard and related issues.
  - ✓ **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. NCDC events are also discussed. A discussion of disaster declarations is included in each hazard section. Other past occurrence data specific to the District follows the disaster declarations 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 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.

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

- **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 format as in Section G.4.1 above. This includes sections on: People and Populations Served; Structures and Critical Facilities, Community Lifelines; Natural, Historic, and Cultural Resources; and Economic Assets and Community Activities of Value. These are discussed in specific terms for mapped hazards, and in more general terms for those hazards that are unmapped.
- **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. Impacts are also affected by the community's ability to mitigate, prepare for, respond to, and recover from an event.
- **Future Conditions/Development** – A discussion of how future development will be affected by the hazard is also included.

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. More information on types of power disruptions can be found in Section 4.3 of the Base Plan.

Public Safety Power Shutoff (PSPS)

A new intentional disruption type of power shortage/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 (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 prevent wildfire. This is called a PSPS. More information on PSPS criteria can be found in Section 4.3 of the Base Plan.

In addition to PSPSs, to help prevent wildfires, electric utilities have begun to evolve safety efforts. This includes installing safety settings on powerlines in and around high fire-risk areas. These are known as Enhanced Powerline Safety Settings (EPSS), and they help prevent falling tree branches, animals and other hazards from starting a wildfire. By stopping ignitions, it helps prevent wildfires from starting and spreading. According to PG&E, if ignitions occur, the size of fires are much smaller due to EPSS. In 2022, there was a 99% decrease in acres impacted by ignitions (as measured by fire size from electric distribution equipment (compared to the 2018-2020 average). This decrease occurred despite dry conditions.

Local Concerns

The District noted that there was minimal concern in relation to PSPS events.

Climate Change

Likelihood of Future Occurrence–Likely
Vulnerability–Medium

Hazard Profile

Climate change adaptation is a key priority of the State of California. The 2023 State of California Multi-Hazard Mitigation Plan noted that climate change is already affecting California. Sea levels have risen by as much as seven inches along the California coast over the last century, increasing erosion and pressure on the State's infrastructure, water supplies, and natural resources. The State has also seen increased average temperatures, more extreme hot days, fewer cold nights, a lengthening of the growing season, shifts in the water cycle with less winter precipitation falling as snow, and earlier runoff of both snowmelt and rainwater in the year. In addition to changes in average temperatures, sea level, and precipitation patterns, the intensity of extreme weather events is also changing.

California's Adaptation Planning Guide: Understanding Regional Characteristics (from 2017) has divided California into 11 different regions based on political boundaries, projected climate impacts, existing environmental setting, socioeconomic factors and regional designations. The District falls in the North Central Valley Region. A map and climate projections for this region are shown in Section 4.3.7 of the Base Plan and include an increase in temperatures, moderate changes in rainfall, and increased risk to wildfire.

Location and Extent

Climate change is a global phenomenon. It is expected to affect the whole of RD 479, the Colusa County Planning Area, surrounding counties, and State of California. There is no scale to measure the extent of climate change. Climate change exacerbates other hazards, such as drought, extreme heat, flooding, wildfire, and others. The speed of onset of climate change is very slow. The duration of climate change is not yet known but is feared to be tens to hundreds of years.

Past Occurrences

Disaster Declaration History

Climate change has never been directly linked to any declared disasters.

NCDC Events

NCDC does not track climate change events.

RD 479 Events

The frequency and severity of extreme swings in weather have impacted the District. In times of drought, the District is minimally affected; however, the periods of high precipitation high levels of stress on the District's infrastructure. High water flows in the ditches create more stream bank erosion. The more precipitation the District receives, the higher the concern for the integrity of the infrastructure, pumps, and pipes maintained by RD 479.

Vulnerability to Climate Change

The whole of the District is at some measure of vulnerability to climate change. The District Planning Team has concerns that the vulnerability of the District will grow to be greater in the future. An assessment of a community's vulnerability to climate change begins with an understanding of local exposure to climate change. 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 vulnerabilities to this hazard.

Assets at Risk

Assets at risk from climate change include people and populations served; structures and critical facilities; community lifelines; natural, historic, and cultural resources; economic assets; and community activities of value. These are discussed in the following sections.

People and Populations Served

Climate change affects people and populations within a community, especially those climate change issues related to increases in temperature over time. While all populations can be affected by temperature extremes, populations particularly vulnerable include the very old and very young, medically fragile people, people without means of shelter (and air conditioning or heat) or transportation, people who are socially isolated and other socially vulnerable or underserved populations (as shown in the Special Populations discussion in Section G.4.1). Acclimatization to extreme temperatures and other weather extremes may help reduce impacts from these extreme events, such as from heat waves, in the healthy general population but may not be sufficient to protect those with underlying medical conditions.

Structures and Critical Facilities

Climate change, on its own, does not generally impact structures. However, structures in areas of increased wildfire or flood areas exacerbated by the effects of climate change would be at increased risk, as described throughout this LHMP. More information on how structures may be affected by climate change can be found in Section 4.3.7 of the Base Plan. As with structures, critical facilities and infrastructure in areas of

increased wildfire or flood areas due to the effects of climate change would be at increased risk. Climate change is expected to increase the vulnerability of critical facilities and infrastructure to natural hazards.

Community Lifelines

Due to the slow onset of climate change, community lifelines in the District are expected to adapt over time to new climate normal. It is thought that community lifelines in the District would not be overwhelmed by climate change. This was discussed in greater detail in Section 4.3.7 of the Base Plan.

Natural, Historic, and Cultural Resources

The rivers, streams, agricultural areas, and open space areas of the District supports rich biodiversity, including many special-status species. These are all at risk from the effects of climate change. In addition, if heat contributes to changes in wildfire patterns, all areas (on land) of the District are at increased risk from fire – including areas of natural, historic, and cultural resources. Furthermore, as climate change exacerbates the drought hazard, areas of wetlands in the City may be reduced or dry up temporarily, which could damage habitat areas for waterfowl and other species that depend on these areas.

