

Delta Annex Chapter 9 Reclamation District 563

9.1 Introduction

This new chapter of the Delta Annex details the hazard mitigation planning elements specific to Reclamation District 563 (RD 563), a new 2016 participating jurisdiction to the Sacramento County Local Hazard Mitigation Plan (LHMP) Update. This chapter of the Delta 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 RD 563. This chapter of the Delta Annex provides additional information specific to RD 563, with a focus on providing additional details on the planning process, risk assessment and mitigation strategy for this District.

9.2 Planning Process

As described above, the District followed the planning process detailed in Section 3 of the Base Plan. In addition to providing representation on the Sacramento County Hazard Mitigation Planning Committee (HMPC), RD 563 formulated its 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 9-1. Additional details on plan participation and RD 563 representatives are included in Appendix A.

Table 9-1 RD 563 Planning Team

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

Source: RD 563

9.3 Community Profile

The community profile for RD 563 is detailed in the following sections. Figure 9-1 displays a map and the location of RD 563 boundaries within Sacramento County.

Figure 9-1 Reclamation District 563 Map



Source: RD 563 2013 5-Year Plan

9.3.1. RD 563 Overview

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

9.3.2. District History and Background

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

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

9.4 Hazard Identification

RD 563's planning team identified the hazards that affect the District and summarized their geographic extent, probability of future occurrences, potential magnitude/severity, and significance specific to RD 563 (see Table 9-2).

Table 9-2 RD 563—Hazard Identification

Hazard	Geographic Extent	Probability of Future Occurrences	Magnitude/Severity	Significance
Agricultural Hazards	Extensive	Occasional	Limited	Low
Bird Strike	Limited	Unlikely	Negligible	Low
Climate Change	Extensive	Occasional	Limited	Low
Dam Failure	Limited	Unlikely	Negligible	Low
Drought and Water Shortage	Extensive	Occasional	Critical	Low
Earthquake	Extensive	Occasional	Limited	Medium
Earthquake: Liquefaction	Significant	Occasional	Limited	Medium
Flood: 100/200/500-year	Extensive	Occasional	Catastrophic	High
Flood: Localized Stormwater Flooding	Extensive	Occasional	Critical	High
Landslides	Limited	Unlikely	Negligible	Low
Levee Failure	Extensive	Occasional	Catastrophic	High
River/Stream/Creek Bank Erosion	Extensive	Likely	Limited	Medium
Severe Weather: Extreme Temperatures – Cold/Freeze	Limited	Unlikely	Limited	Low
Severe Weather: Extreme Temperatures – Heat	Extensive	Likely	Limited	Low
Severe Weather: Fog	Extensive	Likely	Limited	Low
Severe Weather: Heavy Rains and Storms (Thunderstorms, Hail, and Lightning)	Extensive	Likely	Critical	Medium
Severe Weather: Wind and Tornadoes	Extensive	Likely	Critical	High
Subsidence	Extensive	Likely	Critical	Medium
Volcano	Limited	Unlikely	Negligible	Low
Wildfire:(Burn Area/Smoke)	Limited	Unlikely	Negligible	Low
Geographic Extent Limited: Less than 10% of planning area Significant: 10-50% of planning area Extensive: 50-100% of planning area		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		
Probability 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.		Significance Low: minimal potential impact Medium: moderate potential impact High: widespread potential impact		

9.5 Hazard Profile and Vulnerability Assessment

The intent of this section is to profile RD 563’s hazards and assess the District’s vulnerability separate from that of the Planning Area as a whole, which has already been assessed in Sections 4.2 and 4.3 Vulnerability Assessment in the main plan. The hazard profiles in the main plan discuss overall impacts to the Planning Area and describes the hazard problem description, hazard extent, magnitude/severity, previous occurrences of hazard events and the likelihood of future occurrences. Hazard profile information specific to RD 563 is included in this Annex. This vulnerability assessment analyzes the property, population, critical facilities, and other assets at risk to hazards ranked of medium or high significance specific to the District. For more information about how hazards affect the County as a whole, see Chapter 4 Risk Assessment in the main plan.

