Delta Annex Chapter 4 Reclamation District 341

4.1 Introduction

This chapter of the Delta Annex details the hazard mitigation planning elements specific to the Reclamation District 341 (RD 341), a previously 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 the RD 341. This chapter of the Delta Annex provides additional information specific to RD 341, with a focus on providing additional details on the planning process, risk assessment, and mitigation strategy for this District.

4.2 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 341 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 4-1. Additional details on plan participation and RD 341 representatives are included in Appendix A.

Table 4-1 RD 341 Planning Team

Name	Position/Title	How Participated
Robert C. Wagner, P.E.	District Engineer	Reviewed Draft Documents
Patrick W. Ervin, P.E.	Engineer	Attended Meetings, Drafted Text
Martin Berber	Staff Engineer	Collected Data, Reviewed Draft Documents

Source: RD 341

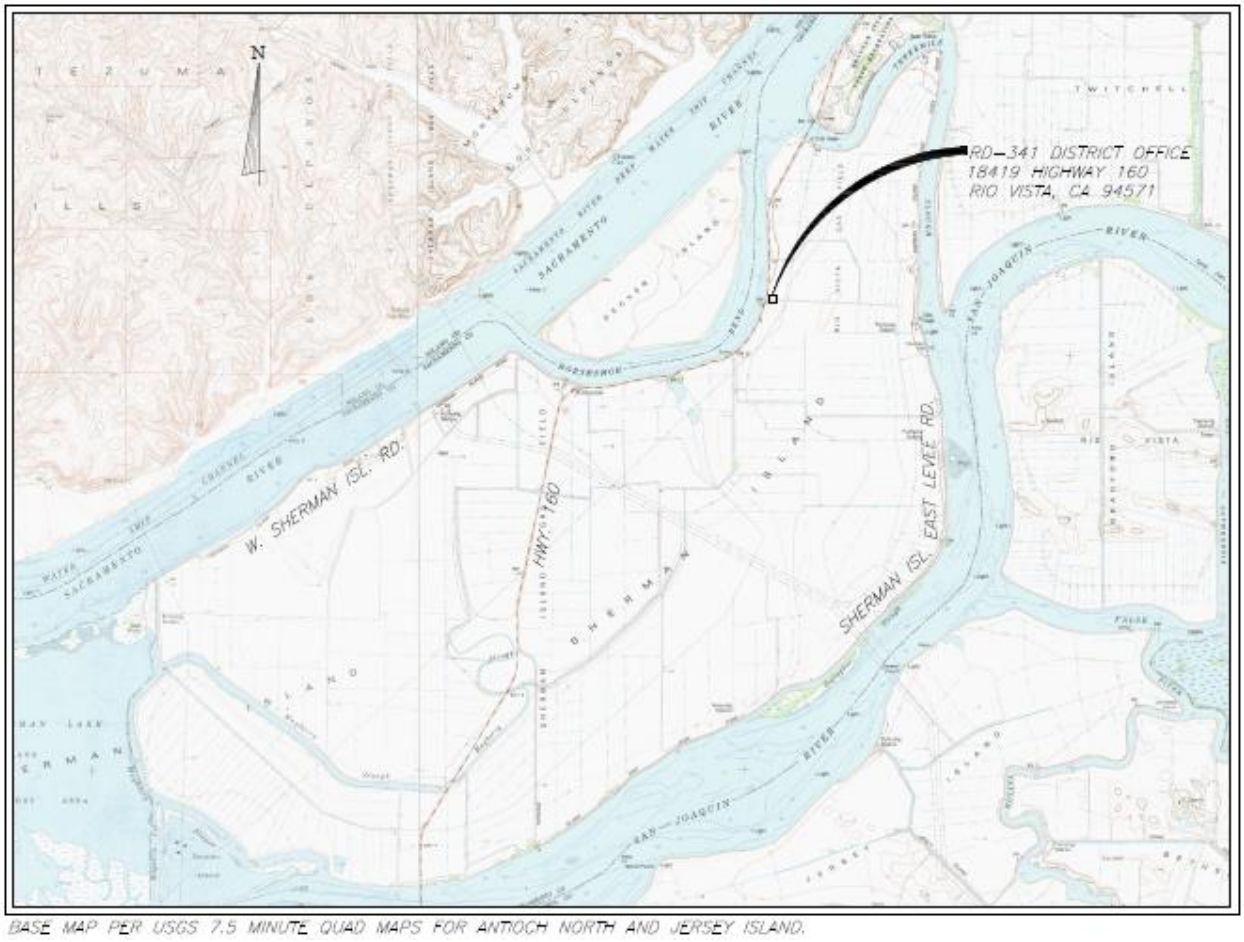
4.2.1. Coordination with Other District Planning Efforts

