Flood Risk Reduction Feasibility Study for Delta Legacy Community of Hood, CA

Funded by California Department of Water Resources Small Communities Flood Risk Reduction Program

Submitted to:
Sacramento County Department of Water Resources

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Visit the Hood Story Map for more details of the community, its history, and flood risk concerns: [Hood Story Map - Sacramento County Small Communities Flood Risk Reduction Program][1]

[1] https://sacramentocounty.maps.arcgis.com/apps/MapJournal/index.html?appid=cda6eb30ff4943ffbae895e122c8791e

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Acronyms and Abbreviations

AFOTF	Agricultural Floodplain Ordinance Task Force
APE	area of potential effect
AWSE	Assessment Water Surface Elevation
B	Billion
BFE	Base Flood Elevation
BWFS	Basin-Wide Feasibility Study
BW-12	Biggert-Waters Flood Insurance Reform Act of 2012
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CFR	California Code of Federal Regulations
cfs	cubic feet per second
Conservancy	Delta Conservancy
County	Sacramento County
CPT	cone penetration test
CRHR	California Register of Historical Resources
CRS	Community Rating System
CVFED	Central Valley Floodplain Evaluation and Delineation
CVFPB	Central Valley Flood Protection Board
CVFPP	Central Valley Flood Protection Plan
CVP	Central Valley Project
CVRMP	Central Valley Riparian Mapping Project
DCA	Delta Conveyance Authority
Delta	Sacramento-San Joaquin Delta
DLIS	Delta Levees Investment Strategy
DPC	Delta Protection Commission
DRMS	Delta Risk Management Strategy
DSC	Delta Stewardship Council

DWR	California Department of Water Resources
EAD	Expected Annual Damages
EAP	Emergency Action Plan
EIR	Environmental Impact Report
ESP	Emergency Safety Plan
FEMA	Federal Emergency Management Agency
FIMA	Federal Insurance and Mitigation Administration
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FODSS	Flood Operation Decision Support System
fps	feet per second
FSRP	Flood System Repair Project
GAR	Geotechnical Assessment Report
GHAD	Geologic Hazard Abatement District
HCC	Hood Community Council
HFIAA	Homeowner Flood Insurance Affordability Act
HMP	Hazard Mitigation Plan
HOA	Homeowners Association
LHMP	Local Hazard Mitigation Plan
LiDAR	Light Detection and Ranging
LMA	Local Maintaining Agency
LURMP	Land Use and Resource Management Plan
M	Million
MA	Maintenance Area
NAVD 88	North American Vertical Datum 1988
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NMFS	National Marine Fisheries Service
NRHP	National Register of Historic Places
NULE	Non-Urban Levee Evaluation

OA	Operational Area
OES	Office of Emergency Services
O&M	operation and maintenance
OMRR&R	operation, maintenance, repair, replacement and rehabilitation
PCS	Potential Conservation Sites
PL	Public Law
RD	Reclamation District
RFMP	Regional Flood Management Plan
RM	river mile
RSP	rock slope protection
SAFCA	Sacramento Area Flood Control Agency
SB	Senate Bill
SCFRRP	Small Communities Flood Risk Reduction Program
SEMS	Standardized Emergency Management System
SFHA	Special Flood Hazard Area
SPA	Special Planning Area
SPFC	State Plan of Flood Control
SR	State Route
SRA	Shaded Riverine Habitat
SRFCP	Sacramento River Flood Control Project
SSJDNHA	Sacramento-San Joaquin Delta National Heritage Area
SWIF	System-Wide Improvement Frameworks
SWP	State Water Project
TM	Technical Memorandum
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WSAFCA	West Sacramento Area Flood Control Agency
WSEL	water surface elevation

Executive Summary

In 2017, Sacramento County received grants from the California Department of Water Resources (DWR) Small Communities Flood Risk Reduction Program to complete feasibility studies to reduce flood risks to six Delta Legacy Communities in the north Delta, including: Hood, Courtland, Locke, West Walnut Grove, Ryde, and East Walnut Grove.

The scope of this study is to identify a potential suite of structural and non-structural flood risk reduction elements, develop management actions based on these potential elements, develop and prepare implementation costs for each of the management actions, identify a preferred suite of management actions and other non-structural measures based on stakeholder and community input, and to develop an implementation plan which includes an implementation schedule and finance plan. The study considers potential solutions to reduce flood risk while sustaining agriculture and the regional economy, improving riverine habitat viability, addressing regional levee maintenance governance, and improving the resiliency and reliability of conveying fresh water through the Delta with an improved leveed system in the Sacramento River Corridor upstream of the Delta Cross Channel.

Hood is located along the left bank of the Sacramento River approximately 16 miles downstream and southwest of downtown Sacramento along the Sacramento River, and approximately 8 miles downstream and south of Freeport. The levee system along the left or east bank of the Sacramento River between Freeport and Hood, which protects the Delta legacy community of Hood, is maintained by DWR's Maintenance Area 9 (MA 9). MA 9 maintains approximately 9.0 miles of levee between Freeport and Courtland, including 2.5 miles that are within the immediate subject study area of Hood. In addition to the 2.5 miles of State Plan of Flood Control (SPFC) levees maintained by MA 9, there are approximately 3.1 miles of former railroad embankments (0.6 miles in length south of Hood, and 2.5 miles in length east of Hood) that offer limited flood protection to Hood from flood waters originating from either the Morrison Creek watershed to the east and/or flood waters originating from the Sacramento River within MA 9. The Hood project study is also bounded on the north by a 0.2-mile-long cross levee, which is formally known as the Reclamation District (RD) 744 south cross levee, which is located along the south boundary of RD 744, approximately 2.5 miles north and upstream of Hood. In total, the Hood study area is protected by 5.85 miles of combined levees and former railroad embankments that provide protection from flows in the Sacramento River to the west, and adjacent streams and sloughs, including Stone Lakes, to the north, east, and south.

The levees in the study area along the left bank of the Sacramento River were initially constructed prior to 1906 by local interests and were generally built using materials dredged from the adjacent Sacramento River and nearby, adjoining sloughs. Over time various improvements have been made to the levees in the study area located along the left bank of the Sacramento River and they are now considered part of the State and federally-authorized

Sacramento River Flood Control Project (SRFCP) and are now part of State Plan of Flood Control (SPFC) levees. The former railroad embankments are largely owned in fee title by State Parks. The RD 744 south cross levee is operated and maintained by RD 744 located to the north. The project study area of Hood was once managed by RD 746, prior to MA 9 assuming responsibility for operating and maintaining the 2.5-mile segment of SPFC levee along the left or east bank of the Sacramento River.

Sacramento County and its consultants developed this feasibility study in coordination with a planning committee comprised of residents living within the community of Hood, including the Hood Community Council, landowners, and business owners that live within the community. Other representative participating stakeholders with interest and knowledge in providing enhanced flood protection for the Delta Legacy Community of Hood were also consulted. Stakeholder meetings and Hood Community Council meetings were held to assist with identifying existing concerns and soliciting feedback on the project process.

Structural-based Management Actions

A suite of nine potential structural-based management actions were formulated based on stakeholder discussions, community input, and available geotechnical data, including new geotechnical data collected in late summer/early fall of 2019 as part of this feasibility study. These structural-based management actions include repairing known critical and serious seepage sites as previously identified by DWR in their Flood System Repair Project (FSRP); repairing and strengthening-in-place various portions of and/or the entirety of the Hood study area perimeter levee system; repairing and strengthening-in-place the entirety of the MA 9 Sacramento River east/left bank levee between Freeport and Hood; potentially constructing a new cross levee north of Hood; and securing 100-year Federal Emergency Management Agency (FEMA) 100-year accreditation for the community of Hood.

These nine structural-based management actions can be paired with a suite of non-structural management actions, including the potential implementation of a community-based private flood insurance program developed specifically for the noted community of Hood and/or additional Delta Legacy Communities via either a homeowners association, Sacramento County, or other means such as a Geologic Hazard Abatement District (GHAD). The key non-structural action items for consideration are summarized below within this Executive Summary and Section 7.3 of this Feasibility Study Report (FSR).

The management actions were evaluated largely qualitatively assessment (and quantitatively utilizing an Expected Annual Damages assessment) against the study's planning objectives of reducing risk to life; reducing risk to property damage; reducing probability of levee failure; reducing high, escalating National Flood Insurance Program (NFIP) flood insurance premiums; improved flood preparedness and response; enhancing resiliency and reliability of through-Delta water conveyance, and identifying multi-objective opportunities. Each of the management actions were also evaluated qualitatively relative to agricultural sustainability, local support, and cost.

With a trade-off analysis and a final stakeholder meeting held in November 2020, and follow-up presentations to the Delta Legacy Communities Board of Directors and regional Rotary Club meetings held November 2020 through June 2021, a recommended suite of structural-based near-term management actions was further identified as follows:

- **Management Action 1**: Repair DWR FSRP Critical and Serious Sites within the Hood Study Area Portion of DWR MA 9

- **Management Action 2**: Raise and Repair/Strengthen-in-Place RD 744 South Cross Levee

- **Management Action 3**: Repair DWR FSRP Critical and Serious Sites North of the Hood Study Area within DWR MA 9

- **Management Action 5**: Community-Preferred Cross Levee Alignment North of Hood Paired with: Repair and Strengthen-in-Place MA 9 SPFC Levee Adjacent to Hood; and Repair and Strengthen-in-Place Existing Non-SPFC Levee South of Hood

The estimated cost, net reduction in Expected Annual Damages (EAD) to the Hood study area under existing conditions (without climate change adjustments), and the flood risk reduction payback period in years (excluding interest) associated with Management Actions 1, 2, 3, and 5 are summarized below. The estimated capital cost for the suite of management actions consisting of Management Actions 1, 2, 3, and 5 ranges between $56 to $63 million (M) in 2020 dollars. Of the four near-term management actions, collectively implementing Management Actions 1 and 3 together provides the largest incremental value to the community of Hood and the larger study area. With the implementation of these management actions, the total net reduction in EAD for the Hood study area is estimated at $8.3 M under existing conditions. Collectively implementing Management Actions 1 and 2 together provides the next largest incremental value to the community of Hood, with the net reduction in EAD to the Hood study area estimated at $2.3M. Management Action 5 is estimated to result in a similar net reduction in EAD to the Hood study area, but at an estimated cost of $45M, has a flood risk reduction payback period of 20 years.

Table ES-1: Estimated Cost, Net Reduction in EAD, and Flood Risk Reduction Payback Period Associated with the Recommended Suite of Management Actions

Management Action (MA)	Estimated Cost	Total Net Reduction in EAD to the Hood Study Area under Existing Conditions	Flood Risk Reduction Payback Period in Years (excluding interest)
Repair DWR FSRP Critical and Serious Sites within the Hood Study Area and in MA 9 North of the Hood Study Area **(MA 1 & 3)**	$13,900,000	$8,300,000	1.7 years
Repair DWR FSRP Critical and Serious Sites within the Hood Study Area and Raise and Repair/Strengthen-in-Place RD 744 South Cross Levee **(MA 1 & 2)**	$11,900,000 - $12,100,000	$2,300,000	5.4 years
Cross Levee North of Hood with Community-Preferred Alignment paired with Repair and Strengthen-in-Place Existing SPFC and Non-SPFC Levees adjacent to Hood **(MA 5)**	$38,400,000 - $45,100,000	$2,300,000	19.5 years

Two key management actions (Management Actions 6 and 9) contain state-wide multi-benefits by repairing and strengthening-in-place the Sacramento River left bank levee within and beyond the immediate bounds of the Hood study. The current river channel and levee system collectively serve as a critical link of the through-Delta water conveyance system that conveys water via the State Water Project (SWP) and the Central Valley Project (CVP) to over 25 million residences and over 3 million acres of agricultural crops south of the Delta. The noted stretches of the freshwater conveyance corridor are essential to continued and sustainable freshwater conveyance through the Delta with or without the introduction of a possible dual or isolated conveyance facility, which is under consideration by the Delta Conveyance Authority (DCA). The 2.5 mile stretch of SPFC levees along the left bank of the Sacramento River between the RD 744 south cross levee and the railroad embankment south of Hood improved under Management Action 6 represent approximately 4 percent of the entire 62 miles of the non-urban SPFC levee system along the freshwater conveyance corridor in the North Delta. Similarly, the 9.0 mile stretch of SPFC levees along the left bank of the Sacramento River between Freeport and RD 755, south of Hood and improved under Management Action 9, represents 15 percent of the non-urban SPFC levee system along the freshwater conveyance corridor in the North Delta. These same stretches of SPFC levees constitute approximately 7 percent (Management Action 6) and 24 percent (Management Action 9) of the entire SPFC non-urban levee system in the north Delta upstream of the Delta Cross Channel. The multi-benefit of improving both the water conveyance system and the flood control system could gain wide acceptance and cost-sharing opportunities at the regional, State, and federal levels within and south of the Delta. The cost of these two multi-benefit elements is currently estimated at approximately $35-$98 M (Management Action 6) and $126 to $358M (Management Action 9), which could gain the sizeable interest and cost-sharing contributions of the noted interests and beneficiaries statewide and south of the Delta.

Implementation recommendations for the multi-benefit project include Hood and its neighboring Delta Legacy Communities to meet and work with Regional Flood Management Plan (RFMP) representatives, including the Sacramento Area Flood Control Agency (SAFCA), West Sacramento Area Flood Control Agency, the Central Valley Flood Protection Board (CVFPB), and DWR MA 9. There are common interests that suggest implementing levee improvements on a limited number of SPFC levee miles in the North Delta along the Sacramento River in the North Delta will also improve the reliability and resiliency of conveying SWP and CVP water through the entire Delta. The multi-benefit attributes of improving and modernizing the SPFC levee system in tandem with improving conveyance of SWP and CVP water through the Delta should also be presented and shared with the Delta Protection Commission, Delta Stewardship Council and the Delta Conservancy.

Non-Structural Measures

In addition to the key structural-based management actions highlighted above, several non-structural measures were evaluated for their potential to reduce residual flood risk. These non-structural measures can be implemented independent of, or in combination with, the structural-based improvements. This study recommends the following key non-structural measures for implementation, some of which are already in the early stages of implementation:

- Voluntary structural elevation of residential and commercial structures
- Wet or dry floodproofing residential, commercial, and agricultural structures
- Improved emergency response for the Hood study area and adjoining RDs in the Lower-Sacramento – Delta North RFMP region
- Implementation of a community-based flood-risk insurance program specific to the community of Hood in lieu of or in tandem with the current FEMA NFIP. The nearby city of Isleton has taken the initial steps in implementing a similar insurance program and there may be some local economies of scale for Hood and other nearby Delta Legacy Communities in the North Delta to pool their resources together and possibly be a pilot test case for establishing a regionally-based insurance program for rural communities in the Delta and the greater Central Valley. In addition to reducing flood insurance rates, the program can also be tailored to buy-down risks by establishing and setting aside local cost-share funds to improve and implement flood risk reduction management actions outlined above and non-structural measures outlined herein.
- Continued and improved public education and awareness
- Support continued actions to improve and maintain high NFIP Community Rating System (CRS) score for Sacramento County/Hood
- Continued State support for refinements and Amendments to the NFIP via Agricultural Floodplain Ordinance Task Force and H.R. 3167 - National Flood Insurance Program Reauthorization Act of 2019

- Improved governance between MA 9, other regional RDs in the north Delta, and potentially establishing a Homeowners Association or GHAD for establishing a community-based flood insurance program and reducing flood risks within the community of Hood.

1. Introduction

The California Department of Water Resources (DWR) Small Communities Flood Risk Reduction Program (SCFRRP) and the Regional Flood Management Plans (RFMPs) were created following adoption of the 2012 Central Valley Flood Protection Plan (CVFPP) by the Central Valley Flood Protection Board (CVFPB). Both the RFMPs and SCFRRP were created by the CVFPB and DWR and are intended to be locally developed flood risk programs authored by regional flood control agencies, Local Maintaining Agencies (LMAs), local Reclamation Districts (RDs), local land-use planning entities such as counties and cities, and the residents of the communities protected by State Plan of Flood Control (SPFC) levees. The RFMP program consists of six regional plans within the extent of the CVFPP, three within the Sacramento River Basin and three within the San Joaquin River Basin. The Lower Sacramento River/North Delta RFMP completed in July of 2014 (herein referred to as the 2014 RFMP) encompasses the greater Sacramento River corridor, the Yolo and Sacramento Bypass systems, and the North Delta Legacy Communities along the Lower Sacramento River system between Sacramento and Rio Vista. Small communities, as defined in the CVFPP, are communities protected by SPFC levees with populations between 200 and 10,000, but exceptions were made to include Delta Legacy Communities with populations of less than 200, such as Locke and Ryde.

The SCFRRP is very similar to the DWR 5-year plans developed for and by the levee districts throughout the Delta where the LMAs or RDs are tasked with identifying where their greatest risks are to flooding and each of the LMAs or RDs prioritize repairs and improvements to their levee systems to minimize flood risks. The key difference between the two programs is the SCFRRP focuses more on the densely populated portions of land tracts protected by SPFC levees; whereas the Delta 5-year plans focus more on the perimeter levee systems protecting the tracts/islands within the Delta independent of whether the levees are SPFC or non-SPFC levee systems.

1.1 Intent of Senate Bill 5 for Small Communities

The Central Valley periodically experiences devastating floods. One of the most recent large events in 1997 led to passage of the Central Valley Flood Protection Act of 2008, also known as Senate Bill (SB) 5. SB 5 requires DWR to prepare a strategic systemwide flood protection plan for SPFC[1] facilities in the Sacramento-San Joaquin Valley. The 2012 CVFPP was the first iteration of this plan, and SB 5 mandates that it be updated on a 5-year interval.

Regarding small communities, SB 5 requires cities, counties and State and local flood management agencies to collaborate to provide cost-effective strategies for reducing flood risk.

[1] In summary, the SPFC includes the State and Federal flood control works, lands, programs, plans, conditions, and mode of maintenance and operations of the Sacramento River Flood Control Project described in Section 8350 of the California Water Code, and of flood control projects in the Sacramento River and San Joaquin River watersheds for which the State (DWR or Central Valley Flood Protection Board) has provided assurances of nonfederal cooperation to the United States.

The bill also called for development of funding mechanisms to finance flood protection responsibilities at the local level. To this end, the 2012 CVFPP included many broad goals for improved flood management for areas protected by SPFC facilities, including small communities and portions of the Sacramento-San Joaquin Delta (Delta).

The SCFRRP focuses specifically on reducing flood risks for small communities protected by SPFC facilities, including areas designated as Delta Legacy Communities. Small communities are defined as communities protected by SPFC facilities with a population of less than 10,000 residents. Delta Legacy Communities are a subset of small communities, located within the legally defined (Legal) Delta, which have cultural, historic, and ambiance value that give the Delta a distinctive sense of place (Delta Protection Commission [DPC], 2012) (Figure 1-1).

Under the SCFRRP, Sacramento County, as the local land-use planning entity, was awarded a DWR grant in 2017 on behalf of the community of Hood, to prepare a feasibility study to identify and prioritize flood risk reduction management actions. For the purposes of this report, the community of Hood refers to the densely populated community of Hood. In addition to Hood there are seven additional Delta Legacy Communities that received grant funds to prioritize flood risk reduction measures in the Sacramento River corridor of the North Delta. Those Delta legacy communities include: Courtland, Locke, East Walnut Grove, West Walnut Grove/Ryde, Clarksburg, Rio Vista, and the city of Isleton,.

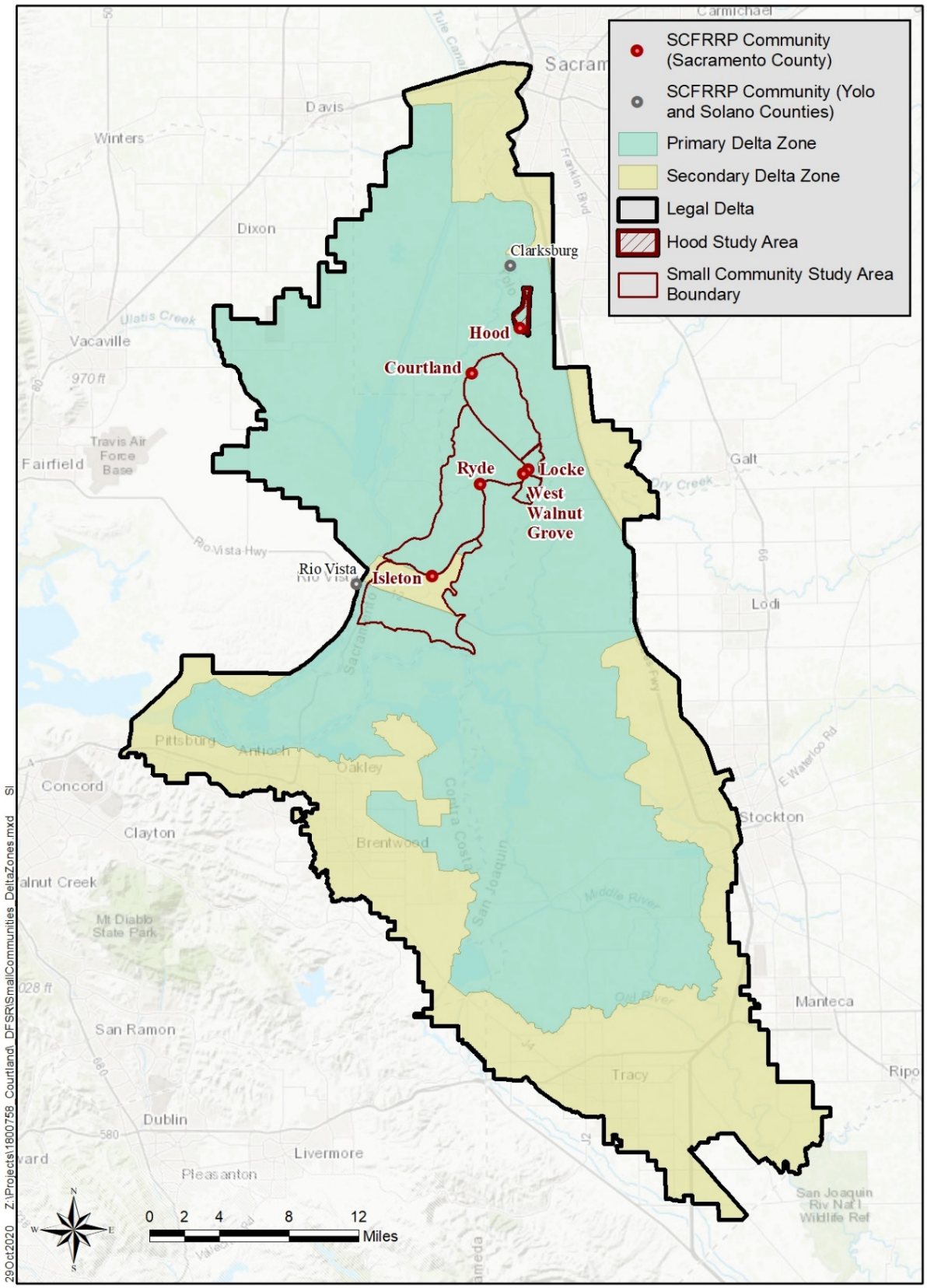


Figure 1-1. Delta Legacy Communities Participating in the DWR Small Communities Flood Risk Reduction Program

1.2 Goals and Scope of the Study

As described in the 2012 and subsequent 2017 CVFPP Update, the goal of the State as well as the Delta Legacy Communities is to improve SPFC levees and applicable adjoining non-SPFC levees protecting small communities to achieve 100-year (1 percent annual chance) flood protection, as defined by the Federal Emergency Management Agency (FEMA). Consistent with this goal, the goal of this feasibility study is to develop, evaluate, and prioritize structural and non-structural flood risk reduction measures for the Hood study area, which would also strengthen and modernize SPFC levees within the study area upstream of the existing Delta Cross Channel, and to ultimately achieve 100-year flood protection and meet FEMA 100-year certification criteria.

Structural Flood Risk Reduction Measures

- Repair/strengthen in-place existing levee system(s)
- Strengthen existing levee(s)/embankments with cut-off walls, seepage berms, stability berms, etc.
- Repair existing erosion sites on levee systems
- Address and correct known encroachments/deficiencies in levee systems that pose threat to levee integrity
- New setback levee in place of existing levee system segments

The flood risk reduction measures to be developed include multi-benefit objectives for Hood and its agricultural, recreation, and socioeconomic attributes, where possible, as well as statewide water conveyance benefits along the Sacramento River. Improvements of the SPFC levee system protecting the Hood study area can collectively enhance the resiliency and reliability of through-Delta water conveyance upstream of the Delta Cross Channel.

While 100-year flood protection is the goal of the State and the Delta Legacy Communities, there are concerns that improvement of the flood control system could encourage development, thereby potentially increasing flood risk. However, within the Primary Zone of the Delta (as shown in Figure 1-1) there are significant restrictions within the 2013 Delta Plan adopted by the Delta Stewardship Council (DSC) that do not permit development to occur by displacing agricultural land uses. As a result, improvements identified in this study are not expected to induce development and/or result in increased flood risk within the Hood study area.

Non-Structural Flood Risk Reduction Measures

- New ring levee system(s) and/or new cross levee to isolate smaller areas (communities) from a larger perimeter levee system that may be more susceptible to levee failures
- New all-weather access roads or flood fight berms to address and potentially fend-off rising flood water that may occur in other portions of a large RD compared to a small fractional area (community) protected by a larger perimeter levee system
- Voluntary elevation of structures, ideally for potential flood depths greater than 3 to 5 feet
- Wet or dry floodproofing of structures, ideally for flood depths less than 5 feet, and some agricultural structures for flood depths greater than 5 feet
- Securing FEMA accreditation by executing a number of combined structural and non-structural measures pursuant to 44 CFR §65.10
- Improved Emergency Response; Local Hazard Mitigation Plans, Flood Emergency Safety Plans, and potential relief cuts
- Alternatives to FEMA's National Flood Insurance Program – community- and flood-risk based insurance programs with or without formation of a Geologic Hazard Abatement District
- Public awareness and education of local and regional flood risks
- Improved governance between neighboring LMAs/RDs and communities
- Regional/local flood easements and flood flow/channel conveyance enhancements
- Acquisitions and relocations of structures and residents

1.3 State's Interest in the Delta

The State of California has broad interests in integrated water management within the Delta which must be considered within the context of this feasibility study, including:

- *Water Supply Reliability* – The State supports the availability and conveyance of surface water (when available based on hydrologic conditions), timely delivery, and adequate water quality for urban and agricultural water users. Water, from north of Delta sources, is delivered through the Delta by DWR, via the State Water Project (SWP), the State Water Contractors and the U.S. Bureau of Reclamation, via the Central Valley Project (CVP).
- SWP and CVP supplies conveyed south of Delta serve approximately 3M acres of agricultural lands and a population of 25M.
- The entire volume of water conveyed by the SWP and CVP currently passes directly by Hood via the SPFC-leveed channel of the Sacramento River.
- The 2.5 miles of SPFC levees managed by DWR as part of Maintenance Area (MA) 9 protecting the Hood study area along the left/east bank of the Sacramento River also serve as a vital element of the primary through-Delta water conveyance channel in the North Delta, with or without an isolated conveyance system as presently proposed by the Delta Conveyance Authority (DCA).

Sustainable Delta – the State supports investments that contribute to Delta sustainability and resiliency in the face of sea level rise and climate change, which will likely result in higher and longer duration flood stages.

- *Delta Ecosystem Protection, Enhancement, and Restoration* – The State supports integrating flood and water management with ecosystem restoration actions that may include riparian, tidal marsh, freshwater marsh, and floodplain habitats.
- *Preserving the Unique Characteristics of the Delta* – Delta Legacy Communities have a distinct natural, agricultural, and cultural heritage with the State recognizing the importance of preserving and enhancing the unique characteristics of these Delta Legacy communities. Through numerous initiatives, the State has prioritized support for the preservation and revitalization of these communities as well as the Delta agricultural economy and culture, fishing, boating, waterfowl and upland game bird hunting, wildlife viewing, and recreation. In addition to the State's recognition of significant cultural values, the entire Legal Delta has received the distinction as California's one and only National Heritage Area, designated by Congress in March 2019.
- *Providing Appropriate Levels of Flood Protection* – The State, through DWR, has a long history of cost-sharing with federal and local agencies on projects that provide benefits to the local, State and national economic interests. Although operation and

maintenance (O&M) is coordinated through Local Maintaining Agencies (LMAs) in the Delta, for most areas, the State ultimately has O&M responsibility for SPFC facilities, including SPFC channel maintenance, and also an interest in providing technical and financial assistance for levee maintenance and rehabilitation of non-SPFC facilities within the Delta.

The State's investment in integrated water management must contribute to a sustainable Delta. Therefore, this feasibility study defines which actions could potentially contribute the most to Delta sustainability and how levee investment metrics are defined, tracked, and measured.

1.4 Hood's Need for Improved Flood Protection

Hood is one of eight Delta Legacy Communities located along the Lower Sacramento River Corridor in the North Delta participating in the SCFRRP (Figure 1-2). The SPFC levees surrounding the community of Hood were initially constructed prior to 1906 by local interests and were generally built using materials dredged from the adjacent Sacramento River and nearby adjoining sloughs. Construction records for the non-SPFC levees within the study area are unavailable. Various improvements have been made to the SPFC levees along the Sacramento River over the years, including levee reconstruction and bank protection work at multiple locations. In 2006, FEMA reached out to Sacramento County to learn if adequate documentation supported certification of the levees. In 2012, FEMA updated the flood insurance rate maps (FIRMs) and the Hood study area, including the community of Hood was mapped as a Special Flood Hazard Area (SFHA) Zone AE.

The levees protecting the community of Hood not only fall well short of meeting current, modern levee design standards to provide a 100-year level of flood protection (pursuant to FEMA accreditation standards in the Code of Federal Regulations, Chapter 1, Subchapter B, Part 65, Section 65.10 [44 Code of Federal Regulations (CFR) §65.10]), but they also contain critical and serious sites identified under the California DWR Flood System Repair Project (FSRP) that still warrant immediate attention for repair, preferably by 2024 or earlier.

Also, in 2012, the Biggert-Waters Flood Insurance Reform Act (BW-12) was passed putting into motion substantial annual increases to flood insurance costs until premiums are rated based on the elevation certificate. The unfortunate oversite in this is that the premiums don't recognize that there is a levee system that has stood the test of time. Instead, premiums are rated as if there were no levees present. Consequently, whether or not one believes the flood hazard to be of concern, the cost of flood insurance administered by FEMA under the current National Flood Insurance Program (NFIP) has certainly become a large and continuously growing concern.

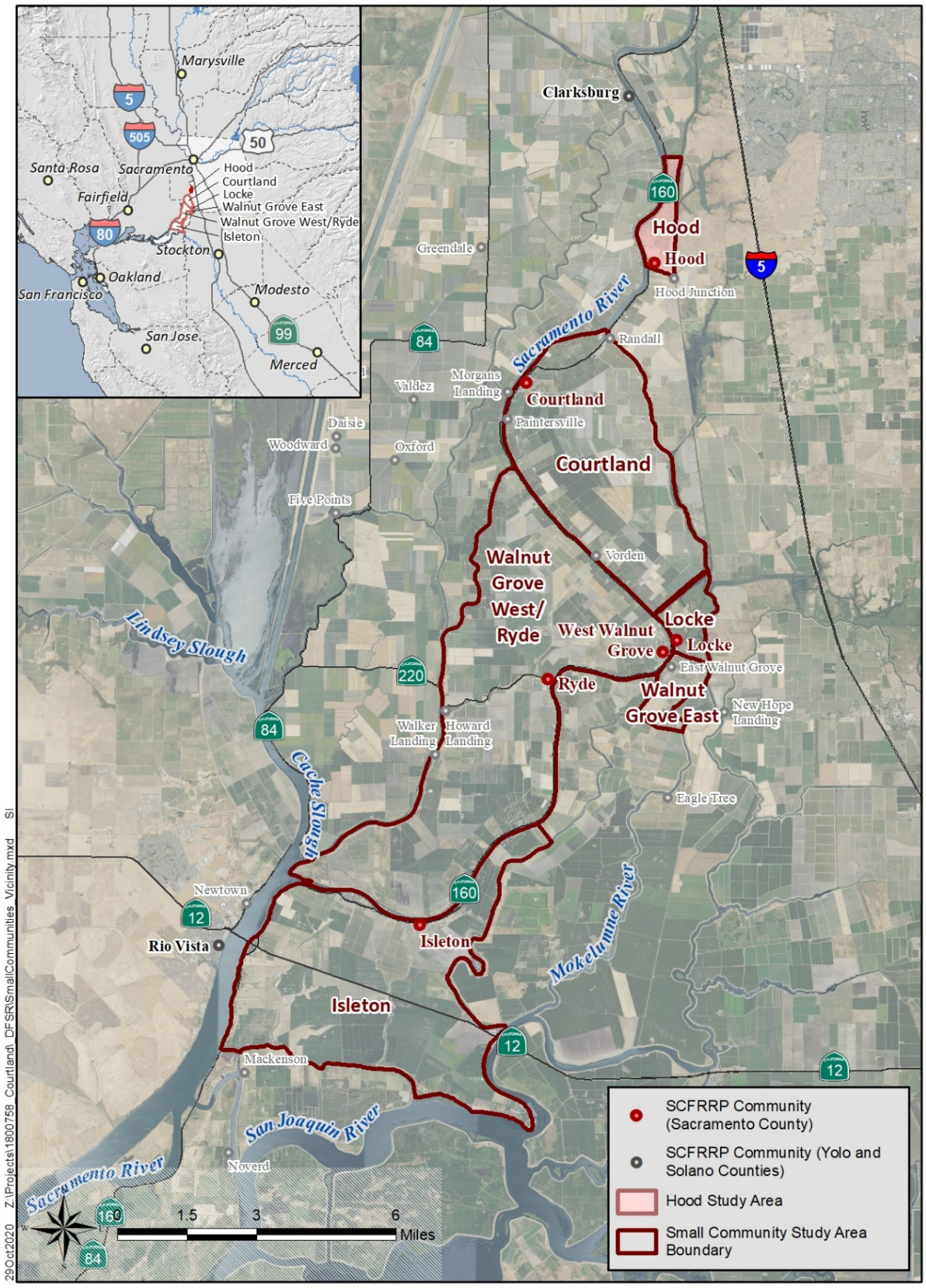


Figure 1-2. Delta Legacy Communities Participating in the SCFRRP.