9.5.1. Hazard Profiles

Each hazard vulnerability assessment in Section 9.5.3, includes a description as to how the hazard affects the RD 563 and information on past occurrences. The intent of these section is to provide jurisdictional specific information on hazards and further describe how the hazards and risks differ across the Planning Area.

9.5.2. Vulnerability Assessment

This section identifies RD 563’s assets at risk, including values at risk, critical facilities and infrastructure, economic assets, natural resources, historic and cultural resources, and growth and development trends.

Assets at Risk and Critical Facilities

This section considers the District’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:

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

Table 9-3 lists particular critical facilities and other District assets identified by the RD 563’s planning team as important to protect in the event of a disaster. RD 563’s physical assets, valued at over \$6.3 million, consist of the buildings and infrastructure to support the RD 563 operations.

Table 9-3 RD 563’s Critical Facilities, Infrastructure, and Other District Assets

Name of Asset	Facility Type	Address	Replacement Value	Hazard Info
Drainage Conveyances (92,650 ft.)	Essential Services	–	\$325,000	Flood, Levee Failure, Liquefaction

Name of Asset	Facility Type	Address	Replacement Value	Hazard Info
Pump Station #1 (including all station components)	Essential Services	–	\$2.0 mil	Flood, Levee Failure, Liquefaction
Pump Station #2 (including all station components)	Essential Services	–	\$2.0 mil	Flood, Levee Failure, Liquefaction
Pump Station #3 (including all station components)	Essential Services	–	\$2.0 mil	Flood, Levee Failure, Liquefaction
West Thornton-Walnut Grove Gas Field	Essential Services	–	–*	Flood, Levee Failure, Liquefaction

Source: RD 563

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

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

Natural Resources

The Reclamation District No. 563 levee provides protection for valuable habitat essential for many threatened and endangered species. In general, Delta lands, including those protected by the District's levees, provide forage and cover for local and migratory populations of birds and terrestrial wildlife including many special status species. The levees also provide important waterside habitat and shoreline for various fisheries that includes several special status species. Flooding of Delta islands destroys habitat and kills most terrestrial species present.

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

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

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

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

Historic and Cultural Resources

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

Growth and Development Trends

Reclamation District No. 563 is zoned almost entirely (96%) as agricultural land. The remainder of the District is zoned as Industrial, Miscellaneous, Pipeline, Residential, Roadway, and Gas Well. The land on the District is owned by more than fifty different entities ranging from private land owners and utility companies to the local county government. The District Planning Team noted that there has been no growth and or development in the District during the last planning period.

9.5.3. Vulnerability to Specific Hazards

This section provides the vulnerability assessment, including any quantifiable loss estimates, for those hazards identified above in Table 9-2 as high or medium significance hazards. Impacts of past events and vulnerability of the RD 563 to specific hazards are further discussed below (see Section 4.1 Hazard Identification in the Base Plan for more detailed information about these hazards and their impacts on the Sacramento County Planning Area). Methodologies for calculating loss estimates are the similar to those described in Section 4.3 of the Base Plan and are based on data provided by the District as described further below. In general, the most vulnerable structures are those located within the floodplain or within levee and dam inundation areas, such as older facilities that may be constructed with unreinforced masonry and buildings built prior to the introduction of modern building codes. Buildings that contain electronic or electrically operated equipment are also vulnerable to flood inundation.

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

An estimate of the vulnerability of the RD 563 to each identified priority hazard, in addition to the estimate of probability 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.

Earthquake

Likelihood of Future Occurrence—Occasional

Vulnerability—Medium

Hazard Profile and Problem Description

Earthquake vulnerability is primarily based on population and the built environment. Urban areas in high seismic hazard zones are the most vulnerable, while uninhabited areas are less vulnerable.

Ground shaking is the primary earthquake hazard. Many factors affect the survivability of structures and systems from earthquake-caused ground motions. These factors include proximity to the fault, direction of rupture, epicenter location and depth, magnitude, local geologic and soils conditions, types and quality of construction, building configurations and heights, and comparable factors that relate to utility, transportation, and other network systems. Ground motions become structurally damaging when average peak accelerations reach 10 to 15 percent of gravity, average peak velocities reach 8 to 12 centimeters per second, and when the Modified Mercalli Intensity Scale is about VII (18-34 percent peak ground acceleration), which is considered to be very strong (general alarm; walls crack; plaster falls).