Coordination with other District planning efforts is paramount to the successful implementation of this plan. This section provides information on how the District integrated the previously-approved 2011 Plan into existing planning mechanisms and programs. The District Planning Team noted that they didn't exactly implement the LHMP document into any planning mechanisms. The District did however complete projects that were part of our strategy to improving mitigation and have ongoing projects as well. For example, the Scour Lake habitat restoration project has been completed and the District is working on the long term maintenance plan for the habitat. The Fish Release Sites project has begun construction and is expected to last through December 2017. The District also already completed Phase 1 of SH-10-1.0 that is listed on the strategies for this updated document.

4.3 Community Profile

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

Figure 4-1 Reclamation District 341 Map



4.3.1. RD 341 Overview, Background, and History

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

rates in excess of relative sea-level rise. The gradual accumulation of the organic and inorganic sediment must have also offset the loss and compaction of existing peat.

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

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

4.4 Hazard Identification

RD 341'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 341 (see Table 4-2).

Table 4-2 RD 341—Hazard Identification

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

Geographic Extent
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area
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.

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

4.5 Hazard Profile and Vulnerability Assessment

The intent of this section is to profile RD 341'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 341 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.

4.5.1. Hazard Profiles

Each hazard vulnerability assessment in Section 4.5.3, includes a description as to how the hazard affects the RD 341 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.

4.5.2. Vulnerability Assessment

This section identifies RD 341'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 4-3 lists particular critical facilities and other District assets identified by the RD 341's planning team as important to protect in the event of a disaster. RD 341's physical assets, valued at over $12.7 million (without the value of the levees), consist of the buildings and infrastructure to support the RD 341 operations.

Table 4-3 RD 341's Critical Facilities, Infrastructure, and Other District Assets

Name of Asset	Facility Type	Address	Replacement Value	Hazard Info
Agricultural	High Potential Loss Facilities		$6,764,520	Flood, Levee Failure
Agricultural-Irrigated from District Facilities	High Potential Loss Facilities		$4,415,800	Flood, Levee Failure
Marina-Recreation	High Potential Loss Facilities		$16,530	Flood, Levee Failure
Urban	High Potential Loss Facilities		$87,700	Flood, Levee Failure
Commercial	High Potential Loss Facilities		$8,300	Flood, Levee Failure
Utilities (Including easements)	Transportation and Lifeline		$615,810	Flood, Levee Failure

Source: RD 341

The District Planning Team noted that "Replacement Value" in the table above isn't accurate. In reality, the true replacement of damages caused by a levee breach will be a far greater cost. Pumping cost to dewater the island would be very expensive, salt intrusion up the Sacramento River would cause serious water supply and agricultural problems, etc.

Natural Resources

The District Planning Team noted no notable natural resources exist in the District boundaries.

Historic and Cultural Resources

The District Planning Team noted no historic or cultural resources exist in the District boundaries.

Growth and Development Trends

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

Development since the 2011 Plan

The RD has not seen an increase in their service area population since the 2011 plan.

4.5.3. Vulnerability to Specific Hazards

This section provides the vulnerability assessment, including any quantifiable loss estimates, for those hazards identified above in Table 4-2 as high or medium significance hazards. Impacts of past events and vulnerability of the RD 341 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 341 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.

Flood: 100-/200-/500-year

Likelihood of Future Occurrence–Occasional
Vulnerability–High

Hazard Profile and Problem Description

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

Past Occurrences

The first significant flooding affecting Sherman Island agriculture occurred during the 1861/62 season and caused wide-spread damage throughout the delta's river islands, and Sherman Island farmers lost most of their livestock as a result when the Sacramento River breached the low levees constructed along its banks. After completion of the levee system in 1869, Sherman Island suffered several floods. Sherman Island levees failed during the winters of 1871/72, 1874/75, 1876, and 1878. Several crevasses cut through the north and south levees west of Mayberry Slough in the 1874 levee failure, resulting in the loss of all but 100 acres of cropland in the western portion of the island. The subsequent levee reconstruction featured a

12-foot high peat levee with 120 feet widths at the base. Even so, the 1876 flood covered the western portion of the island again. The flood of 1878 devastated the entire island.