Economic Assets and Community Activities of Value

Economic assets and community activities of value for the District are similar or the same as those for the County as a whole. Those assets and activities were discussed in greater detail in Section 4.3.7 of the Base Plan.

Impacts from Climate Change

The California APG: Understanding Regional Characteristics identified the following impacts specific to the North Central Valley region in which the District is part of:

- Increased temperatures
- Reduced precipitation
- Public health – heat and air pollution
- Reduced agricultural productivity (e.g., wine grapes)
- Reduced tourism

In addition to these sources, the 2023 State of California Hazard Mitigation Plan noted that according to California's Fourth Climate Change Assessment, the state will experience the following climate impacts:

- Annual average daily high temperatures are expected to rise by 2.7° F by 2040, 5.8°F by 2070, and 8.8°F by 2100 compared to observed and modeled historical conditions. These changes are statewide averages.
- Heat waves are projected to become longer, more intense, and more frequent.
- Warming temperatures are expected to increase soil moisture loss and lead to drier conditions. Summer dryness may become prolonged, with soil drying beginning earlier in the spring and lasting longer into the fall and winter.
- Droughts are likely to become more frequent and persistent through 2100.

- The strength of the most intense precipitation and storm events affecting California is expected to increase.
- Snowpack levels are projected to decline significantly by 2100 due to reduced snowfall and faster snowmelt.
- Marine layer clouds are projected to decrease.
- Extreme wildfires (i.e., fires larger than 24,710 acres) would occur 50 percent more frequently. The maximum area burned statewide may increase 178 percent by the end of the century.

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. Changes in population patterns and land use, and the extent to which they affect this hazard, are discussed in the Future Conditions/Future Development discussion below.

Future Conditions/Future Development

Climate change is anticipated to worsen over time. The anticipated future changes in population in the areas served by RD 479 are relatively small, which limits additional impacts to RD 479. The District noted it has no control over population changes, it merely reacts to them by providing additional (or reduced) services. It is unknown how changes in land use and development will affect streambank erosion in the District's service territory. Building codes are in effect to reduce this risk and should be updated as necessary to continue to address future conditions.

Climate change can influence development in the District over time. The District could see population fluctuations as a result of climate impacts relative to those experienced in other regions, and these fluctuations are expected to affect the District. While there are currently no formal studies of specific migration patterns expected to impact the District, climate-induced migration was recognized within the UNFCCC Conference of Parties Paris Agreement of 2022.

Flood: 1%/0.2% Annual Chance

Likelihood of Future Occurrence–Occasional/Unlikely
Vulnerability–Medium

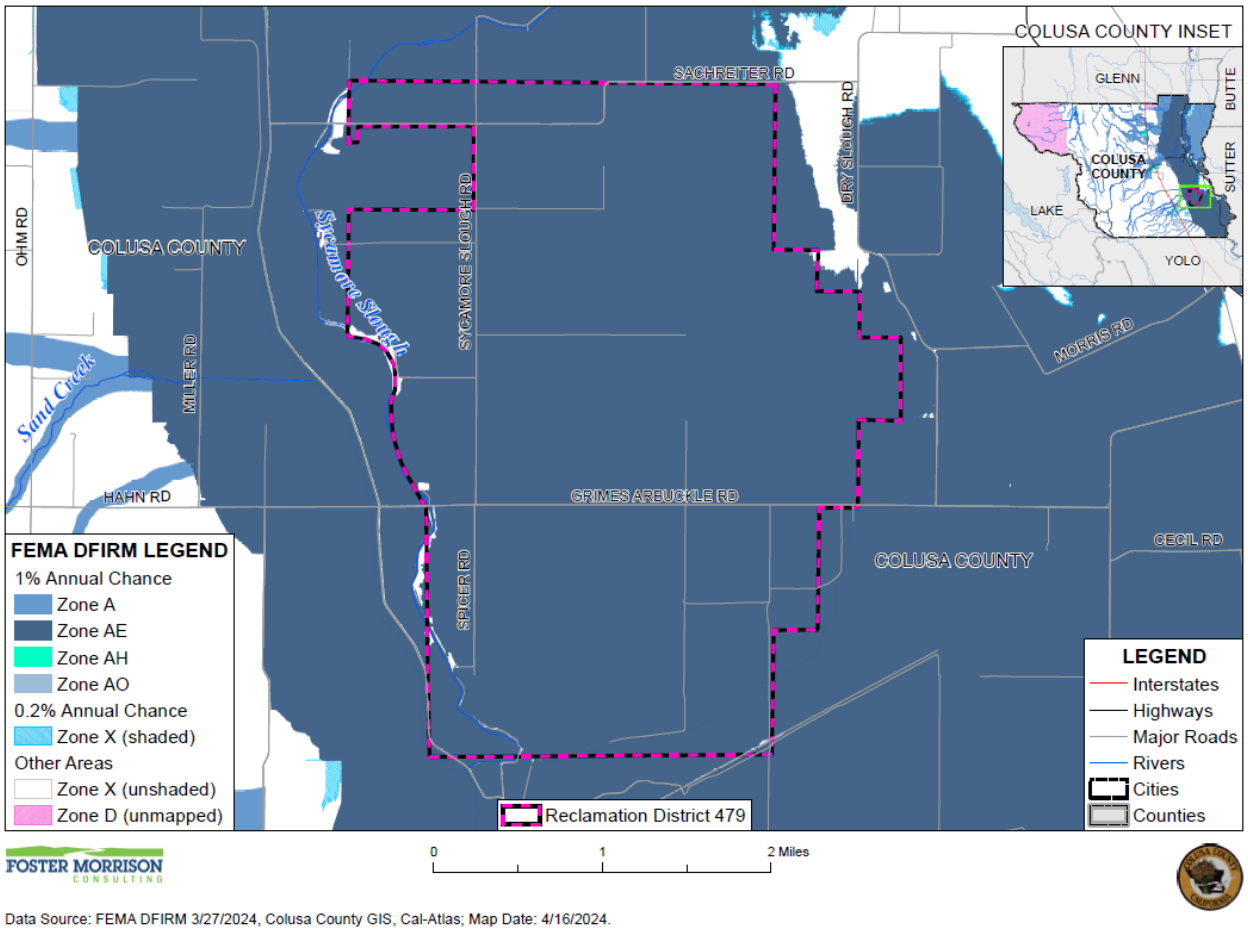
Hazard Profile

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 District and may 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. Normally, storm floodwaters are kept within defined limits by a variety of storm drainage and flood control measures. Occasionally, extended heavy rains result in floodwaters that exceed normal high-water boundaries and cause damage. Flooding has occurred both within the 1% and 0.2% annual chance floodplains and in other localized areas.