1.5 Study Area and Location

The study area for this SCFRRP effort includes the community of Hood and the larger 725-acre agricultural area which is protected by levees maintained as part of MA 9 (Figure 1-3). The densely populated community of Hood encompasses approximately 97 acres and generally sits at an elevation of 8 to 16 feet (North American Vertical Datum 1988 [NAVD 88]) along the east (left bank) of the Sacramento River, south of Freeport and north of Courtland. Elevations and flood depths provided herein are referenced to NAVD 88. MA 9 is responsible for levee maintenance in this area and maintains 2.5 miles of SPFC levee[2] along with several former railroad embankments owned in fee title by State Parks, which are considered non-SPFC levee embankments, surrounding the community of Hood to the east and south. The portions of the embankments protecting the community of Hood include approximately 2.5 miles of the embankment to the east of Hood and about 0.6 miles of embankment along the south end of the community. Within the study area, there is also an approximately 0.20-mile-long cross levee north of Hood which extends from the MA 9 left bank Sacramento River SPFC levee east to the former railroad embankment. This cross levee is owned and maintained by the adjacent RD 744. This combined levee and former railroad embankment system protects approximately 820 acres, including the community of Hood, and agricultural lands which primarily consist of permanent orchard and vineyard crops. A levee breach of the SPFC levees within the Hood study area could very likely result in inundating significant portions of the study area, including the community of Hood to flood depths greater than 10 feet.

[2] In addition to other flood management facilities, the SPFC includes "Project levees," which were constructed by the USACE as part of fFederal-State flood control projects and were turned over to the State for operations and maintenance ("assurances"). The State has generally passed on the responsibility for routine maintenance of Project levees to LMAs. The SPFC relies on many other non-SPFC features, such as non-State or federal reservoirs to regulate flows and reduce loading on the system, and private levees in the Central Valley or non-project (local) levees in the Delta, for which the State has not provided assurances.

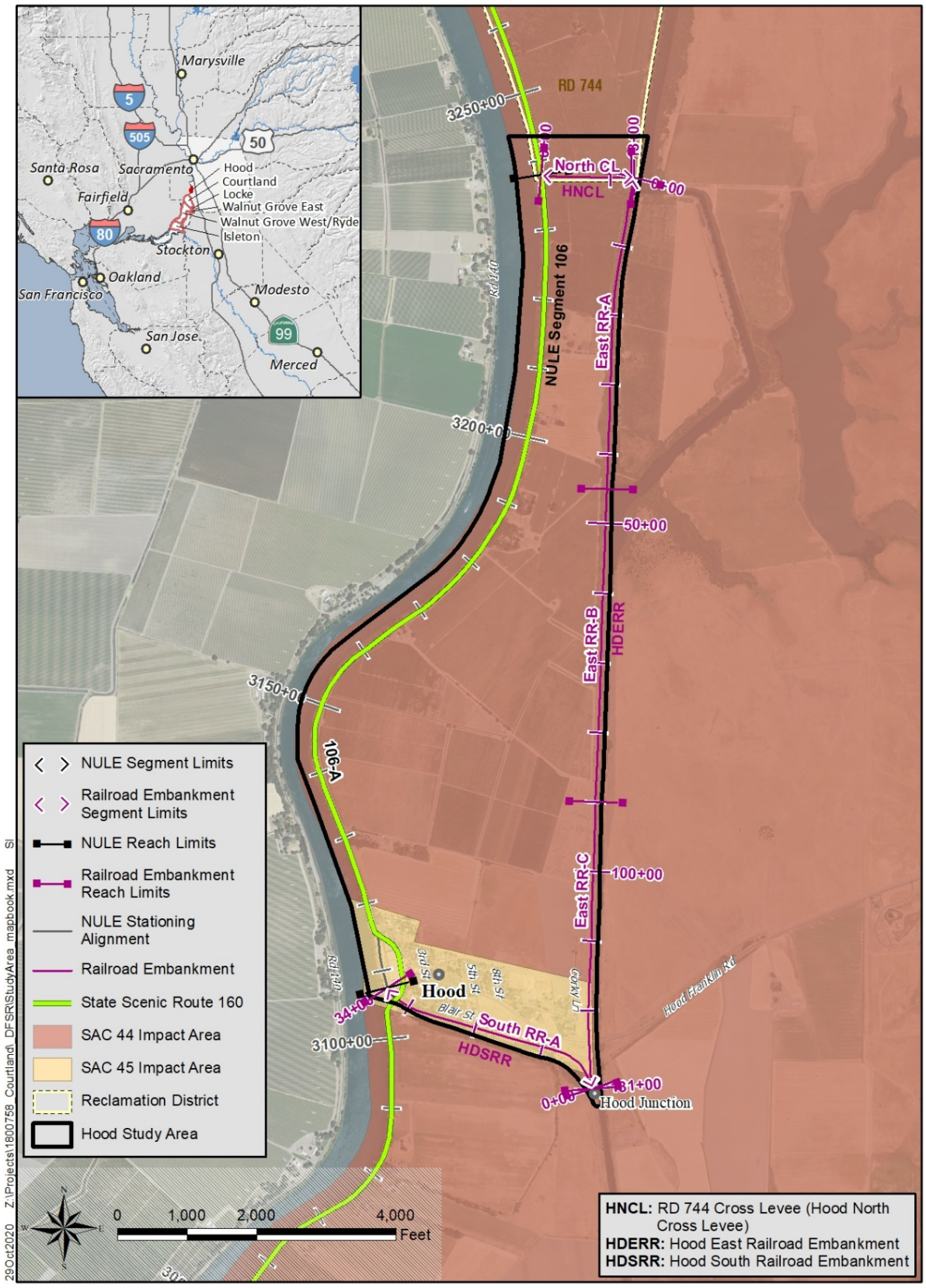


Figure 1-3. Hood Study Area

1.6 Public Outreach and Engagement

This feasibility study has been prepared in close coordination with the community of Hood and agencies with a shared interest in a safe, sustainable, and vibrant Delta. Sacramento County has been engaged with local planning groups for each Delta Legacy Community in Sacramento County to share the story of each community, help the public understand flood risks, and share possible flood risk reduction planning documents and solutions for the future.

Visit the Hood Story Map for more details: Hood Story Map - Sacramento County Small Communities Flood Risk Reduction Program[3].

1.6.1 Stakeholder Identification and Outreach

The residents and business owners of Hood have been invited and encouraged to participate in this planning effort that is intended to be developed from within the community of Hood. This feasibility study has been prepared in close coordination with representative stakeholders with interest and knowledge in providing enhanced flood protection for Hood. Stakeholders include landowners and NFIP policy holders within the Hood study area, the Hood Community Council (HCC), the Sacramento County Department of Water Resources, inclusive of the County's floodplain administrator; and State and federal agencies (including FEMA), and non-governmental agencies with interests at the nexus of ecosystem restoration and flood risk solutions within and beyond the Delta. Community residents and landowners within Hood have been encouraged to stay engaged in this process through implementation of both structural-based management actions and non-structural measures.

1.6.2 Common Stakeholders for Hood

The project team has met with the HCC at various regular meetings in 2018 through 2021 to obtain their recommendations on flood risk reduction measures, review plan progress and coordinate geotechnical investigations.

1.6.2.1 Hood Community Council

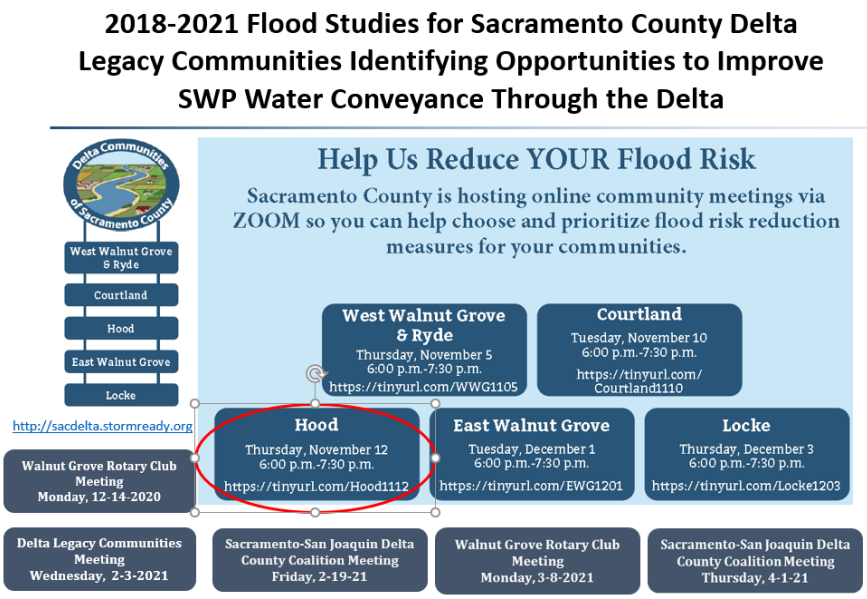
The HCC consists of fifteen members of the Hood community and within the 95639-zip code. The HCC plans for and raises funds to make improvements within the community of Hood and in the surrounding community. This group serves as the local governing body for the community of Hood.

It should be noted that Hood is one of the few isolated communities within the north Delta that is not formally represented by a local RD. The community relies on DWR MA 9 to maintain the

[3] https://sacramentocounty.maps.arcgis.com/apps/MapJournal/index.html?appid=cda6eb30ff4943ffbae895e122c8791e

Sacramento River levee adjoining the community, and State Parks to manage the railroad embankments directly south and east of Hood

1.6.3 Communications and Engagement



The goal of this feasibility study is to have the flood risk reduction solutions be developed, promoted, and prioritized by the community of Hood, including areas beyond the community of Hood and within the larger study area. The feasibility study began by developing a planning committee initially comprised of people that live within the community and within the larger study area maintained by MA 9. The committee is comprised of the following members: Dave Welch, Angelica Whaley, Dan Whaley, Linda Escobar, Marlene Barriga, and Mario Moreno.

Meeting fatigue has occurred in the Delta due to the multitude of planning processes that have been performed particularly in the last decade. Thus, the planning committee acted as representatives that could help guide the study through development prior to being released to the entire community and residents/business owners within the study area. The community of Hood has recently formed the HCC, which was an ideal forum to gather information and garner feedback from the community on various flood risk reduction measures. The study process began with the development of an interactive Story Map on Sacramento County's Storm Ready[4] website (published in September 2018, and updated periodically through 2021) that describes the community, its importance to the region, its current flood risk, and recommended solutions to reduce that risk.

An initial meeting with the planning committee as well as HCC members from the larger study area was held in June 2018. The purpose of this meeting was to identify existing concerns, brainstorm opportunities, and develop an array of potential flood risk reduction solutions. This meeting acted as a guide to direct the study. The concerns identified were securing protection from upstream flooding as well as flooding from the south and east through the railroad

[4] http://sacdelta.stormready.org/

embankment and developing a way for the community to fund flood control improvements such as formation of an RD or others local means.

The opportunities identified include: (1) formation of a new RD outside of MA 9 which could provide maintenance and drainage services for the entire study area including the railroad embankments; and (2) a multi-benefit opportunity of the levee system repairs/improvements to improve the resiliency of through-Delta water conveyance and protecting lands to the south and east that support wintering birds and agriculture.

Structural management actions and non-structural measures were discussed. To provide protection from flooding at the north, an improved RD 744 South Cross Levee as well as an entirely new cross levee just north of Hood. The group expressed concerns pertaining to cost and land acquisition associated with a new cross levee system just north of the community. Repairs to known weak areas on the Sacramento River were also discusses, including nine critical and serious sites previously identified by DWR and their Flood System Repair Project (FSRP).

Non-structural measures discussed included improvements to the emergency communication system by updating the phone tree for emergency notification, as well as working with FEMA and/or others to reduce flood insurance premiums. A common non-structural measure is to raise houses so that the lowest inhabitable floor space is safely above the flood hazard elevation on a firm flood resistant foundation.

Following this meeting, the Story Map for Hood was drafted and in fall 2018 and spring 2019, the Story Map[5] was presented to the HCC at their regular meetings for review and to garner more input. Alternatives to the NFIP, including potential community-based flood insurance programs were also discussed during these meetings. Subsequent meetings were conducted with the team and other consultants to determine a funding mechanism for Hood to obtain an alternative to the NFIP. The levees that protect Hood also protect urban areas and Interstate 5 east of the Sacramento River within the community of Elk Grove. Representatives of those areas were engaged to see if there is a shared interest in certifying the Sacramento River levee north of Hood. The community of Elk Grove determined there was also a freeboard deficiency in their levee system(s) east of Interstate 5 and determined it may be easier to obtain a 200-year level of flood protection by modifying and improving their levee system east of Interstate 5. The community of Hood noted with the community of Elk Grove improving only their levee system east of Interstate 5, that both Hood and the Interstate would remain vulnerable to flooding from the Sacramento River located west of Hood and Interstate 5.

Planning committee representatives felt that additional data regarding the existing levee system would help in this planning effort. In spring of 2019, the study team reached out to individual landowners, HCC, as well as representatives from MA 9 to perform geotechnical explorations. This included identification of Cone Penetration Tests (CPTs) locations in select areas along the

[5] http://sacdelta.stormready.org/

levee system around Hood, as well as where a potential cross levee would go to fill in data gaps, and obtain an improved picture of levee hazard classifications and performance. Assurances were made to MA 9 and landowners that such investigations would not cause any detriment to property or the levee system. The geotechnical investigations were completed in late summer/early fall of 2019.

As the geotechnical data was analyzed and the suite of structural and non-structural management actions were developed, the study team again met with the community members to discuss initial findings from geotechnical evaluations as well as evaluate management actions in October of 2019. Findings from the geotechnical evaluations revealed and further confirmed that the levees materials are sandy and subject to both through- and underseepage. The community expressed a desire for a fix-in place alternative of the Sacramento River MA 9 levee system and to use cut-off walls versus a seepage berm to remedy critical seepage sites. They also expressed support of a cross levee north of Hood. HCC expressed the desire to certify the levees up to current standards to meet FEMA's 100-year accreditation standards pursuant to 44 CFR §65.10. Structural elevation was also proposed as a means to reduce NFIP premiums within the study area. Click here to learn more about achieving a 100-year level of flood protection pursuant to the current FEMA accreditation standards.[6]

A close review of the FEMA regulations, in particular 44 CFR §65.10 (b) *Design criteria* (4) *Embankment and foundation stability,* indicates certain through-seepage and underseepage criteria and factors of safety must be adhered to meet full certification criteria. In the North Delta, where there are significant sandy soil materials underlying the levee systems initially built over 150-years ago and periodically upgraded decades ago, the levees still fall short of meeting current modern engineering and FEMA accreditation standards. To meet such standards, most of the levees in the North Delta, inclusive of the SPFC and non-SPFC levees and former railroad embankments protecting the community of Hood, need significant repairs and strengthening in-place to meet FEMA accreditation standards.

As the draft feasibility study report (FSR) was composed, the study team sought feedback from HCC and members from the community to discuss elevating homes and alternatives to the NFIP and coordinated with MA 9 for levee segments in need of repairs. These meetings helped inform and prioritize remediation actions. The HCC, as well as the public, were provided a draft FSR in November 2020 for their review, which was also followed by a virtual meeting in November 2020 to discuss the report and receive additional input. During the November 2020 meeting, stakeholders expressed concern over constructing a cross levee along the immediate northern boundary of Hood but expressed support for a cross levee constructed further north of the community. Stakeholders also expressed concern over the range of costs to repair and strengthen the levees within the Hood study area and any associated assessments on the community members that would be required as a result of these improvements.

[6] FEMA Guidance for Flood Risk Analysis and Mapping - Levees, December 2020 https://www.fema.gov/sites/default/files/documents/fema_levee-guidance.pdf

This input was incorporated into the final report to be submitted to the County Board of Supervisors for consideration of adoption by December of 2021. Additional stakeholder input regarding the preference, prioritization, and implementation of management actions and accompanying non-structural measures summarized in Sections 7 and 8 was also sought between the development of the draft and final FSR.

A summary of outreach meetings held for the Hood study area is provided in Table 1-1.

Table 1-1. Outreach Community Meetings for the Hood Study Area.

Date	Event/Location	Address	Host Organization	Attendance
6/6/2018	Hood Supply Company	10761 Hood Franklin Road, Hood	SCFRRP Study Team	8
9/13/2018	Courtland Fire Station (Hood)	1125 Hood Franklin Road, Hood	HCC	13
3/14/2019	Courtland Fire Station (Hood)	1125 Hood Franklin Road, Hood	HCC	13
4/2/2019	California Railroad Museum	125 I St, Sacramento	California State Parks	7
5/8/2019	Courtland Fire Station (Hood)	1125 Hood Franklin Road, Hood	HCC	11
7/9/2019	Courtland Fire Station (Hood)	1125 Hood Franklin Road, Hood	HCC	11
10/10/2019	Courtland Fire Station (Hood)	1125 Hood Franklin Road, Hood	HCC	12
5/28/2020	Alternatives to NFIP	10724 State Route (SR) 160, Hood	SCFRRP Study Team	6
6/17/2020	Structural and Non-Structural Alternative Review	10724 SR 160, Hood	SCFRRP Study Team	8
10/2/2020	Structural and Non-Structural Alternative Review Updates	10724 SR 160, Hood	Delta Legacy Communities & SCFRRP Study Members	7
11/12/2020	Virtual Zoom Meeting	--	SCFRRP Study Team	11

1.6.4 Coordination with Key Agencies within the Delta

This FSR has been prepared in close coordination with the Delta stakeholders. They include representatives of MA 9 for conducting geotechnical CPT explorations, landowners, FEMA NFIP policy holders within MA 9, the HCC, the Delta Legacy Communities Task Force,

Sacramento County, State and federal agencies, and non-governmental agencies with environmental interests that are knowledgeable about the flood risks and potential solutions within the Delta.

Although many agencies are involved in the Delta, three regional agencies are heavily involved in land use policy and sustainability in this region, and thus have a special interest in SPFC improvements, as detailed below.

1.6.4.1 Delta Protection Commission

The DPC is focused on conservation of agricultural land and supporting economically sustainable agricultural operations in the Delta. The DPC maintains and implements the Land Use and Resource Management Plan (LURMP) for the Primary Zone of the Delta. City/County General Plans and future projects that affect land use in the five Delta counties must be consistent with the LURMP and are subject to review by the DPC.

DSC Delta Plan Coequal Goals

1) Providing a more reliable water supply for California and
2) Protecting, restoring, and enhancing the Delta ecosystem.

"The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place." (CA Water Code §85054)

1.6.4.2 Delta Stewardship Council

The DSC was created to achieve the State mandated coequal goals for the Delta. The DSC also drafts updates and administers the Delta Plan, a long-term management plan with recommendations to further the coequal goals, in a manner that protects and enhances the unique cultural, recreational, natural resources, and agricultural values of the Delta as an evolving place. All proposed projects within the Delta must be consistent with the Delta Plan, which precludes displacement of agricultural land uses with non-agricultural land uses and subsequent structural solutions, such as improving and modifying the existing levee systems identified in this study for the community of Hood, which may be subject to a consistency determination by the DSC.

1.6.4.3 Delta Conservancy

The Delta Conservancy (Conservancy) is the primary State agency focused on the implementation of ecosystem restoration in the Delta and supports efforts that advance environmental protection and the economic well-being of Delta residents. The Conservancy collaborates and cooperates with local communities and other parties to preserve, protect, and restore the natural resources, economy, and agriculture of the Delta and Suisun Marsh. The Conservancy also collaborates on Delta branding and marketing, the Delta Carbon Program, invasive species control, and the California Department of Fish and Wildlife (CDFW) Delta Conservation Framework. The Conservancy's Delta Public Lands Strategy includes integrated conservation for publicly funded lands in the Delta.

1.7 Related Plans, Programs and Studies

Many plans influence flood management in the Delta, as summarized below. This study aggregates and uses evaluations from the CVFPP and DWR's Non-Urban Levee Evaluations (NULE) Program and FSRP to inform the development and prioritization of flood risk reduction measures for the Hood study area.

1.7.1 Central Valley Flood Protection Plan

The CVFPP, mentioned previously, proposed improvements to SPFC levees, and where applicable, Delta (non-SPFC) levees, ecosystem enhancements, and flood risk reduction measures for small communities. The CVFPP identifies structural and non-structural options to protect small communities from the 100-year flood, and is the basis for selecting flood risk reduction elements and management actions considered in this feasibility study, including (DWR, 2012a):

1. Reconstructing or repairing perimeter levees in-place or making improvements to existing SPFC perimeter levees, and non-SPFC levees that could impact and/or enhance the performance of SPFC levees.
2. Protecting small communities "in-place" using ring levees, training levees, or floodwalls when improvements do not exceed a certain predetermined cost threshold.
3. Implementing non-structural improvements, such as developing flood fight berms raising and elevating structures, floodproofing, willing seller purchases, and/or relocating structures, when the in-place improvements described above are not feasible.

1.7.2 Sacramento River Basin-Wide Feasibility Study

The Sacramento River Basin-Wide Feasibility Study (BWFS) was prepared subsequent to the 2012 CVFPP and focused on a multi-benefit approach to expansion of the flood bypasses. Solutions proposed in the BWFS germane to the Hood study area include addressing system capacity constraints to allow for improved conveyance through widening the Yolo and Sacramento Bypasses and Fremont and Sacramento Weirs. These expansions and modifications are underway and are expected to provide a reduction in flood stage of 1 to 2 feet. along segments of the Sacrament River, adjacent to Delta Legacy Communities, as depicted in Figure 1-4. The noted expansions and modifications to the upstream Sacramento and American Rivers/Bypasses will help neutralize some of the basin-wide impacts of climate change in the Lower Sacramento River as most all excess flows will be diverted into the bypass systems with metered or controlled flows being routed downstream of the American River into the Lower Sacramento River in the North Delta.

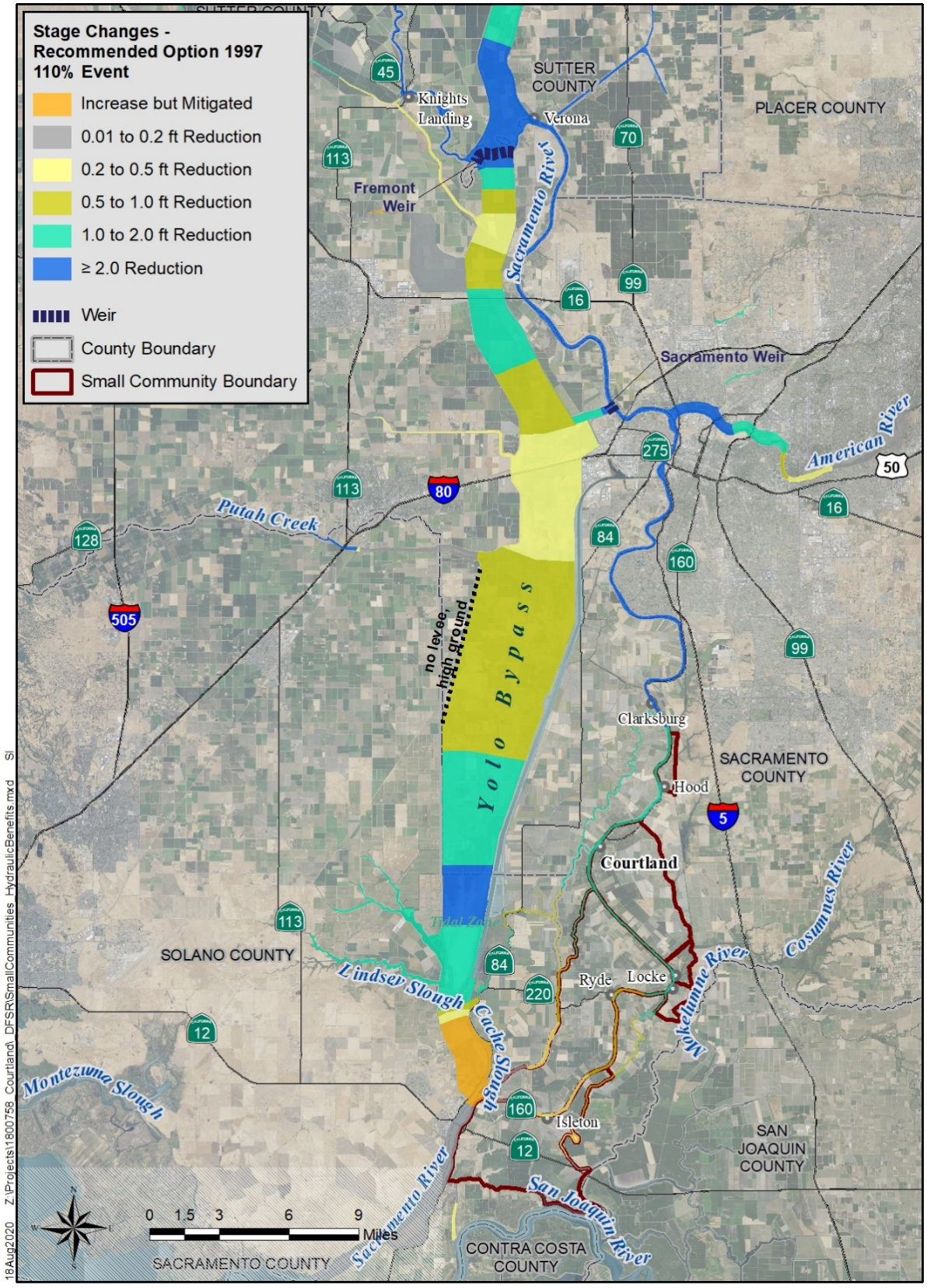


Figure 1-4. Flood Stage Reductions as a Result of the BWFS Expansions and Modifications.

1.7.3 Lower Sacramento River/Delta North Regional Flood Management Plan

The 2014 RFMP, was developed by FloodProtect, a regional working group, as the regional follow-on to DWR's 2012 CVFPP. The 2014 RFMP was funded by DWR but drafted by local agencies and identified pre-feasibility level regional flood management solutions (FloodProtect, 2014).

The 2014 RFMP recommended further flood risk reduction feasibility studies for many small communities and Delta Legacy Communities, including Hood. Additionally, the 2014 RFMP identified Potential Conservation Sites (PCS) offering ecosystem multi-benefits near Hood, namely: PCS 13 – habitat enhancements along the left (and right) bank of the Sacramento River to connect 11 miles of riparian river corridor between River Mile (RM) 35 near Sutter Slough and RM 46 near Freeport.

1.7.4 Delta Levees Investment Strategy

The Delta Levees Investment Strategy (DLIS) was prepared by the DSC as a follow-up to the Delta Plan to identify funding priorities for State investments in Delta levees. Funding priorities were developed using a risk-based analysis, which quantified risks to people, property and infrastructure, water supply reliability, ecosystems, and the Delta as a place, by developing estimates of flooding probability due to seismic and hydrologic events.

The DSC's goal was to develop a list of very-high priority and high priority islands and tracts by quantifying risks using several metrics such as expected annual fatalities and expected annual damages (EAD). Seventeen islands were identified as very-high priority and 36 islands and tracts were identified as high priority (DSC, 2017). MA 9 south, inclusive of the Hood study area but also including RD 744 to the north and Stone Lake to the east, was placed in the "Very High" category, and as such, is currently highly prioritized for State investments under DLIS prioritization (Figure 1-5).

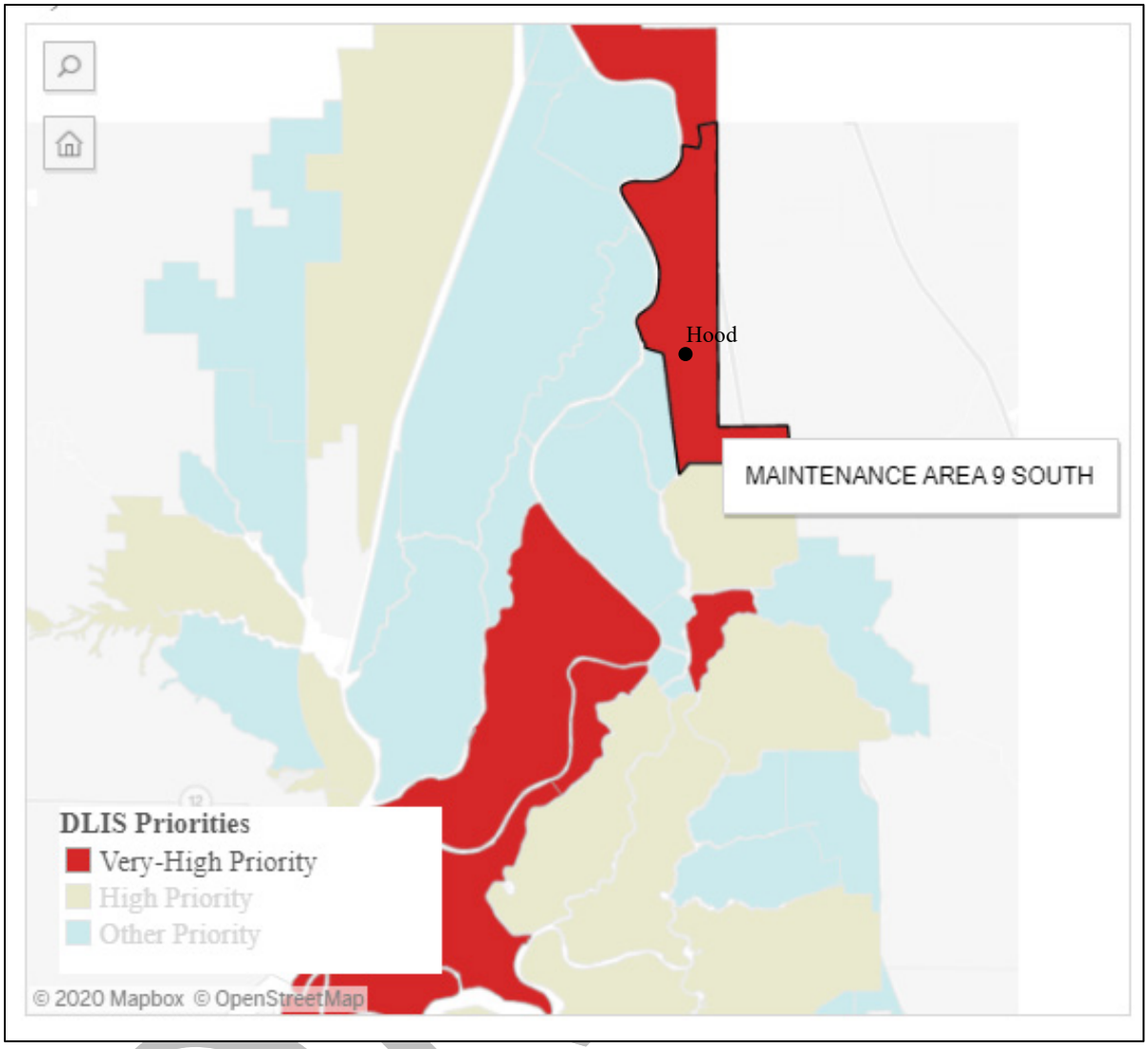


Figure 1-5. DLIS Analysis – Overall Prioritization (Rand Corporation, 2020)

It should be noted that the DSC is in the current process of updating their DLIS, based upon more current data and updated methodologies. A representation of the initial DLIS analysis (annual probability of flooding due to a hydrologic event) is shown in Figure 1-6. The Hood study area was initially estimated to have an annual probability of 6.6 percent of flooding as a result of a hydrologic event according to DLIS. This annual probability of flooding is largely based upon overtopping, combined with information provided in the Delta Risk Management Strategy (DRMS), and not the current geotechnical characteristics of the levee system. The latest analyses related to the DWR FSRP identify as many as nine combined critical and serious repair sites near Hood that suggest repairs need to be made at the nearest opportunity, and until they are repaired, it is deemed that the MA 9 levee system adjoining Hood is susceptible to failure in any given year and is rated to have only a 16-year level of flood protection. The noted MA 9 levee segment currently falls well short of meeting the project study goal of obtaining a 100-year level of flood protection for the community of Hood.