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

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

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

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

The southern levee on the San Joaquin River side failed and flooded the Island on January 20, 1969 at approximate levee station 520+00. Upon finding the break, a large quantity of rock was placed on the upstream and downstream ends of the levee to protect against further erosion from high velocities into and out of the break due to tide. Without placement of the rock, the break which was approximately 275 feet wide and about 45 feet below mean sea level, would have been greatly enlarged. After the break, the water inside the island and in the San Joaquin River was at the same level. The flooding created a deep hole in the channel on the waterside and a deep lake on the landside toe of the levee at the site of the break. Pumps to dewater the Island were rented (District pumps were entirely submerged). Pumping with the rented equipment commenced February 28, 1969 and continued through August 9, 1969, at which point District pumps continued to remove the remaining water from the Island. All 93,000 feet of District drainage ditches were cleaned and/or excavated, primarily by drag line and ditcher operations before District ditches

were operable. The Corps of Engineers spent approximately $600,000 in emergency funds to repair, reslope, and regrade the levee break area after the 1969 break. Seepage and settlement in the area of the break have been ongoing issues requiring constant levee improvements.

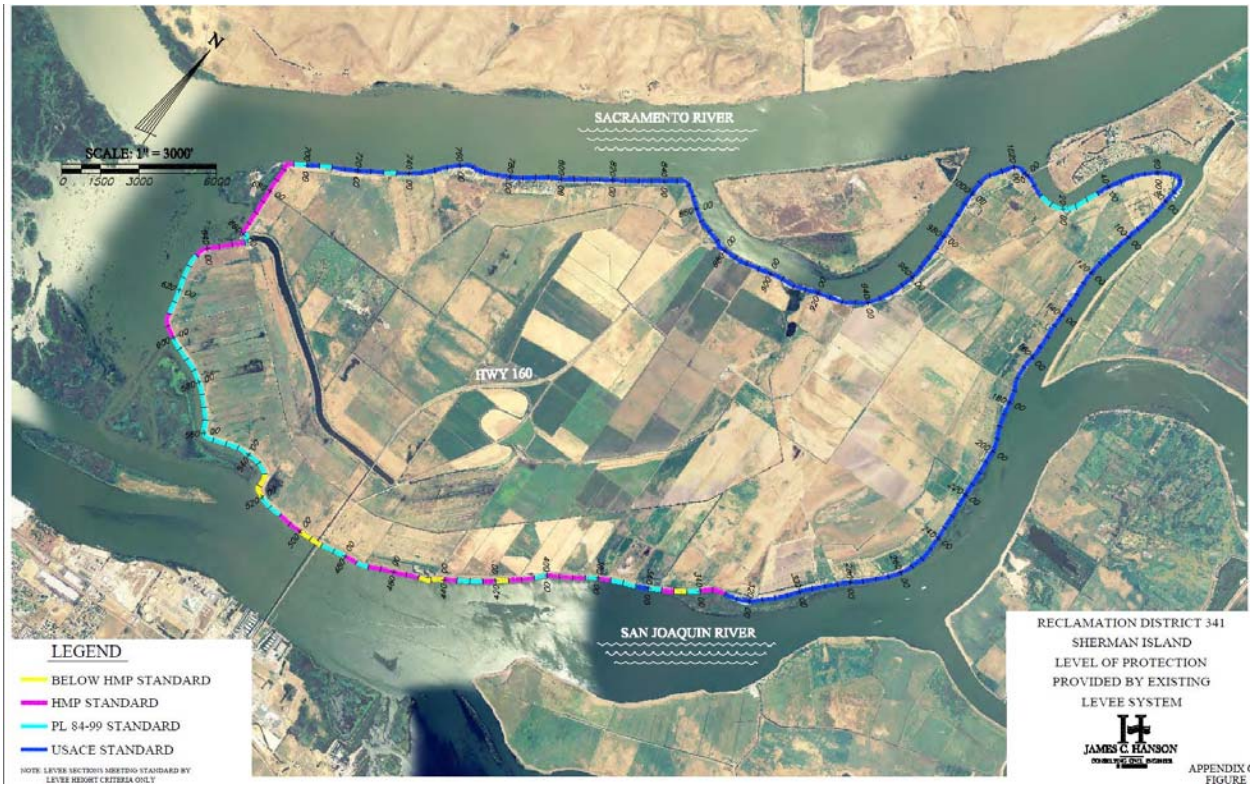
Vulnerability to Flood

Assets at Risk

Should a high water flood event cause levees to collapse, Sherman Island would be fully inundated, risking the $12.7 million in district assets discussed in Table 4-2.