Location and Extent

RD 479 has areas located in the 1% and 0.2% annual chance flood zones. This is seen in Figure G-2.

Figure G-2 RD 479 – FEMA DFIRM Flood Zones



Data Source: FEMA DFIRM 3/27/2024, Colusa County GIS, Cal-Atlas; Map Date: 4/16/2024.

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.

Past Occurrences

Disaster Declaration History

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

Table G-4 Colusa County – State and Federal Disaster Declarations from Flood 1950-2024

Disaster Type	Federal Declarations		State Declarations	
	Count	Years	Count	Years
Flood (including heavy rain and storms)	17	1955, 1958, 1963 (twice), 1970, 1983, 1986, 1995 (twice), 1997, 1998, 2005/2006, 2017, 2019 (twice), 2023 (twice)	19	1950, 1955, 1958 (twice), 1963 (twice), 1973, 1978, 1983, 1986, 1995 (twice), 1997, 1998, 2005/2006, 2008, 2017, 2019 (twice)

Source: Cal OES, FEMA

NCDC Events

The NCDC tracks flooding events for the County. Events have been tracked for flooding since 1993. Colusa County has seen 14 events. These events most likely had some impact on the District.

RD 479 Events

The most recent flood event occurred in the winter of 2020. The District noted that there were areas of stream bank erosion along its network of ditches. The District was granted FEMA funding for stream bank erosion repairs, which began in 2021.

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 CAS, climate change may affect flooding in California and the Colusa County Planning Area, including 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.

Vulnerability to Flood: 1% 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. Predominantly, the effects 1% and 0.2% chance of flooding are generally confined to areas near the waterways of the District.

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 vulnerabilities to this hazard.

The main issue for the District lies in their existing infrastructure. A key part and area of concern is a steel box used to build up water pressure to drain water out of the basin of the drainage system which will fail at some point. If this pressure box and/or the original foundation underneath it fails during a critical time, the basin may experience massive damage. The current pressure box, as it sits, was installed as a temporary fix in 1998 when the old system failed at a critical time, causing flooding in the basin. This 25+ year old steel box is feared to fail again someday, causing flooding, erosion, property damage, and road closures. An example of this can be seen in Figure G-3.

Figure G-3 RD 479 Steel Box

Source: RD 479
A display of the operational pumps at the foot of the drain canal. The pump engines are underneath the canopy.

There are multiple vulnerable areas on the District's drainage pump system. While the pipe from the steel pressure box pictured above to the canal was replaced in 2015, the largest concern for the District is the infrastructure of the steel box. The length of integrity is unknown, but a failure could be catastrophic. The pressure box is deemed the most vulnerable at this point. Next to the pressure box, the pumps sit at a vulnerable elevation. Raising their height above the drain ditch from where they currently sit would help mitigate vulnerability.

Assets at Risk

Assets at risk from flood include people and populations served; structures and critical facilities; community lifelines; natural, historic, and cultural resources; economic assets; and community activities of value. These are discussed in the following sections.

People and Populations Served

All people and populations located in the 1% and 0.2% annual chance floodplains 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.

District residents that live in the 1% and 0.2% annual chance floodplains are often 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.

Structures and Critical Facilities

Certain structures in the District are at risk of DFIRM flooding and primarily include those structures located within the 1% and 0.2% annual chance floodplains. As shown in Table G-2, all District assets are at risk to this hazard.

Flooding presents a threat to threat to both critical facilities and infrastructure, as well as community lifelines. Critical infrastructure plays an immensely important role in our communities. As previously noted, communities rely on roads, rail corridors, and related biking and pedestrian routes for transportation, and on water infrastructure for drinking water, wastewater service, and draining streets of rainwater. Damage to any one of these systems can threaten public safety, wreak havoc on daily life, impact properties far from flood zones, and result in economic impacts that cascade throughout California.

Community Lifelines

1% and 0.2% annual chance flooding presents a threat to life and property, including community lifelines in the District. Many of the District's community lifelines are the same as or similar to Colusa County's. This was discussed in greater detail in Section 4.3.11 of the Base Plan. Generally, even major flood events are temporary events with flood waters receding back to pre-storm levels at the conclusion of the storm. However, depending on the location, duration, and magnitude and severity of any given flood event, some of these community lifelines may be overwhelmed in the short term.

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 levées 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 survive 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 G-2 would be vulnerable. This is especially true if a 0.2% annual chance flood event occurs.

Economic Assets and Community Activities of Value

Economic assets and community activities of value for the District are similar or the same as those for the County as a whole. Those assets and activities were discussed in greater detail in Section 4.3.11 of the Base Plan.

Impacts from Flood: 1% 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% and 0.2% annual chance floods, can cause substantial damage to structures, landscapes, and utilities as well as life safety issues. 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 that are not quantified, but can be anticipated in large future events, include:

- Injury and loss of life;
- Commercial and residential structural and property damage;
- Disruption of and damage to public infrastructure, utilities, and services;
- Damage to roads/bridges resulting in loss of mobility;
- Significant economic impact (jobs, sales, tax revenue) to the community; and
- Negative impact on commercial and residential property values

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. Changes in population patterns and land use, and the extent to which they affect this hazard, are discussed in the Future Conditions/Future Development discussion below.