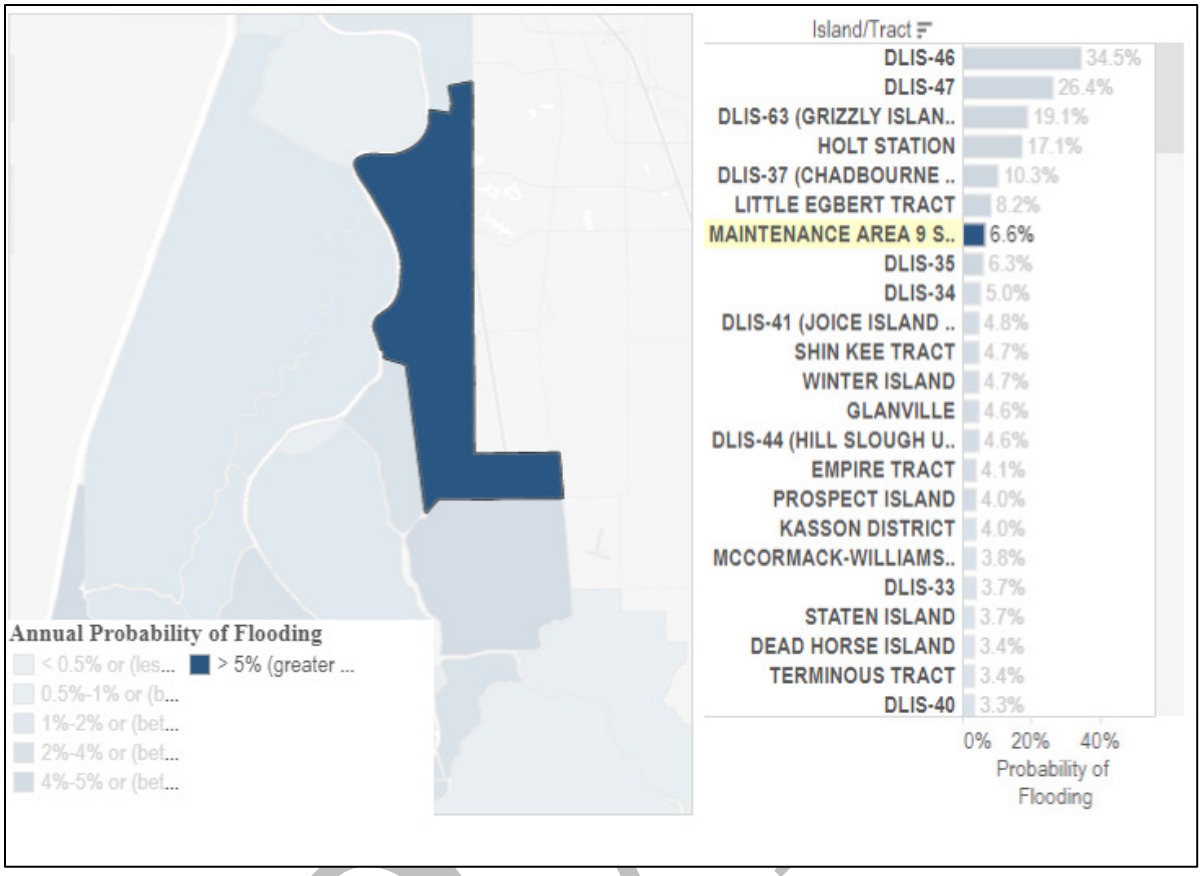


Figure 1-6. DLIS Analysis - Hydrologic Event (Rand Corporation, 2020)

The rulemaking process to adopt regulations implementing the DLIS is ongoing. However, the interactive DLIS Decision Support Tool, representing the current prioritization and analysis framework, is publicly accessible online here.[7]

1.7.5 Flood System Repair Project

The FSRP was funded by $150M of Proposition 1E funding and aims to assist LMAs in reducing flood risk on a cost-sharing basis. Through the FSRP, LMAs are provided technical and financial support to repair documented critical or serious problems with flood protection. The master database from the FSRP identifies levees with past performance problems for seepage, slope instability, erosion, and other problems (FloodProtect, 2014). Currently, there are nine collective critical and serious seepage sites along the left, east bank of the Sacramento River within NULE Segment 106 both within the Hood study area and upstream of the Hood study area in RD 744. These sites pose imminent flood threats to the community of Hood, requiring priority attention. It is hoped that this feasibility study in combination with the DWR FSRP can assist MA 9 and the

[7] Decision Support Tool for the San Francisco Bay-Delta Levee Investment Strategy: https://www.rand.org/pubs/tools/TL266/tool.html

community of Hood in prioritizing and implementing the remaining repairs of the known and documented FSRP critical and serious sites by 2022-2024.

1.7.6 Non-Urban Levee Evaluations

DWR's NULE program evaluated non-urban levees against geotechnical criteria likely to impact levee performance, including stability, through seepage, underseepage, and erosion. In general, the program was administered using a phased approach in communities with less than 10,000 residents and included Phase 1 preliminary geotechnical evaluations using historical data for all NULE levees, and Phase 2 geotechnical field investigations to further evaluate those levees protecting more than 1,000 persons. NULE levee segments were assigned ratings based on potential failure mode and placed in an overall hazard category for which recommendations and cost estimates were prepared. Data from the NULE program are currently used in conjunction with LMA inspection reports and data from the FSRP to characterize SPFC and non-SPFC levees and to inform future state, regional and local flood planning and financing efforts.

The results of Phase 1 NULE studies for the study area (NULE Segment 106) are detailed in Appendix A and in Section 2.1.1, Topography and Levees. However, the Hood study area did not meet the population threshold for NULE Phase 2 studies and therefore geotechnical investigations were not conducted as part of that study. Therefore, site-specific geotechnical conditions were warranted and CPT soundings and accompanying soil sample lab tests were conducted as part of this study in 2019 to further inform this feasibility study (see Appendix A for additional information).

2. Existing Conditions

2.1 Existing Conditions

2.1.1 Topography and Levees

Ground elevation for the Hood study area is highest immediately adjacent to the landward toe of Sacramento River levees (12 to 16 ft., NAVD 88) and slopes toward the center of the study area (less than 0 ft., NAVD 88) (Figure 2-1). Top of levee elevations vary from approximately 20 to 31 feet within the study area, with highest levee elevations located on the northwesterly upstream portion of the basin. The community of Hood generally sits at an elevation of 8 to 16 feet NAVD 88 near the landward base of the adjacent Sacramento River levee in comparison to the larger study area that sits at an elevation of less than 0 feet to 8 feet NAVD 88, near the center of the study area, northeast of Hood.

The study area is encompassed by approximately 5.85 miles of levees and former railroad embankments (Figure 2-1). Of these, approximately 2.5 miles are SPFC levees along the Sacramento River (NULE Segment 106) and maintained by MA 9, and the remaining 3.35 miles are non-SPFC levees (0.25-mile-long RD 744 south cross levee at the north end of the study area maintained by RD 744 [RD 744 cross levee], and a combined 3.10 miles of railroad embankments surrounding the community of Hood to the east and the south (URS, 2011a)).

As part of the 2017 update to the CVFPP, flood risk was assessed by defining impact areas with associated index points within the San Joaquin and Sacramento River Basins. Within this context, defined flood risks were quantified at discrete index points with impact area-specific levee performance curves. The levee performance curves were developed to be representative of a levee reach protecting the impact area, typically the worst case. Those areas that were vulnerable to a flood hazard from the reach associated with the index point were defined as impact areas. The Hood study area was aggregated into two separate impact areas: SAC 45 (Hood) and SAC 44 (Stone Lake, inclusive of the entirety of MA 9, less SAC 45). Though the majority of SAC 44 resides outside of the project study area boundaries, levees within the study area help to protect people and assets within MA 9 and include Interstate 5 and the city of Elk Grove located east of Hood. Levee performance curves were collectively updated by DWR and Sacramento County for each of the project levee segments in the study area during the course of this study as a result of geotechnical explorations performed in 2016. The new levee performance curves are included in Appendix E.

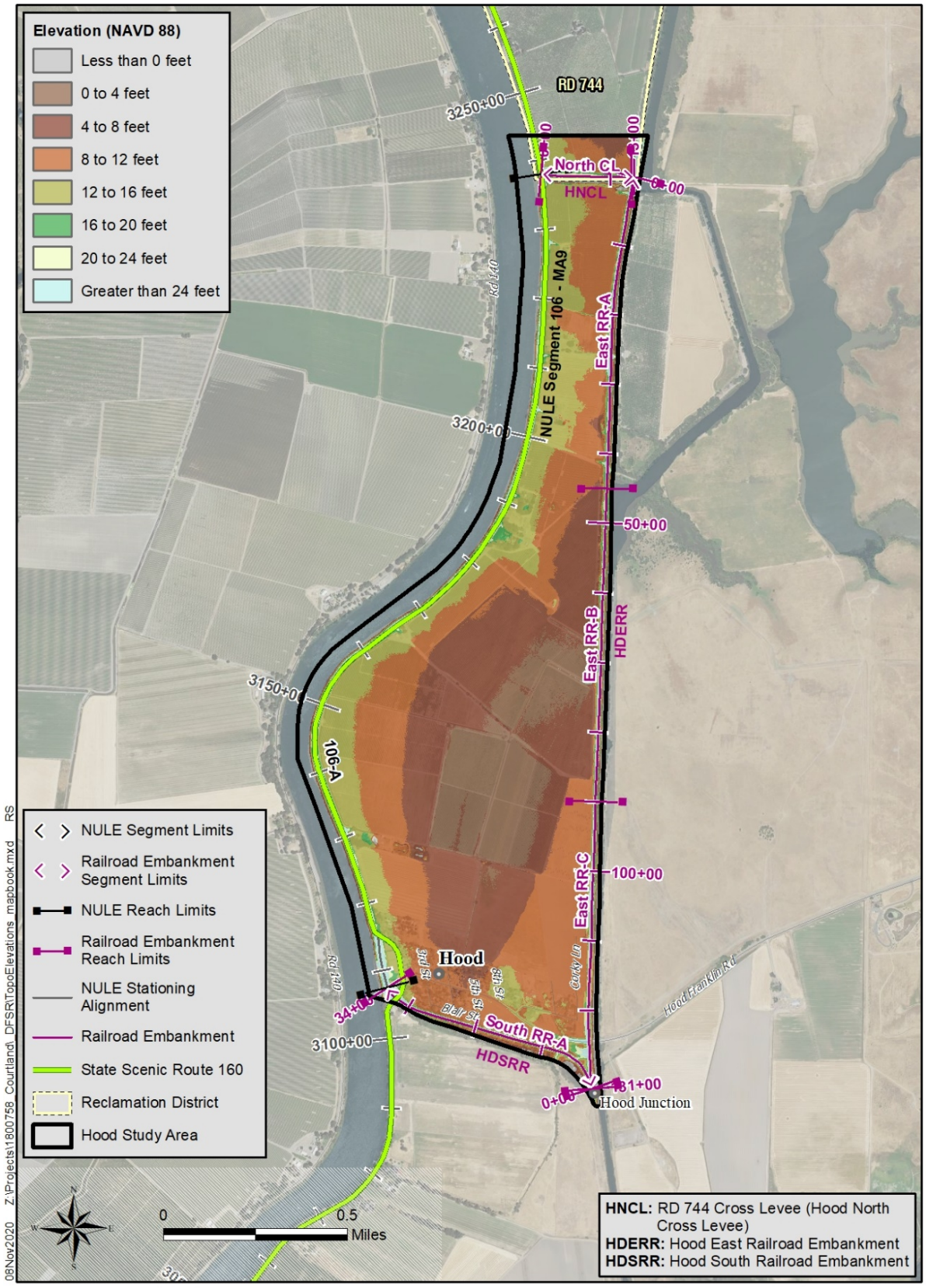


Figure 2-1. Study Area Ground Elevations and Levees.

Levee miles associated with each impact area are summarized in Table 2-1 below.

Table 2-1. Levee Miles for SAC 44 and SAC 45 (URS, 2011a)

CVFPP Impact Area	Levee Miles		
	SPFC Levee	Non-SPFC Levee	Total
SAC 44: Stone Lake, inclusive of the entirety of MA 9, (33,342 acres)	9.01	N/A	9.01
SAC 45: Hood (97 acres)	0.25	0.95	1.20

Existing levee conditions information for these levees is available from the Sacramento Area Flood Control Agency (SAFCA) Evaluation of Sacramento River Non-Urban Levees memorandum (SAFCA Evaluation) performed by GEI and the DWR NULE program and is included with collective Appendices A-1 and A-2. The NULE program and the SAFCA Evaluation both reviewed freeboard and geometry for the Sacramento River MA 9 levee protecting Hood. Both assessments utilized levee geometry data based on Light Detection and Ranging (LiDAR) topography collected for DWR's Central Valley Floodplain Evaluation and Delineation (CVFED) between October 2008 and February 2009. The NULE program geometry review was at the segment level (summarizing all 9 miles of NULE Segment 106 together, some of which extends beyond the Hood study area), while the SAFCA Evaluation summarized conditions every 500 feet Geometry information presented in the SAFCA Evaluation for the Sacramento River levee protecting the community of Hood is summarized in Table 2-2. The RD 744 cross levee and railroad embankments surrounding the community of Hood are non-SPFC embankments, so geometry reviews are not available in existing data as they were not assessed as part of the NULE program or SAFCA Evaluation.

Table 2-2. Summary of Levee Geometry – Sacramento River Levee Protecting the Hood Study Area (GEI Consultants, 2017)

NULE Segment and Location	NULE Stationing from D/S to U/S[1]	Approx. Base Width	Approx. Crest Width	Approx. Landside Levee Height	Approx. Landside Toe Elevation	Approx. Landside Slope (XH:1V)	Approx. Waterside Slopes (XH:1V)
Portion of NULE Segment 106, Left Bank Sacramento River (SPFC Levee)	3105+00	158	101	8	18.6	5.0	2.1
	3110+00	143	107	10	14.5	1.8	1.8
	3115+00	87	36	11	14.3	2.7	1.9
	3120+00	102	33	17	13.0	2.1	1.8
	3125+00	98	33	16	14.3	1.8	2.2
	3130+00	119	48	16	13.8	2.1	2.2
	3135+00	102	33	16	13.5	1.7	2.5
	3140+00	113	28	15	14.9	3.0	2.6
	3145+00	101	39	15	13.9	1.8	2.3
	3150+00	100	36	16	14.0	1.8	2.1
	3155+00	88	36	15	13.9	1.6	1.8
	3160+00	95	30	16	13.2	1.6	2.3
	3165+00	88	37	15	14.5	1.7	1.6
	3170+00	94	30	16	12.9	2.0	2
	3175+00	101	34	17	12.3	2.1	1.7
	3180+00	97	37	16	13.2	2.0	1.7
	3185+00	92	41	12	17.1	2.9	1.3
	3190+00	100	37	15	13.9	1.6	2.5
	3195+00	94	38	16	13.5	1.7	1.7
	3200+00	97	37	16	13.6	2.0	1.6
	3205+00	109	34	17	13.3	2.2	2.1
	3210+00	96	37	16	14.0	2.0	1.6
	3215+00	108	38	17	13.0	1.5	2.5
	3220+00	107	30	17	13.8	2.2	2.2
	3225+00	100	37	16	14.0	2.1	1.7
	3230+00	104	32	17	14.1	2.0	2.1
	3235+00	95	35	17	14.1	1.8	1.7

Note: [1]NULE Sta 3105+00 is located D/S of Hood and NULE Sta 3235+00 is located U/S near the RD 744 South Cross Levee

2.1.2 Geomorphology

Geomorphology (bed and bank erosion and sediment deposition) mapping developed for the DWR NULE program indicates the levee along the left bank of the Sacramento River that protects the community of Hood and the larger study area primarily overlies historical and Holocene overbank deposits (Rob and Hob) likely consisting of interbedded sand, silt, and clay deposited during high-stage flow, overtopping channel banks (Figure 2-2). A localized area of a Holocene distributary channel deposits (Hch) is mapped near GEI-Hood-001C shown on Figure 2-2 below. The distributary channel deposits likely contain sand, silt, and clay from channelized flow conducting sediment to the floodplain. A borrow pit (present in 1937) is mapped on the landside of the levee approximately 0.4-miles downstream from the RD 744 cross levee.

While the RD 744 cross levee and former railroad embankments surrounding the community of Hood were not a part of the NULE program assessment, the geomorphologic mapping does cover their extents. The RD 744 cross levee is mapped overlying historical overbank deposits (Rob) with borrow pits (present in 1937) in Holocene basin deposits (Hn) mapped along the south side of the cross-levee. The basin deposits are likely to contain fine sand, silt, and clay.

The railroad embankment to the east overlies historical and Holocene overbank deposits (Rob and Hob) along the northern half, with a localized area near the middle of the segment overlying Holocene Marsh deposits (Hs), and the southern half overlying lower member Pleistocene Riverbank Formation (Qrl). The Marsh deposits likely consist of silt and clay and are organic-rich. The lower member Riverbank Formation is likely composed of consolidated dense to very dense alluvium consisting of gravel, sand silt, and minor clay. Along the northern portion of the embankment, there is a waterside bench and a borrow pit (present in 1937) is mapped adjacent to the embankment.

The railroad embankment to the south of Hood is mapped to overly lower member Pleistocene Riverbank Formation (Qrl) along the eastern half and Holocene Basin deposits (Hn) to the west with small extents of historical and Holocene overbank deposits closest to the Sacramento River levee. A localized area of a Holocene distributary channel deposit (Hch) is also mapped through the basin deposits. A borrow pit (present in 1937) is also mapped on the south side of the embankment for most of the extent. *See* Appendix A-1 for additional information on existing geotechnical conditions within the study area, which includes and the collection and evaluation of 8 recent CPT explorations and subsequent laboratory data that were gathered in 2019 as a component of this feasibility study.

Levees within the study area which are built on sandy soil materials are of particular note since these levees can be particularly impacted by through seepage and underseepage, which can result in levee failure if left unchecked. In these areas where the levees are more susceptible to seepage and underseepage, remediations to address these vulnerabilities are generally more costly, requiring deeper vertical cutoff walls or wider combination seepage/stability berms. Retrofitting these levees, which is required to secure FEMA accreditation, can often cost upwards of $15M

or more per mile. Click here to read FEMA's guidance for levee certification that lists a number of additional criteria that must be met in addition to the underlying seepage problems that are prevalent throughout the North Delta and other leveed areas within the Sacramento and San Joaquin River Basins[1].

[1] FEMA Guidance for Flood Risk Analysis and Mapping - Levees, December 2020: https://www.fema.gov/sites/default/files/documents/fema_levee-guidance.pdf

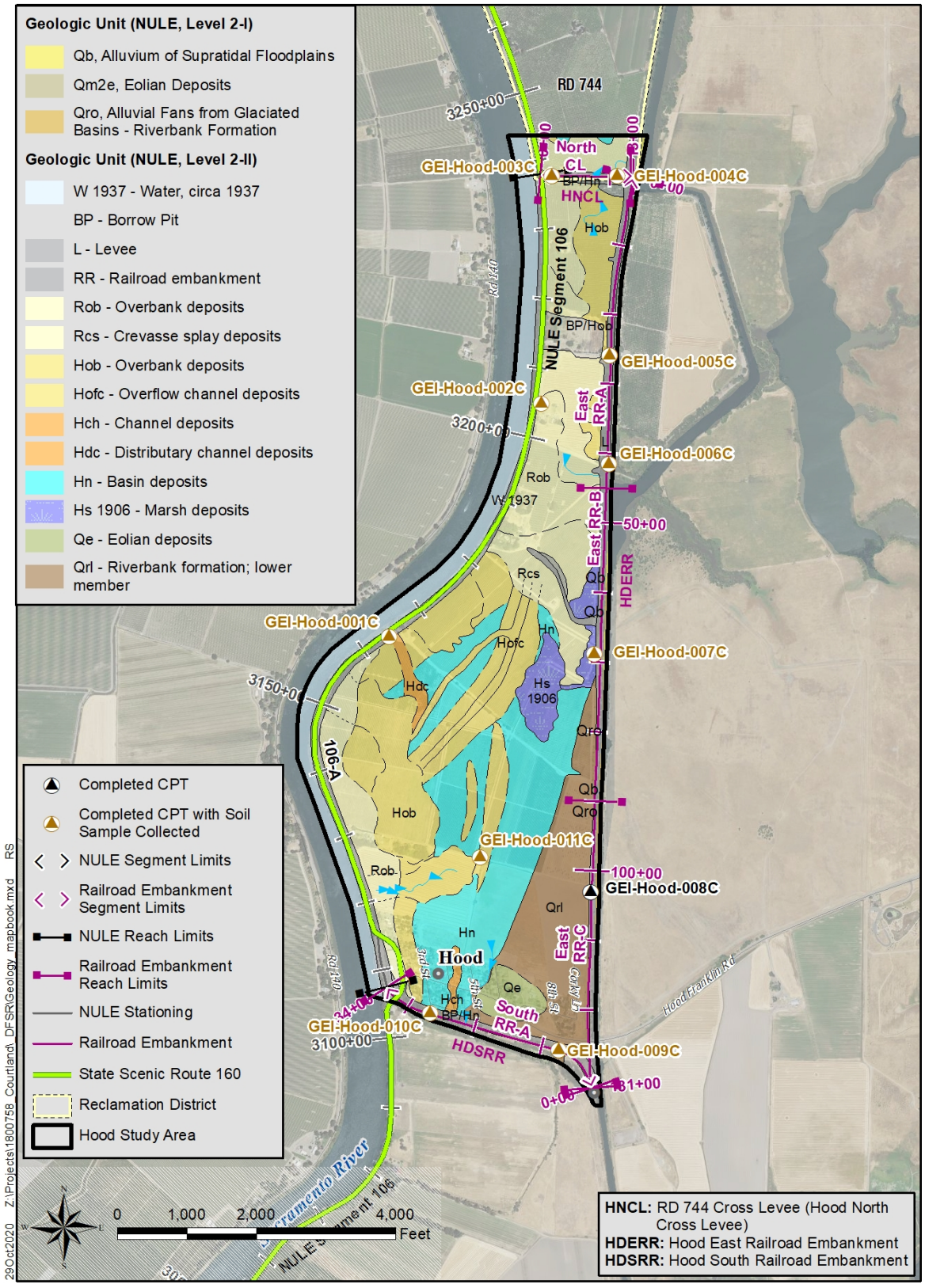


Figure 2-2. Geomorphology within the Study Area.

2.1.3 Population, Communities, and Land Use

Hood's 2010 population as reported in the 2010 Census was 271 residents. Between 2016 and 2018 the median household income decreased from $69,375 to $58,690 (United States Census Bureau, 2010). Hood was recently determined to be a disadvantaged community in 2018-2019 as defined by the state of California while qualifying to receive funding to remove the community's individual septic systems with an interceptor pipeline that will connect Hood with the Sacramento Regional Sanitation facility located near Elk Grove.

Hood is within the Primary Zone of the Legal Delta which means that local and County general plans and land use decisions must also be consistent with the Delta Plan. However, limited development within Hood along with several other communities in the Delta (Courtland, Ryde, and Walnut Grove) is permitted within 23 California Code of Regulations (CCR) Section 5010 (*Locate New Urban Development Wisely)* and exempt from 23 CCR Section 5013 (*Require Flood Protection for Residential Development in Rural Areas)* of the Delta Plan (Figure 2-3). Section 5010 of the Delta Plan requires new residential, commercial, and industrial development be limited to those areas designated by city or county general plans, while Section 5013 prescribes floodproofing requirements for new residential development. The exemption from Section 5013 allows for development within the immediate community to be unconstrained by Delta-specific floodproofing requirements. These land use requirements help prevent uninhibited growth which can sometimes result from improvements to the flood control system in other portions of the Central Valley outside of the Primary Zone of the Delta.

Managing Rural Floodplains to Avoid Increased Flood Risk

As stated in the Delta Plan, "to reduce the risk to lives, property, and State interests in the Delta, additional standards are needed to address new residential development… the policies in [the Delta Plan] are designed to reduce risk while *preserving the Delta's unique character and agricultural way of life.* **These policies should be construed as those required to provide the minimum level of flood protection and should not be viewed as encouraging development in flood prone Delta areas.** Consistent with existing law, urban development in the Primary Zone should remain prohibited."

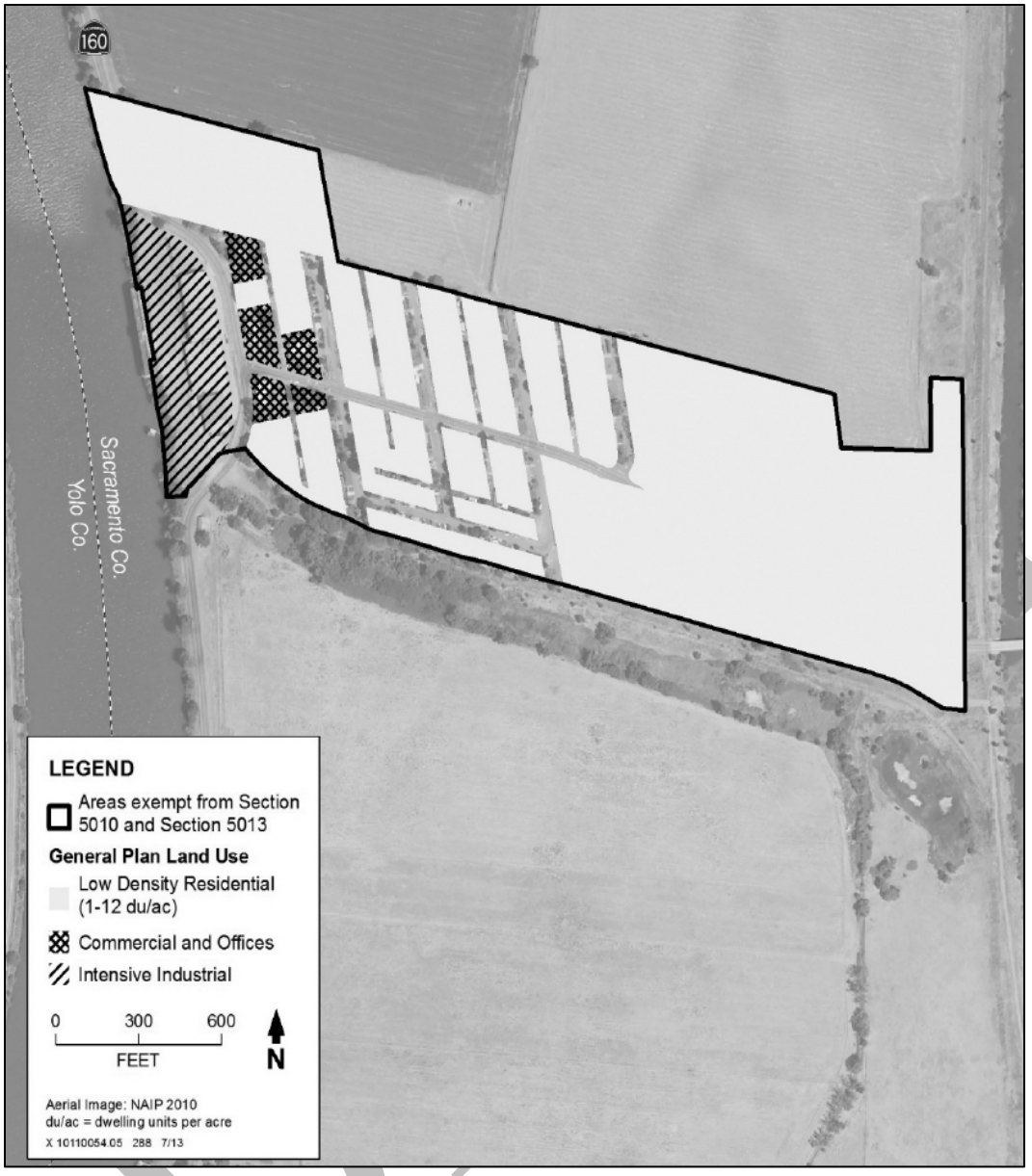


Figure 2-3. Hood Land Use under the Delta Plan (DSC, 2013)

2.1.4 Hydrology and Hydraulics

The Hood study area is bounded by the Lower Sacramento River and its tributary waterways. These waterways are also partially influenced by tidal conditions from the San Francisco Bay. The Sacramento River watershed is approximately 27,500 square miles and drains north to south. Flows in the Sacramento River are regulated by four major upstream reservoirs, namely Shasta, Oroville, New Bullards Bar, and Folsom. The upstream Yolo Bypass and Sacramento Bypass channels are currently designed and operated to divert as much as 75 percent of the total flood flows from the Lower Sacramento River. Systemwide improvements are planned and identified in the 2017 CVFPP Update to enlarge the Sacramento and Yolo Bypass and Weirs upstream of the Delta which will divert or shunt greater amounts of flood flows (greater than 75%) away

from the Lower Sacramento River immediately adjacent to the Hood study area, including the community of Hood.

Estimated existing 100-year peak flows and future 100-year peak flows adjusted for climate change and sea level rise, which also account for future systemwide improvements along with predetermined U.S. Army Corps of Engineers (USACE) 1957 design flow and profile, are summarized in Table 2-3. Additional information on how these peak flows were estimated can be found in Appendix I. The existing 100-year peak flow in the Sacramento River from the RD 744 cross levee to RD 755 is approximately 113,300 cubic feet per second (cfs). For this reach, the future 100-year peak flow is approximately 10 percent lower than the existing 100-year peak flow, due to favorable upstream, system-wide improvements at the Sacramento and Yolo Bypass/Weirs.

Table 2-3. Sacramento River Existing and Future 100-Year Peak Flows and USACE 1957 Design Flows

Reach	Existing 100-Year Peak Flow (cfs)	Future 100-Year Peak Flow (cfs)	USACE 1957 Design Flows
Sacramento River, RD 744 Cross Levee to RD 755	113,300	100,700	110,000

It should also be noted that the 100-year water surface profile "With Future Conditions" (inclusive of the upstream system-wide bypass/weir improvements, climate change adjustments and downstream seal level rise adjustments) is up to 1 to 2 feet higher in some locations than the USACE 1957 profile grade in the lower Sacramento River that is used as a guide for the operations and maintenance of the Hood study area perimeter levee system (Figure 2-4). However, the 100-year water surface elevation "With Future Conditions" closely matches the USACE 1957 profile grade directly in front of the community and study area of Hood. See Appendix I for further details on the water surface elevations, current and future, that are anticipated for the Sacramento River located along the west side of the Hood study area.