Areas of the existing levee system most susceptible to overtopping are those which do not meet the PL 84-99 height standard. An inventory of levee sections and their respective heights is maintained by the District. Analysis of this inventory shows that the levee along the San Joaquin River from about levee station 330+00 to 450+00, the Sacramento River from about 720+00 to 750+00 and Three Mile Slough from about 20+00 to 40+00 contains stretches which are below the PL 84-99 height standard (1.5 feet above 1:100 year flood event) and therefore are susceptible to overtopping. Figure 4-2 depicts levee flood protection levels for each individual section of the Sherman Island levees.

Figure 4-2 Level of Levee Flood Protection in Reclamation District 341



Source: Reclamation District 341 Five Year Plan (2009)

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 and can protect against floods. The District Planning Team noted that the State of California has purchased the majority of the land on Sherman Island over the last several years with the intent of not developing the island. It's leased as grazing land or being converted back to natural habitat.

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

Past Occurrences

See the flood section of this document for a history of flooding and levee failure.

Vulnerability to Levee Failure

Assets at Risk

In addition to the costs incurred to repair or replace the assets destroyed by Sherman Island levee failure, an immediate cost would be pumping out the Island. To estimate the cost of restoring Sherman Island, the 2004 failure of the Upper Jones Tract was considered, an Island of 6,259 acres which cost approximately $120 million to restore. This equates to about $19,100 per acre, and assuming inflation of 4% a year, would be about $22,200 in 2009. Accordingly, it would cost approximately $221 million to pump out and restore Sherman Island (9,937 acres X $22,200 per/acre). This estimate is conservative in that it does not account for the elevations on the interior of Sherman Island, which are up to 20 feet below sea level. Sherman will likely impound a greater volume of water per acre than Upper Jones Tract, and per acre restoration costs will therefore be greater.

Electrical Infrastructure Affected

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

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

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

Oil and Gas Production Affected

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

Civil Infrastructure Affected

Sherman Island levees also protect State Highway 160 and the drawbridge at Three Mile Slough. State Route 160 connects Sherman Island to the mainland Sacramento County on the northeast corner via

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

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

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

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. The District Planning Team noted that the State of California has purchased the majority of the land on Sherman Island over the last several years with the intent of not developing the island. It's leased as grazing land or being converted back to natural habitat.