Future Conditions/Future Development

As discussed in the hazard profile section, climate change is anticipated to exacerbate this hazard over time. The anticipated future changes in population in the areas served by RD 479 are relatively small, which limits additional impacts to RD 479. The District noted it has no control over population changes, it merely reacts to them by providing additional (or reduced) services. It is unknown how changes in land use and development will affect streambank erosion in the District's service territory. Building codes are in effect to reduce this risk and should be updated as necessary to continue to address future conditions.

One of the most effective ways to reduce vulnerability to potential flood damage is through careful land use planning that fully considers applicable flood management information and practices. Master planning will also be necessary to assure that open channel flood flow conveyances serving the smaller internal streams and drainage areas are adequately prepared to accommodate the flows. Preservation and maintenance of natural and riparian areas should also be an ongoing priority to realize the flood control benefits of the natural and beneficial functions of these areas.

Future development in the District may be built in the floodplain, in conformance to the standards of the floodplain ordinance. The District enforces the floodplain ordinance on new development in RD 479.

Flood: Localized Stormwater Flooding

Likelihood of Future Occurrence–Likely
Vulnerability–Medium

Hazard Profile

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 District 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

RD 479 is subject to localized flooding throughout the District. This is discussed in Table G-5 below. 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.

NCDC Events

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

RD 479 Events

The District noted the following past occurrences of localized flooding:

The District noted localized flooding in **1983**. According to local farmers present at the time, this localized flooding caused road closures at Grimes-Arbuckle Rd and Sycamore Slough Rd

The old pressure box failed in **1997/98**. The steel box which is currently in use was installed as an emergency fix in 1998. It was never intended to be the permanent pressure box. At the time, the plan was to replace the steel box with a permanent concrete one eventually, though there was no specific timeline for completing that project.

The District noted that there have been failures prior to 1997 as well, though they are not documented.

Climate Change and Localized Flood

It is likely that climate change will increase the chance of future occurrence as well as future impacts associated with 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 vulnerabilities to this hazard.

Historically, the District has been affected by flooding of streams and creeks occurring during heavy rain and storm 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 District tracks localized flooding areas. Affected localized flood areas identified by the RD 479 are summarized in Table G-5.

Table G-5 RD 479 – List of Localized Flooding Problem Areas

Road/Area Name	Flooding	Pavement Deterioration	Washouts	High Water/ Creek Crossing	Landslides/ Mudslides	Debris	Downed Trees
Grimes-Arbuckle Rd	Yes	Unknown	Unknown	Not if extreme	No	No	No
Sycamore Slough Rd	Yes	Unknown	Unknown	Not if extreme	No	No	No

Source: RD 479

The pump station and surrounding infrastructure are the most likely to be affected, as well as the section of the ditch closest to the pumps. Near these locations, water velocity appears to be the highest and therefore is a greater factor for stream bank erosion.

Assets at Risk

Assets at risk from localized flood include people and populations served; structures and critical facilities; community lifelines; natural, historic, and cultural resources; economic assets; and community activities of value. These are discussed in the following sections.

People and Populations Served

People and populations are traditionally not highly vulnerable to localized flooding, but their structures and contents can be at risk. Localized flooding may also cause transportation issues as roads and lanes are impacted or closed and affect the ability for people to travel throughout the District.

Structures and Critical Facilities

Structures and critical facilities in areas with localized flooding can be affected if floodwaters intrude into the structure. Structures in low lying areas, or those with basements 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 damages. As shown in Table G-2, all District assets are at risk to this hazard.

Localized flooding, while often more of a nuisance, can cause damage to critical facilities and infrastructure during a heavy rain and storm event. Any facility that experiences localized flooding can be impacted. Utilities and other critical infrastructure can all be affected, causing interruptions in service until repairs can be made. For example, water and wastewater systems can be vulnerable to heavy rains and flood events. Rainfall creates a high water table, surging streams and creeks, and saturates soil. Infiltration of stormwater into water and wastewater systems may occur and presents a threat to public health and safety, when the infrastructure is no longer able to meet operational needs and local demands. Other critical facilities such as roads, bridges and other transportation facilities can also experience localized flooding causing road closures and other impacts until storm waters recede. This can result in extended road closures requiring alternate routes.

Community Lifelines

Due to the relatively minor nature of localized flooding, community lifelines are unlikely to be overwhelmed. Many of the District's community lifelines are the same as or similar to Colusa County's. This was discussed in greater detail in Section 4.3.12 of the Base Plan.

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. Wetlands 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. 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.

Economic Assets and Community Activities of Value

Economic assets and community activities of value for the District are similar or the same as those for the County as a whole. Those assets and activities were discussed in greater detail in Section 4.3.12 of the Base Plan.

Impacts from Localized Flood

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.

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. Localized flooding impacts may be exacerbated in the future due to the effects of climate change, changes in population patterns (migration, density, or the makeup of socially vulnerable populations), and changes in land use and development.

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. Changes in population patterns and land use, and the extent to which they affect this hazard, are discussed in the Future Conditions/Future Development discussion below.

Future Conditions/Future Development

As discussed in the hazard profile section, climate change is anticipated to exacerbate this hazard over time. The anticipated future changes in population in the areas served by RD 479 are relatively small, which limits additional impacts to RD 479. The District noted it has no control over population changes, it merely reacts to them by providing additional (or reduced) services. It is unknown how changes in land use and development will affect streambank erosion in the District's service territory. Building codes are in effect to reduce this risk and should be updated as necessary to continue to address future conditions.

Future development in the District will add more impervious surfaces causing an increase in stormwater runoff and the continued need to drain these waters. The District will need to be proactive to ensure that increased development has proper siting and drainage for stormwaters. The risk of localized flooding to future development can be minimized by accurate recordkeeping of repetitive localized storm activity. Mitigating the root causes of the localized stormwater flooding will reduce future risks of losses. The District noted that major developments are not likely in the near future.