Past Occurrences

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

Vulnerability to Earthquake

Assets/Critical Facilities at Risk

The levees structures, pump stations and drainage conveyances are potentially at risk to an earthquake.

Natural Resources at Risk

All natural resources could be affected by an earthquake causing damage to the levee structure should the island flood due to an earthquake.

Historic and Cultural Resources at Risk

There are no known historic and or cultural resources at risk on the island.

Future Development

While future development may occur in the areas protected by levee, which could be compromised during an earthquake event, the District does not control this development. The District only can control whether the levees meet certification standards.

Earthquake: Liquefaction

Likelihood of Future Occurrence—Occasional

Vulnerability—Medium

Hazard Profile and Problem Description

Earthquake is discussed in the section above, but is primarily focused on the vulnerability of buildings and people from earthquake shaking. This section deals with a secondary hazard associated with earthquake – the possible collapse of structural integrity o and the possible collapse of delta levees, due to liquefaction.

Past Occurrences

The District Planning Team noted that there are no known past occurrences of liquefaction to have affected RD 563.

Vulnerability to Liquefaction

Assets/Critical Facilities at Risk

The U.S. Geological Survey estimates that an earthquake of magnitude 6.7 or greater has a 62 percent probability of occurring in the San Francisco Bay Area between 2003 and 2032. Such an earthquake is capable of causing multiple levee failures in the Distict which could result in fatalities, extensive property damage and the interruption of water exports from the Delta for an extended period of time. Potential earthquakes on the Hayward, Calaveras or San Andreas faults pose the highest risk to Delta Region levees. All assets in the District are at risk to the effects of liquefaction.

Natural Resources at Risk

All natural resources in the District would be at risk to liquefaction and associated levee failures.

Historic and Cultural Resources at Risk

There are no known historic and or cultural resources at risk on the island.

Future Development

While future development may occur in the areas protected by levee, which could be compromised during an earthquake event, the District does not control this development. The District only can control whether the levees meet certification standards.

Flood: 100/200/500-year

Likelihood of Future Occurrence—Occasional
Vulnerability—High

Hazard Profile and Problem Description

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

Past Occurrences

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

- 1906 and 1907 - A series of regional flood events occurred. More information can be found in the Past Occurrences Section of Levee Failure below.

Vulnerability to Flood

Assets/Critical Facilities at Risk

Flooding of Delta islands has the potential to negatively impact water quality both locally and statewide. The largest of California's drinking water sources is the Sacramento-San Joaquin Delta and its tributaries. The Delta provides water throughout the state via the State and Federal water projects. During a flood, there is a higher potential for the waters in the Delta to be exposed to chemicals, fuel, oil, and multiple other constituents of concern that can quickly degrade water quality. Flooding can also disturb soil and soil-borne materials such as mercury and organic matter that can degrade water quality.

Should a flood breach the levees, the entirety of the assets of RD 563 would be at risk. Levee failure is discussed later in this section. Flooding also causes erosion, which is discussed later in this section.

Natural Resources at Risk

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

Historic and Cultural Resources at Risk

The District Planning Team noted that there are no known historic and or cultural resources at risk on the island.

Future Development

While future development may occur in the areas protected by levee, the District does not control this development. The District only can control whether the levees meet certification standards.