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

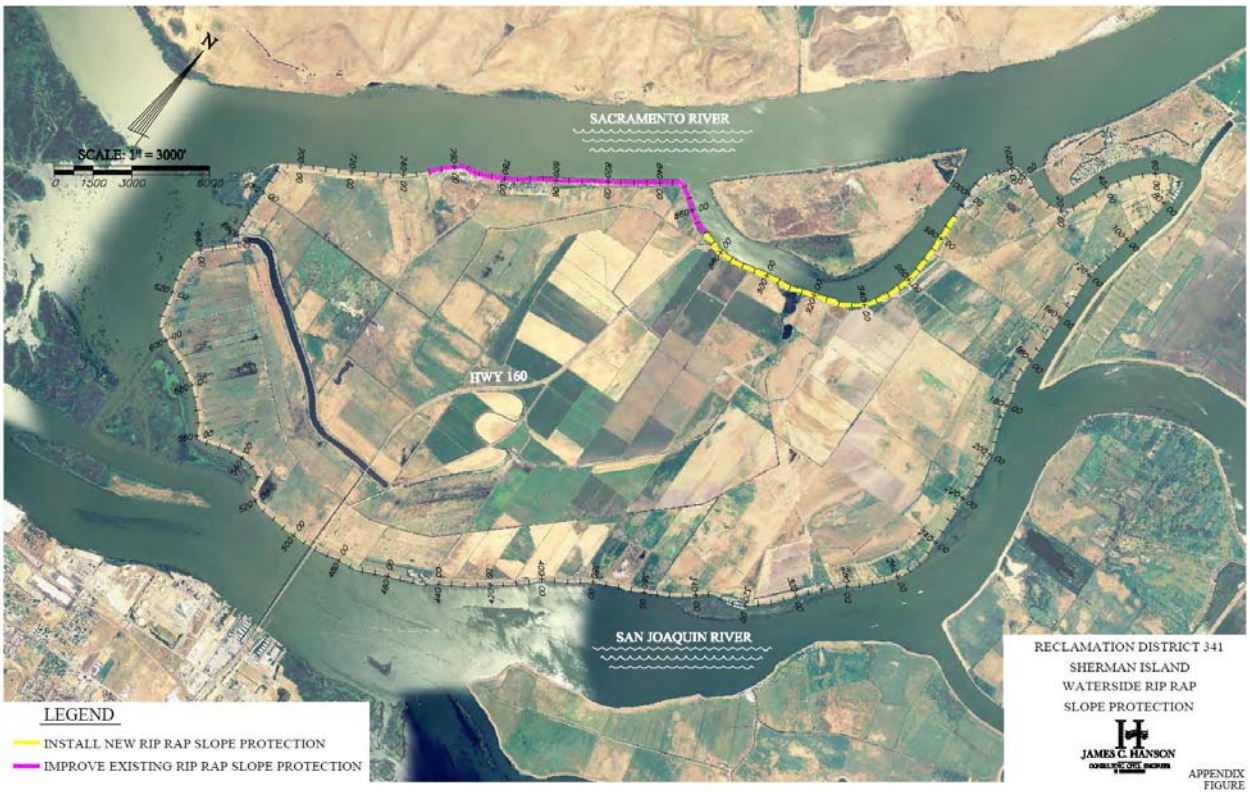
settled the valleys in the 1800s, the Gold Rush drew prospectors to the hills. As mining in the Sierra Nevada turned to the more "efficient" methods of hydraulic mining, the use of environmentally destructive high-pressure water jets washed entire mountainsides into local streams and rivers. As a result,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

Due to the public benefit provided by Sherman Island levees and the valuable local and non-local assets they protect, District employees conduct visual inspections of the Sherman Island levee system every day of the year. In addition, the superintendent, Board president and District engineer survey the levee a minimum of twice a month and participate in an annual inspection of the levee from the waterside. These inspections are invaluable for identifying issues such as seepage, cracking, erosion and lack of splash cap and riprap.

Past Occurrences

According to the District's Five Year Plan, levee erosion is an ongoing problem. Areas of the existing levee system most susceptible to failure due to flooding resulting from erosion are those areas with inadequate riprap protection. The large expanse of waterway of the Sacramento River adjacent to Sherman Island provides the necessary distance, or fetch, when accompanied by high winds can produce large waves. The existing rip rap protection lacks the required coverage of the waterside slope to protect the levee from wind generated waves. The existing large breakwater quarry stones and limited amount of rip rap are below the high tide level of the Sacramento River exposing the unprotected levee embankment material to wind generated erosion damage. High winds originating from the north during periods of high tide and/or high storm runoff will seriously erode the unprotected levee slope. Accordingly, the District feels that the lack of riprap slope protection is a critical issue which could affect the stability of the levee, should erosion damage occur.

Figure 4-3 Erosion Sites in Reclamation District 341 Levees



Source: RD 341 Five Year Plan (2009)

The District Planning Team noted that erosion is an ongoing issue, with varying levels of erosion occurring every year.

Vulnerability to Erosion

Assets at Risk

The entirety of the levee system in RD 341 is at risk to erosion.

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 and are protected from erosion. The District Planning Team noted that the State of California has purchased the majority of the land on Sherman Island over the last several years with the intent of not developing the island. It's leased as grazing land or being converted back to natural habitat.

4.6 Capability Assessment

Capabilities are the programs and policies currently in use to reduce hazard impacts or that could be used to implement hazard mitigation activities. This capabilities assessment is divided into five sections:

regulatory mitigation capabilities, administrative and technical mitigation capabilities, fiscal mitigation capabilities, mitigation education, outreach, and partnerships, and other mitigation efforts.

4.6.1. Regulatory Mitigation Capabilities

Table 4-4 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 341.