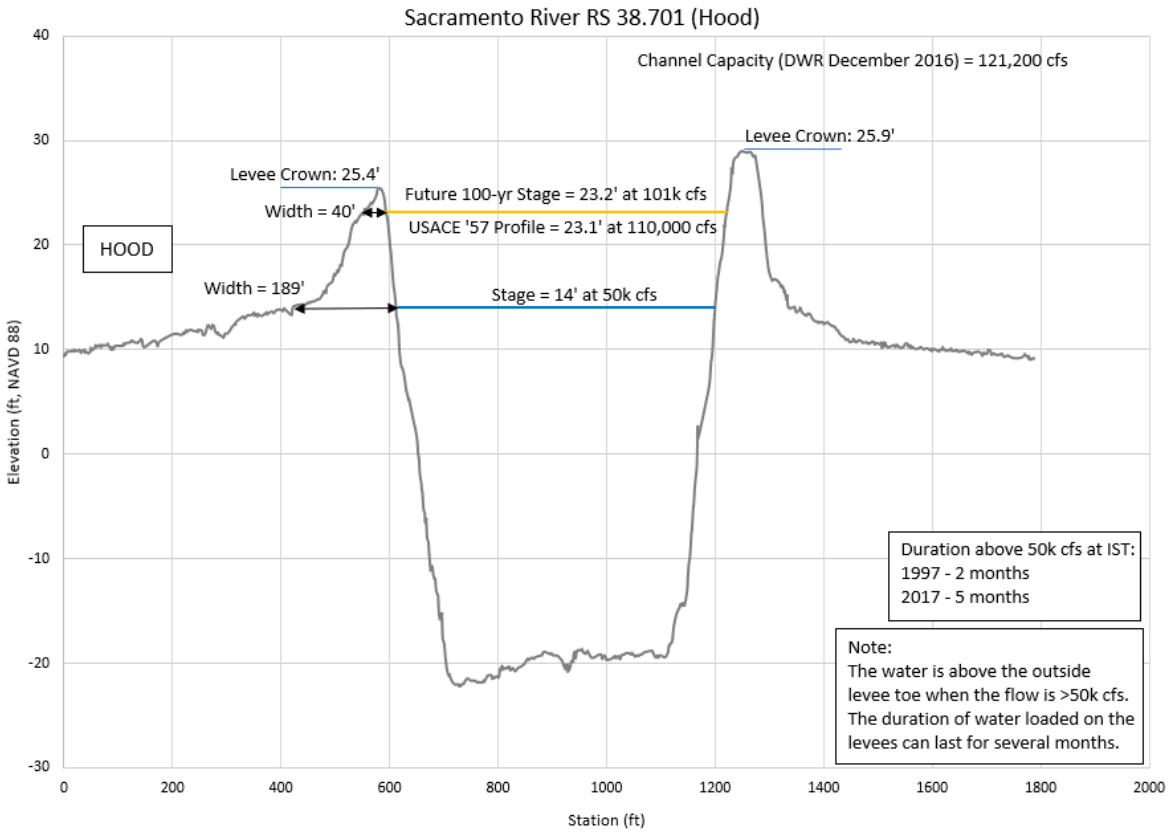


Figure 2-4. Cross Section at Sacramento River Station 38.701 at Hood Viewing Downstream

2.1.5 Water Resources and Water Conveyance

Delta waterways are important to North Delta communities and the State's water supply system. Hood lies along the Sacramento River and the Stone Lakes National Wildlife Refuge, immediately to the east. The Sacramento River and the nearby Stone Lake Refuge are important recreational and habitat resources for the area. The waterways provide vital agricultural water supply to local farmers and convey water to areas throughout the State of California south of the Delta.

2.1.6 Existing Infrastructure

The community of Hood's water well and distribution system is served by the Sacramento County Water Agency.

Critical infrastructure within the study area is shown as Figure 2-5. Critical infrastructure includes SR 160, County maintained paved roads, a bridge, a fire station, gaging stations, water wells, and oil/gas wells. Additionally, as of September 2020, a new water well and accompanying treatment facility was being constructed near the southeast corner of the study area. The water supply facility consists of an onsite well, water treatment system, control building, water storage, and a booster system.

There is also an agricultural drainage ditch north of Hood that receives runoff from Sacramento County's storm drain collection system in Hood. The storm drainage water from Hood is conveyed north via the agricultural drainage ditch to a pumping station that is located approximately 0.8 miles north of the community along the eastern railroad embankment. The pump station lifts the water through the railroad embankment and into the North Stone Lake area. If the pump is inoperable, low-lying areas of Hood on the north side of the community are subject to stormwater flooding. This same agricultural ditch and pump system also drains water that seeps through the east, left bank levee of Sacramento River whenever there are high water stages present in the Sacramento River.

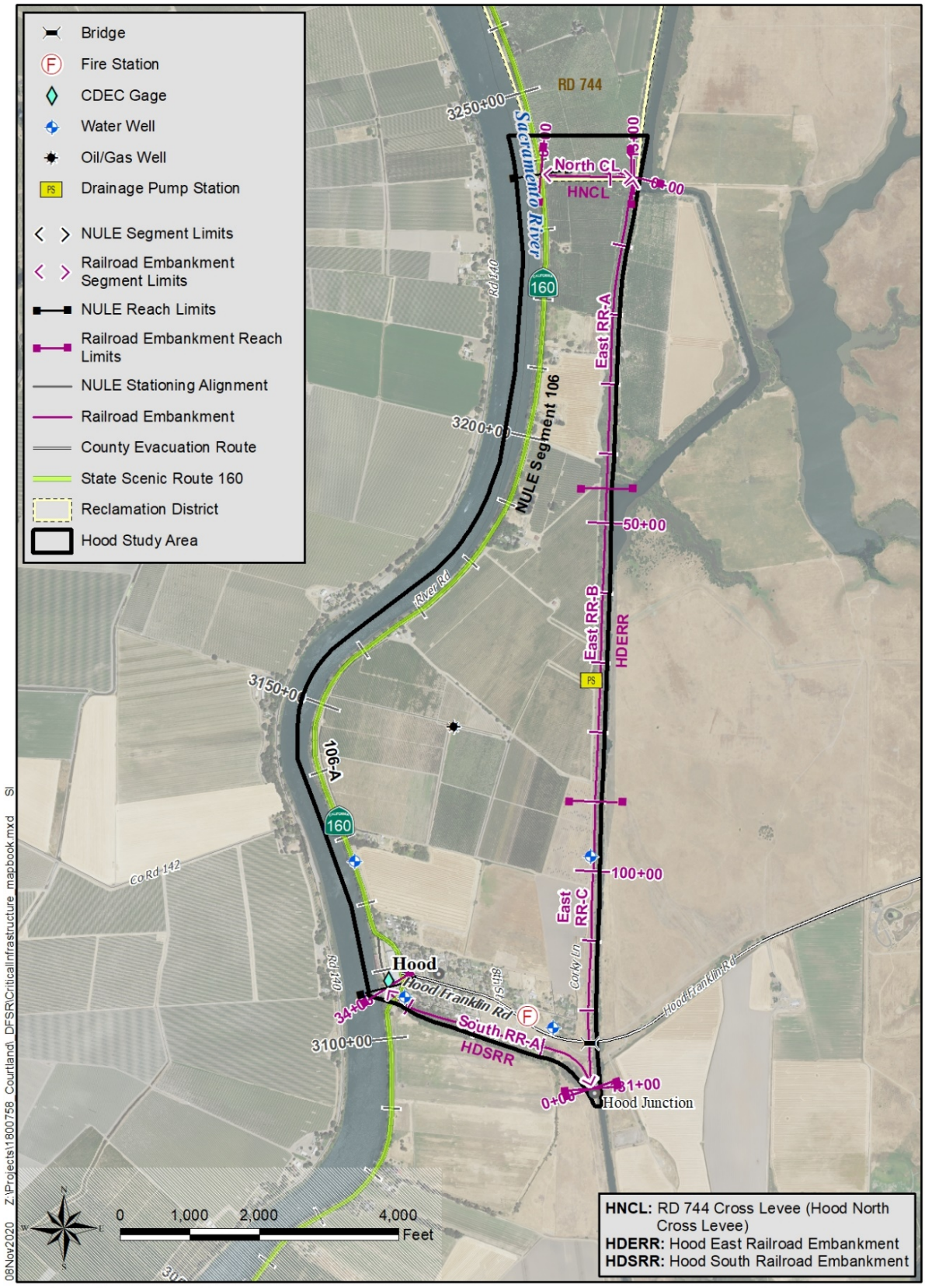


Figure 2-5. Critical Infrastructure within the Study Area

Infrastructure is a critical input in evaluating flood damage, which informs flood risk. The 2017 CVFPP Update inventoried structures, vehicles, highways, and streets within the Hood study area to evaluate the annualized EAD for the Hood study area, which were updated during the course of this study as part of the 2022 CVFPP Update. These inventories are largely provided within the discussion of flood risk to the study area in Section 3.1.1.4.

2.1.7 Biological Resources

According to the U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory database, freshwater emergent wetland, freshwater forested/shrub wetland, freshwater pond, and riverine features are found in the study area. The Sacramento River is the primary aquatic feature within the study area, located adjacent to the western boundary of the study area. An unnamed slough, between North Stone Lake and Stone Lake approximately 2 miles south of the study area, borders the eastern portion of the study area. The freshwater forested/shrub wetland is situated on the waterside boundary of the levees at the northern, eastern and southern boundaries of the study area. Three freshwater ponds are mapped, two of which are located in the northern boundary of the study area and one adjacent to a residential property on the western portion of the study area. A freshwater emergent wetland is mapped adjacent to the freshwater pond at said residential property, as well as along the southeastern boundary.

The majority of the Hood study area is designated as prime farmland (Figure 2-6). Farmland of local and statewide importance is located adjacent to the densely populated community of Hood, with some unique farmland located on the southeastern border of the study area.

When conducting work on the waterside slopes, particularly below the ordinary high-water lines in any waterways in the North Delta, and particularly within the Lower Sacramento River and adjoining sloughs, work is normally limited to the short three-month construction period of August 1 through October 31 due to the presence of special-status and endangered fish species and supporting habitat.

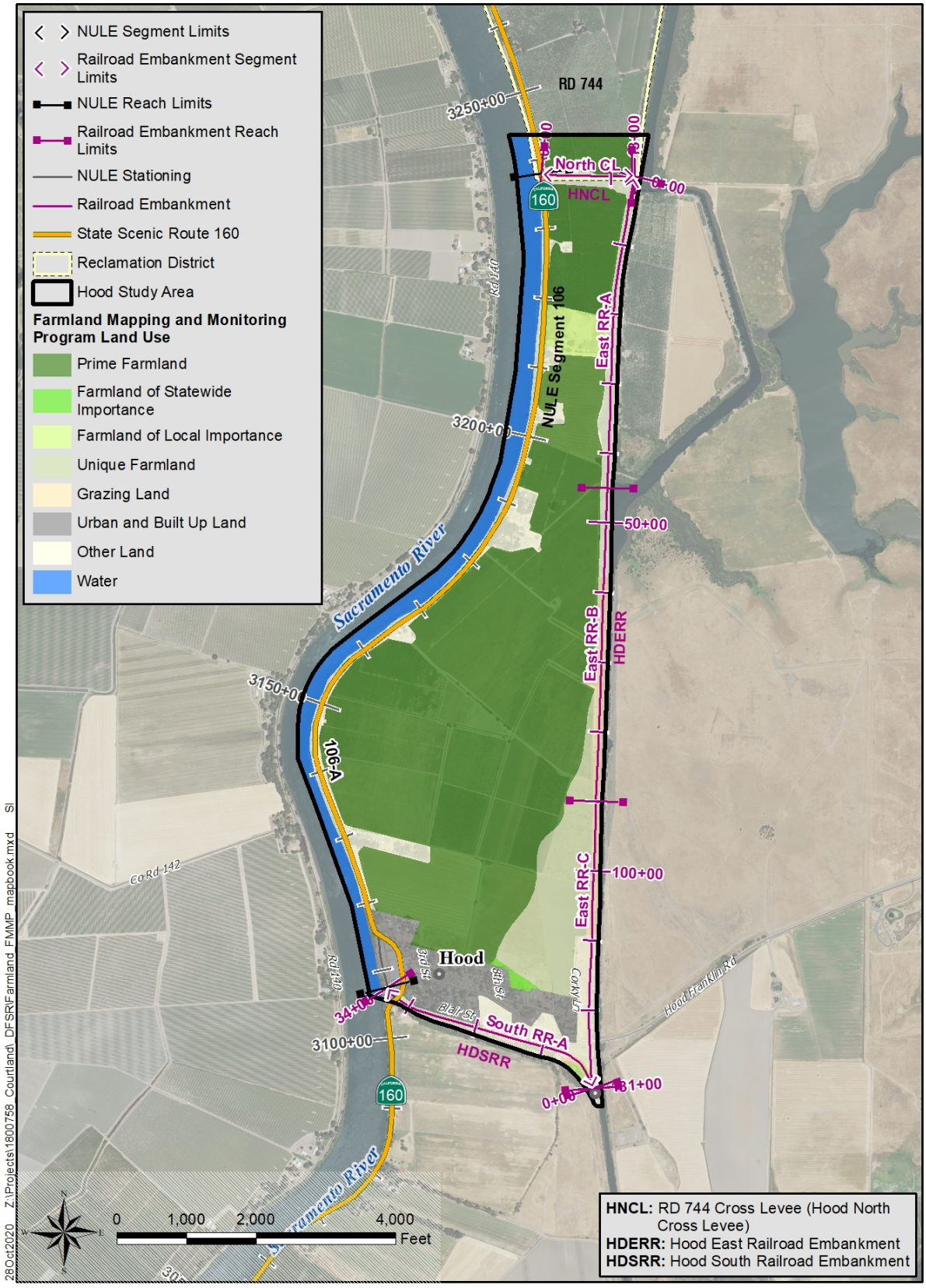


Figure 2-6. Farmland Designations within the Study Area

Vegetation classifications include a crosswalk between Central Valley Riparian Mapping Project (CVRMP) and the United States National Vegetation Classification Standard, whereby habitat is defined by CVRMP. There are eight vegetation communities within the study area (Figure 2-7). The majority of the study area is comprised of cropland, which includes permanent orchards and vineyards, seasonal corn, alfalfa, grain, hay, and other miscellaneous row crops. Other vegetation types within the study area include riparian forest, riparian scrub, and marsh.

Sixteen special-status plant species and 37 special-status wildlife species are documented or have potential to occur in the study area. The study area also supports suitable habitat for five special-status fish species. Designated USFWS and National Marine Fisheries Service critical habitat and Essential Fish Habitat also occur within the Sacramento River and border the study area.

See Appendix B for additional information on biological resources within the study area.

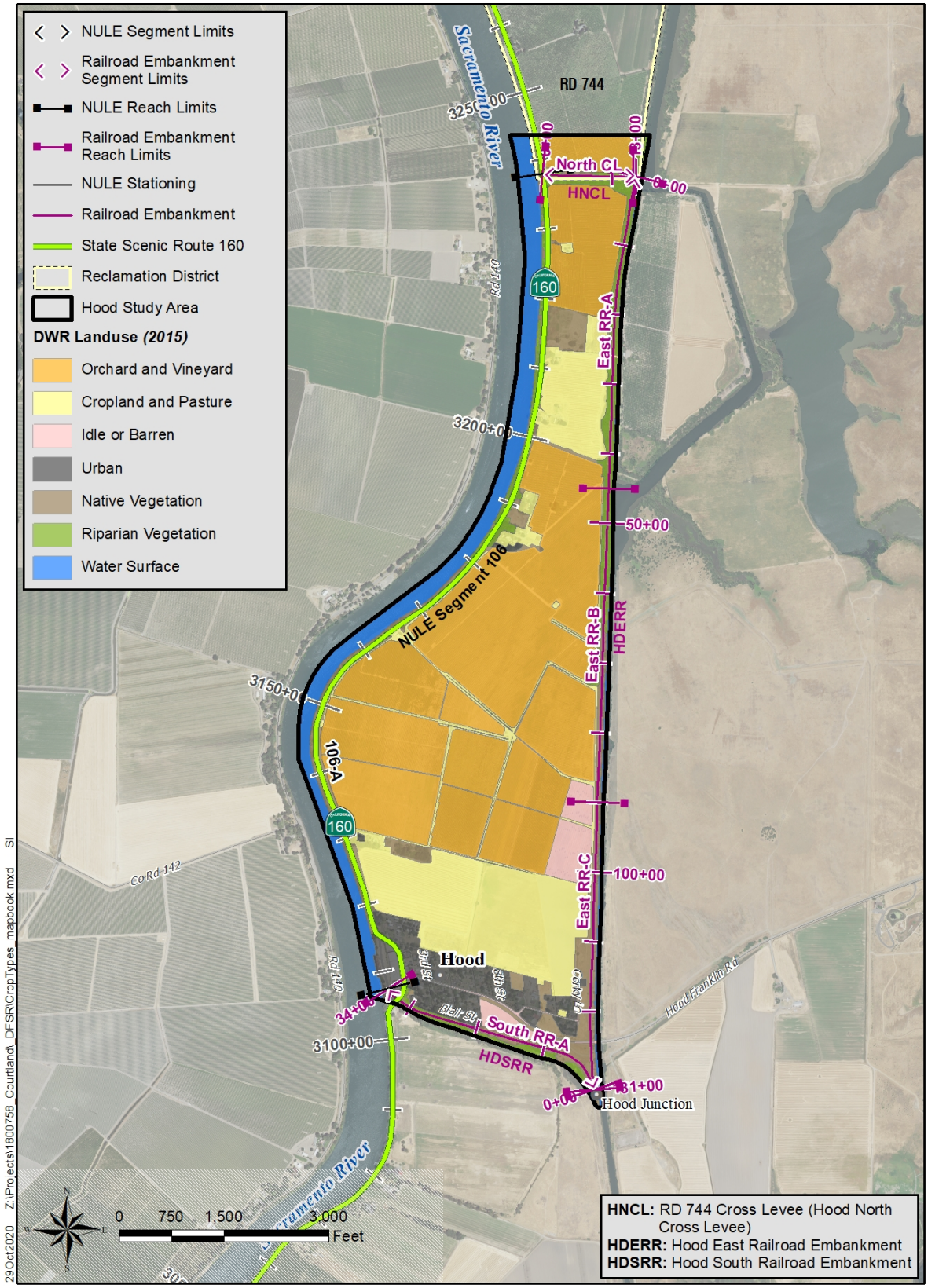


Figure 2-7. Crop Types within the Study Area

2.1.8 Cultural Resources

According to a records search conducted at the North Central Information Center, a total of 12 cultural resources are within the study area. Of those, five are prehistoric archaeological sites, one is a historical era archaeological site and the remaining six are built environmental resources dating to the historic era. Two of the built environment resources, Walnut Grove Branch Line Railroad (P-34-001497) and Rosebud Ranch (P-34-002102) have been determined eligible for listing in the National Register of Historic Places (NRHP) and the California Register of Historical Resources (CRHR). None of the other identified resources have been evaluated. The built environment resources are located throughout the project area, and some of the resources do not have specific addresses (such as the railroad and levee).

Information provided by Sacramento County indicates an additional four cultural resources within the study area. All of the resources are built environment resources dating to the historic era. None of the resources have been formally evaluated for listing in either the NRHP or CRHR, but from written descriptions two of the resources are single family residences and appear to be eligible for listing in the NRHP and CRHR.

In addition to the above resources, there are also historic resources located within the Hood study area, including the Walnut Grove Branch Line Railroad, and Rosebud Ranch (Figure 2-8).

In addition to the above resources located within the Hood study area, the entire study area is part of the Sacramento-San Joaquin Delta National Heritage Area (SSJDNHA). Established on March 12, 2019, the SSJDNHA, the first National Heritage Area established in California, supports historic preservation, natural resource conservations, recreation, heritage tourism, and educational projects within and beyond the Primary Zone of the Delta, but otherwise has no effect on water rights, property rights, or hunting and fishing rights within the designated area.

See Appendix C for additional information on cultural resources within the study area.

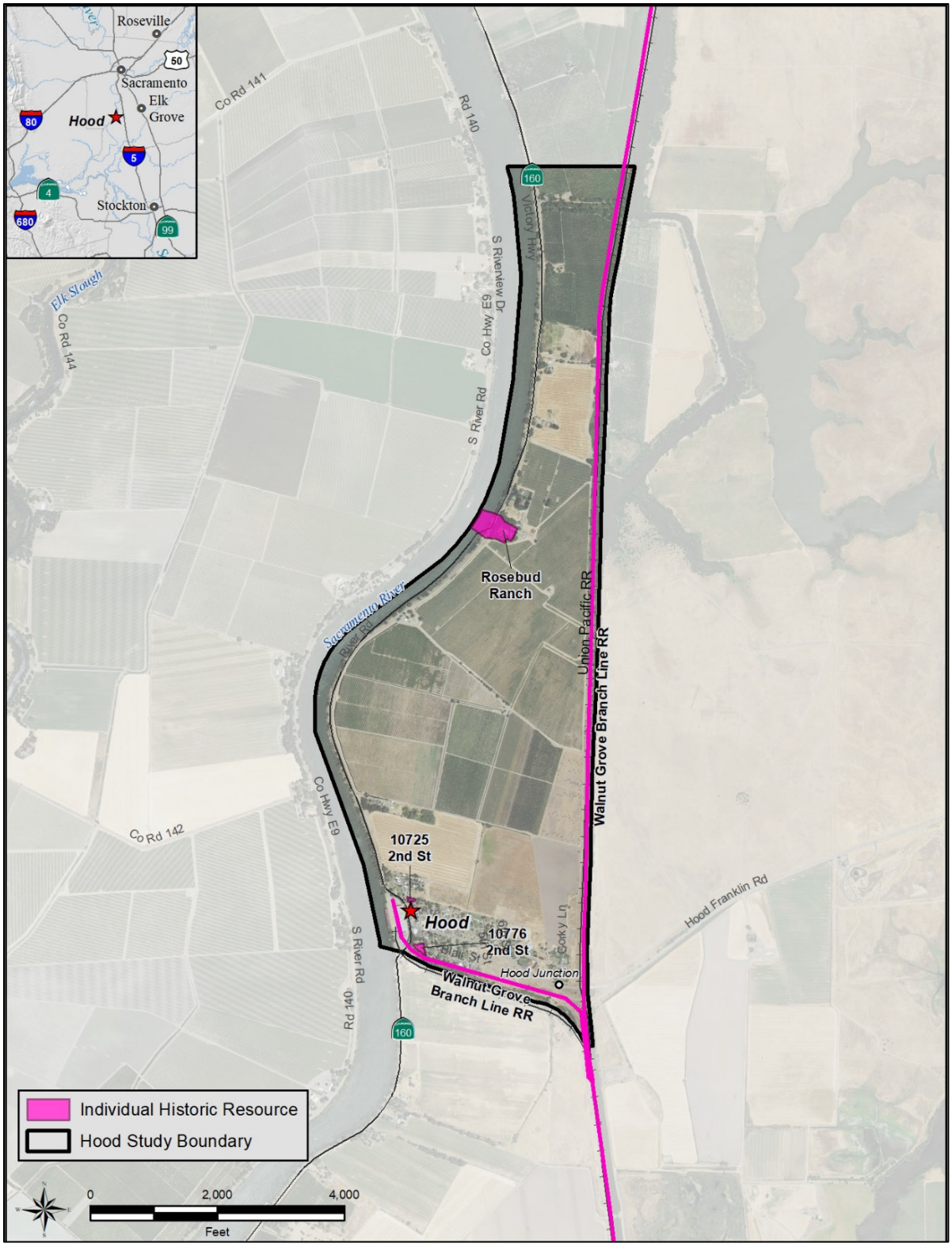


Figure 2-8. Historic Resources within the Study Area.

3. Problems, Opportunities and Constraints

3.1 Problems

In order for Hood to thrive in the future as the wonderful place that it is, the issue of flood risk must be addressed. There are nearly 6 miles of levees surrounding the Hood study area and a breach anywhere would cause widespread flooding putting Hood at risk of significant floodwater depths and velocities causing damage, including the potential loss of lives.

Other issues for the study area include escalating NFIP insurance premium rates, vulnerability of levees protecting through-Delta water conveyance, compliance with current FEMA accreditation standards, agricultural sustainability, threatened ecosystems, and future threats from climate change and sea level rise.

3.1.1 Flood Risk

In the 2012 CVFPP, flood threats to small communities were characterized using attributes related to flood frequency, potential flood depth, and proximity to the nearest river. These characterizations were then used to prioritize the small communities into four categories (DWR, 2012b):

- **Group A (Flood Threat Level: High Hazard)**: Communities subject to high flooding frequency (greater than 1% per year) and also subject to deep flooding conditions (potential flood depths exceeding 3 ft. on average).
- **Group B (Flood Threat Level: Moderate to High Hazard)**: Communities subject to high flooding frequency (greater than 1% per year), subject to sheet flooding conditions (potential flood depths of less than 3 ft. on average), and less than two miles from a major flooding source.
- **Group C (Flood Threat Level: Low to Moderate Hazard)**: Communities subject to high flooding frequency (greater than 1% per year), subject to sheet flooding conditions (potential flood depths of less than 3 ft. on average), and more than two miles from a major flooding source.
- **Group D (Flood Threat Level: Low Hazard)**: Communities that are not subject to high flooding frequency (less than 1% per year).

Of those small communities protected by SPFC levees throughout the entire Central Valley, a total of 8 were prioritized as **High Hazard – Group A**, including the communities of Hood, Courtland, Locke, East Walnut Grove, West Walnut Grove, and Ryde. Consequently, flood risk to these communities, including the community of Hood, is the highest relative to flood threats in the larger Central Valley, warranting improved flood protection in these areas.

Within the context of this feasibility study, flood risk is the largest issue facing the Hood study area. In the event of a levee failure, particularly on the levee immediately fronting and upstream of the community, Hood and the larger study area could see both life loss and significant property damage.

Flood risk is used as a basis to develop and prioritize flood risk reduction management actions for the purposes of this feasibility study. Flood risk is defined as:

Flood Risk = Probability of a Levee Failure x Consequences of a Levee Failure

Probability of levee failure within the Hood study area has been historically evaluated by the DSC in the DLIS, and by DWR in the FSRP, 2017 CVFPP Update and through the NULE program. These estimates are provided in Section 3.1.1.2.

Within the context of this study, consequences of levee failure are defined in terms of life loss and property damage. Life loss and property damage, as a result of flooding within the Hood study area, has historically been evaluated by DWR as part of the 2012 CVFPP and the 2017 CVFPP Update and are being re-evaluated as part of the 2022 CVFPP Update. Current life loss estimates for the Courtland study area are provided in Section 3.1.1.3, and an inventory of property at risk of flooding is provided in Section 3.1.1.4.

The number of lives lost and the extent of property damage as a result of a levee failure also depend on several factors, including depth of flooding, inundation time, and floodwater velocity. Expected flood depths and inundation time within the study area have been estimated as part of the preparation of the Delta Flood Emergency Safety Plan (ESP) for MA 9, and are summarized in Sections 3.1.1.5 and 3.1.1.6.

3.1.1.1 History

There is no record of flooding in MA 9 since formation of the MA in 1956. However, the SPFC levee protecting the community of Hood (NULE Segment 106) has experienced widespread seepage, boils, and erosion including slips, bank caving, and revetment failure during past high-water events. There are currently a combined total of nine critical and serious repair sites within the MA 9 levee segment between Freeport and Hood that remain outstanding and pose significant flood threats to the community of Hood

3.1.1.2 Probability of Levee Failure

As previously discussed, the probability of levee failure within the study area has been historically evaluated by DWR as part of the FSRP, the NULE program, the 2017 CVFPP Update, and by the DSC as part of the DLIS. The collective CVFPP and FSRP analyses aggregated the level of flood protection by impact area. The levels of flood protection offered by the current levee system(s) as detailed in the 2017 CVFPP Update were updated with new geotechnical information during the course of this study. Levee performance curves were collectively updated by DWR and Sacramento County for each of the project levee segments in

the study area and are provided in Appendix E. With updates to these levee performance curves, the SAC 45 (Hood) and SAC 44 (larger balance of the study area including the remainder of MA 9 outside the immediate study area) impact areas are estimated to have a 9-year level of flood protection at the USACE 1957 assessment water surface elevation (AWSE), largely due to the presence of known FSRP critical and serious sites within MA 9 along the SPFC left bank levee of the Sacramento River.

DLIS analyses suggest that study area has a 14-year level of flood protection. Based upon empirical data and history provided above in Section 3.1.1.2, the latter estimate of a 14-year level of flood protection is more applicable, particularly when comparing to the current modern standard of obtaining a 100-year level of flood protection in accordance with FEMA's accreditation standards, pursuant to 44 CFR §65.10.

DWR's NULE Geotechnical Assessment Report (GAR) qualitatively evaluated probability of failure for the Hood study area (Table 3-1). For each NULE segment, four potential failure mechanisms (underseepage, slope stability, through seepage, and erosion) were evaluated and the segment was categorized based on its overall vulnerability (low, moderate, high) to the various failure mechanisms. Segments were categorized as low, moderate, or high, based on the likelihood of either levee failure or the need to flood fight to prevent levee failure at the USACE 1957 design water surface elevation (WSEL). These analyses found NULE Segment 106 along the Sacramento River to have a high likelihood of either levee failure or the need to flood fight to prevent levee failure at the USACE 1957 design WSEL or AWSE based on the potential vulnerability to underseepage, slope stability, through seepage, and erosion. These same values are currently being updated by DWR during the course of this feasibility study. The non-SPFC levees (RD 744 cross levee and railroad embankments) were not evaluated along as part of the NULE GAR for the north NULE study area, but they are being evaluated as part of this feasibility study.

Table 3-1. Summary of NULE GAR Assessment Results for the Hood Study Area (URS, 2011a)

Levee Segment Location	NULE Segment	Overall Segment Characterization	Results by Individual Failure Mechanism			
			Under-Seepage	Slope Stability	Through Seepage	Erosion
Left Bank Sacramento River – MA 9 (SPFC levee)	106[1]	High	High	Moderate	High	Moderate

Note: [1] NULE segment 106 extends beyond the Hood study area, NULE assessment is for segment as a whole

3.1.1.3 Life Loss

The 2017 CVFPP Update estimated potential life loss on an annualized basis for the subject impact areas: (1) SAC 44 (Stone Lake, including the entirety of MA 9 and large portions of Elk Grove, but excluding SAC 45 - Hood); and SAC 45 (Hood). Life loss on an annualized basis was analyzed in the 2017 CVPP Update for a series of scenarios over a 60-year period of 2007 to

2067. The baseline scenario included an approximation of system performance prior to 2007, before implementation of system improvements in the Sacramento Basin. Four other scenarios were also analyzed which considered, to varying degrees, the impact of implementation of DWR flood control projects, non-structural systemwide actions including enhancement of flood preparedness and warning notifications, larger-scale actions such as widening the Sacramento weir and Yolo Bypass system(s), climate change, sea-level rise and population and land use changes. For all five scenarios, no life loss was estimated for either impact area, including for the 2007 baseline case (DWR, 2017d).

Life loss on an annualized basis was also estimated as part of the DLIS. From this analysis, expected annual fatalities for MA 9 south, inclusive of the Hood study area, were estimated to be between 0.4 to 0.6 (DSC, 2017).

A breach on the levee immediately fronting the community of Hood could result in floodwater depths in Hood up to 20 feet in some locations combined with floodwater velocities in excess of 10 feet per second (fps). Combined floodwater depths and velocities in this scenario would result in little to no warning time for evacuation, which poses imminent flood threats to the community of Hood and would very likely result in life loss.

Instantaneous flooding with combined high flood depths and velocities into homes is a messy, dangerous situation likely resulting in loss of lives and costly cleanup expenses.

3.1.1.4 Property Damage

Structure counts, agricultural acreage, vehicle counts, and total miles of highways and streets, along with their associated values, were quantified as part of the 2017 CVFPP Update. These inventories and their associated values were updated as part of the 2022 CVFPP Update efforts during the course of this study. Within the SAC 44 and SAC 45 impact areas, including the community of Hood and also including the larger area of MA 9, which is in part protected by levees within the Hood study area, the value of structures, vehicles, highways and streets, and agricultural crops total over $9.49 billion (B) in 2020 dollars:

- Total estimated depreciated replacement value of the 17,158 structures in the SAC 44 and SAC 45 Impact Areas: $8.9B
- Total estimated vehicle value: $502.2M
- Total estimated value of highways and streets: $59.5M
- Total estimated value of agricultural crops: $36.2M

Structures at risk of flooding are summarized in Table 3-2. There are an estimated 117 structures in the community of Hood (SAC 45), with an estimated 17,041 structures in SAC 44. Though the majority of the SAC 44 structures are located outside the immediate project study area, a levee failure within the Hood study area could easily result in flooding in parts of MA 9 outside the study area, which has the potential to directly impact these structures as well as Interstate 5. As

part of the 2017 CVFPP Update, depreciated replacement values for these structures and contents were defined for SAC 44 and SAC 45, which are being updated as part of the 2022 CVFPP Update. As shown in Table 3-3, the total depreciated replacement value for the SAC 44 and SAC 45 impact areas escalated to 2020 dollars is over $8.90B, with an estimated $42.7M of this total replacement value located within the community of Hood.

Table 3-2. Structures within SAC 44 and SAC 45 (HDR, 2021).

CVFPP Impact Area (area in acres)	Total Structures Count				
	Residential	Commercial	Industrial	Public	Total
SAC 44: Stone Lake, including the entirety of MA 9, less SAC 45 (33,342 acres)	16,357	144	286	254	17,041
SAC 45: Hood (97 acres)	104	4	7	2	117
Total (33,439 acres)	16,461	148	293	256	17,158

Table 3-3. 2022 CVFPP Depreciated Replacement Value for SAC 44 and SAC 45 (HDR, 2021).