Levee Failure

Likelihood of Future Occurrence–Unlikely
Vulnerability–High

Hazard Profile

A levee is a raised area that runs along the banks of a river, stream, or canal. Levees reinforce the banks and help prevent flooding by containing higher flow events to the main channel of a stream. 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.

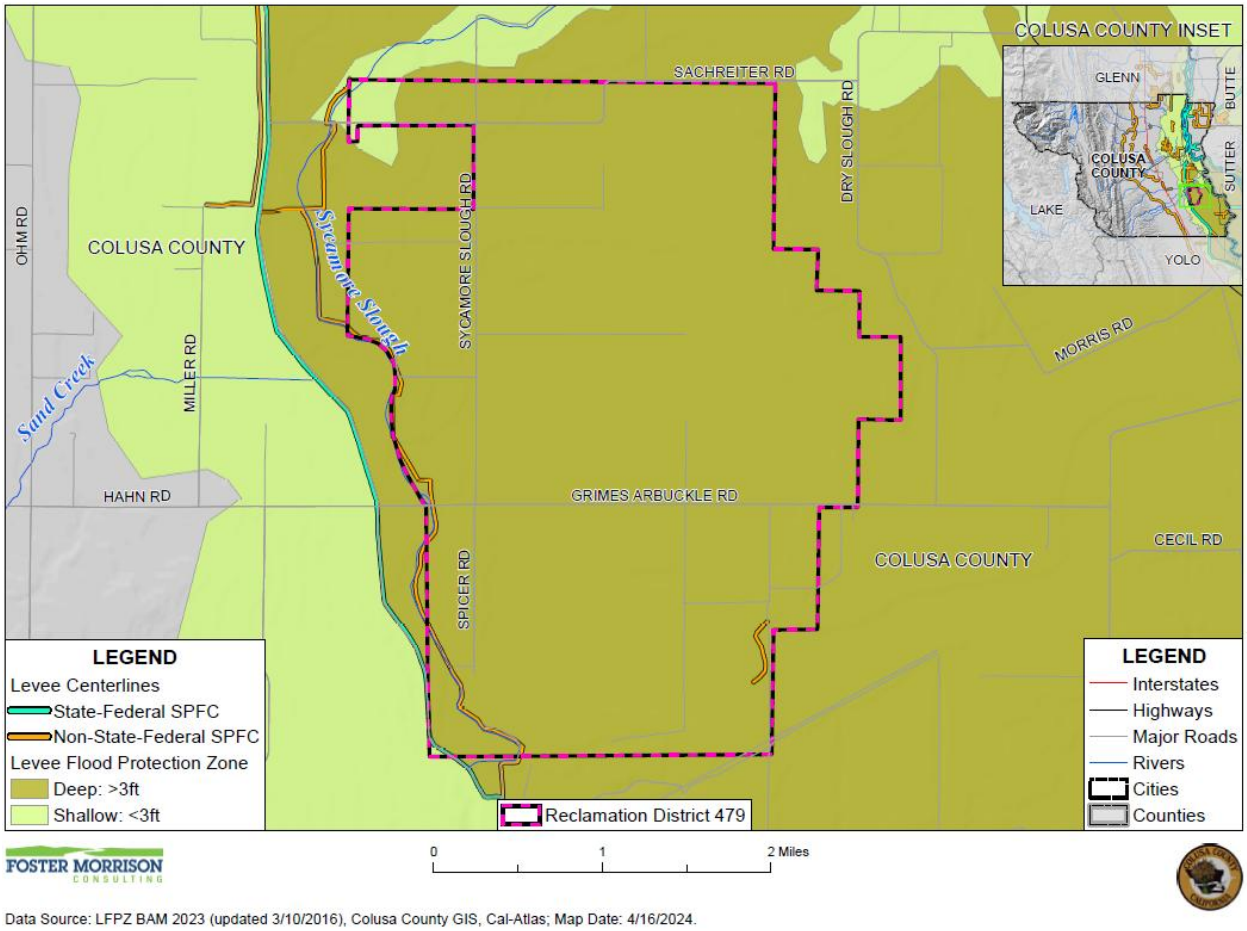
Levees provide strong flood protection, but they are not failsafe. Levees are designed to protect against a specific flood level and could be overtopped during severe weather events or dam failure. For example, levees can be certified to provide protection against the 1% annual chance flood. Levees reduce, 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

Numerous levees are located throughout the District (as shown in Section 4.3.14 of the Base Plan. Figure G-4 shows the Levee Flood Protection Zones (LFPZs) in the District. Since the decertification of the levees, there is no FEMA DFIRM X Protected by Levee Flood Zone. However, analysis is performed using the LFPZ data for expected flood depths.

There is not a scientific scale or measurement system in place for levee failure. Expected flood depths from a levee failure in the District are not fully known, but the LFPZ maps provide a rough estimation. 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 a levee failure can be hours to weeks, depending on the water flows that the levee holds back. The District noted that when northern California reservoirs are nearing maximum capacity, they release water through the river systems, causing additional burdens on District levees.

Figure G-4 RD 479 – LFPZs



Data Source: LFPZ BAM 2023 (updated 3/10/2016), Colusa County GIS, Cal-Atlas; Map Date: 4/16/2024.

Past Occurrences

Disaster Declarations

There have been no state or federal disaster declarations from levee failure.

NCDC Events

There have been no NCDC levee failure events in Colusa County.

RD 479 Events

The District noted that there have been no levee failure events that have impacted the area.

Climate Change and Levee Failure

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

In general, increased flood frequency in California is a predicted consequence of climate change. Mechanisms whereby climate change leads to an elevated flood risk include more extreme precipitation events and shifts in the seasonal timing of river flows. This threat may be particularly significant because recent estimates indicate the additional force exerted upon the levees is equivalent to the square of the water level rise. These extremes are most likely to occur during storm events, leading to more severe damage from waves and floods.