Table 4-4 RD 341'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	N	
Capital Improvements Plan	N	
Economic Development Plan	N	
Local Emergency Operations Plan	N	
Continuity of Operations Plan	N	
Transportation Plan	N	
Stormwater Management Plan/Program	N	
Engineering Studies for Streams	N	
Community Wildfire Protection Plan	N	
Other special plans (e.g., brownfields redevelopment, disaster recovery, coastal zone management, climate change adaptation)	Y	5-year plan, California DWR Emergency Safety Plan
Building Code, Permitting, and Inspections	**Y/N**	**Are codes adequately enforced?**
Building Code	N	Version/Year:
Building Code Effectiveness Grading Schedule (BCEGS) Score	N	Score:
Fire department ISO rating:	N	Rating:
Site plan review requirements	N	
Land Use Planning and Ordinances	**Y/N**	**Is the ordinance an effective measure for reducing hazard impacts? Is the ordinance adequately administered and enforced?**
Zoning ordinance	N	
Subdivision ordinance	N	
Floodplain ordinance	N	
Natural hazard specific ordinance (stormwater, steep slope, wildfire)	N	

Flood insurance rate maps	N	
Elevation Certificates	N	
Acquisition of land for open space and public recreation uses	N	
Erosion or sediment control program	Y	Erosion control measures on levee and canal slopes as necessary
Other		
How can these capabilities be expanded and improved to reduce risk?		

Source: RD 341

4.6.2. Administrative/Technical Mitigation Capabilities

Table 4-5 identifies the department(s) responsible for activities related to mitigation and loss prevention for RD 341.

Table 4-5 RD 341's Administrative and Technical Mitigation Capabilities

Administration	Y/N	Describe capability Is coordination effective?
Planning Commission	N	
Mitigation Planning Committee	N	
Maintenance programs to reduce risk (e.g., tree trimming, clearing drainage systems)	N	
Mutual aid agreements	N	
Other		
Staff	**Y/N FT/PT**	**Is staffing adequate to enforce regulations? Is staff trained on hazards and mitigation? Is coordination between agencies and staff effective?**
Chief Building Official	N	
Floodplain Administrator	N	
Emergency Manager	N	
Community Planner	N	
Civil Engineer	Y	
GIS Coordinator	N	
Other		
Technical		
Warning systems/services (Reverse 911, outdoor warning signals)	N	
Hazard data and information	N	
Grant writing	N	
Hazus analysis	N	

Other
How can these capabilities be expanded and improved to reduce risk?

Source: RD 341

4.6.3. Fiscal Mitigation Capabilities

Table 4-6 identifies financial tools or resources that the RD 341 could potentially use to help fund mitigation activities.

Table 4-6 RD 341's Fiscal Mitigation Capabilities

Funding Resource	Access/ Eligibility (Y/N)	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Capital improvements project funding	N	
Authority to levy taxes for specific purposes	Y	
Fees for water, sewer, gas, or electric services	N	
Impact fees for new development	N	
Storm water utility fee		
Incur debt through general obligation bonds and/or special tax bonds	N	
Incur debt through private activities	N	
Community Development Block Grant	Y	
Other federal funding programs		
State funding programs		
Other		
How can these capabilities be expanded and improved to reduce risk?		

Source: RD 341

4.6.4. Mitigation Education, Outreach, and Partnerships

Table 4-7 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 4-7 RD 341's Mitigation Education, Outreach, and Partnerships

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

4.6.5. Other Mitigation Efforts

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

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

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

	Estimated Funding Required	2009	2010	2011	2012	2013	Accumulated Total
Existing Project Funding Agreements (PFA)							
1. PFA SH 08-1.0 Mayberry Farms - Construction	$1,600,000						$1,600,000
2. PFA SH 08-2.0 Highway 160 landside slope repair	$275,000						$1,875,000
3. PFA SH 08-3.0 Engineering and Long-Term Planning	$150,000						$2,025,000
4. SH 08-5.0 Beneficial Reuse Project	$200,000						$2,225,000
Existing PFAs for which additional funds are required							
5. PFA SH 06-1.0 Mayberry Farms - Planning *Budget augmentation of $150,000 requested	$250,000						$2,475,000
6. PFA SH 08-4.0 Mayberry Slough Phase II Waterside Construction *Budget augmentation of $1,600,000 requested	$2,400,000						$4,875,000
Draft Recommendations FY 08-09 Funding							
7. Phase I - Landside Setback Sta. 520+00 to 545+00	$2,300,000						$7,175,000
8. Waterside Rock Reinforcement - Levee Sta. 700+00 to 850+00 Planning, permitting	$500,000						$7,675,000
9. Investigation of levee anomalies - Phase II	$720,000						$8,395,000

LEGEND:
- Planning and Engineering
- Construction

Source: RD 341 Five Year Plan (2009)

Figure 4-5 Reclamation District 341 Strategy to Meet Desired Levels of Protection (cont.)