CVFPP Impact Area (area in acres)	Depreciated Replacement Value				
	Residential	Commercial	Industrial	Public	Total
SAC 44: Stone Lake, including the entirety of MA 9, less SAC 45 (33,342 acres)	$7,402,855	$328,378	$642,891	$484,029	$8,858,153
SAC 45: Hood (97 acres)	$25,107	$2,317	$14,141	$1,090	$42,655
Total (33,439 acres)	$7,427,962	$330,695	$657,032	$485,119	$8,900,808
Average Depreciated Value of Structures	$362,000	$508,000	$1,407,000	$777,000	$783,000

Note: Costs are reported in Quarter 1, 2020 dollars

The total amount of vehicles, total miles of highways and streets, and a summary of agricultural acreage, along with their estimated worth for the SAC 44 and SAC 45 impact areas, are summarized for each impact area and totaled in Table 3-4 Table 3-6 and Table 3-6 below. In summary, the total vehicle value (excluding agricultural equipment) within the densely populated community of Hood is over $3.0M in 2020 dollars. The estimated 55,463 vehicles within SAC 44 are valued at over $499.1M in 2020 dollars.

Table 3-4. Vehicle Count and Value for SAC 44 and SAC 45 (HDR, 2021).

CVFPP Impact Area (area in acres)	Total Vehicle Count	Total Vehicle Value
SAC 44: Stone Lake, inclusive of the entirety of MA 9, less SAC 45 (33,342 acres)	55,463	$499,167,000
SAC 45: Hood (97 acres)	338	$3,042,000
Total (33,439 acres)	55,801	$502,209,000

Note: Costs are reported in Quarter 1, 2020 dollars

Within the populated community of Hood, the 0.3-mile-long portion of SR 160 is valued at $188,000 and streets are valued at $321,000. A total of 41 miles of highway and nearly 200 miles of streets in the SAC 44 impact area are valued at over $59M.

Table 3-5. Total Miles of Highways and Streets and Value for the Study Area (HDR, 2021).

CVFPP Impact Area (area in acres)	Highways Miles	Total Highways Value	Streets Miles	Total Streets Value	Total Value of Highways and Streets
SAC 44: Stone Lake, inclusive of the entirety of MA 9, less SAC 45 (33,342 acres)	41.3	$23,184,000	198.4	$35,856,000	$59,040,000
SAC 45: Hood (97 acres)	0.3	$188,000	1.8	$321,000	$509,000
Total	41.6	$23,372,000	200.2	$36,177,000	$59,549,000

Note: Costs are reported in Quarter 1, 2020 dollars

Agricultural crops adjoining the populated community of Hood (SAC 45) are valued at $1,000 in 2020 dollars and crops in the SAC 44 impact area are valued at over $36.2M in 2020 dollars.

Table 3-6. Crop Acreage and Total Value for SAC 44 and SAC 45 (HDR, 2021).

CVFPP Impact Area (area in acres)	Agricultural Acreage (acres)									Total Value
	Citrus	Deciduous	Field	Grain	Pasture	Rice	Truck	Vineyard	Total	
SAC 44: Stone Lake, including the entirety of MA 9, less SAC 45 (33,342 acres)	16	667	1,355	1,047	4,560	0	835	4,121	12,601	$36,230,000
SAC 45: Hood (97 acres)	0	0	2	0	0	0	0	0	2	$1,000
Total	16	667	1,357	1,047	4,560	0	835	4,121	12,603	$36,231,000

Note: Costs are reported in Quarter 1, 2020 dollars

Baseline (or without project) EAD estimates for the two impact areas within the Courtland study area have also developed as part of the 2022 CVFPP Update efforts (Table 3-7). As previously discussed, EAD is a common metric used to estimate risk within the Delta and other components of the Sacramento River Flood Control Project (SRFCP). EAD is calculated on an annualized basis and represents the annual average expected damages through the consideration of potential flooding conditions. Baseline EAD estimates incorporate updated levee performance curves and are provided for existing conditions and future conditions. Baseline EAD values under existing conditions include the existing conditions of the flood management system(s) in the Central Valley and includes projects that have been authorized and have funding, or that have started construction or implementation under the 2022 CVFPP. Baseline EAD values under future conditions have the same features as the existing conditions, with the addition of the effects of inland climate change projections and sea level rise. As shown below in Table 3-7, the total baseline EAD for the SAC 44 and SAC 45 impact areas under existing conditions is estimated at nearly $8.6M in 2020 dollars. With the effects of climate change and sea level rise, baseline EAD for the SAC 44 and SAC 45 impact areas under future conditions is estimated at over $71M in 2020 dollars. It should be noted that the EAD analyses utilized the hydrologic and hydraulic (H&H) models developed specifically for the CVFPP 2017-2022 updates by DWR's consultant team, and not the H&H models prepared by the GEI Consultant Team in Appendix I.

Table 3-7. 2022 CVFPP EAD Values for SAC 44 and SAC 45 (HDR, 2021)

Impact Area	EAD[1], Existing Conditions	EAD[2], Future Conditions with Climate Change Adjustments
SAC 44: Stone Lake, including the entirety of MA 9, less SAC 45 (33,342 acres)	$6,253,000	$65,688,000
SAC 45: Hood (97 acres)	$2,331,000	$5,830,000
Total for the SAC 44 and SAC 45 Impact Areas	$8,584,000	$71,518,000

Notes: [1]EAD as defined by the 2022 Without-Project Scenario from the 2022 CVFPP.
[2]EAD as defined by the Future Without-Project Scenario with climate change adjustments as applied in the 2017 CVFPP.

3.1.1.5 Floodwater Depths and Velocities

Inundation mapping was conducted in May 2017 for MA 9, including the Hood study area, as part of Sacramento County's Flood ESPs for the RDs collectively located in the North Delta and in Sacramento County. Hypothetical levee breaches for MA 9 were modeled at four locations, two of which are relevant for the purposes of this feasibility study: 1) upstream of the Hood study area in RD 744 (along the Sacramento River NULE Segment 106); and 2) upstream of the community of Hood and within the Hood study area (also along the Sacramento River NULE Segment 106). A simulation of a potential levee breach occurring upstream of the project study area within the RD 744 portion of the MA 9 area near Scribner Bend can be reviewed on the Hood Story Map developed by Sacramento County: Hood Story Map - Sacramento County Small Communities Flood Risk Reduction Program.[2]

Based on these analyses, flood depths and corresponding velocities are greatest in the community of Hood and in the Hood study area when there is a breach along the Sacramento River upstream of Hood and within the Hood study area. Figure 3-1 shows potential flood depths within the study area as a result of a representative levee breach upstream near Scribner Bend as well as from breach closer to the community within the project sturdy area. In this scenario, flood depths are estimated to reach 10 to 15 feet along the SPFC levee located along the left bank of the Sacramento River, with flood depths increasing towards 20 feet near the center of the study area. In the community of Hood, flood depths are estimated to reach between 10 to 15 feet, with some areas experiencing flooding upwards of 20 feet and flow velocities in excess of 10 feet fps.

Potential flood depths within the study area as a result of a levee breach at this location are estimated to reach near 27 feet northeast of Hood (Figure 3-1). As shown in Figure 3-1, denoted by the arrows extending from the hypothetical breach location north of Hood, these flood depths are representative of a levee breach anywhere along the left bank of the Sacramento River within the Hood study area, as well as north of the study area in RD 744.

[2] Hood Story Map - Sacramento County Small Communities Flood Risk Reduction Program: https://sacramentocounty.maps.arcgis.com/apps/MapJournal/index.html?appid=cda6eb30ff4943ffbae895e122c8791e

A levee breach upstream of the community of Hood within the Hood study area is also estimated to result in flooding outside of the study area to the north and east of RD 744, into Elk Grove and the Franklin Pond east of Stone Lake), and to the south into RD 813. In the event of a levee failure at this location, flood depths in RD 744 could reach up to 27 feet, with flood depths in the adjacent communities of Elk Grove and Franklin Pond, as well as RD 813, reaching upwards of 10 feet in some locations.

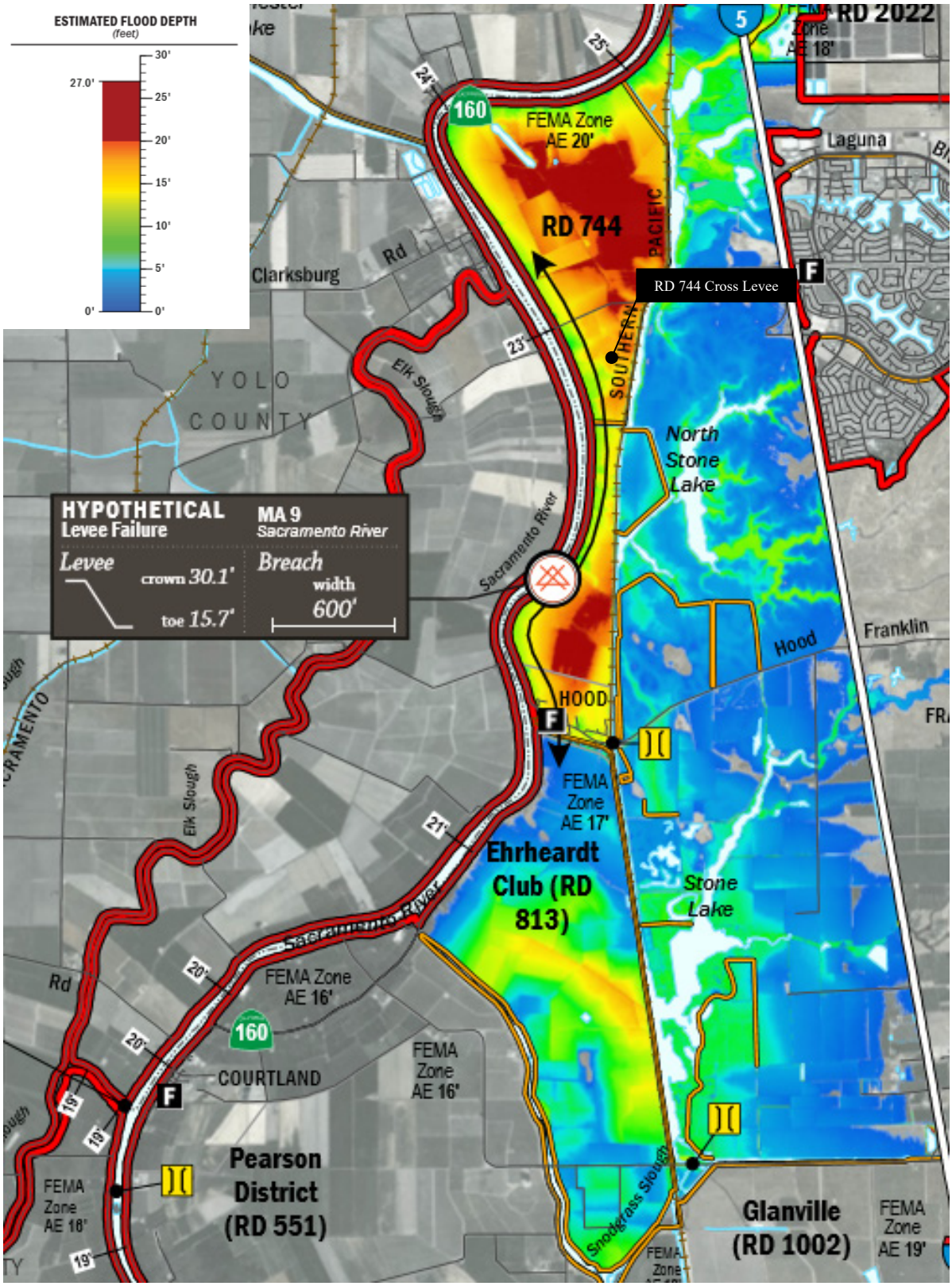


Figure 3-1. Flood Depths as a Result of a Hypothetical Levee Breach in the Hood Study Area (Dynamic Planning + Science, 2017).

A levee breach upstream of the Hood study area in RD 744 (along the Sacramento River NULE Segment 106) is also relevant to this feasibility study as select DWR FSRP critical and serious seepage sites discussed as part of this study are located in RD 744 along the left bank of the Sacramento River. A levee failure along this segment of levee could result in flooding within RD 744 and the Hood study area, including the community of Hood, due to the RD 744 cross levee being approximately 5 feet lower compared to the former railroad embankment immediately south of Hood. In the community of Hood, a levee breach at this location could result in flood depths upwards of 15 feet in the community, and upwards of 30 feet in the larger study area. A breach along this segment of levee is also estimated to result in flooding to the east in the adjacent communities of Elk Grove and Franklin Pond, where flood depths could reach up to 5 feet (Figure 3-2).

The results of this inundation mapping demonstrate that, of the two breach locations discussed, a breach in the levee along the Sacramento River between the southern boundary of the study area and in RD 744 upstream and north of the study area produces the greatest floodwater depths and velocities within the study area, collectively posing the greatest risk to loss of life and property damage.

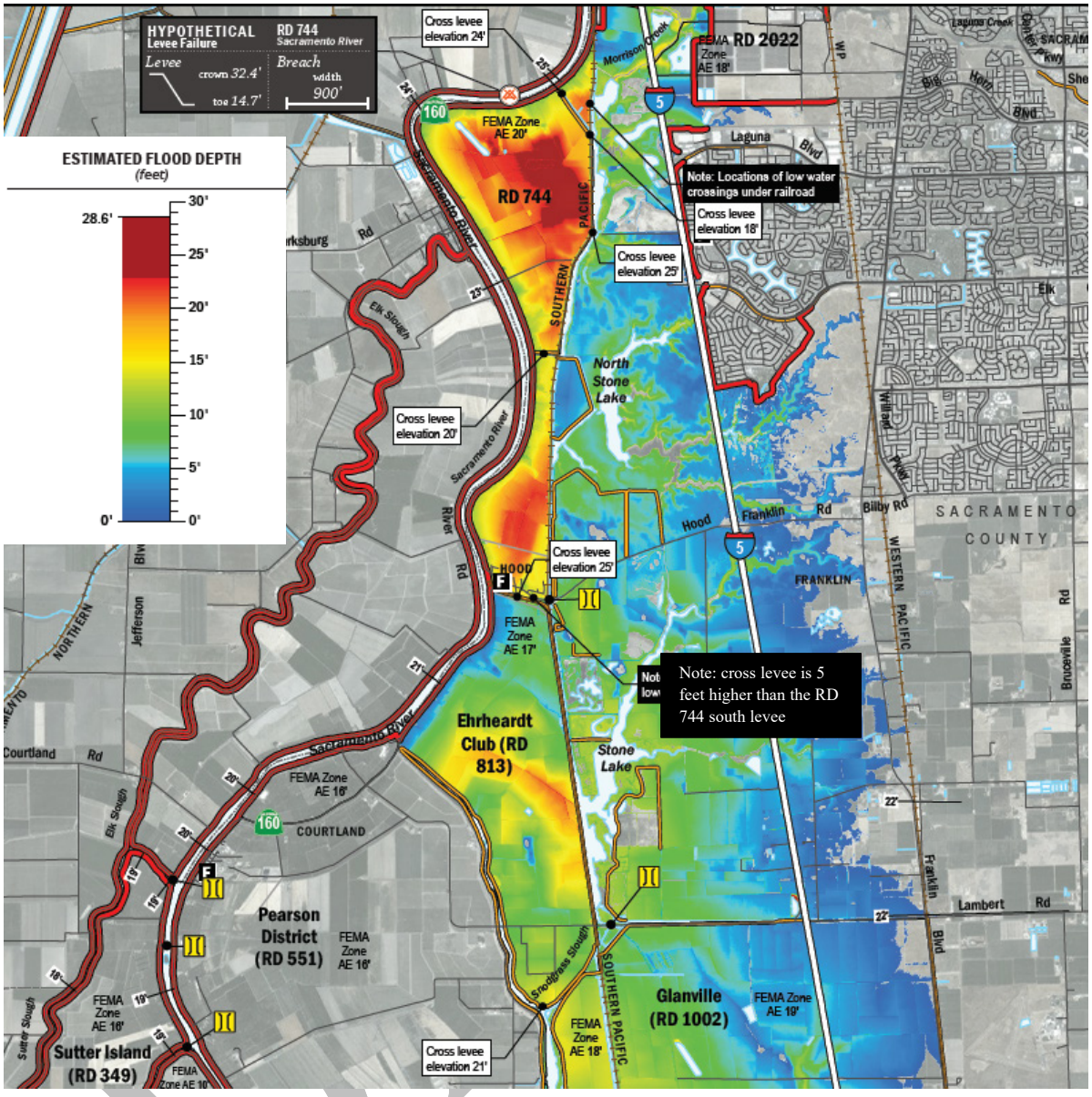


Figure 3-2. Flood Depths as a Result of a Hypothetical Levee Breach Upstream of the Hood Study Area in RD 744 (Dynamic Planning + Science, 2017).

Figure 3-1 and Figure 3-2 depict worse case flood depths that could occur in the Hood study area with a levee breach along the Sacramento River in or upstream of the project study area.

3.1.1.6 Inundation Time

Using the same breach location in the Hood study area discussed in the preceding Section Life Loss, the time to 1 foot of inundation in the Hood study area and for areas outside of the Hood study area was estimated as part of the inundation mapping performed for the MA 9 Delta Flood ESP. For the majority of the Hood study area, including the community of Hood, inundation to 1 foot is nearly instantaneous in the event of a levee failure along the left bank of the Sacramento River within the study area, ranging from 2 to 8 hours. The duration of time prior to reaching a

1 foot depth of flooding is longer (8 to 16 hours) for select parts of the community and other areas where flood depths are lowest.

For more information on flood risk and to view a hypothetical flood simulation of the Hood study area, visit the Hood Story Map developed by Sacramento County located here: Hood Story Map - Sacramento County Small Communities Flood Risk Reduction Program.[3]

3.1.2 Escalating NFIP Insurance Premium Rates

Delta legacy communities are subject to deep flooding behind a combination of State and federal authorized (SPFC) levees and non-SPFC, private levees.
However, most all Delta Legacy Communities have **not** flooded in the last 100-years due to oversized levees with surplus freeboard and low to moderate risk of levee failure.

Flood risk can be determined using information from FEMA's Flood Insurance Study (FIS) in conjunction with FIRMs. FIRMs delineate SFHAs, which are defined as areas that will be inundated by the 100-year flood event. These areas include lands and improvements behind levees that are not fully accredited by FEMA in accordance with 44 CFR §65.10. The current FIS for Sacramento County is dated August 16, 2012 (FEMA, 2012). The community of Hood, as shown in Figure 3-3, is located within Zone AE, which, as defined by FEMA, is "subject to inundation by the one-percent-annual-chance flood event determined by detailed methods." According to Figure 3-3 excerpted from the FEMA FIRM the Hood study area is subject to flooding in Zone AE to a Base Flood Elevation (BFE) of 18 feet NAVD 88. It should be noted that the BFE of 18 feet NAVD 88 assumes that a relief cut can be deployed at the downstream, lower gradient of the subject study area.

[3] Hood Story Map - Sacramento County Small Communities Flood Risk Reduction Program: https://sacramentocounty.maps.arcgis.com/apps/MapJournal/index.html?appid=cda6eb30ff4943ffbae895e122c8791e

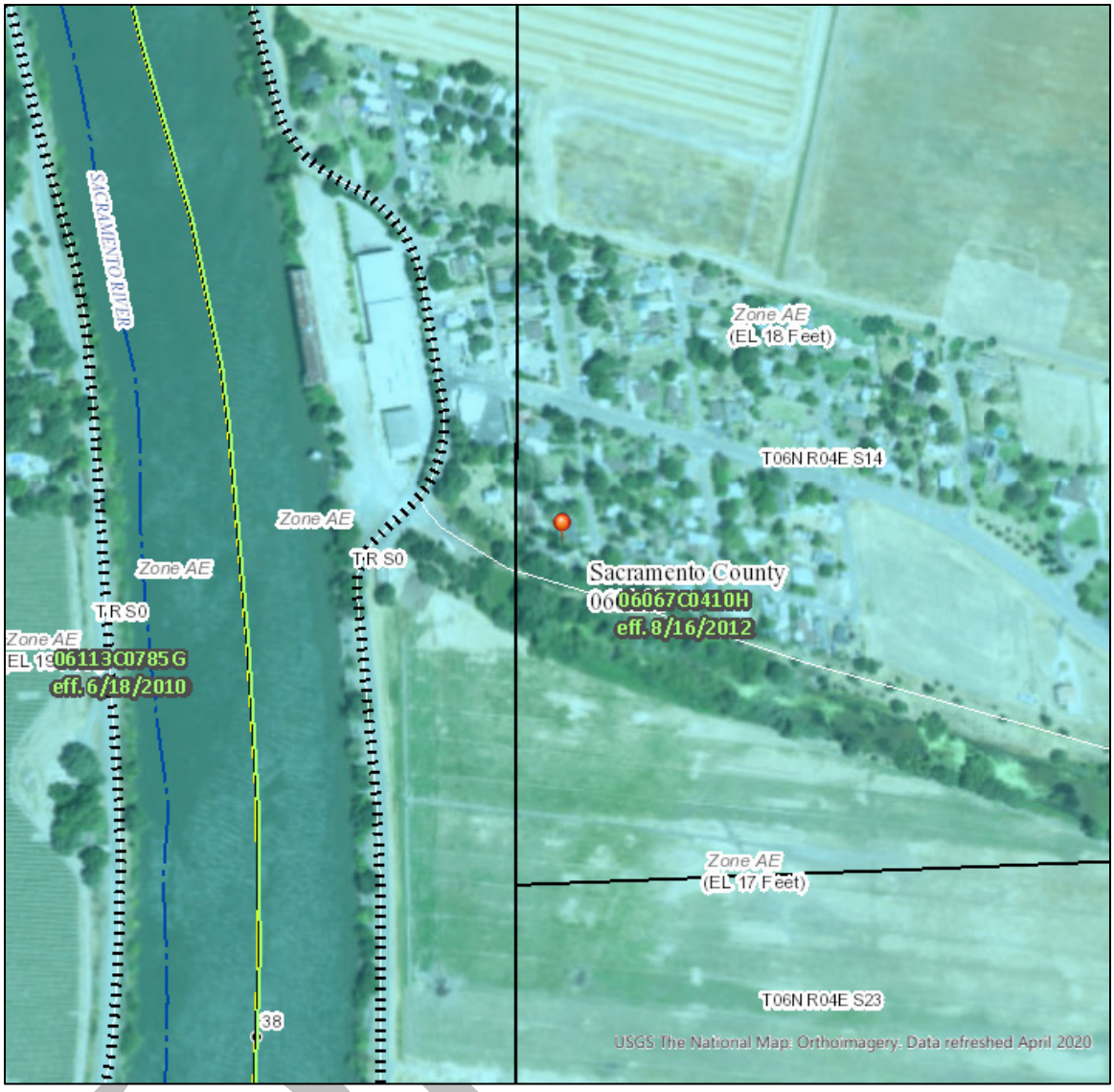


Figure 3-3. Hood's 100-Year Base Flood Elevation (BFE) Floodplain Recognized by FEMA (FEMA, 2020).

Flood insurance through the NFIP is mandatory for buildings with a federally backed mortgage located in a SFHA. These premiums have been steadily on the rise since the passage of flood insurance reform laws including the BW-12 and the Homeowner Flood Insurance Affordability Act (HFIAA) of 2014. Under HFIAA, policyholders can expect to see gradual increases in annual premiums until they reach a rate that the NFIP deems to be actuarially based. Effective April 1, 2018, NFIP annual premiums increased by eight percent from $866 per policy to $935 per policy, not including HFIAA surcharges or other fees (FEMA, 2017). In October 2019, FEMA announced that beginning on April 1, 2020, annual renewal premiums would increase by 11.3 percent (FEMA, 2019a). This rate restructuring has been postponed to October 2021 according to FEMA as of November 7, 2019 (FEMA, 2019b).

For those who do not already have a current NFIP policy, they will be rated by FEMA based on the elevation of the living quarters of their structure(s) relative to Hood's BFE of 18 feet NAVD 88. Sacramento County currently enjoys up to 40 percent discount on flood insurance costs due to the County's high Community Rating System (CRS) score, which is one of the top five CRS scores in the entire nation. Still, the rates are rising rapidly. Many NFIP policies in Hood are grandfathered in at low rates that increase each year until reaching the rate based on an elevation certificate. *For example: if the floor of a house is 4 feet below the FEMA BFE of 20 feet in Hood, with a cost of $200,000 per dwelling structure and $40,000 for structure contents, the new (non-grandfathered) NFIP premium would be $6,804 per year plus fees (and this is with Sacramento County's favorable 40 percent discount with its high CRS score).*

As NFIP flood insurance rates increase the number of insured homes decrease. As a result, the Hood study area is increasingly and significantly under insured. While there are an estimated 117 structures in Hood valued with an estimated replacement value of $42.6M[4], there are only 34 NFIP polices (valued at $350,000 maximum per policy inclusive of structure contents, presently capped at $250,000/structure and $100,000 for structure contents) providing less than $12M[5] in coverage.

To remove the entire project study area from the current FEMA BFE of 18 feet NAVD 88, the entire combined perimeter levee systems would require reparing and strengthening in-place to current, modern engineering standards, consistent with the FEMA 100-year accreditation standards contained in 44 CFR §65.10. Click here to learn more about achieving a 100-year level of flood protection pursuant to the current FEMA accreditation standards.[6]

Levees protecting the Delta Legacy Communities fall well short of meeting current seepage and stability criteria pursuant to 44 CFR §65.10

The current cost estimate of such levee repairs/improvements for strengthening in place to achieve FEMA accreditation for just the community of Hood are provided in Sections 6.2.1 and, 6.2.2 with estimated costs to achieve FEMA accreditation for the entire study area in Section 6.2.7.

[4] The FEMA Open Source data is aggregated by zip code. This estimate is representative of SAC 45 from the draft 2017 CVFPP Update – Technical Analyses Summary Expanded Report, 2017 and has been escalated to July 2020 dollars.
[5] These estimates are sourced from the FEMA Open Source policy database.
[6] FEMA Guidance for Flood Risk Analysis and Mapping - Levees, December 2020 https://www.fema.gov/sites/default/files/documents/fema_levee-guidance.pdf

3.1.3 Vulnerability of Levees Providing Through-Delta Water Conveyance

There are more than 1,100 combined miles of SPFC and non-SPFC levees in the Delta which convey water to 750,000 acres of farmland within the Delta for irrigation. Some, but not all of these levees in concert with the adjoining river channels convey water toward the Clifton Forebay, which pumps the water south of Delta to serve approximately 3 million acres of agricultural lands and a population of 25M. Some of these same levees serve to protect the community of Hood, which relies on this critical infrastructure to sustain the local agriculture economy, thus preserving the community's rich agricultural heritage. According to NULE evaluations performed in 2015, over 50 percent of SPFC non-urban levees and 40 percent of non-SPFC non-urban levees do not meet acceptable criteria for underseepage, through seepage, structural stability and/or erosion (DWR, 2017b). Within the Hood study area, the majority of the SPFC levees do not meet acceptable criteria for through seepage, underseepage, structural stability and erosion.

The vulnerability of these levees is further compounded by climate change, which can intensify rain events and heighten flood risk, and the risk of a seismic event in the future which could cause the levees to fail. Additionally, as previously discussed, levees which are vulnerable to through seepage and underseepage can be particularly costly to remediate, making FEMA certification and 100-year flood protection infeasible to attain without significant cost-share from the State or others.

Maintenance and improvement of the current in-channel river conveyance system for the CVP and SWP water supply system(s) is a vastly better solution than a tunnel as presently proposed by the DCA. It costs less, is ecologically friendly, protects the "Delta as a Place", and reduces flood risk to the Delta Legacy Communities, inclusive of the community of Hood, located upstream of the Delta Cross Channel. With or without the DCA as presently proposed, through-Delta conveyance will continue to rely on the freshwater corridor established both upstream and downstream of the Delta Cross Channel. Presently there are 37 miles of non-urban SPFC levees upstream and 25 miles downstream of the Delta Cross Channel that help convey water through the Delta (a total of 62 miles of SPFC levees which comprise significant portions of the Delta's freshwater corridor) (Figure 3-4). Improving 2.5 miles of SPFC levees to current, modern standards consistent with FEMA's 100-year accreditation standards within the Hood study area would constitute improving 7 percent of the non-urban SPFC levees between Freeport and the Delta Cross Channel and 4 percent of the total non-urban SPFC levees in the Delta's freshwater conveyance corridor. Furthermore, improving the entire 9 miles of SPFC levees located along the left bank of the Sacramento River between Freeport and just south of Hood would constitute improving 24 percent of the non-urban SPFC levees upstream of the Delta Cross Channel and 15 percent of the total non-urban SPFC levees in the Delta's freshwater conveyance corridor.

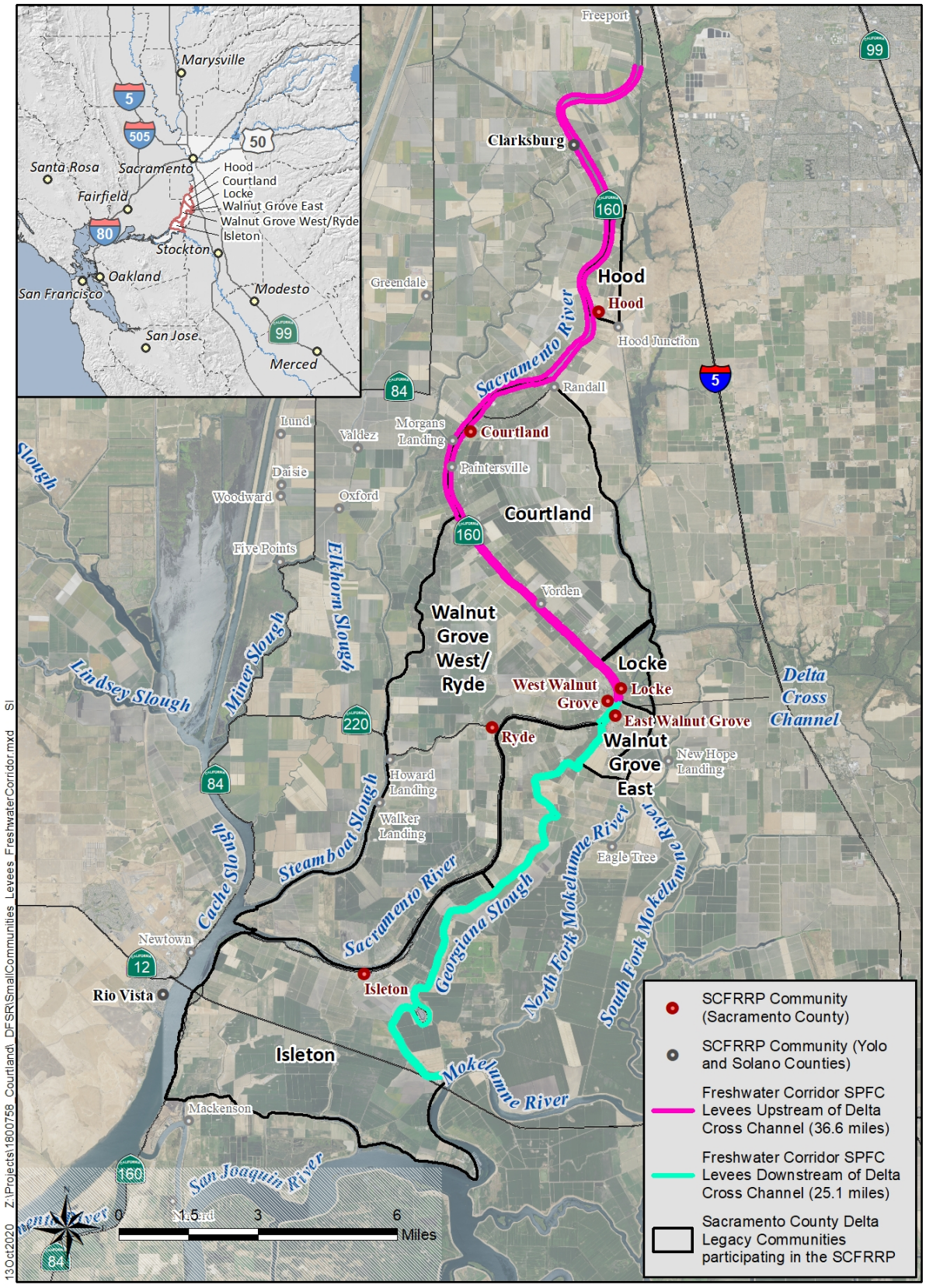


Figure 3-4. SPFC Levees in the Delta which Comprise the Delta's Freshwater Corridor.

3.1.4 Agricultural Sustainability

Agricultural lands within the Delta and in the immediate project study area are a key element of sustaining the economic health for the community of Hood. In 2001, FEMA began updating FIRMs, and as a result, many small communities, including Hood in 2012, were subsequently mapped into SFHAs. As a result, these communities are subject to regulations set forth by the NFIP, including land use requirements for elevating or flood-proofing new and substantially improved structures, and the requirement to purchase a flood insurance policy through the NFIP for each structure with a federally backed mortgage (aka mandatory insurance purchase requirement). These requirements do not provide the flexibility needed to sustain agriculture within the community and can make reinvestments that are needed in support of the agricultural economy infeasible or unattainable.