Flood: Localized Stormwater Flooding

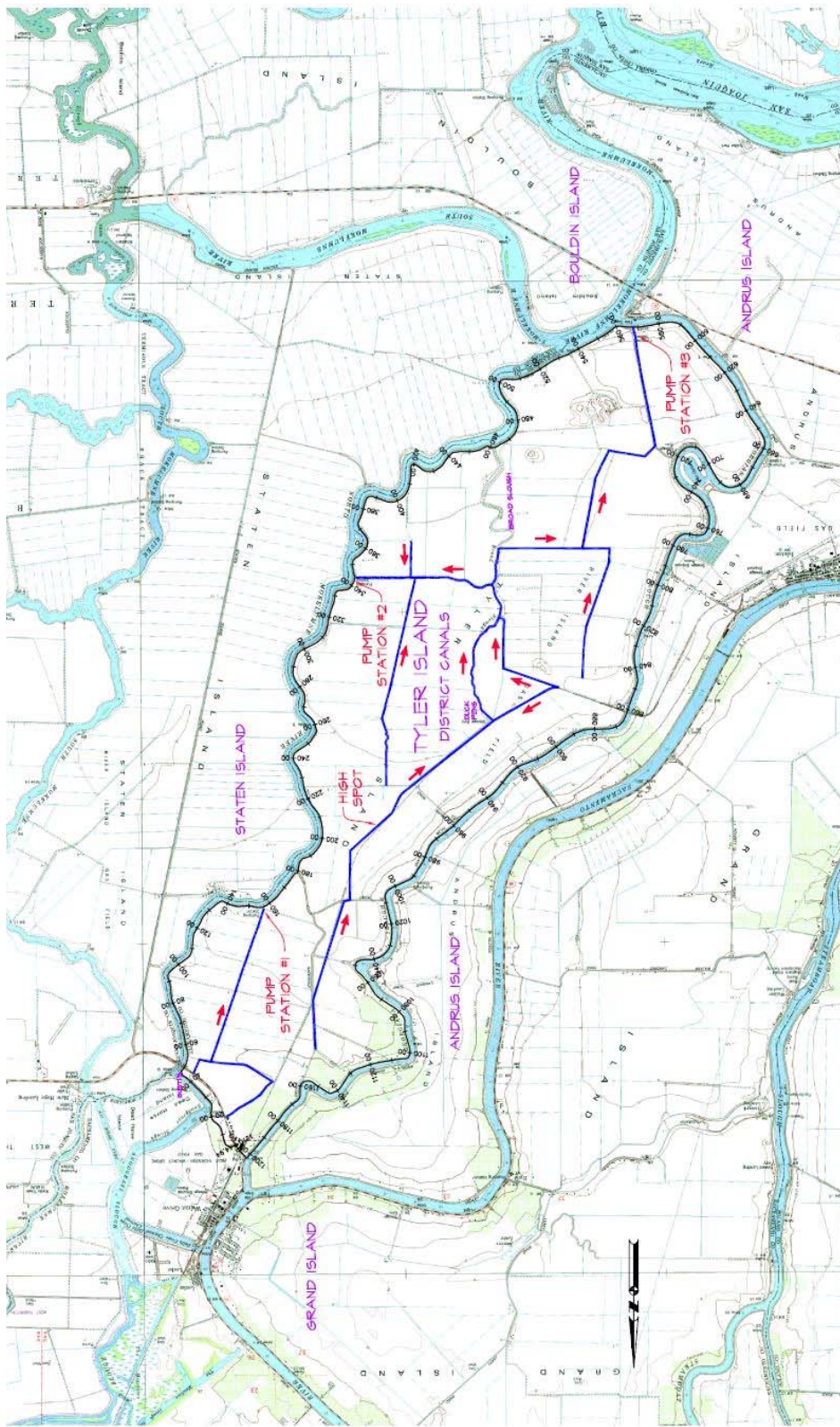
Likelihood of Future Occurrence—Occasional

Vulnerability—High

Hazard Profile and Problem Description

Historically, RD 563 has been at risk to flooding primarily during the spring months when river systems in the County swell with heavy rainfall. Localized flooding also occurs throughout the Planning Area at various times throughout the year with several areas of primary concern unique to the District. The District has a drainage system set up deal with localized flooding. This is shown on Figure 9-2.

Figure 9-2 RD 563 Drainage System



Source: RD 563 2013 5-Year Plan

Past Occurrences

The District Planning Team noted that in the last planning period there were no past occurrences.

Vulnerability to Localized Flood

Assets/Critical Facilities at Risk

The District Planning Team noted that all District assets are at risk to localized flooding; however, this flooding is likely to be a nuisance-type of flood, and would not have lasting impacts on the District.

Natural Resources at Risk

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

Historic and Cultural Resources at Risk

The District Planning Team noted that there are no known historic and or cultural resources at risk on the island.

Future Development

While future development may occur in the areas protected by levee, the District does not control this development. The District only can control whether the levees meet certification standards.

Levee Failure

Likelihood of Future Occurrence—Occasional

Vulnerability—High

Hazard Profile and Problem Description

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

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

collect in these low areas and the levels will rise as the flow continues. When the rivers are high, it is not possible to close or repair a levee break until the water surface in the river and the flooded area equalize.