Vulnerability to Levee Failure

The probability of levee failure is increasing over time due to increased storms and flooding potential from global climate change. Levee failure flooding can occur as the result of partial or complete collapse of an impoundment, and often results from prolonged rainfall and flooding. A levee failure can range from a small uncontrolled release to a catastrophic failure. The primary danger associated with levee failure is the high velocity flooding of those properties downstream of the breach. Vulnerability to levee failures is generally confined to the areas subject to inundation downstream of the levee. In addition, levee failure can cause stream bank erosion, which can in some instances have effects worse than those of flooding itself.

All of the District are at some measure of vulnerability to levee failure as shown by the LFPZs. An assessment of a community's vulnerability to levee failure begins with an understanding of local exposure to levee failure. This is included in the Local Concerns section below followed by a discussion of the District's Assets at Risk to this hazard. It should be noted that in the following sections, only the certified levees are analyzed.

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 vulnerabilities to this hazard.

RD479's purpose is to manage drainage water for over 6,000 acres in the Mormon Basin, a part of the much larger Colusa Basin. We are primarily concerned with preserving the use of farmland by actively maintaining drainage and seepage water in the basin to serve the needs of farmers. Though its name does not indicate it, RD479 also serves as a flood control agency to keep the water in the basin from adversely affecting farmland and public travel, namely on Grimes-Arbuckle Rd.

It is unknown to the District which parts of the 2047 canal levee are the most vulnerable to the District. DWR maintains this levee to which RD479 may be vulnerable to if there was a failure. The Sacramento River levee is outside of RD479's boundary and is not foreseen as a hazard to the district.

Assets at Risk

Assets at risk from levee failure include people and populations served; structures and critical facilities; community lifelines; natural, historic, and cultural resources; economic assets; and community activities of value. These are discussed in the following sections.

People and Populations Served

Populations in the floodplains are at risk to flooding, including the LFPZ. Certain vulnerable populations may be at a greater risk of a sudden levee failure, including the unsheltered, those with limited mobility and those that lack the resources to leave the area. District residents that live in the LFPZ are often 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.

Structures and Critical Facilities

A levee failure can affect the District, with some structures and critical facilities in the District at risk to a levee failure event. Structures protected by levees that fail are often total losses. The extent and depth of actual flooding and associated damage will vary depending on the location, nature, depth, and extent of any levee break. Critical infrastructure failures such as loss of power, impacts to potable and wastewater treatment systems, and road and bridge failures can all be caused by levee failure events, depending on the magnitude of the resulting flood. As shown in Table G-2, all District assets are at risk to this hazard.

Community Lifelines

Community lifelines may be affected by levee failure. Many of the District's community lifelines are the same as or similar to Colusa County's. Levee failure may overwhelm community lifelines. These were discussed in greater detail in Section 4.3.14 of the Base Plan.

Natural, Historic, and Cultural Resources

Large levee failure events can affect natural, historic, and cultural resources. There are a number of ways levee failures and associated floodwaters can impact natural resources and the environment in the District. Wildlife habitats can be destroyed. Contaminated floodwater can pollute rivers and habitats. Silt and sediment can destroy natural areas. Riverbanks and natural levées 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 survive 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 areas protected by levees, but other cultural resources such as those associated with Native Americans and old tribal areas can also be disturbed, damaged and lost during extreme levee failure events. Any of these that fall in the LFPZ flood zones would be vulnerable.

Economic Assets and Community Activities of Value

Economic assets and community activities of value for the District are similar or the same as those for the County as a whole. Those assets and activities were discussed in greater detail in Section 4.3.14 of the Base Plan.

Impacts from Levee Failure

Floods and their impacts vary by location, including the added 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

LFPZ analysis, it is evident that levee failure floods could potentially have significant impacts to areas of the District protected by levees, depending on the severity of the event. Impacts that are not quantified, but could be anticipated in large future levee failure events, include:

- Injury and loss of life.
- Commercial and residential structural and property 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 at risk to failure during earthquake. Levee failure flooding could accompany an earthquake if a dam or storage reservoir or tank fails. Severe ground shaking from an earthquake event can cause a dam to fail or overflow to the surrounding area. 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 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. Changes in population patterns and land use, and the extent to which they affect this hazard, are discussed in the Future Conditions/Future Development discussion below.

Future Conditions/Future Development

As discussed in the hazard profile section, climate change is anticipated to exacerbate this hazard over time. The anticipated future changes in population in the areas served by RD 479 are relatively small, which limits additional impacts to RD 479. The District noted it has no control over population changes, it merely reacts to them by providing additional (or reduced) services. It is unknown how changes in land use and development will affect streambank erosion in the District's service territory. Building codes are in effect to reduce this risk and should be updated as necessary to continue to address future conditions.

Future development in levee protected areas may be affected by this hazard. However, in these areas the District's floodplain management ordinance would be enforced.

Stream Bank Erosion

Likelihood of Future Occurrence– Likely
Vulnerability–High

Hazard Profile

Erosion is the general process whereby rocks and soils are broken down, removed by weathering, or fragmented and then deposited in other places by water or air. Stream bank erosion poses problems for the District. The rate of erosion depends on many variables, including the soil or rock texture and composition, soil permeability, slope, extent of vegetative cover, and precipitation amounts and patterns. Erosion increases with increasing slope and precipitation and with decreasing vegetative cover, which includes areas where protective vegetation has been removed by fire, construction, or cultivation. The District is traversed by many waterways, including leveed areas. These locations are all subject to bank erosion. Stream bank erosion is a natural process, but acceleration of this natural process leads to a disproportionate sediment supply, stream channel instability, land loss, habitat loss and other adverse effects.

Location and Extent

Stream bank erosion occurs on rivers, streams, and other moving waterways, including leveed areas, in the District. Erosion and deposition are occurring continually at varying rates over the Planning Area. Swiftly moving floodwaters cause rapid local erosion as the water carries away earth materials. This is especially problematic in leveed areas. Severe erosion removes the earth from beneath bridges, roads and foundations of structures adjacent to streams. By undercutting it can lead to increased rockfall and landslide hazard. The deposition of material can block culverts, aggravate flooding, destroy crops and lawns by burying them, and reduce the capacity of water reservoirs as the deposited materials displace water.