3.1.5 Threatened Ecosystems

Many of the historic tidal wetland areas of the Delta have been lost to development and placement of levees with a configuration that does not support tidal inundation of areas to sustain viable habitat. Vulnerability to flow and temperature changes associated with Delta water supply conveyance (and naturally occurring drought) and predation of migrating fish species from invasive species is also an issue in certain areas of the Delta.

3.1.6 Threats from Climate Change and Sea Level Rise

Climate change and sea level rise have the potential to increase peak flows and flood stages in the Sacramento River. As discussed in Appendix I, peak flows in the Sacramento River could increase by 4 percent for the 100-year flood and 2.3 percent for the 200-year flood as a result of climate change. Additionally, climate change combined with sea level rise could increase the 100-year flood stage in the Sacramento River at Hood between Elk Slough and Sutter Slough by nearly 1.11 feet, with the 200-year flood stage along the same extent increased by 0.60 feet Increased flows and flood stages can not only result in more frequent flooding, which can lead to levee failure through greater hydro-dynamic pressures (and potential overtopping), but can also result in greater stresses to the levee system as levees are loaded more frequently with water for longer durations of time and via other mechanisms resulting from increased flow/flood stages (e.g., erosion). However, note that within the Hood study area, the effects of climate change and sea level rise are less pronounced along the mainstem of the Sacramento River, as a result of planned improvements in the upstream/adjacent bypass systems.

It should be noted that the effects of climate change and sea level rise are partially neutralized along the Lower Sacramento River near the Hood study area due to the planned system-wide improvements of widening both the Sacramento and Yolo Bypasses and their associated weirs. The said enhancements to the weir and bypass systems will shunt or divert greater amounts of water from entering the Lower Sacramento River downstream of the American River during high water stage conditions. The value of reducing flood stages in the Lower Sacramento River

system by widening the Sacramento Weir and Yolo Bypass system(s) is briefly discussed above in Section 1.7.2 and shown in Figure 1-4.

3.2 Opportunities

Opportunities to address the problems discussed above are summarized below.

3.2.1 Reduce Flood Risks

The levees protecting the Hood study area do not meet FEMA accreditation and current engineering standards to achieve a 100-year level of flood protection. When a levee is accredited by FEMA, the levee system is certified to meet current engineering standards contained in 44 CFR §65.10. These standards include criteria for through- and underseepage, freeboard, stability, settlement, encroachments, interior drainage, and other operations and maintenance criteria. These standards and criteria help to reduce the overall probability of levee failure and to ensure that communities and areas located behind the accredited levee(s) are protected during high water events. Since flood risk is partially characterized by the probability of levee failure, improving levees up to FEMA standards can help to reduce flood risk, thereby reducing the potential for life loss and property damage. A discussion surrounding the potential for life loss and within the Hood study area is provided in the preceding Section 3.1.1.3. The potential for property damage within the Hood study area was evaluated as part of this study using updated inventories of structures, vehicles, agricultural crops, highways, and streets from the forthcoming 2022 CVFPP Update. These inventories were used in a flood damage analysis to quantify EAD for the Hood study area under existing and future conditions. These updated inventories are provided in Section 3.1.1.4, and results from the flood damage analysis are presented in Section 6.3.1.2 and further detailed in Appendix E.

Securing levee improvements to FEMA accreditation standards can also enhance the resiliency and reliability of the through-Delta water conveyance system and help to ensure that water is conveyed as needed to agricultural farmland within the Delta and through the Delta to the SWP and CVP export pumps in the south Delta. Once a levee is accredited, the designation is shown on FIRM maps and can result in areas being mapped out of SFHAs. This can subsequently result in lower NFIP insurance premium rates. FEMA accreditation could also substantially reduce premiums for a community, flood-risk based insurance program that may be applicable for the community of Hood and other nearby Delta Legacy Communities.

3.2.2 Agricultural Sustainability

Efforts to improve agricultural sustainability within the Delta, including the Hood study area, are outlined in the DPC's Land Use and Resource Management Plan (LURMP). The LURMP identifies methods of supporting the long-term viability of agriculture within the Delta region while being responsive to enhancing natural habitats and ecosystem restoration efforts by:

- Supporting the continued capability for agricultural operations to diversify and remain flexible to meet changing market demands and crop production technology.
- Promoting the ability for agriculture operations to change the crops or commodities produced to whatever is most economically viable at the time.
- Supporting the use of new crop production technologies that keep Delta agricultural operations competitive and economically sustainable.

The DSC's Delta Plan also identifies policies and recommendations which seek to maintain Delta agriculture as a primary land use, food source, key economic sector, and as a way of life for the community of Hood and for the Delta as a whole. The purpose of these policies and recommendations is to address the impacts to local agriculture from changing markets, water conveyance facilities, and changing water quality. A subset of these policies and recommendations include:

- Floodproofing the Delta, as far as feasible, mainly by improving existing levees
- Restricting urban development, while supporting farming and recreation
- Encouraging agritourism in and around legacy communities
- Promoting value-added crop processing

3.2.2.1 Agricultural Floodplain Ordinance Task Force

The Agricultural Floodplain Ordinance Task Force (AFOTF) is comprised of officials from FEMA, DWR, the CVFPB, RDs, levee districts, flood control agencies, counties, engineers, farmers, and non-governmental organizations. After forming in 2015, the AFOTF's goal was to develop administrative options of FEMA's NFIP to address sustainability of modern agriculture in deep floodplains. Administrative options were considered as they could be potentially implemented without changing law or regulation.

Administrative options to improve agricultural sustainability within the Sacramento Valley were summarized in a technical memorandum prepared in 2016. In total, the memorandum summarized nine recommendations which addressed how rules and practices could be modified to, "(1) reduce or remove elevation and floodproofing requirement s for new and substantially improved agricultural structures, and (2) reduce the cost of NFIP insurance premiums for agricultural structures with a federally backed mortgage to a more appropriate portion of the financial risk in the NFIP" (AFOTF, 2016). Further details and recommendations developed by the AFOTF are highlighted as item No. 9 in supporting Appendix H - Identification of Non-Structural Measures for the Communities of Hood, Courtland, Locke, East Walnut Grove, West Walnut Grove & Ryde, and the City of Isleton.

3.2.3 Potential Ecosystem Restoration Opportunities

Potential restoration opportunities adjacent to the Hood study area, some of which were previously identified in the Lower Sacramento-North Delta RFMP include:

1) Creating wetland habitat within areas used for borrow during levee improvements or construction, particularly lands already in State ownership on the southern portion of the study area (known as Hood Junction).
2) Enhancing existing freshwater marsh, riparian, and potentially tidal marsh habitat along the southern end of the study area could create connectivity with multiple areas, including habitat improvements planned for Courtland and East Walnut Grove/Locke, and also provide a continuous habitat corridor connecting backwater areas on the east study area boundary to the existing Stone Lakes NWR, Snodgrass Slough and Cosumnes River Preserve.
3) Enhancing or creating additional Shaded Riverine Aquatic (SRA) habitat along the Sacramento River in connection with addressing erosion concerns and/or replenishing rocks slope protection at known erosion sites within the study area. These improvements also be combined with improvements identified for RM 35 to 46 of the Sacramento River, between the Hood and Courtland study area boundaries.
4) If borrow material is need for improving levees within the Hood study area, project proponents could work with other regional entities, and consider borrowing material from the Stone Lakes Wildlife Refuge (south and north of Hood-Franklin Road) that may create opportunities for enhancing tidal-influenced Delta habitat while also marginally reducing flood stages in the Franklin Pond areas east of Snodgrass Slough.

See Appendix D for additional information on ecosystem opportunities within or adjoining the study area.

3.2.4 Enhance Resiliency and Reliability of Through-Delta Conveyance

Levees within the study area are vulnerable to earthquakes, climate change and sea level rise, and most levee reaches do not meet current 100-year FEMA accreditation standards. These levees are used to protect both people and property and help convey water used to support the agricultural economy within the community of Hood and beyond, including south of Delta interests. SPFC levees in the North Delta are particularly critical since they assist with the conveyance of water to and downstream of the Delta Cross Channel, which augments the flow of the Sacramento River water through the Delta to the collective SWP and CVP export pumps in the south Delta near Tracy. In the event of a levee failure, sea water intrusion from the San Francisco Bay could enter areas that are critical to the distribution of fresh water, threatening water supply.

Over time, through the DWR Delta Levee Subventions local-state cost share program, the levees have been maintained throughout the Delta, and some have been enlarged or geometrically

improved to various Delta standard levels. Although not improving the Delta levees to modern 100-year FEMA accreditation criteria, continuing to maintain and improve levees within the Delta not only enhances flood protection for those people and properties within the study area and the Delta, but enhances the resiliency and reliability of through-Delta water conveyance. To promote this resiliency and reliability, levees both upstream and adjacent to the Delta Cross Channel along the Delta's freshwater corridor should be modernized to at least current 44 CFR §65.10 levee standards but also ultimately to a seismic standard to guard against earthquakes.

3.3 Constraints

3.3.1 Limited Local Funding Sources

LMAs partner with the State through the Delta Levee Subventions program to fund maintenance and repair of their flood control systems. However, the landscape by which levees are maintained by LMAs has drastically changed since levees were first constructed. Today, engineering design standards are more rigorous and environmental regulations are more stringent. In concert with deferred maintenance, these new requirements have increased costs to maintain the levee systems, and lack of funding is a common problem facing many LMAs. This is particularly notable in small communities with limited resources and reduced tax base. LMAs derive assessment valuation per acre for each parcel in proportion to benefits derived from reclamation operation. Notably, improvements on parcels including buildings are not included in the assessment calculation per provisions of the California Water Code. With residential properties often falling below an acre, there is thus a limitation on how much properties within these communities can be assessed (California Water Code § 50000 et seq.).

3.3.2 Proposition 218 Assessments and Other Funding Issues

Performing levee upgrades or improvements often requires a cost sharing between local and State agencies. State funding for investments in flood management systems has been largely supported by general obligation bonds (DWR, 2017a). Multiple State programs with the purpose of rehabilitating levees within the Delta have been established as a result of these bond funds, including the SCFRRP, the Delta Subventions Program and the Delta Levees Special Projects Program.

At the local level, LMAs rely primarily on taxes or special assessments on an acreage basis to make up their share of the funding for flood control projects. In 1996, California voters passed Proposition 218, the so-called "Right to Vote on Taxes Act." Proposition 218 amended the California Constitution by adding procedural and substantive requirements that must be met prior to levying new assessments (California Special Districts Association, 2013). As a result, all new assessments that are used for flood management must be voter approved. This directly impacts a LMA's ability to raise funding for local flood management projects, and without a local funding source, LMAs are unable to partner in cost-sharing programs through the State.

Direct reclamation district assessments to homeowners are constrained by the California Water Code, and are approximately $25 per home, annually, in the nearby downstream community of Courtland. This is an order of magnitude lower than average assessments for flood protection in nearby urban areas (for comparison, Sacramento Flood Control Agency's assessment for a residential property located behind levees in Sacramento is over $250 annually, excluding costs for applicable flood insurance).

For large repair and improvement projects, like what may be proposed in this feasibility study, LMAs must access a line of credit to implement repairs, but then substantial time may pass before cost-share reimbursements or assessment funds are available for repayment. Thus, large cash reserves are often needed in advance of securing project funds for the State or other entities.

Another difficulty in funding repairs is that LMAs are responsible for mitigation costs associated with repairs and maintenance. These cost increase over time, especially as offsite mitigation opportunities become limited and are a requirement under State cost-share programs.

In addition to assessing properties within the Hood study area for levee remediation repairs and improvements, said improvements and additional infrastructure may require additional O&M funds, and thus additional Proposition 218 Assessments may be required to address the incremental increases in O&M costs for new infrastructure such as a new cross levee.

3.3.3 Existing Delta Levee Standards

There are three agricultural levee standards that are widely used within the Delta: Hazard Mitigation Plan (HMP), Public Law (PL) 84-99, and the DWR Bulletin 192-82. These standards are summarized below in Figure 3-5 (DWR, 2019). The HMP levee configuration is widely used in the Delta on non-SPFC levees and is regarded as providing the minimal level of flood protection that is required for federal disaster assistance eligibility.

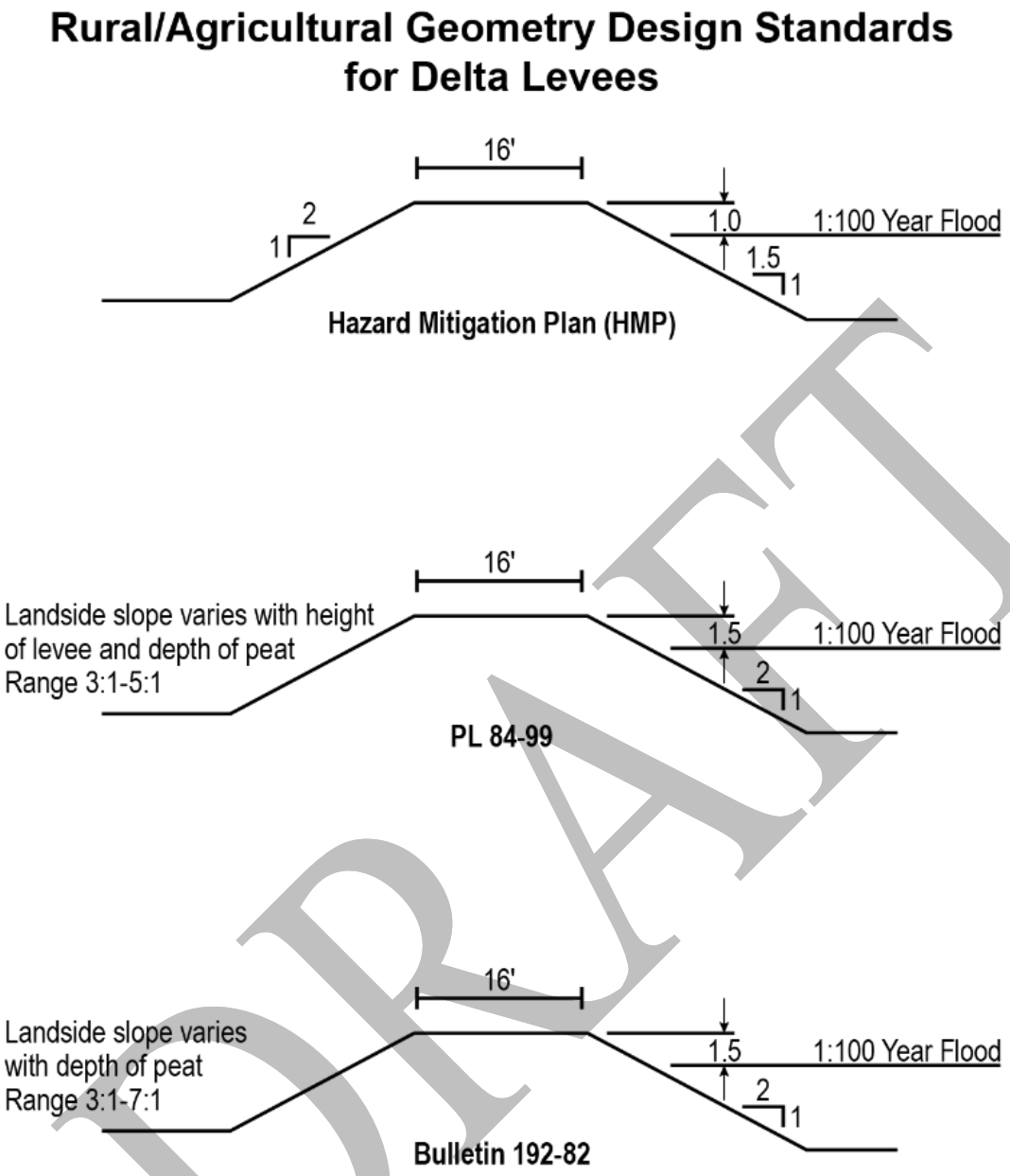


Figure 3-5. Rural Agricultural Levee Geometry Design Standards for Delta Levees

PL 84-99 guidance provides for somewhat better flood protection than the HMP standard, however it does not provide adequate protection from more extreme floods and earthquakes and does not provide a basis for adaption should sea level rise at an enhanced rate. The DWR Bulletin 192-82 standard is similar to the PL 84-99 criteria, except that it is designed relative to a one in three-hundred-year flood event (0.33% annual chance of flooding).

The three Delta levee standards mentioned above are focused on protecting agricultural portions of the Delta and fall substantially short of the FEMA accreditation standards for meeting a 100-year level of flood protection pursuant to in 44 CFR §65.10 generally used for urban levees (Figure 3-6). The economic sustainability of the Delta Legacy Communities cannot be assured when applying the lower agricultural levee standards previously established for the Delta.

Urban Geometry Design Standards for Delta Levees

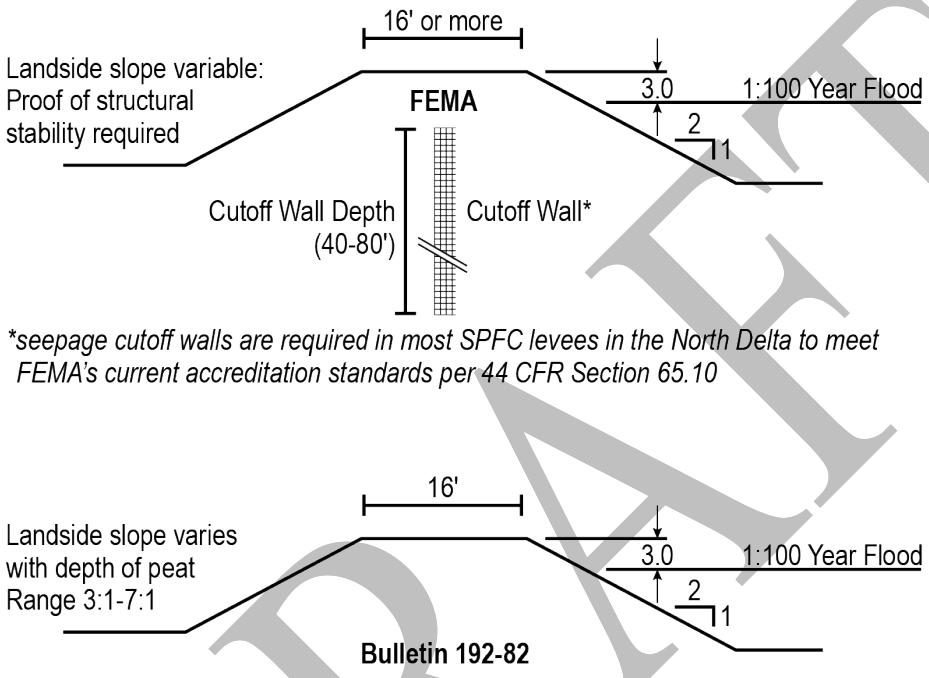


Figure 3-6. Urban Geometry Design Standards for Delta Levees

Agricultural levees within the Delta and those offering protection to the Hood study area are largely improved to the PL 84-99 or Bulletin 192-82 geometry standards. However, FEMA accreditation requires levees to also meet USACE criteria contained in 44 CFR §65.10 generally used for urban levees, which goes beyond simple geometry standards. As previously discussed, this includes criteria for through and underseepage, stability, settlement, erosion, and other operations and maintenance criteria. Currently, very few Delta levees outside of urban areas meet the USACE criteria required for FEMA accreditation. Delta Plan.

If Hood hopes to be mapped by FEMA as Zone X (as they were before 2012 outside of the floodplain), the entire 5.85-mile perimeter levee system of the Hood study area may require certification or smaller segments, such as one fronting the community paired with a certifiable cross levee, must be collectively improved to obtain a 100-year level of flood protection pursuant to 44 CFR §65.10.

3.3.4 Delta Plan Land Use Constraints

As previously discussed in Section 2.1.3, the Delta Plan prescribes requirements for land use and floodproofing. However, there are a number of other requirements in the Delta Plan aimed at protecting, restoring, and enhancing the Delta which constrain development within the Delta Legacy Communities located in the Primary Zone of the Delta. Levee improvements made within the study area must be consistent with these Plan requirements, in addition to local ordinances or regulations. By prioritizing protection and enhancement of the Delta, the Delta Plan effectively restricts the loss of agricultural lands and/or the displacement of Delta Legacy Communities. This can limit structural levee remediations to more costly alternatives, such as cutoff walls, over less costly alternatives, such as seepage/stability berms, since these berms are constructed on the landside toe of the levee and often require a displacement of agricultural lands or structures with a setback of anywhere from 150 to 350 feet.

Additionally, the Delta Reform Act established a certification process for projects within and affecting the Delta. This requires any State or local agency proposing to undertake a "covered action" to submit to the DSC a written certification of consistency with detailed findings as to whether the covered action is consistent with the Delta Plan (California Water Code, § 85225). The project must not have significant adverse impacts on the achievement of the coequal goals or affect implementation of government-sponsored flood control programs to reduce risks to people and property in the Delta. Development of a consistency determination is usually prepared concurrently and alongside the regulatory documentation for a project, and thus represents a variable cost.

3.3.5 Biological Constraints

As described in Section 2.1.7, the study area contains sensitive vegetation communities and habitat for several special-status species. Project activities that have the potential to affect these sensitive resources will require additional studies and environmental permits, prior to project implementation.

Major biological constraints to projects in the study area include limited work windows in the three-month period of August 1 through October 31 to perform any in-water work below the ordinary high-water line due to restrictions tied to the presence of several special status and endangered species within the Delta. Repairs of waterside erosion sites have been deferred around Hood due to the permitting difficulty of completing these projects. There is also significant difficulty in obtaining space for mitigation for any impacts to existing vegetation along the levees. Many past projects in the study area attempted to be "self-mitigating" but this can only occur where the space and opportunity exist on a project site. There are limited (or no) mitigation credits remaining to purchase for SRA impacts in the area.

Any levee improvement project will need to consider biological impacts and resulting mitigation measures. See Appendix B for additional information on biological resources within the study

area. It is hoped that a programmatic biological mitigation program can be established leading to a practical and effective program to repair and strengthen the levees surrounding the community of Hood, and possibly other neighboring Delta Legacy Communities as well.

3.3.6 Cultural Resources Constraints

As described in Section 2.1.8, a total of 16 cultural resources were identified during the records search and from information provided by Sacramento County, but only two have been formally evaluated for their eligibility for listing in either the NRHP or CRHR. Based on existing information, two additional resources may be eligible for listing. However, before implementation of any project activities, a smaller area of potential effect (APE) would need to be defined and any resources within the APE would be formally evaluated for their cultural or historical significance during the project's California Environmental Quality Act (CEQA)/National Environmental Protection Act (NEPA) permitting process. This evaluation involves consultation with interested Tribes/tribal organizations and consultation under Section 106 of the Historic Preservation Act (with a concurrence from the State Office of Historic Preservation).

If any significant resources are determined to likely be affected by project construction, then proper treatment of the resource would be determined. Since one form of treatment for cultural resources is avoidance, this could represent a constraint for implementation of a project element. Even if resources are not avoided and the project moves forward for construction, a cost would be incurred during excavation, archiving, or development of interpretive facilities and information, required to mitigate effects to the cultural resource. Additionally, there are documented cultural resources within the larger study area, but outside the community of Hood and the presence of these resources would make relocation of all or parts of the town difficult, if not impossible.

See Appendix C for additional information regarding known and potential cultural resources within the project study area of Hood and how they need to be addressed prior to any ground disturbing activities. Appendix C also further describes National Heritage Designation Area within the study area and greater Delta.

3.3.7 Additional Regulatory Considerations

A permit under Section 14 of the Rivers and Harbors Appropriation Act of 1899, as amended, and codified in 33 U.S. Code 408 (Section 408 Permission) is required for permanent or temporary alteration or use of facilities that were built as part of a USACE civil works project (the Sacramento-San Joaquin Flood Control Project, along the Sacramento River portion of the study area). A Section 408 permission is generally needed for any work on SPFC levees and within easements generally within 15 to 20 feet of the landward levee toe, unless the work is classified as maintenance. However, maintenance and repair activities conducted by LMAs on

SPFC levees for which they have O&M responsibilities that do not require Section 408 permission may still require coordination or concurrence from the USACE Sacramento District.

Additionally, a permit under Section 10 of the Rivers and Harbors Act of 1899 (applicable to construction of any structure in or over any navigable water of the U.S.) may be needed for work along the Sacramento River, depending on the nature of project implementation. The law applies to any dredging or disposal of dredged materials, excavation, filling, rechannelization, or any other modification of a Navigable Waters of the U.S., particularly any navigable waters in the North Delta.

4. Plan Formulation

The problems and opportunities described above led to the formulation of the study goals (Section 1) and planning objectives, detailed in this Section. These goals and objectives provide solutions for Hood while capitalizing on opportunities to maximize multi-benefit projects and investment efficiency. Additionally, these goals and objectives, as well as stakeholder input, are utilized to measure how well plan flood risk reduction management actions meet the objectives of this study.

4.1 Planning Objectives

To achieve the study goal of modernizing SPFC levees to meet FEMA 100-year certification criteria, several broad objectives were identified as a framework for developing the preliminary suite of flood risk reduction elements and ultimately the final array of flood risk reduction management actions for Hood. In prioritized order, these include:

- Reducing risk to life
- Reducing risk to property damage
- Reducing probability of levee failure
- Limitation of high insurance premiums
- Improved flood preparedness and response
- Enhance resiliency and reliability of through-Delta water conveyance
- Foster environmental stewardship

These objectives help to address the problems described in the preceding Section and are aligned with the State's interest as expressed within the framework of the CVFPP, the 2014 RFMP, SCFRRP, and the goals of other Delta agencies, where possible.

4.1.1 Reducing Risk to Life

Reducing risk to life is the first objective used to meet the goal of achieving 100-year flood protection for the Hood study area. Life loss is the most devastating consequence of flooding. Since the mid-1800s, catastrophic flooding and life loss has been documented in California, particularly in the Central Valley. Deficiencies in the flood control system, fast-moving floodwaters, deep floodplains, and lack of preparedness and emergency response procedures have all contributed to this life loss. Most of these are of similar concern to the Hood study area.

The risk of life loss is of greatest concern for the Hood study area within the densely populated community of Hood. Should a levee breach occur along the Sacramento River immediately

upstream and fronting the community, floodwaters would likely inundate the community at high velocities and depths, leaving little time to respond or evacuate, resulting in substantial life loss. Section 3.1.1.5, including Figure 3-1, provide in detail how and where the greatest risk of life loss exists to the community of Hood and the greater study area encompassed by a portion of DWR MA 9.

Reducing risk to life is achieved by reducing flood risk. As described earlier, flood risk within the community and the larger study area is of concern and is based on the probability of flooding and the consequences of levee failure. By implementing flood risk reduction measures which reduce overall flood risk, either by reducing the probability of flooding or reducing the consequences of levee failure, risk of life loss is similarly reduced.

4.1.2 Reducing Risk to Property Damage

Property damage is another significant consequence of flooding. According to USACE, as documented in the 2017 CVFPP Update, flooding in 1986 and 1997 together caused over $1B in damage to the areas protected by the SRFCP. Within the SAC 44 and SAC 45 impact areas, inclusive of the community of Hood but also including the larger area of MA 9 which is in part protected by levees within the Hood study area, the value of structures, vehicles, highways and streets, and agricultural crops total over $9.49B in 2020 dollars. These inventories and their associated values for the Hood study area are provided in Section 3.1.1.4, including baseline values of EAD under existing conditions and future conditions with climate change adjustments (Table 3-7). A levee failure could result in substantial property damage in Hood and the larger study area, as well as the immediate areas outside of the Hood study area including inundation of Interstate 5 and portions of Elk Grove located east of Hood. Additionally, damage to property as a result of flooding could also have a ripple effect within the community, with economic impacts sustained due to damages to businesses, homes, agricultural operations, and disruption to the transportation corridor of State Scenic Route 160. This study prioritizes flood risk reduction management actions which reduce the risk to property damage and to achieve the goal of 100-year flood protection for the study area. The net reductions in EAD values for several structural-based management actions developed specifically for the subject Hood study area are provided in Section 6.3.1.2 - Reducing Risk to Property Damage, with Table 6-6 and Table 6-7 providing a summary comparison of net EAD reductions for current baseline conditions and future conditions with climate change adjustments.

4.1.3 Reducing Probability of Levee Failure

Since flood risk is defined as the product of probability of levee failure and the consequences of levee failure, reducing the probability of levee failure is integral to reducing flood risk and thus achieving the goal of 100-year flood protection.

Reducing the probability of levee failure for the Hood study area can be accomplished by implementing a number of measures:

- Repairing known deficiencies in the Sacramento River east/left bank levee system, including but not limited to repairing known FSRP critical and serious sites in the Hood study area and in RD 744, all located within DWR MA 9
- Addressing erosion concerns identified by GEI Consultants along the non-SPFC levees/former railroad embankments
- While repairing known deficiencies also strengthen in-place the existing perimeter levee system(s) to offer improved levels of protection to the community
- Conduct annual inspections of the levee system and correct any known deficiencies including non-compliant encroachments that may pose a threat to the structural integrity of the levee system
- Enhance existing flood warning, preparedness, flood-fight and response systems and practices as identified in the Flood ESPs developed by Sacramento County
- Secure 100-year FEMA Certification for the community of Hood and possibly for the entire Hood project study area pursuant to 44 CFR §65.10

4.1.4 Limit of High Insurance Premiums

As previously noted in Section 3.1.2, of the estimated 117 structures in Hood valued at an estimated $42.6M, there are only 34 NFIP polices (valued at $350,000 maximum per policy including of structure contents, presently capped at $250,000/structure and $100,000 for structure contents) providing less than $12M[7] in coverage. Rising insurance premiums over the last decade are a contributing factor to this differential and are an increasing problem within the study area. Lowering flood risks, and thus increasing flood protection, is a key action that can be taken to reduce flood insurance costs each year under the existing NFIP or under a new community-based flood insurance program.

4.1.5 Improved Flood Preparedness and Response

Improved flood preparedness and response is another objective used to complement the goal of 100-year flood protection. Improved preparedness and emergency response can limit the loss of life and property damage as a result of flooding by developing the framework needed to enhance the understanding of local flood risks, foster communication, and to promote public awareness of flood risks, thus reducing flood risk.

4.1.6 Enhancing Resiliency and Reliability of Through-Delta Water Conveyance

As previously noted, the vulnerability of levees protecting through-Delta water conveyance is a problem within the study area. Levees within the study area are vulnerable to through seepage

[7] These estimates are sourced from the FEMA Open Source policy database.

and underseepage, earthquakes, climate change and sea level rise, and in many places, do not meet current engineering and FEMA accreditation standards. These levees are used to protect both people and property and support the agricultural economy within the community of Hood and the adjoining project study area. SPFC levees in the North Delta are particularly critical since they convey water to the Delta Cross Channel, which augments the flow of the Sacramento River water through the Delta to the collective SWP and CVP export pumps in the south Delta near Tracy. In the event of a levee failure, sea water intrusion from the San Francisco Bay could enter areas of the freshwater corridor that are critical to the distribution of fresh water, threatening water supply to areas south of the Delta.

Continuing to improve levees within the Delta along the freshwater corridor not only enhances flood protection for those people and properties within the study area and the Delta, but it also contains the multi-benefit of enhancing the resiliency and reliability of through-Delta water conveyance. The existing through-Delta water conveyance system conveying water to the collective SWP and CVP export pumps in the south Delta provides water to over 3 million acres of agricultural lands and to over 25M residences south of the Delta.

4.1.7 Environmental Stewardship and Multi-Benefits

In 2010, DWR formally adopted an Environmental Stewardship Policy to advance a department-wide "Total Resource Management" approach to planning and design of projects. By building environmental benefits into projects on a meaningful scale, DWR supports sustainability from an engineering, economic, social, and environmental perspective. The CVFPP includes the supporting goal of integrating recovery and restoration of key physical processes, self-sustaining ecological functions, native habitats, and species into flood management improvements (DWR, 2017c). Additionally, the SCFRRP increases the State cost-share for projects which advance multi-benefit flood protection for small communities (protection of State facilities, contribution to the State's sustainability objectives, water supply, and open space and recreation) (DWR, 2017e).

Waterside levee repairs such as known erosion concerns can provide opportunities to introduce more SRA habitat valuable to fisheries and other aquatic species.

4.2 Future Baseline Conditions

The future baseline conditions provide the basis to formulating flood risk reduction management actions and assessing their benefits and impacts. Since impact assessment is the basis for plan evaluation, comparison, and selection, clear definition and full documentation of future baseline conditions are essential (DWR, 2014). These conditions are influenced by climate change, sea level rise, development, and land subsidence, and are summarized as the future without project condition. Future baseline conditions in the Lower Sacramento River also consider system-wide benefits that are being implemented upstream in the Sacramento and Yolo Bypass/Weirs that

have the added benefit of diverting more flood waters into the bypasses and lowering flood stages in the Lower Sacramento River in the North Delta downstream of Sacramento.