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

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

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

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

Past Occurrences

Historically, flooding in the Delta has resulted from levee failures caused by the separate or coincidental occurrence of very high tides and high stream outflow through the delta region. Strong onshore winds associated with low pressure storms aggravate flood potential by causing an additional rise of the water surface elevations, and can cause severe erosion on levees in a short period of time. Flood events resulting from high tides and/or high stream outflow cannot be reliably predicted, but should be expected to occur in the future. Levee failures from collapse of rodent dens, seepage, falling trees, or some other mechanical failure are unpredictable and relatively uncommon. Routine levee inspections are the primary protection against these types of levee failure events. It should be noted that since 1986, significant portions of the levee system within the Legal Delta have been rehabilitated and improved, which has resulted in an overall reduction in the number of flooded islands during post-1986 Delta flood threats.

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

- 1906 and 1907 – A series of regional flood events caused the inundation of several islands including Reclamation District No. 563.

- 1982 – A series of large storms that produced heavy rain and high winds caused heavy runoff and high tide conditions that impacted the District's levee, as well as the entire Sacramento – San Joaquin Delta region. The resulting impacts to the District's levee included water overtopping the levee, increased seepage through the levee, subsidence and partial failure of the levee landside slope, and severe erosion on the waterside slope including degradation of the existing rock slope erosion protection. \$1.44 million in damages were sustained in this event.
- 1986 – Due to the extreme storm event, multiple days of heavy rain, strong winds from extreme low pressure gradients, high tides and runoff affecting the entire Sacramento-San Joaquin Delta, the District's levee failed in two locations along the North Fork of the Mokelumne River at approximate levee stations 228+00 and 238+00. More than \$9 million in damages were sustained in this event.
- 1997 - A series of large storms that produced heavy rain and high winds caused heavy runoff and high tide conditions that impacted the District's levee, as well as the entire Sacramento – San Joaquin Delta region. The District claimed costs for flood event related erosion repairs, emergency response – floodfight, and engineering technical assistance. Due to the improvements to the District's levee since the 1986 flood event, and well organized floodfight response, the District's levees and sustained only minor damage and performed well. \$781,912 in damages were reported.
- 2006 Winter Storms. (FEMA 1628-DR) A large series of storm events generating high winds and heavy rain caused rivers to rise above flood stage. High winds during this time caused damage to the District's rock slope protection at various locations, road damage from levee patrols and repair equipment and seepage problems. Repairs were made to the rock slope protection and roads. The seepage site was stabilized with a gravel blanket. Overall the levee performance was good.

Vulnerability to Levee Failure

The primary threats to Delta levees are high water surface elevations from floods or high tides, wave action due to high winds or boat wakes, and rodent damage, either as individual actions or in combination. Levees that may have structural issues involving poor foundations, inadequate geometry or other geotechnical issues can be at a higher risk of failure from any of the primary threats. Subsidence of Delta lands has been reported to be a major risk to Delta levees, however, subsidence is limited or non-existent under and adjacent to the levees as those areas have consolidated over the last fifty years and oxidation of the peat foundations is limited because it is not farmed. Subsidence in general is limited to a very small percentage of the delta. Seismic risk is always a factor for California, but it is generally thought by Delta engineers to have been overstated in the DRMS study, and therefore is not something that is currently designed for, although, any levee improvements will help to mitigate that risk. Climate change and sea level rise have also been identified as issues for levee vulnerability. Because these impacts will occur over long periods of time, it should not be an overwhelming problem to address them as they occur.

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

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

Assets/Critical Facilities at Risk

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

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

Natural Resources at Risk

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

Historic and Cultural Resources at Risk

The District Planning Team noted that there are no known historic and or cultural resources at risk on the island.

Future Development

While future development may occur in the areas protected by levee, the District does not control this development. The District only can control whether the levees meet certification standards.