The speed of onset of stream bank erosion is slow, as the erosion takes place over periods of years. Duration of erosion is extended. Greater erosion occurs during periods of high stream flow and during storm and wind events when wave action contributes to the extent and speed of streambank erosion.

Past Occurrences

Disaster Declaration History

There have been no federal or state disaster declarations related to erosion.

NCDC

The NCDC does not track stream bank erosion.

RD 479 Events

The winter of 2020 created stream bank erosion on the District's ditch banks. There were several areas in the District ditches that were reinforced via FEMA funding following this event.

Climate Change and Stream Bank Erosion

It is likely that climate change will increase the chance of future occurrence as well as future impacts associated with stream bank erosion. 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 CAS, climate change may affect flooding which contributes to erosion in Colusa County. 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. Future precipitation projections were shown in Section 4.3.4 of the Base Plan. Also, according to the National Center for Atmospheric Research in Boulder, Colorado, atmospheric rivers are likely to grow more intense in coming decades, as climate changes warms the atmosphere enabling it to hold more water. All of the events above could exacerbate stream bank erosion in the County.

Vulnerability to Stream Bank Erosion

Parts of the District located along streambanks are at some measure of vulnerability to streambank erosion. An assessment of a community's vulnerability begins with an understanding of local exposure to streambank erosion. 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 vulnerabilities to this hazard.

The District noted that sections of ditches that are already showing damage are of concern, especially where the water moves fastest and crosses underneath county and private roads.

Assets at Risk

Assets at risk from streambank erosion include people and populations served; structures and critical facilities; community lifelines; natural, historic, and cultural resources; economic assets; and community activities of value. These are discussed in the following sections.

People and Populations

Streambank erosion will have a minimal direct effect on District staff, people, and populations in the District. Indirect effects on people and populations include damages to roads or bridges from streambank erosion, causing transportation issues. Streambank erosion can also cause high sediment loads. While rare, this can cause water quality impacts. Water quality can be impacted causing health problems, especially to vulnerable populations where access to clean water supplies can be more challenging.

Structures and Critical Facilities

Structures and critical facilities near rivers are at some risk from the effects of streambank erosion. Structures that are in areas protected by levees are at greater risk of streambank erosion. Streambank

erosion can undercut structure foundations causing instability and other issues. Should levees erode quickly, their risk of failure increases. Those structures behind the levees would be at risk. This is discussed in greater detail in Levee Failure section above. Damage to any one of these systems can threaten public safety, wreak havoc on daily life, impact properties far from flood zones, and result in economic impacts that cascade throughout California. As shown in Table G-2, many District assets are at risk to this hazard.

Community Lifelines

Streambank erosion that causes significant impacts such as levee failures presents a threat to life and property, including community lifelines in the District. Many of the District's community lifelines are the same as or similar to Colusa County's. These were discussed in greater detail in Section 4.3.15 of the Base Plan.

Natural, Historic, and Cultural Resources

Streambank erosion could cause levee failure flooding. 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 levées 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 survive 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 resources that fall in the flood zones would be vulnerable.

Economic Assets and Community Activities of Value

Economic assets and community activities of value for the District are similar or the same as those for the County as a whole. Those assets and activities were discussed in greater detail in Section 4.3.15 of the Base Plan.

Impacts from Streambank Erosion

Stream bank erosion is a natural process, but acceleration of this natural process leads to a disproportionate sediment supply, stream channel instability, land loss, habitat loss and other adverse effects. Stream bank erosion processes, although complex, are driven by two major components: stream bank characteristics (erodibility) and hydraulic/gravitational forces. Many land use activities can affect both of these components and lead to accelerated bank erosion. The vegetation rooting characteristics can protect banks from fluvial entrainment and collapse, and also provide internal bank strength. When riparian vegetation is changed from woody species to annual grasses and/or forbs, the internal strength is weakened, causing acceleration of mass wasting processes. Stream bank aggradation or degradation is often a response to stream channel instability. Since bank erosion is often a symptom of a larger, more complex problem, the long-term solutions often involve much more than just bank stabilization. Numerous studies have demonstrated that stream bank erosion contributes a large portion of the annual sediment yield.

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. Changes in population patterns and land use, and the extent to which they affect this hazard, are discussed in the Future Conditions/Future Development discussion below.

Future Conditions/Future Development

As discussed in the hazard profile section, climate change is anticipated to exacerbate this hazard over time. The anticipated future changes in population in the areas served by RD 479 are relatively small, which limits additional impacts to RD 479. The District noted it has no control over population changes, it merely reacts to them by providing additional (or reduced) services. It is unknown how changes in land use and development will affect streambank erosion in the District's service territory. Building codes are in effect to reduce this risk and should be updated as necessary to continue to address future conditions.

Determining the cause of accelerated streambank erosion is the first step in solving the problem. When a stream is straightened or widened, streambank erosion increases. Accelerated streambank erosion is part of the process as the stream seeks to re-establish a stable size and pattern. Damaging or removing streamside vegetation to the point where it no longer provides for bank stability can cause a dramatic increase in bank erosion. A degrading streambed results in higher and often unstable, eroding banks. When land use changes occur in a watershed, such as clearing land for agriculture or development, runoff increases. With this increase in runoff the stream channel will adjust to accommodate the additional flow, increasing streambank erosion. Addressing the problem of streambank erosion requires an understanding of both stream dynamics and the management of streamside vegetation.

Planned developments should take erosion risk areas into account during the construction of new homes and commercial properties

G.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.

It should be noted (for all of the tables in the sections below) that these tables were designed to display capability information for a county or city. The District has very few of these capabilities, due to their lack of size, lack of complexity, as well as their lack of statutory ability to regulate. The District depends on other jurisdictions for many of these capabilities, and partners with them on case-by-case issues that affect the District.