By incorporating EAD assessments for existing baseline conditions (consistent with the values and methodologies utilized by DWR for the 2022 CVFPP update) and comparing them to future baseline conditions (consistent with the adjustments for climate change and sea level rise utilized by DWR for the 2017 CVFPP update) this feasibility study was able to compare net reductions in EAD values for various management actions under existing and future conditions. Appendix E provides more details on the EAD methodologies, net reductions in EAD values for various levels of flood risk reductions measures, and findings based on existing conditions and future conditions that include adjustments for climate change and sea level rise.

4.2.1 Climate Change and Sea Level Rise

Climate change is expected to significantly affect California's water resources in the form of changes to the hydrologic regime, sea level rise, and warmer temperatures. Although sea level rise is a minor issue in the North Delta, Californians will face a higher flood risk due to more rain and decreasing snowfall. Snow will melt faster and earlier in the season meaning more frequent flooding and less opportunity for natural storage in the mountains and will result in higher flood flows in the Delta. Reservoirs may fill earlier due to changing runoff patterns and operators will need to release water earlier in the season to make space for flood storage. Additionally, sea level rise combined with climate change is expected to increase the 100-year flood stage in the Sacramento River between Elk Slough and Sutter Slough by nearly 1.11 feet on average, with the 200-year flood stage along the same extent increased by 0.60 feet on average. Increased flows and flood stages can not only result in more frequent flooding, which can lead to levee failure through overtopping, but can also result in greater stresses to the levee system as levees are frequently loaded with water for longer durations of time and via other mechanisms resulting from increased flow/flood stages (e.g., erosion). However, note that within the Hood study area, the effects of climate change rise are less pronounced along the mainstem of the Sacramento River, as a result of improvements in the upstream/adjacent bypass systems.

Climate change and sea level rise also have the potential to impact the estimates of flood damage, or EAD, under future conditions within the Hood study area. The effects of inland climate change projections and sea level rise were incorporated into the EAD analyses performed as part of this study using a median estimate consistent with the methods and results of the 2017 CVFPP Update. These effects are described in greater detail in Section 6.3.1.2 and a full inventory of potential EAD values for the Hood study area under future conditions is provided in Appendix E.

4.2.2 Development in the Floodplain

Improvement of levees can induce population growth and encourage development within the floodplain. This is true for all areas within the Central Valley, except for those areas within the

Primary Zone of the Legal Delta. As noted in previous Sections, development within the Primary Zone of the Delta, including the Hood study area, is constrained by the Delta Plan and Special Planning Area (SPA) ordinances which limit new residential, commercial, and industrial development. As such, future development within the study area is not expected to be substantial as a result of either removing the entire community of Hood and/or large parts of the Hood Study Area from the current (2012) FEMA 100-year floodplain with a BFE of 18 feet NAVD 88.

4.2.3 Land Subsidence in the Delta

While land subsidence is prevalent throughout large portions of the Delta due to underlying peat soils and land use practices, the effects are most pronounced within the central Delta and are least pronounced along the perimeter of the legal Delta. As such, the Hood study area, particularly underlying and adjacent to most of its perimeter levee system, is not subject to notable subsidence.

Substantial land subsidence in the study area, particularly along the alignment of the SPFC levee system along the left bank of the Sacramento River, is not expected in the future.

4.3 Alignment with Goals and Policies of Delta Agencies

Actions required to meet the objectives outlined above need to be in alignment with goals and policies of other requirements. Projects and management actions should be qualitatively measured against the requirements of various Delta planning and regulatory agencies. A multitude of broad policies and goals are described in various planning documents drafted by the DPC, DSC, and Conservancy and an exhaustive matrix of potentially relevant Delta goals and policies is included as Appendix G.

4.3.1.1 Delta Protection Commission

DPC's LURMP includes several broad goals regarding land use and sustainability in the Delta. Specific to the study area is a goal to direct new non-agriculturally oriented non-farmworker residential development within the existing unincorporated Delta towns (Walnut Grove, Clarksburg, Courtland, *Hood*, Locke, and Ryde), to help encourage a critical mass of farms, agriculturally-related businesses and supporting infrastructure to ensure the economic vitality of agriculture within the Delta. Improved flood protection would indirectly contribute to this goal. Further LURMP goals are summarized in Appendix G.

DPC's Economic Sustainability Plan does not include a detailed evaluation of Hood. However, the report mentions that all Delta levees should be brought to the HMP standard, if not to the more stringent PL 84-99 Standard. Many broad policies generally applicable to the study area are summarized in Appendix G.

4.3.1.2 Delta Stewardship Council

The Delta Reform Act (California Water Code §85306) requires that the DSC, in consultation with the CVFPB, recommend Delta Plan priorities for State investments in levee operations, maintenance, and improvements in the Delta, including project levees that are part of the SPFC and non-SPFC levees that are constructed and maintained by LMAs.

The Delta Plan outlines a process to prioritize O&M State investments in Delta levees, O&M and levee improvements, and sets interim priorities to guide budget and funding for levee improvements, as detailed in Table 4-1. Levee improvements in the Delta should attempt to be responsive to the 3 x 3 goals established by the DSC in the Delta Plan outlined below in Table 4-1.

Table 4-1. 3x3 Goals of the DSC for State Investment in Delta Integrated Flood Management.

Goals	Localized Network	Levee Network	Ecosystem Conservation
1	Protect existing urban and adjacent areas by providing 200-year flood protection.	Protect water quality and water supply conveyance in the Delta, especially levees that protect freshwater aqueducts and the primary channels that carry fresh water through the Delta.	Protect existing and provide for a net increase in channel-margin habitat.
2	Protect small communities and critical infrastructure of statewide importance (located outside of urban areas).	Protect floodwater conveyance in and through the Delta to a level consistent with the State Plan of Flood Control for project levees.	Protect existing and provide for net enhancement of the floodplain habitat.
3	Protect agriculture and local working landscapes.	Protect cultural, historic, aesthetic, and recreational resources (Delta as Place).	Protect existing and provide for net enhancement of wetlands.

As described previously, the DSC also developed an overall DLIS, that: 1) quantifies flood risk, by considering the threats to Delta levees and the assets protected by these levees and 2) prioritizes investments for levee repairs, improvements, and rehabilitation, as Very High, High, or Other Priority. Generally, the priorities address the relationship between the flood risk of each island or tract, and the number of State interests that island's or tract's assets encompass (people, property, ecosystem, water supply, and Delta as place). The entirety of the Hood study area is currently designated as "Very High" under the DLIS prioritization. This prioritization is largely based upon levee geometry and availability of freeboard to the noted project area in comparison to other tracts within the Delta as well as protecting the large areas east of Hood (including portions of Elk Grove, Point Pleasant, and Interstate 5). Geotechnical evaluations by DWR under the NULE program and FSRP, including recent explorations conducted in 2019 specifically for

this study, collectively confirm there are significant deficiencies, with known seepage concerns that are considered critical and serious. The noted deficiencies warrant immediate attention and repair to reduce the risk of flooding to the Delta Legacy Community of Hood.

The Delta Plan includes many performance measures (including net reductions in EAD values) focused on reducing flood damages and loss of life, multi-hazard coordination, levee improvements, water supply reliability, sustainability, and recreation and economic opportunities associated with the Delta Legacy Communities. Additional Delta Plan goals generally applicable to the study area are summarized in Appendix G.

4.3.1.3 Delta Conservancy

The Conservancy's Delta Public Lands Strategy includes integrated conservation for publicly funded lands in the Delta and identifies small areas in and adjacent to the study area for implementation of SRA habitat on levees within the study area and dryland habitat, and "urban greening" around the developed area of Hood. Additional Conservancy goals generally applicable to the study area are summarized in Appendix G.

5. Preliminary Suite of Flood Risk Reduction Elements

The following Section details the structural and non-structural preliminary suite of flood risk reduction elements considered as part of this feasibility study. These elements will be used to form management actions which can be implemented by the community of Hood as funding sources are identified and become available. Potential multi-objective components which could be incorporated as part of the structural elements and non-structural measures are also discussed.

5.1 Structural Elements

Structural elements are those that repair or improve the existing levee/flood control system as it exists today. Structural elements considered in this feasibility study include fix/improve-in-place levee repairs, prioritization of DWR FSRP critical and serious sites in DWR MA 9 and strengthening the existing levee system to meet the objectives outlined in Section 4.1.

Structural elements discussed in this Section propose various remediations, such as cutoff walls, stability berms, combination seepage/stability berms, and rock slope protection (RSP), to address levee vulnerabilities within the study area. New cross levees are also presented as measures to improve the flood control system in the Hood study area. A brief discussion of these remediations is provided below. The proposed remediations are feasibility level, developed using limited available data, and new, but limited geotechnical data and analyses. Additional geotechnical explorations and analysis are recommended to refine these remediations, and to ensure they are designed to FEMA criteria in an effort to secure FEMA accreditation for the community of Hood and the larger study area in the future. New cross levees are also proposed to improve the flood control system in the Hood study area.

Cutoff Wall: A cutoff wall is a vertical trench in the levee filled with a slurry material that becomes nearly impermeable. It is used to reduce permeability through and under levee systems that may be susceptible to seepage. Cutoff walls are designed and installed to depths necessary to minimize through seepage and underseepage vulnerabilities. One advantage to this method is that it stabilizes the levee by constructing a barrier at either the levee centerline or near the levee waterside hinge-point and does not require the displacement/reclamation of land on the landside toe, as required by other methods to address seepage as described below. A typical cutoff wall is shown in Figure 5-1. For this study a levee degrade of one half the height of the levee system was assumed to accommodate the installation of the cutoff walls. Subsequent analyses prior to implementation may indicate shorter degrades may be possible, resulting in less ground disturbance, but leading to higher cutoff wall heights than reported herein.

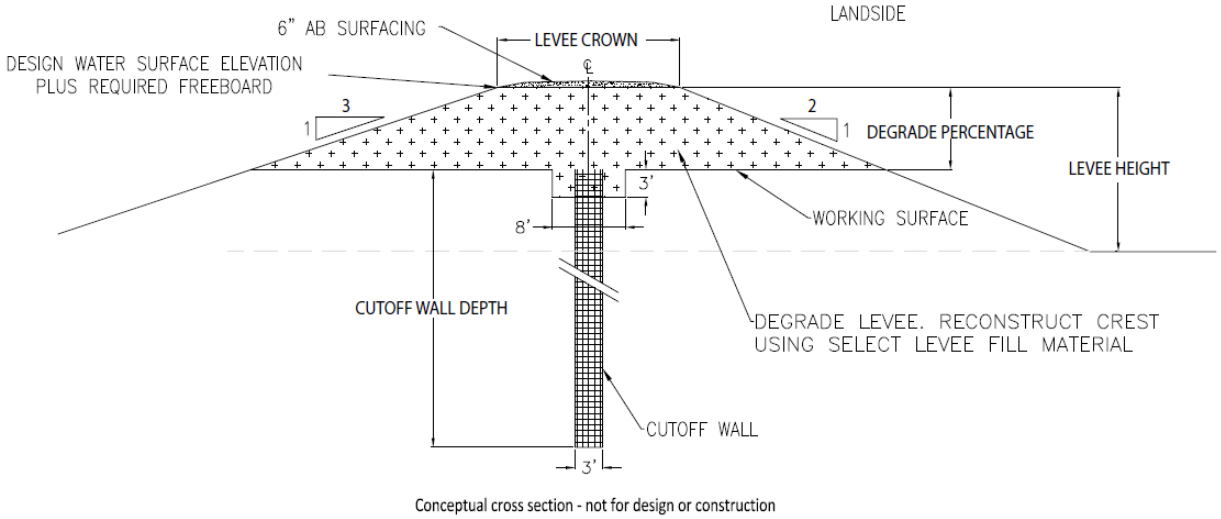


Figure 5-1. Typical Cutoff Wall.

Stability Berm: Stability berms are earthen berms constructed on the levee landside slope to address through seepage and stability vulnerabilities. When a levee is only vulnerable to through seepage, a stability berm can be a more cost-effective alternative to a cutoff wall. However, this remediation requires construction on the levee landside and results in a loss of usable land. The overall width and depth of the stability berm depends upon the degree to which the levee is vulnerable to stability. A typical stability berm is shown in Figure 5-2.

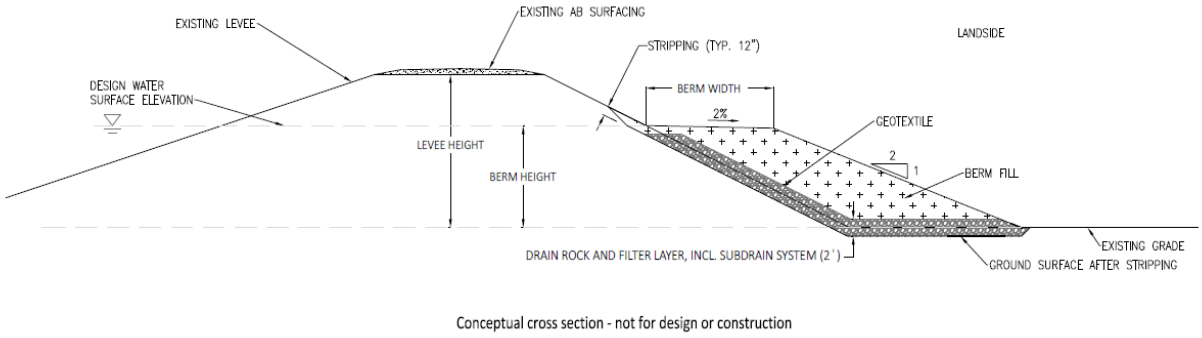


Figure 5-2. Typical Stability Berm.

Combination Seepage and Stability Berm: Combination seepage and stability berms are constructed to address levees which have both underseepage and through seepage vulnerabilities. A typical combination seepage and stability berm is shown in Figure 5-3.

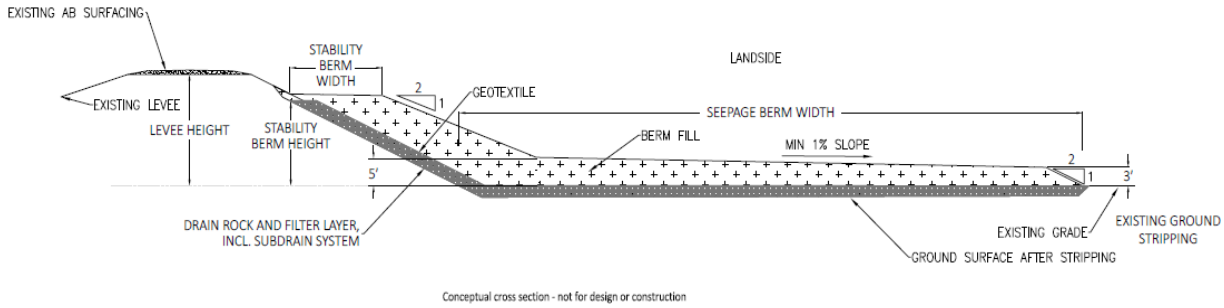


Figure 5-3. Typical Combination Seepage and Stability Berm.

Rock Slope Protection: RSP is used to address erosion through the placement of riprap on the waterside slope of the levee. A conceptual cross section for the proposed RSP is provided in Figure 5-4.

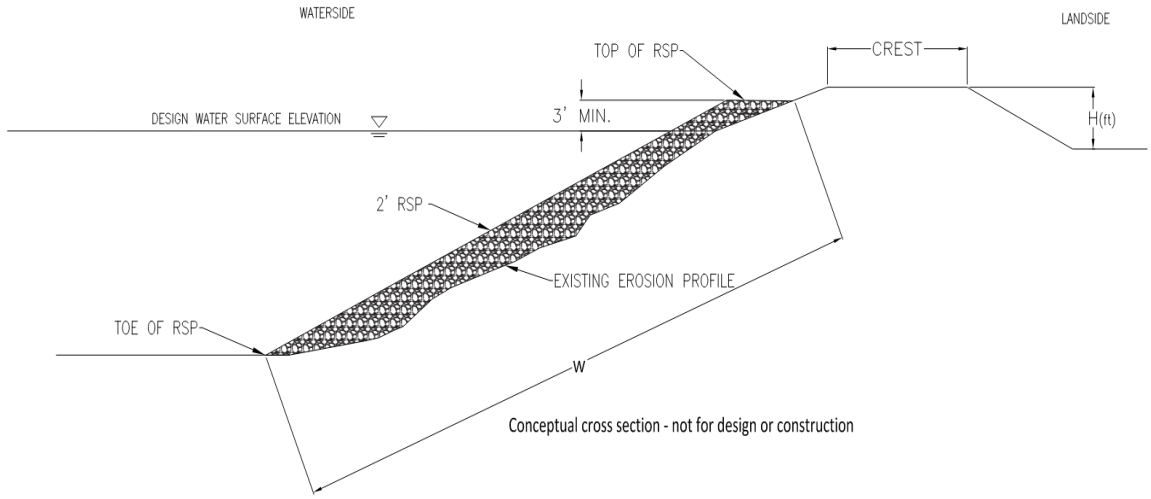


Figure 5-4. Typical RSP Detail to Address Erosion Concerns Within the Study Area

5.1.1 Previously Identified Repair Needs

A number of studies and evaluations have identified various issues within the study area associated with through seepage, underseepage, stability, and erosion. The following is a summary of these studies and evaluations.

5.1.1.1 DWR FSRP Critical and Serious Sites

DWR FSRP critical and serious sites are thought to pose the greatest risk to the community of Hood within DWR's MA 9 between Freeport and Hood. This flood risk reduction element repairs and strengthens-in-place these known critical and serious sites as documented in the DWR FSRP to current FEMA standards.

Within the context of the FSRP, critical and serious sites are generally defined as follows (URS, 2013a):

Critical Site: If not repaired, the site presents a significant risk of failure or would impede flood control function or flood fight activities during the next high-water event.

Serious Site: If not repaired in a timely manner, the site has the potential to become critical during the next high-water event.

As shown in Figure 5-5, there are two critical seepage sites and one serious seepage site within the Hood study area, with another critical seepage site located just south of Hood (four sites in total). Beyond the boundaries of the study area to the north and upstream of Hood, but within the SAC 44 impact area and MA 9, are an additional three serious seepage sites and two critical seepage sites (five sites in total). All nine of the combined FSRP critical and serious seepage sites are located along the left bank of the Sacramento River within DWR MA 9, along NULE Segment 106, with eight of the sites located upstream from the community of Hood. These sites are further characterized in Table 5-1 (FSRP sites located within/just south of the Hood study area) and Table 5-2 (FSRP sites located north of the Hood Study area) below.

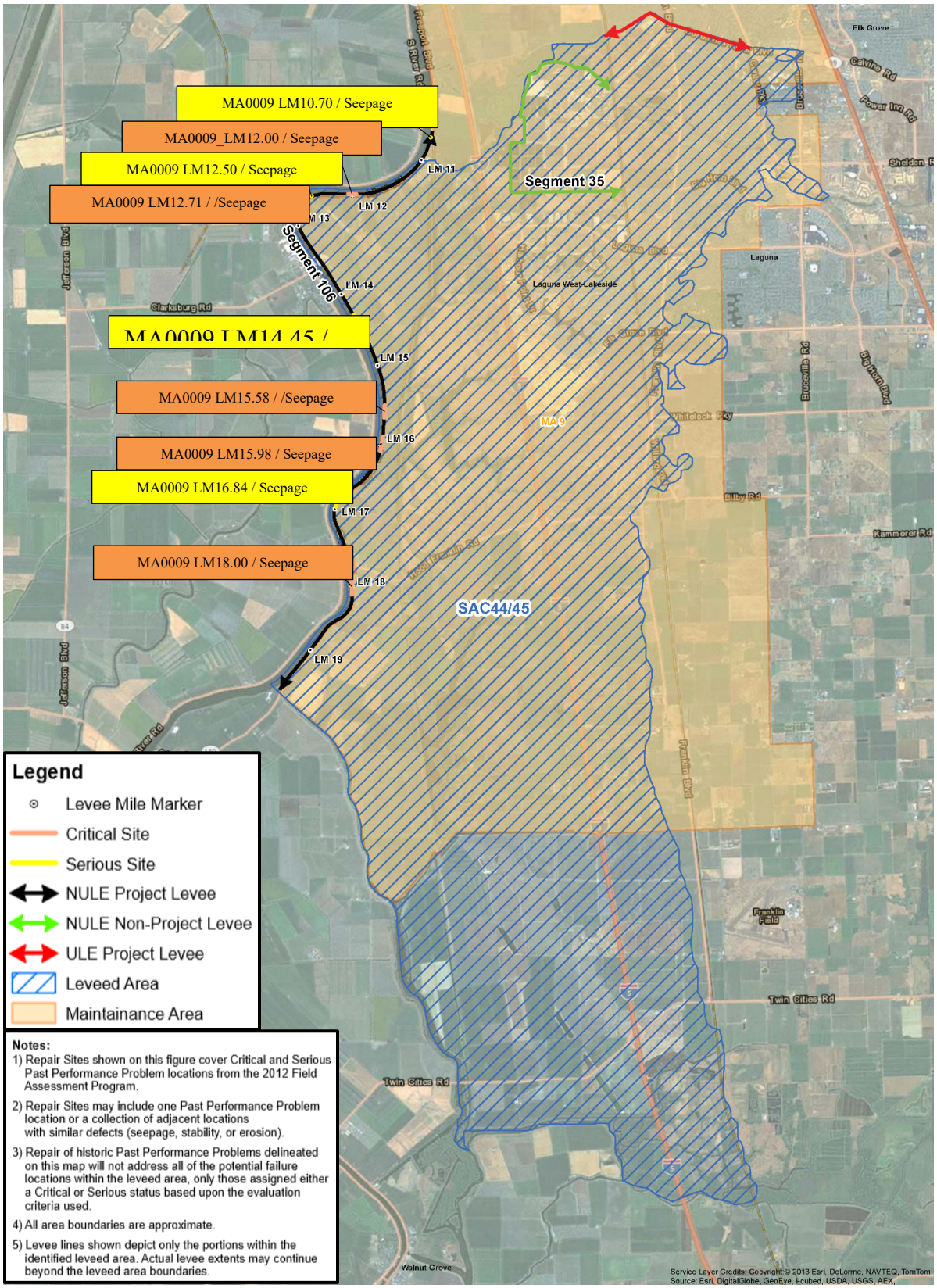


Figure 5-5. Critical and Serious Seepage Sites within SAC 44 and SAC 45 Impact Areas (URS, 2013a), updated in 2020 by Sacramento County

Table 5-1. FSRP Critical and Serious Seepage Sites and Proposed Remediations Within/Just South of the Hood Study Area (URS, 2013a)

Segment Location	Failure Mode	Site Status	Approximate Levee Mile Location	Length (ft.)	Supporting Evidence	Proposed Remediation[1]	Estimated Cost [2]
Left Bank Sacramento River, NULE Segment 106 (SPFC Levee)	Seepage	Critical	15.50 to 15.67	900	Poor levee material, pervasive hydrophilic vegetation, rodent burrow holes, minor toe cut. Sack rings at LM 15.64. Past boils 1980, 1997; flood fight 1997.	68-ft.-wide 11-ft-tall combination drained seepage/stability berm	$1,380,000
	Seepage	Critical	15.89 to 16.07	1,100	Poor levee material, pervasive hydrophilic vegetation, rodent activity, slope slough and slump, pipe penetration. Past boils 1997, 1988; flood fight 1986 likely, 1997 sack ring; slope sloughing/slumping 1998 (and current).	64-ft.-wide 11-ft-tall combination drained seepage/stability berm	$2,040,000
	Seepage	Serious	16.70 to 16.97	1,600	Poor levee material, rodent activity, pipe penetration. 1993 USACE report calls for repair of this reach from LM 16 to 18.2. Past boils 1964, 1986, 1997, 2006; flood fight 1986 likely, 1997 sack ring; slope sloughing/slumping in 1995.	64-ft. wide 11 ft. tall combination drained seepage/stability berm	$2,100,000
	Seepage	Critical	17.86 to 18.16	1,700	Poor levee material, landside slope slump and shallow slough, rodent burrow holes. 1993 USACE report calls for repair of this reach from LM 16 to 18.2. Past boils 1986, 1997; flood fight 1986 likely.	64-ft.-wide. 11-ft.-tall combination drained seepage/stability berm	$2,220,000

[1] As proposed by DWR in the 2013 FSRP Pre-Feasibility Report for Leveed Area SAC44/45: Stone Lake and Hood
[2] As detailed in the 2013 FSRP Pre-Feasibility Report for Leveed Area SAC44/45: Stone Lake and Hood and escalated to July 2020 dollars

Table 5-2. FSRP Critical and Serious Seepage Sites and Proposed Remediations North of the Hood Study Area (URS, 2013a)

Segment Location	Failure Mode	Site Status	Approximate Levee Mile Location	Length (ft.)	Supporting Evidence	Proposed Remediation[3]	Estimated Cost [4]
Left Bank Sacramento River, NULE Segment 106 (SPFC Levee)	Seepage	Serious	10.68 to 10.72	250	Seepage and boil at landside toe, during 1981 and 1997. Site is serious because of recurrent boils not carrying material.	60-ft.-wide, 10-ft.-tall combination drained seepage/stability berm	$840,000
	Seepage	Critical	11.95 to 12.05	600	Past flood fights: 1986 likely; 1997 landside. Sack rings. 1993 USACE report calls for repair of this reach. This location was noted in 2008 MA9 interview as boil spot.	68-ft.-wide, 11-ft.-tall combination drained seepage/stability berm	$1,200,000
	Seepage	Serious	12.48 to 12.52	200	Boils noted in 1981, slope sloughing/slumping noted in 1996.	56-ft.-wide, 9-ft.-tall combination drained seepage/stability berm	$340,000
	Seepage	Critical	12.62 to 12.82	1,100	Poor levee material, pervasive hydrophytic vegetation. Past boils 1981, 1988; flood fight 1998; slope sloughing/slumping 1998.	52-ft.-wide 9-ft.-tall combination drained seepage/stability berm	$1,200,000
	Seepage	Serious	14.30 to 14.60	1,600	Poor levee material, pervasive hydrophytic vegetation, some rodent activities. 1993 USACE report calls for repair of this reach. Past boils 1986, 1997; flood fight 1986.	68-ft.-wide 11-ft.-tall combination drained seepage/stability berm	$2,340,000
Totals for MA9 FSRP Sites	Seepage	Critical & Serious	10.68 Thru 8.16	9,050	Previous poor levee performance dating back to 1964	Drained seepage /stability berms; but cut-off walls preferred	$13,660,000

[3] As proposed by DWR in the 2013 FSRP Pre-Feasibility Report for Leveed Area SAC44/45: Stone Lake and Hood
[4] As detailed in the 2013 DWR FSRP Pre-Feasibility Report for Leveed Area SAC44/45: Stone Lake and Hood and escalated to July 2020 dollars

This element addresses the critical and serious sites along the left bank of the Sacramento River in DWR MA 9 as proposed in the 2013 FSRP Pre-Feasibility Report for Leveed Area SAC44/45: Stone Lake and Hood (2013 FSRP Pre-Feasibility Report) (URS, 2013b). The remediations for the critical and serious seepage sites within SAC 44 and SAC 45 consist of combination seepage/stability berms as detailed in the 2013 FSRP Pre-Feasibility Report and summarized in Table 5-1.

5.1.1.2 Cross Levee North of Hood Paired with; Repair and Strengthen-in-Place MA 9 SPFC Levee Adjacent to Hood; and Repair/Strengthen Existing Non-SPFC Levees South of Hood (2012 CVFPP and 2014 RFMP Configuration)

As previously discussed, a breach on the levee immediately fronting the community poses great risk to Hood and the larger study area since a failure would likely result in significant property damage and life loss as a result of high floodwater depths and velocities and little time to evacuate. The community of Hood and the larger study area are also at risk of flooding from the north, which could result in flood depths upwards of 15 feet in the community of Hood and up to 26 feet in the larger study area.

This flood risk reduction element repairs and strengthens this portion of SPFC levee immediately adjacent to the community of Hood along the left bank of the Sacramento River (total of 0.25 miles) in DWR MA 9 in conjunction with a new cross levee north of Hood (total of 0.70 miles) to fend off floodwaters from the north and further reduce flood risk to the community of Hood. These repairs and improvements are also combined with repairing and strengthening the railroad embankment south of Hood (total of 0.65 miles). At this present time there are no remediation measures identified nor warranted for the former railroad embankment immediately east of Hood (non -SPFC Segment HDERR, sub-reach East RR-C). This cross levee system, including the adjoining levee system improvements, would be collectively improved to allow for FEMA accreditation pursuant to the standards contained in 44 CFR §65.10.

Improvement of the SPFC levees along the Sacramento River in MA 9 was investigated as part of the NULE Phase 1 study, as documented in the NULE GAR and in the 2012 CVFPP and 2014 RFMP, and as identified in DWR's 2013 FSRP critical and serious repair sites for MA 9. This feasibility study leverages data from the NULE Phase 1 and FSRP studies along with additional data from

CPTs collected in 2019 to develop two remedial alternatives for the levees located to the west and south of Hood, and to construct a new cross levee north of Hood. The new cross levee alignment previously identified within the 2012 CVFPP and the 2014 RFMP would likely be constructed with a 20 foot minimum crown width, 3H:1V landside and waterside slopes, and levee crest elevation of 28 feet, assuming design WSEL of 25 feet NAVD 88 and 3 feet of freeboard resulting from a levee breach upstream in the RD 744 portion of DWR MA 9 (Table 5-4). No repairs or improvements are proposed for the former railroad embankment immediately east of Hood, as this segment of levee system was not recently identified as vulnerable to

underseepage, through seepage, slope stability, erosion, or freeboard, based on the available data. Further explorations are recommended to confirm this segment of the perimeter levee system is not vulnerable to these failure modes.

Remediations for this element, and those discussed in subsequent sections below, were developed considering through seepage, underseepage, slope stability, erosion, and freeboard. Additional information regarding the data used to develop these remediations and how levee vulnerabilities were identified can be found in Appendices A-1 and A-2. Appendix A-1 is a comprehensive geotechnical evaluation of the SPFC and non-SPFC levee segments based upon previous investigations and the most recent geotechnical data collected in 2019. Appendix A-2 is a vulnerability assessment conducted by GEI on behalf of SAFCA in May of 2017 indicating that the MA 9 levees along the left bank of the Sacramento River are much more susceptible to levee failure between Freeport and Courtland in Sacramento County than the right bank levees in Yolo County. As depicted in Figure 5-6 and summarized in Table 5-3, this element primarily addresses through seepage, underseepage, slope stability, and erosion by reach using available data. Two remedial alternatives are provided to address the vulnerabilities associated with each reach. Further geotechnical investigations in connection with obtaining FEMA accreditation are warranted to confirm these levee segments do not have geometry deficiencies in certain, localized locations.