River/Stream/Creek Bank Erosion

Likelihood of Future Occurrence–Likely

Vulnerability–Medium

Hazard Profile and Problem Description

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. As farmers settled the valleys in the 1800s, the Gold Rush drew prospectors to the hills. As mining in the Sierra Nevada turned to the more “efficient” methods of hydraulic mining, the use of environmentally destructive high-pressure water jets washed entire mountainsides into local streams and rivers. As a result, the enormous

amounts of silt deposited in the riverbeds of the Central Valley increased flood risk. As a remedy to these rising riverbeds, levees were built very close to the river channels to keep water velocity high and thereby scour away the sediment. However, the design of these narrow channels has been too successful. While the Gold Rush silt is long gone, the erosive force of the constrained river continues to eat away at the levee system and stream banks within the District.

Past Occurrences

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

- 1982 – A series of large storms that produced heavy rain and high winds causing erosion in the District. More information can be found in the Past Occurrences Section of Levee Failure above.
- 1997 – A series of large storms that produced heavy rain and high winds caused heavy runoff and high tide conditions that eroded the District's levee. More information can be found in the Past Occurrences Section of Levee Failure above.
- 2006 – A large series of storm events generating high winds and heavy rain caused rivers to rise above flood stage. High winds during this time caused damage to the District's rock slope protection at various locations. More information can be found in the Past Occurrences Section of Levee Failure above.

Vulnerability to Erosion

Assets/Critical Facilities at Risk

The entirety of the levee system in RD 563 is at risk to erosion.

Natural Resources at Risk

The District Planning Team noted that flooding of Delta islands destroys habitat, kills most species present, and can entrain and strand large populations of native and non-native fish species.

Historic and Cultural Resources at Risk

The District Planning Team noted that there are no known historic and or cultural resources at risk on the island.

Future Development

While future development may occur in the areas protected by levee, which can be compromised by severe erosion, the District does not control this development. The District only can control whether the levees meet certification standards.

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

Likelihood of Future Occurrence–Likely

Vulnerability–Medium

Hazard Profile and Problem Description

According to historical hazard data, severe weather is an annual occurrence in the District. Damage and disaster declarations related to severe weather have occurred and will continue to occur in the future.

Past Occurrences

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

- 1986 – Due to the extreme storm event, multiple days of heavy rain, strong winds from extreme low pressure gradients, high tides and runoff affecting the entire Sacramento-San Joaquin Delta, the District’s levee failed. More information can be found in the Past Occurrences Section of Levee Failure above.
- 1997 – A series of large storms that produced heavy rain and high winds caused heavy runoff and high tide conditions that impacted the Districts levee, as well as the entire Sacramento – San Joaquin Delta region. More information can be found in the Past Occurrences Section of Levee Failure above.

Vulnerability to Heavy Rains and Storms

Assets/Critical Facilities at Risk

Heavy rain and thunderstorms are the most frequent type of severe weather occurrence in the area. Wind and lightning often accompany these storms and have caused damage in the past. Problems associated with the primary effects of severe weather include flooding, pavement deterioration, washouts, high water crossings, landslide/mudslides, debris flows, and downed trees. However, it is the secondary effects of heavy rain and storms that are of concern to RD 563. Heavy rains can cause flooding, levee failure, and stream bank erosion. Flooding, levee failure, and stream bank erosion can cost RD 563 millions in damages.

Natural Resources at Risk

The District Planning Team noted that flooding of Delta islands destroys habitat, kills most species present, and can entrain and strand large populations of native and non-native fish species.

Historic and Cultural Resources at Risk

The District Planning Team noted that there are no known historic and or cultural resources at risk on the island.

Future Development

While future development may occur in the areas protected by levee, which can be compromised during severe storm events, the District does not control this development. The District only can control whether the levees meet certification standards.

Severe Weather: Wind and Tornadoes

Likelihood of Future Occurrence–Likely

Vulnerability–High

Hazard Profile and Problem Description

According to historical hazard data, severe weather (including high winds) is an annual occurrence in the District. Tornadoes occur much less frequently. Damage and disaster declarations related to severe weather have occurred and will continue to occur in the future.

Past Occurrences

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

- 1986 – Due to the extreme storm event, multiple days of heavy rain, strong winds from extreme low pressure gradients, high tides and runoff affecting the entire Sacramento-San Joaquin Delta, the District’s levee failed. More information can be found in the Past Occurrences Section of Levee Failure above.
- 2006 Flood Event. Rip rap was placed on waterside slopes to mitigate damage caused from high winds.