G.5.1. Regulatory Mitigation Capabilities

Table G-6 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 479.

Table G-6 RD 479'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	
Comprehensive/Master Plan	N	
Continuity of Operations Plan	N	
Economic Development Plan	N	
Land Use Plan	N	
Local Emergency Operations Plan	N	
Stormwater Management Plan	N	
Transportation Plan	N	
Other (describe)	N	
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	N	
How can these capabilities be expanded and improved to reduce risk?		
The District relies on the County to provide regulatory mitigation in the District. RD 479 will continue to partner and look for opportunities to inform the County on regulations needed to reduce hazard impacts in the District.		

Source: RD 479

G.5.2. Administrative/Technical Mitigation Capabilities

Table G-7 identifies the District department(s) responsible for activities related to mitigation and loss prevention in the District.

Table G-7 RD 479'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	N	
Community Planner	N	
Emergency Manager	N	
Floodplain Administrator	N	
GIS Coordinator	N	
Planning Commission	N	
Other	N	
Technical	**Y/N**	**Has capability been used to assess/mitigate risk in the past?**
Grant writing	N	
Hazard data and information	N	
GIS analysis	N	
Mutual aid agreements	N	
Other	N	
How can these capabilities be expanded and improved to reduce risk?		
The District is very small in size and has limited staff. However, the District would like to increase its grant writing capabilities and will seek ways to do that in the future.		

Source: RD 479

G.5.3. Fiscal Mitigation Capabilities

Table G-8 identifies financial tools or resources that the District could potentially use to help fund mitigation activities.

Table G-8 RD 479'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	N	
Community Development Block Grant	N	
Federal funding programs (non-FEMA)	N	

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?
Fees for water, sewer, gas, or electric services	Y	Yes, for district improvements as needed and afforded. Dry years help build capital in the District to spend on projects for mitigation. Wet years use up District funds to drain district, so there typically isn't much capital left to spend on improvement projects.
Impact fees for new development	N	
State funding programs	N	
Stormwater utility fee	N	
Other	N	
How can these capabilities be expanded and improved to reduce risk?		
An increase in funding will allow the District to handle mitigation projects in a more timely manner, instead of waiting for a hazard event to occur. The District will seek funding to improve RD 479 infrastructure.		

Source: RD 479

G.5.4. Mitigation Education, Outreach, and Partnerships

Table G-9 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 G-9 RD 479'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	
Other	N	
How can these capabilities be expanded and improved to reduce risk?		
The District board is made up of landowners and seems to attract very little interest from invested parties. Implementing education, outreach, and partnerships will be pursued as staff time and budgets allow. The District will seek to partner with the County on any education events that occur within RD 479 boundaries.		

Source: RD 479

G.5.5. Other Mitigation Efforts

The District feels the lists above adequately reflect the District's mitigation capabilities.

G.6 Mitigation Strategy

G.6.1. Mitigation Goals and Objectives

RD 479 adopts the hazard mitigation goals and objectives developed by the HMPC and described in Chapter 5 Mitigation Strategy.

G.6.2. Mitigation Actions

The planning team for RD 479 identified and prioritized the following mitigation actions based on the risk assessment. Background information and information on how each action will be implemented and administered, such as ideas for implementation, responsible office, potential funding, estimated cost, and timeline are also included. The following hazards were considered a priority for purposes of mitigation action planning:

- Climate Change
- Floods: 1%/0.2% annual chance
- Floods: Localized Stormwater
- Levee Failure
- Stream Bank Erosion

Non-priority hazards for the District include:

- Ag Hazards: Severe Weather/Invasive Species (Pests and Weeds)
- Dam Failure
- Drought & Water shortage
- Earthquake
- Landslide, Mudslide, and Debris Flow
- Severe Weather: Extreme Cold and Freeze
- Severe Weather: Extreme Heat
- Severe Weather: Heavy Rain and Storms (Wind, Hail, Lightning)
- Severe Weather: High Winds and Tornados
- Subsidence
- 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.

Mitigation Actions

Action 1. RD479 Integrity Preservation

Hazards Addressed: Flood: 1%/0.5%/0.2%, Flood: Localized Stormwater Flooding, Climate Change, Stream Bank Erosion

Goals Addressed: 1, 3, 4, 5

Issue/Background: RD479's purpose is to manage drainage water for over 6,000 acres in the Mormon Basin, a part of the much larger Colusa Basin. We are primarily concerned with preserving the use of farmland by actively maintaining drainage and seepage water in the basin to serve the needs of farmers. Though its name does not indicate it, RD479 also serves as a flood control agency to keep the water in the basin from adversely affecting farmland and public travel, namely on Grimes-Arbuckle Rd.

Our main issue lies in our infrastructure. A key part of our drainage system will fail at some point. This area of concern is a steel box used to build up water pressure to drain water out of the basin. If this pressure box and/or the original foundation underneath it fails during a critical time, the basin may experience massive damage. The current pressure box, as it sits, was installed as a temporary fix in 1998 when the old system failed at a critical time, causing flooding in the basin. This 25+ year old temporary fix is feared to fail again someday, causing flooding, erosion, property damage, and road closures.

Project Description: Being able to minimize downtime on this project will be critical because of the demand on the system. The best way to complete this project is to build a new pressure box next to the existing one. Once construction is complete, the old box and pipes will need to be removed and connections will need to be made to pumps upstream, and drainpipe downstream. On a normal year, there is about a 3-week window in the fall in which the drain pumps and system aren't operating.

Other Alternatives: No action.

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

Responsible Office/Partners: RD479 – Derick Strain

Benefits (Losses Avoided): Flooding, Farmland damage, Streambank erosion damage, public road damage

Potential Funding: State grants through CA DWR and others, possible FEMA FMA or BRIC grants.

Timeline: Summer/Fall work will be performed when grant funding is available. The goal is to complete this in the next 5 years.

Project Priority (H, M, L): Medium