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

LEGEND:

Planning and Engineering

Construction

Source: RD 341 Five Year Plan (2009)

4.7 Mitigation Strategy

4.7.1. Mitigation Goals and Objectives

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

4.7.2. Mitigation Actions

The planning team for RD 341 identified and prioritized the following mitigation actions based on the risk assessment. Background information and information on how each action will be implemented and administered, such as ideas for implementation, responsible office, potential funding, estimated cost, and timeline are also included.

Action 1. San Joaquin River Setback Levee/Habitat Bench Multi-Benefit Project, Phase 1

Hazards Addressed: Levee Failure / Flooding

Goals Addressed: 1, 2, 3, 4

Issue/Background: The existing levees on Sherman Island were constructed approximately 100 years ago, using sandy soil dredged out of the river. The construction of these historic levees were not engineered to modern standards and did not include concerted compaction efforts nor did it include screening out granular soils for the more preferred fine-grained soils. Historic boring logs show the levees to be comprised of sandy material over an organic silty/clayey foundation. Additionally, the levees were constructed adjacent to the river bank, limiting riparian and riverine habitat. Since the levees were constructed of sandy material and directly adjacent to the river, they are highly susceptible to seepage, erosion, and stability failures.

The setback levee will be designed and constructed to meet the minimum U.S. Army Corps of Engineers (USACE) Standard along with a 28-foot crest, 2H:1V waterside slope, 4H:1V landside slope. Prior to Project design, geotechnical investigations including borings and strength parameters will be performed to develop design criteria. The 28-foot crest will support a road built to required Sacramento County rural road standards which includes 12-foot travel lanes in each direction along with 2-foot shoulders.

Other Alternatives: None

Existing Planning Mechanisms through which Action will be Implemented: Delta Levees Program 2016 Projects Solicitation Package for Multi-Benefit Projects

Responsible Office: RD 341, RD 341 Engineer, California Department of Water Resources Delta Levees Program

Priority (H, M, L): High

Cost Estimate: $10,070,000

Potential Funding: Delta Levees Program

Benefits (avoided Losses): The Delta Risk Management Strategy (DRMS) July 16, 2008 Risk Analysis Report indicates that the Sherman Island levee system protects approximately $11,500,000 in local assets. Adjusted for inflation, the system currently protects $12,700,000 in local assets.

The levees also protect non-local assets which provide public benefit. Facilities which would be impacted by the failure of the levee system protecting Sherman Island are State Route 160, the water delivery systems for the State Water Project and the Central Valley Water Project, and utilities such as natural gas and major transmissions lines. The levee system also provides access to recreational resources such as fishing, windsurfing, and Sherman Island County Park. The proposed Project bolsters the Sherman Island levee system, thus providing benefit to local and non-local assets. In addition, Sherman Island is home to approximately 250 permanent residents. Levee system integrity protects the safety of these individuals and their property.

Schedule: Landside construction would occur during the 2018 construction season while awaiting issuance of the regularity permits. Waterside construction would occur during the 2019 construction season.

Action 2. Complete Projects from Regional Flood Management Plan

Hazards Addressed: Levee Failure, Flooding, Streambank Erosion

Goals Addressed: 1, 2, 3, 4

Issue/Background: Sherman Island has similar issues to the other communities in the region. Its primary issues however, are related maintenance activities.

Project Description: There are four erosion sites along the Sacramento River identified in the FSRP. These erosion sites can be improved through the construction of a bank protection project along Cache Slough. The project will rehabilitate the waterside bank from levee mile 4.12 and 6.09, a total rehabilitated length of 1,994 feet.

Other Alternatives: None

Existing Planning Mechanisms through which Action will be Implemented: Regional Flood Management Plan

Responsible Office: RD 341, RD 341 Engineer

Priority (H, M, L): High

Cost Estimate: $2,261,136

Potential Funding: Cal DWR Grant

Benefits (avoided Losses):

Schedule: As soon as funds are available.