Vulnerability to Wind and Tornadoes

Assets/Critical Facilities at Risk

The District Planning Team noted that the entire levee structures are at risk from wind.

Natural Resources at Risk

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

Historic and Cultural Resources at Risk

The District Planning Team noted that there are no known historic and or cultural resources at risk on the island.

Future Development

While future development may occur in the areas protected by levee, which can be compromised during high wind events, the District does not control this development. The District only can control whether the levees meet certification standards.

Subsidence

Likelihood of Future Occurrence–Likely

Vulnerability–Medium

Hazard Profile and Problem Description

For over a century, subsidence of the organic soils in portions of the Delta has led to an increasing need for subsurface drainage. Aerobic oxidation of organic carbon, the primary cause of subsidence, began in the late 1800s as the nutrient-rich organic soils were cleared and farming began. Peat fires, lit to level agricultural fields prior to 1950, and wind erosion are also significant causes of subsidence throughout the Delta. Since reclamation of the island began, elevations have fallen to as much as 20 feet below sea level, requiring protection by over 1,125 miles of man-made levees throughout the Delta. Drainage is provided by a network of ditches that collect and transport shallow groundwater, irrigation runoff, and levee seepage to pump stations that discharge back into the Delta waterways. These ditches create an unsaturated root zone for crops, and provide a more stable levee foundation.

Past Occurrences

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

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

Vulnerability to Subsidence

Assets/Critical Facilities at Risk

The management issues raised by land subsidence range in scale from those faced by individual farmers to the possible global-scale issue posed by the carbon-dioxide flux, with its possible link to climate change. At the most local level, individual farmers or reclamation districts must maintain drainage networks on the islands and pump the agricultural drainage back into waterways. These costs increase gradually as subsidence progresses. All levee structures in RD 563 are at risk to subsidence.

Natural Resources at Risk

The District Planning Team noted that all natural resources are at risk from subsidence.

Historic and Cultural Resources at Risk

The District Planning Team noted that there are no known historic and or cultural resources at risk on the island.

Future Development

While future development may occur in the areas protected by levee, which can be compromised by subsidence activity, the District does not control this development. The District only can control whether the levees meet certification standards.

9.6 Capability Assessment

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

9.6.1. Regulatory Mitigation Capabilities

Table 9-4 lists regulatory mitigation capabilities, including planning and land management tools, typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in the RD 563.

Table 9-4 RD 563's Regulatory Mitigation Capabilities

Plans	Y/N Year	Does the plan/program address hazards? Does the plan identify projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?
Comprehensive/Master Plan	Y 2013	5 Year Plan identifies hazards that may affect RD 563. Some mitigation strategies are proposed. An Evacuation Plan is detailed, as well as an Emergency Response Plan.
Capital Improvements Plan	N	
Economic Development Plan	N	
Local Emergency Operations Plan	Y	Under development at time of development of this planning process
Continuity of Operations Plan	N	
Transportation Plan	N	
Stormwater Management Plan/Program	N	
Engineering Studies for Streams	N	
Community Wildfire Protection Plan	N	
Other special plans (e.g., brownfields redevelopment, disaster recovery, coastal zone management, climate change adaptation)		
Building Code, Permitting, and Inspections	Y/N	Are codes adequately enforced?
Building Code	N	Version/Year:

Building Code Effectiveness Grading Schedule (BCEGS) Score	N	Score:
Fire department ISO rating:	N	Rating:
Site plan review requirements	N	
Land Use Planning and Ordinances	Y/N	Is the ordinance an effective measure for reducing hazard impacts? Is the ordinance adequately administered and enforced?
Zoning ordinance	N	
Subdivision ordinance	N	
Floodplain ordinance	N	
Natural hazard specific ordinance (stormwater, steep slope, wildfire)	N	
Flood insurance rate maps	N	
Elevation Certificates	N	
Acquisition of land for open space and public recreation uses	N	
Erosion or sediment control program	N	
Other	N	
How can these capabilities be expanded and improved to reduce risk?		

Source: RD 563

9.6.2. Administrative/Technical Mitigation Capabilities

Table 9-5 identifies the department(s) responsible for activities related to mitigation and loss prevention for RD 563.

Table 9-5 RD 563's Administrative and Technical Mitigation Capabilities

Administration	Y/N	Describe capability Is coordination effective?
Planning Commission	N	
Mitigation Planning Committee	Y	RD 1601 staff and KSN, Inc. staff
Maintenance programs to reduce risk (e.g., tree trimming, clearing drainage systems)	Y	
Mutual aid agreements	Y	
Other		
Staff	Y/N FT/PT	Is staffing adequate to enforce regulations? Is staff trained on hazards and mitigation? Is coordination between agencies and staff effective?
Chief Building Official	N	
Floodplain Administrator	N	

Emergency Manager	Y	KSN, Inc.
Community Planner	N	
Civil Engineer	Y	KSN, Inc.
GIS Coordinator	Y	KSN, Inc.
Other		
Technical		
Warning systems/services (Reverse 911, outdoor warning signals)	N	
Hazard data and information	Y	KSN, Inc.
Grant writing	Y	KSN, Inc.
Hazus analysis	N	
Other		
How can these capabilities be expanded and improved to reduce risk?		

Source: RD 563

9.6.3. Fiscal Mitigation Capabilities

Table 9-6 identifies financial tools or resources that the RD 563 could potentially use to help fund mitigation activities.

Table 9-6 RD 563's Fiscal Mitigation Capabilities

Funding Resource	Access/ Eligibility (Y/N)	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Capital improvements project funding	Y	
Authority to levy taxes for specific purposes	Y	Levy Assessment Program but not taxes
Fees for water, sewer, gas, or electric services	N	
Impact fees for new development	N	
Storm water utility fee	Y	Part of our Levy Assessment Program
Incur debt through general obligation bonds and/or special tax bonds	Y	
Incur debt through private activities	N	
Community Development Block Grant	N	
Other federal funding programs	Y	USACE PL84-99
State funding programs	Y	DWR Levee Subventions and Special Projects Program
Other		
How can these capabilities be expanded and improved to reduce risk?		

9.6.4. Mitigation Education, Outreach, and Partnerships

Table 9-7 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 9-7 RD 563’s Mitigation Education, Outreach, and Partnerships

Program/Organization	Yes/No	Describe program/organization and how relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?
Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	N	
Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)	N	
Natural disaster or safety related school programs	N	
StormReady certification	N	
Firewise Communities certification	N	
Public-private partnership initiatives addressing disaster-related issues	N	
Other		
How can these capabilities be expanded and improved to reduce risk?		

9.6.5. Other Mitigation Efforts

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

9.7 Mitigation Strategy

9.7.1. Mitigation Goals and Objectives

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

9.7.2. Mitigation Actions

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

Action 1. Rock Slope Protection Project

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

Goals Addressed: 1, 3

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

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

Other Alternatives: none

Existing Planning Mechanism(s) through which Action Will Be Implemented: Permitting process, Finalizing the EIR, potential CEQA Design Process

Responsible Office/Partners: RD 563

Project Priority: High

Cost Estimate: \$813,000

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

Potential Funding: Prop 1 and 1E, 84 Funds, HMGP Grant Programs, seeking cost sharing partners for project ongoing.

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

Action 2. HMP and PL-8499 Levee Improvement Projects

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

Goals Addressed: 1, 3

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

Project Description: The District would like to bring portions of the RD 563 levee currently below the HMP Criteria to six inches above the PL 84-99 Standard using 2:1 landside slopes. If sufficient funding is available, the segments of levee improved during this phase will include portions of the levee that meet the HMP Criteria, but do not meet the design template for this project, due to the many relatively short stretches of levee that do not meet the PL 84-99 Standard in close proximity to longer stretches of levee that do not meet the HMP Standard. After the entire levee meets or exceeds the HMP Criteria, the District will bring any remaining portions of levee below the PL 84-99 Standard to six inches above the PL 84-99 Standard.

Other Alternatives: none

Existing Planning Mechanism(s) through which Action Will Be Implemented: Permitting process, Finalizing the EIR, CEQA Design Process

Responsible Office/Partners: RD 563

Project Priority: High

Cost Estimate: \$16,000,000

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

Potential Funding: Prop 1 and 1E, 84 Funds, HMGP Grant Programs, seeking cost sharing partners for project.

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