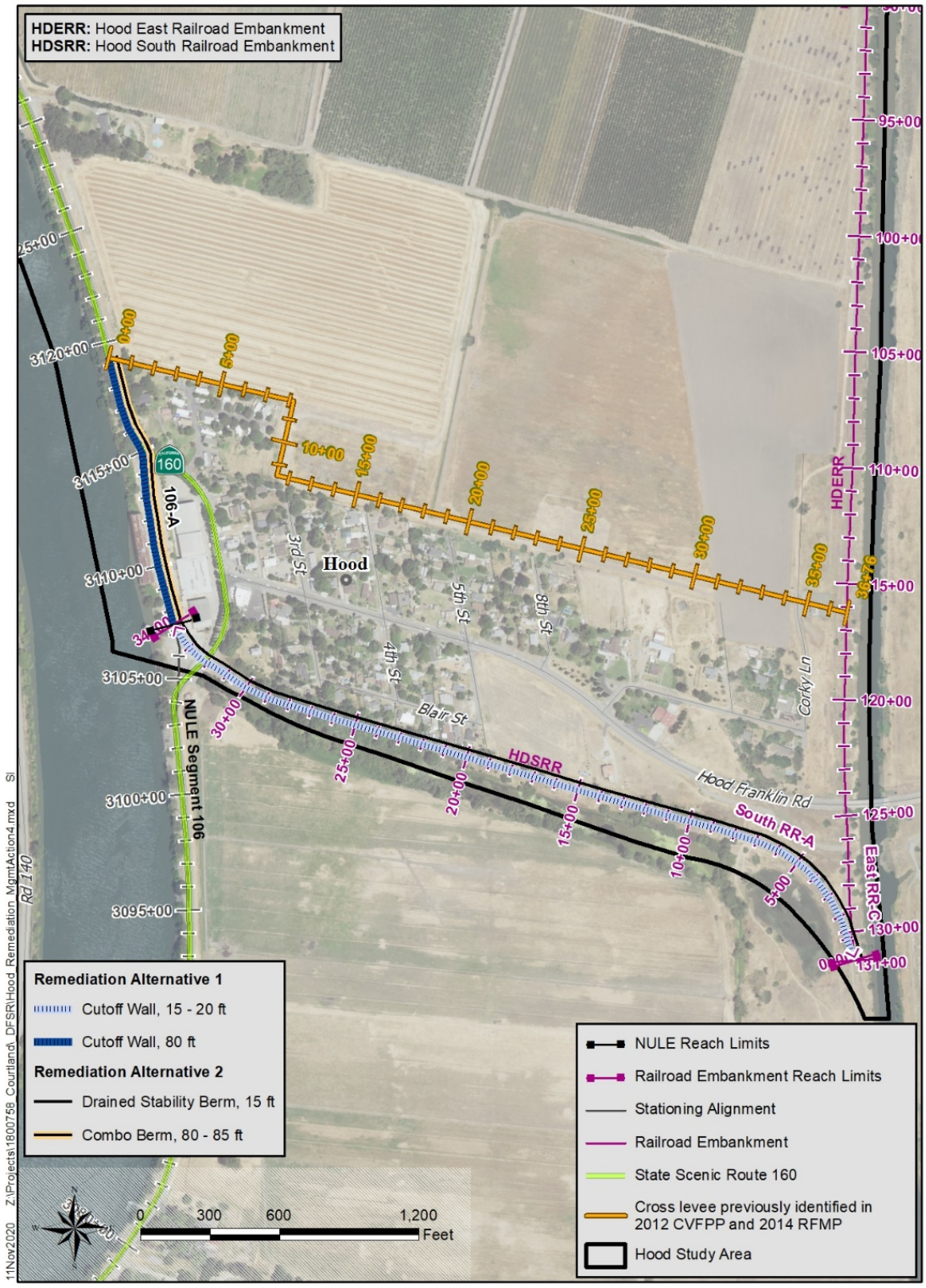


Figure 5-6. Cross Levee North of Hood Paired with; Repair and Strengthen-in-Place MA 9 SPFC Levee Adjacent to Hood; and Repair/ Strengthen Existing Non-SPFC Levee South of Hood (2012 CVFPP and 2014 RFMP Configuration)

Table 5-3. Summary of Remedial Alternatives to Improve the SPFC MA 9 Levee Immediately Fronting Hood and to Improve the non-SPFC Railroad Embankments South and East of Hood

Levee Segment Location	Reach	Start Station	End Station	Reach Length (ft.)[1]	Remediation Alternative 1	Remediation Alternative 2	Vulnerability				
							Under- Seepage	Through Seepage	Slope Stability	Erosion	Freeboard (% Deficient)
Left Bank Sacramento River	106-A	3107+39	3120+59	1,300	80-ft.-deep cutoff wall	80-ft.-wide, 9-ft.-tall combination seepage and stability berm	X	X	-	-	-
Hood East Railroad Embankment	East RR-C	90+00	131+25	4,100	-	-	-	-	-	-	-
Hood South Railroad Embankment	South RR-A	0+00	34+21	3,400	15-ft.-deep cutoff wall 105-ft.-wide RSP (3,000 ft.)	13-ft.-tall, 15.-ft-wide drained stability berm 105 ft. wide RSP (3,000 ft.)	-	X	X	X	-

Note: [1]Reach lengths rounded to the nearest 100 feet

Table 5-4. Hood Cross Levee Dimensions

Crown Width	Landside Slope (H:V)	Waterside Slope (H:V)	Crest Elevation	Average Cross Levee Height
20 ft.	3:1	3:1	28 ft. NAVD 88	18.4 ft.

5.1.2 Additional Remediations and Improvements

Additional remediations to improve flood protection for the community of Hood and the larger study area were investigated as part of this feasibility study and are provided below.

5.1.2.1 Raise and Repair/Strengthen-in-Place RD 744 South Cross Levee

This element raises, repairs, and strengthens-in-place the entirety of the 0.25-mile-long cross levee maintained by RD 744 which extends from the MA 9 left bank Sacramento River levee east to the former railroad embankment. Additional information regarding the data used to develop these remediations and how levee vulnerabilities were identified can be found in Appendix A-2. Based on the available data, remediations were developed to address vulnerabilities primarily for through seepage and under seepage, as well as geometry deficiencies. As depicted in Figure 5-7, this element includes two remedial alternatives to address these vulnerabilities: a 50-foot-deep cutoff wall (Remediation Alternative 1) or a 16-foot-tall, 85-foot-wide combination seepage/stability (Remediation Alternative 2). To address freeboard deficiencies, the levee would be raised by 1 foot from station 0+00 to 5+00, and by 2.5 feet from station 5+00 to 13+00. These remediations are summarized below in Table 5-5. Further geotechnical investigations in connection with obtaining FEMA accreditation are warranted to confirm the RD 744 south cross levee does not have erosion or slope stability deficiencies.

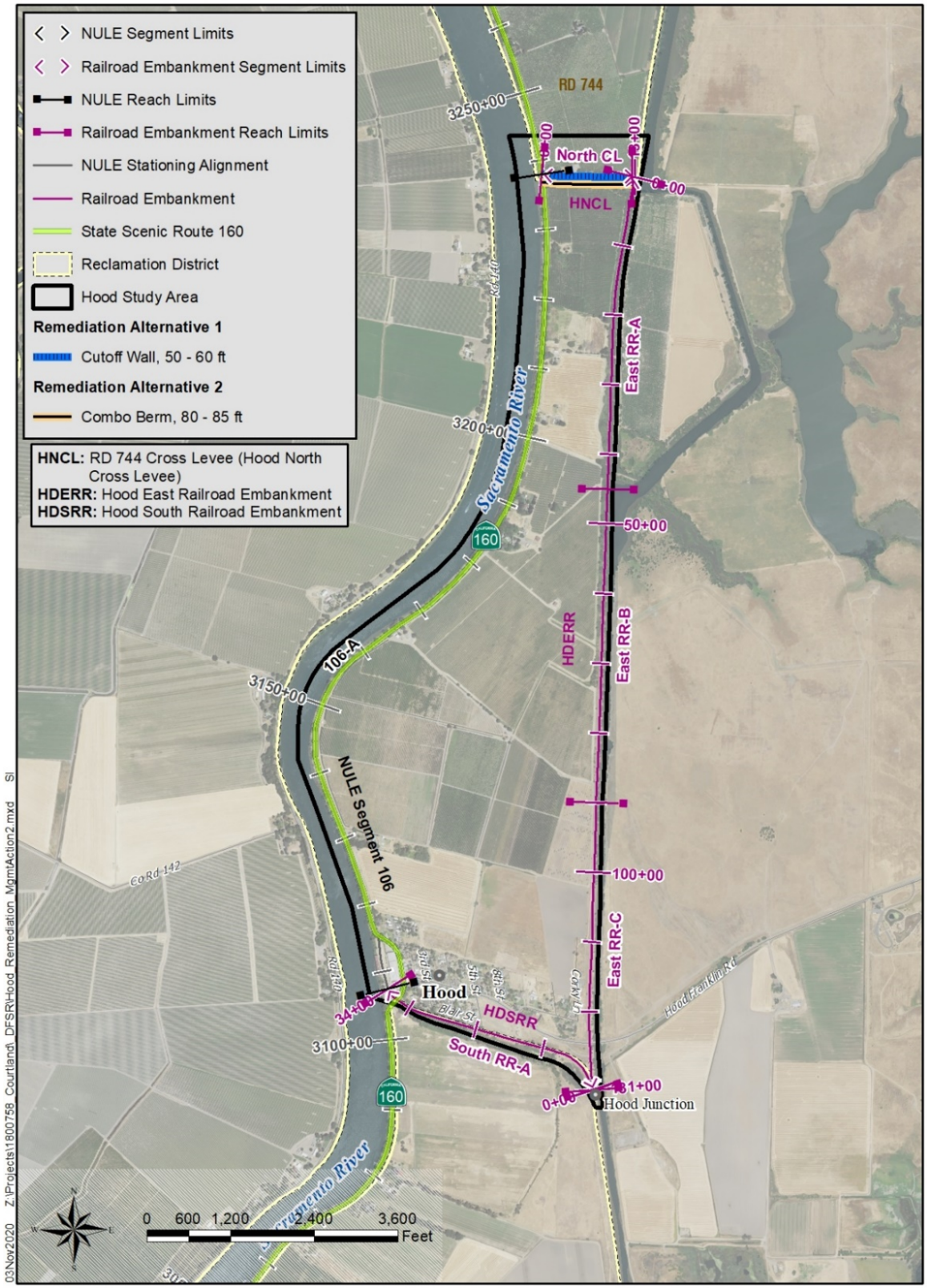


Figure 5-7. Remedial Alternatives to Address Levee Vulnerabilities on the RD 744 South Cross Levee

Table 5-5. Summary of Remedial Alternatives to Address Levee Vulnerabilities on the RD 744 South Cross Levee

Levee Segment Location	Reach	Start Station	End Station	Reach Length (ft.)	Remediation Alternative 1	Remediation Alternative 2	Vulnerability				Freeboard (% Deficient)
							Under-Seepage	Through-Seepage	Slope Stability	Erosion	
RD 744 South Cross Levee	North CL	0+00	5+00	500	50-ft.-deep cutoff wall 1 ft. levee raise	85-ft.-wide, 16-ft.-tall combination seepage and stability berm 1 ft. levee raise	X	X	-	-	100%
		5+00	13+00	800	50-ft.-deep cutoff wall 2.5 ft. levee raise	85-ft.-wide, 16-ft.-tall combination seepage and stability berm 2.5 ft. levee raise	X	X	-	-	100%

5.1.2.2 Cross Levee with Community-Preferred Alignment North of Hood Paired with: Repair and Strengthen-in-Place MA 9 SPFC Levee Adjacent to Hood; and Repair and Strengthen Existing Non-SPFC Levee South of Hood

This element is similar to the flood risk reduction element described in Section 5.1.1.2 as previously developed by DWR for the 2012 CVFPP; however, this cross levee would be located approximately 0.25 miles further north of the community of Hood as preferred by local interests and landowners. With this configuration, an additional 0.15 miles of SPFC levee along the left bank of the Sacramento River would be repaired and strengthened-in-place (total of 0.40 miles). The total length of cross levee to the north remains relatively the same as previously described at 0.70 miles and would be constructed with a 20-foot minimum crown width, 3H:1V landside and waterside slopes, and levee crest elevation of 28 feet, assuming a design WSEL of 25 feet NAVD 88 and 3 feet of freeboard to address any potential levee breach upstream from the Sacramento River within DWR MA 9 (Table 5-7). The levee system would be constructed to allow for FEMA accreditation pursuant to the standards contained in 44 CFR §65.10.

As discussed in Section 5.1.1.2, data from: (1) the DWR NULE Phase 1 study; (2) the DWR FSRP site investigations; and (3) additional CPTs collected in 2019 were all used to develop potential remediations for this element. As shown in Figure 5-8 and summarized in Table 5-6, this element primarily addresses through seepage, underseepage, and slope stability by reach using available data. RSP is also proposed for the former railroad embankment south of Hood to remediate erosion concerns. Two remedial alternatives are provided to address the vulnerabilities associated with each reach. Further geotechnical investigations in connection with obtaining FEMA accreditation are warranted to confirm these levee segments do not have isolated geometry deficiencies. Additional information regarding the data that was used to develop these remediations and how levee vulnerabilities were identified can be found in Appendices A-1 and A-2.

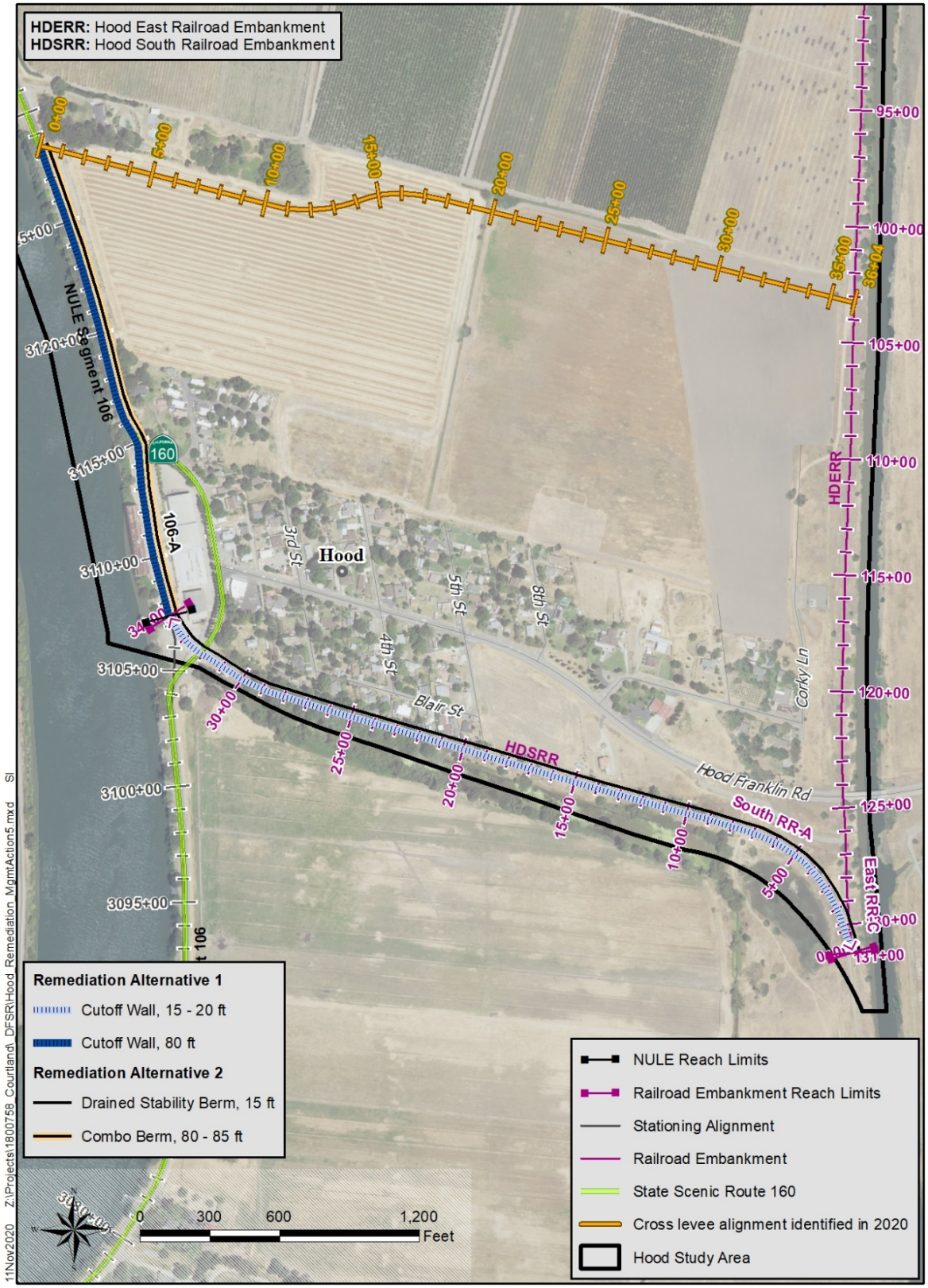


Figure 5-8.Cross Levee with Community-Preferred Alignment North of Hood Paired with: Repair and Strengthen-in-Place MA 9 SPFC Levees Adjacent to Hood; and Repair and Strengthen Existing Non-SPFC Levee South of Hood

Table 5-6. Summary of Remedial Alternatives to Repair and Strengthen the Levee Immediately Fronting Hood and to Improve the Levees South of Hood

Levee Segment Location	Reach	Start Station	End Station	Reach Length (ft.)[1]	Remediation Alternative 1	Remediation Alternative 2	Vulnerability				Free-board Deficient
							Under- Seepage	Through Seepage	Slope Stability	Erosion	
Left Bank Sacramento River	106-A	3107+ 39	3128+ 51	2,100	80-ft.-deep cutoff wall	80-ft.-wide, 9-ft.-tall combination seepage and stability berm	X	X	-	-	-
Hood East Railroad Embankment	East RR-C	90+00	131+25	4,100	-	-	-	-	-	-	-
Hood South Railroad Embankment	South RR-A	0+00	34+21	3,400	15-ft.-deep cutoff wall 105 ft. wide RSP (3,000 ft.)	13-ft.-tall, 15.-ft.-wide drained stability berm 105 ft. wide RSP (3,000 ft.)	-	X	X	X	-

Note: [1] Reach lengths rounded to the nearest 100 feet

Table 5-7. Locally Preferred Hood Cross Levee Alignment Dimensions

Crown Width	Landside Slope (H:V)	Waterside Slope (H:V)	Crest Elevation	Average Cross Levee Height
20 ft.	3:1	3:1	28 ft. NAVD 88	19.6 ft.

5.1.2.3 Repair and Strengthen-in-Place Sacramento River – MA 9 SPFC Levees in Hood Study Area

This element repairs and strengthens the entirety of the 2.5 miles of SPFC levees within DWR MA 9 located along the left bank of the Sacramento River (NULE Segment 106). As discussed in Sections 5.1.2.1 and 5.1.2.2. data from the DWR NULE Phase 1 study, the DWR FSRP sites and additional CPTs recently collected in 2019 were used to develop potential remediations for this element, which are summarized by reach according to the vulnerabilities present in the levee.

This element primarily addresses through seepage and underseepage for the entire 2.5 miles of the DWR MA 9 SPFC levees within the study area (NULE Segment 106) via two remedial alternatives: 1) an 80-foot-deep cutoff wall (Remediation Alternative 1), or 2) an 80-foot- wide, 9-foot- tall combination seepage/stability berm (Remediation Alternative 2) (Figure 5-9). Further geotechnical investigations in connection with obtaining FEMA accreditation are warranted to confirm these levee segments do not have slope stability, erosion, or geometry deficiencies. Additional information regarding the data and evaluations that were used to develop these remediations and how levee vulnerabilities were identified can be found in Appendices A-1 and A-2.

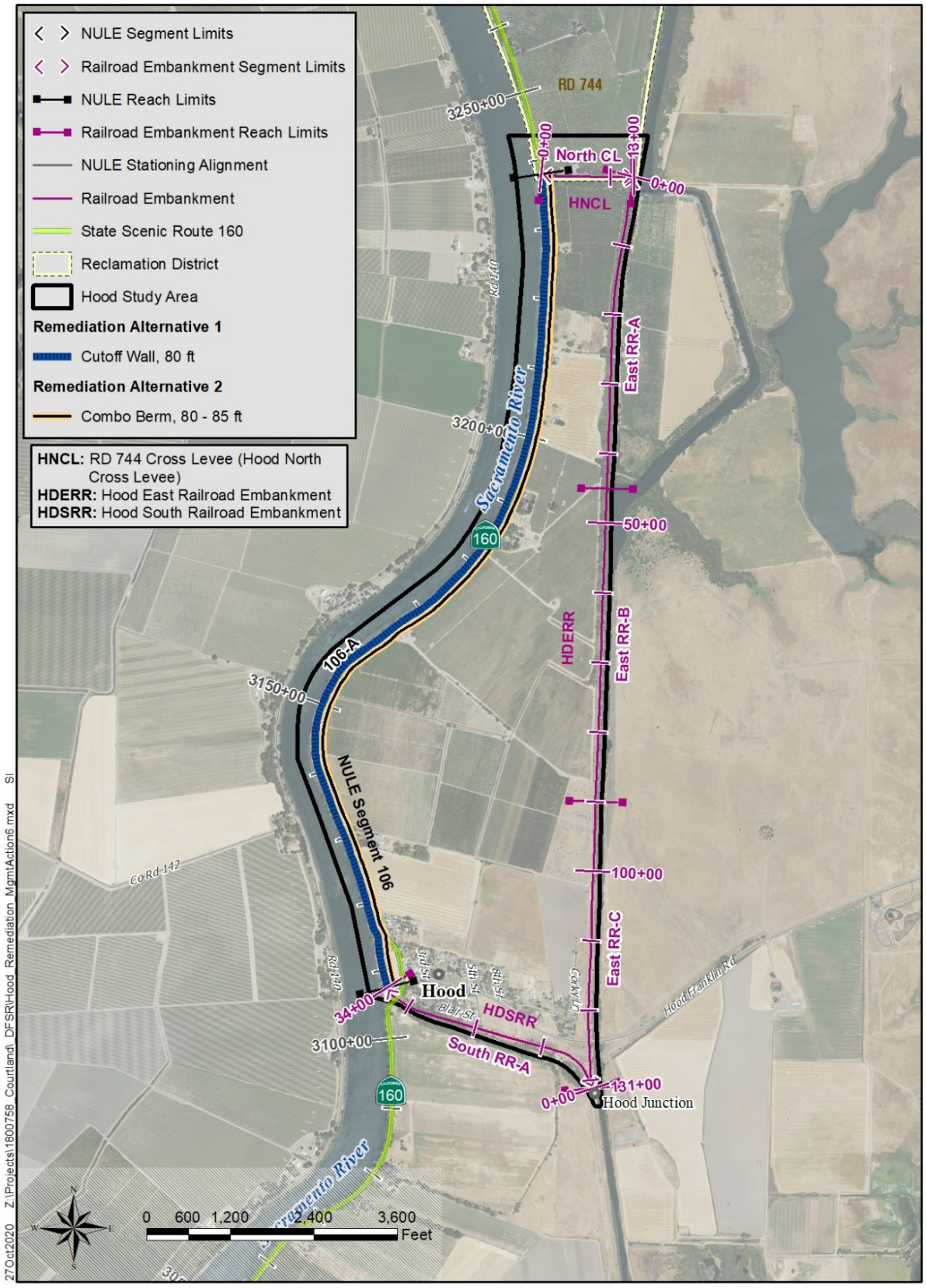


Figure 5-9. Remedial Alternatives to Repair and Strengthen the DWR MA 9 SPFC Levees Within the Hood Study Area

5.1.2.4 Repair and Strengthen-in-Place Non-SPFC Levees/Former Railroad Embankments

This element repairs and strengthens the entirety of the nearly 2.5 miles of non-SPFC levees within the study area, including the 0.25-mile-long RD 744 south cross levee, and 2.25 miles of former railroad embankments located to the east and south of Hood. Data from the DWR NULE Phase 1 study, DWR's FSRP critical and serious sites, and additional CPTs recently collected in 2019 were used to develop remediations for this element.

As shown in Figure 5-10 and summarized in Table 5-8, this element addresses through seepage, underseepage, slope stability, erosion, and freeboard deficiencies for the entirety of the non-SPFC levee system within the study area. Two remedial alternatives are provided to address the vulnerabilities associated with each levee reach, which include RSP to address erosion vulnerabilities and raising of select levees to address freeboard deficiencies. Additional information regarding the data that was used to develop these remediations and how levee vulnerabilities were identified can be found in Appendices A-1 and A-2.

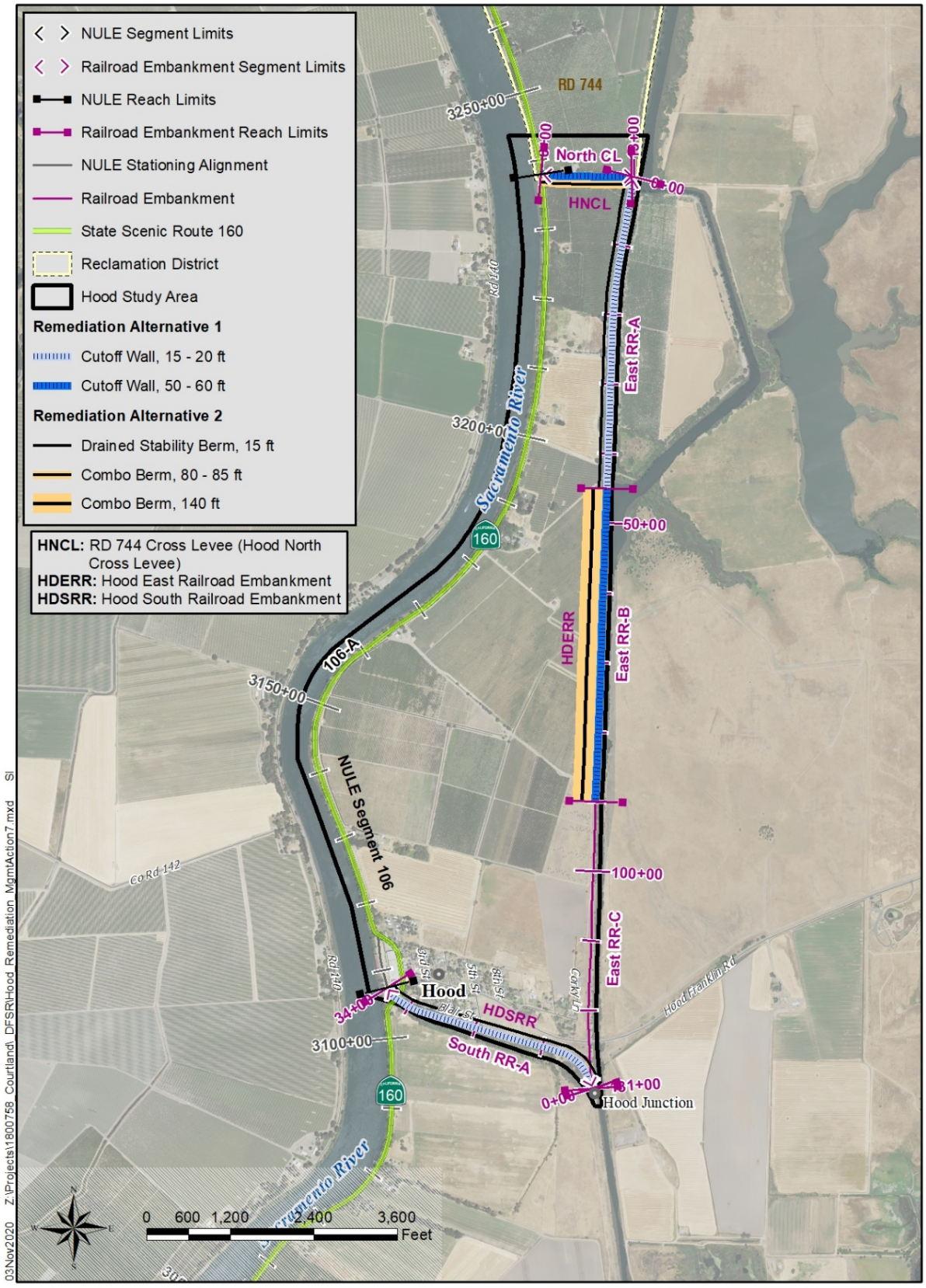


Figure 5-10. Remedial Alternatives to Improve non-SPFC Levee System (former railroad embankments) within the Hood Study Area

Table 5-8. Summary of Remedial Alternatives to Repair and Strengthen non-SPFC Levee System within the Hood Study Area

Levee Segment Location	Reach	Start Station	End Station	Reach Length (ft.)	Remediation Alternative 1	Remediation Alternative 2	Vulnerability				Freeboard (% Deficient)
							Under Seepage	Through Seepage	Slope Stability	Erosion	
RD 744 South Cross Levee	North CL	0+00	5+00	500	50-ft.-deep cutoff wall; 1 ft. levee raise	85-ft.-wide, 16-ft.-tall combination seepage and stability berm 1 ft. levee raise	X	X	-	-	100%
		5+00	13+00	800	50-ft.-deep cutoff wall; 2.5 ft. levee raise	85-ft.-wide, 16-ft.-tall combination seepage and stability berm 2.5 ft. levee raise	X	X	-	-	100%
Hood East Railroad Embankment	East RR-A	0+00	45+00	4,500	15-ft.-deep cutoff wall; 105-ft.-wide RSP (4,500 ft.)	12-ft.-tall, 15-ft.-wide drained stability berm 105-ft. wide RSP (4,500 ft.)	-	X	-	X	-
	East RR-B	45+00	90+00	4,500	60-ft.-deep cutoff wall; 140-ft.-wide RSP (3,500 ft.)	140-ft.-wide, 19-ft.-tall combination seepage and stability berm 140-ft.-wide RSP (3,500 ft.)	X	X	X	X	-
	East RR-C	90+00	131+25	4,100	-	-	-	-	-	-	-
Hood South Railroad Embankment	South RR-A	0+00	34+21	3,400	15-ft. deep cutoff wall; 105-ft.-wide RSP (3,000 ft.)	13-ft.-tall, 15-ft.-wide drained stability berm 105-ft.-wide RSP (3,000 ft.)	-	X	X	X	-

Note: [1]Reach lengths rounded to the nearest 100 feet

5.1.2.5 Secure 100-Year FEMA Certification for Community and Entire Hood Study Area

This element builds on the previous elements (Sections 5.1.2.3and 5.1.2.4) by improving all levee segments (SPFC and non-SPFC) within the Hood study area in accordance with FEMA standards for freeboard, seepage, erosion, and stability and settlement concerns pursuant to 44 CFR §65.10. In addition to the proposed structural remediations depicted in Figure 5-9 and Figure 5-10, certain FEMA design criteria, O&M requirements, and documentation requirements specified in 44 CFR §65.10 would also be addressed. These FEMA accreditation requirements are discussed briefly below.

Freeboard: Riverine levees must provide a minimum freeboard of 3 feet above the 100-year water-surface level, preferably that addresses both climate change and sea level rise. An additional 1 foot above the minimum is required within 100 feet on either side of structures (such as bridges) riverward of the levee or wherever the flow is constricted.

Embankment Protection: Engineering analyses must be submitted that demonstrate no appreciable erosion of the levee embankment can be expected during the base flood, as a result of either currents or waves, and that anticipated erosion will not result in failure of the levee embankment or foundation directly or indirectly through reduction of the seepage path and subsequent instability. The factors to be addressed in such analyses include but are not limited to: Expected flow velocities (especially in constricted areas); expected wind and wave action; ice loading; impact of debris; slope protection techniques; duration of flooding at various stages and velocities; embankment and foundation materials; levee alignment, bends, and transitions; and levee side slopes.

Embankment and Foundation Stability (Including Through Seepage and Underseepage): Engineering analyses that evaluate levee embankment stability must be submitted. The analyses provided shall evaluate expected seepage during loading conditions associated with the base flood and shall demonstrate that seepage into or through the levee foundation and embankment will not jeopardize embankment or foundation stability. An alternative analysis demonstrating that the levee is designed and constructed for stability against loading conditions for Case IV, as defined in the USACE manual "Design and Construction of Levees" (EM 1110-2-1913, Chapter 6, Section II), may be used. The factors that shall be addressed in the analyses include, depth of flooding, duration of flooding, embankment geometry, length of seepage path at critical locations, embankment and foundation materials, embankment compaction, penetrations, other design factors affecting seepage (such as drainage layers), and other design factors affecting embankment and foundation stability (such as berms).

Settlement: Engineering analyses must be submitted that assess the potential and magnitude of future losses of freeboard as a result of levee settlement and demonstrate that freeboard will be maintained within the minimum standards set forth in paragraph (b)(1) of this section. This analysis must address embankment loads, compressibility of embankment soils, compressibility of foundation soils, age of the levee system, and construction compaction methods. In addition,

detailed settlement analysis using procedures such as those described in the USACE manual "Soil Mechanics Design - Settlement Analysis" (EM 1100-2-1904), must be submitted.

Design Criteria

Closures/Encroachments: All openings must be provided with closure devices that are structural parts of the system during operation and design according to sound engineering practice.
Interior Drainage: An analysis must be submitted that identifies the source(s) of such flooding, the extent of the flooded area, and, if the average depth is greater than 1 ft., the water-surface elevation(s) of the base flood. This analysis must be based on the joint probability of interior and exterior flooding and the capacity of facilities (such as drainage lines and pumps) for evacuating interior floodwaters.
Other Design Criteria: In unique situations, such as those where the levee system has relatively high vulnerability, FEMA may require that other design criteria and analyses be submitted to show that the levees provide adequate protection. In such situations, sound engineering practice will be the standard on which FEMA will base its determinations. FEMA will also provide the rationale for requiring this additional information.

Operations Plans and Criteria

Closures: Operation plans for closures must include the following: • Documentation of the flood warning system, under the jurisdiction of federal, State, or community officials, that will be used to trigger emergency operation activities and demonstration that sufficient flood warning time exists for the completed operation of all closure structures, including necessary sealing, before floodwaters reach the base of the closure. • A formal plan of operation including specific actions and assignments of responsibility by individual name or title. • Provisions for periodic operation, at not less than 1-year intervals, of the closure structure for testing and training purposes.
Interior Drainage Systems: Interior drainage systems associated with levee systems usually include storage areas, gravity outlets, pumping stations, or a combination thereof. These drainage systems will be recognized by FEMA on NFIP maps for flood protection purposes only if the following minimum criteria are included in the operation plan: • Documentation of the flood warning system, under the jurisdiction of federal, State, or community officials, that will be used to trigger emergency operation activities and demonstration that sufficient flood warning time exists to permit activation of mechanized portions of the drainage system. • A formal plan of operation including specific actions and assignments of responsibility by individual name or title. • Provision for manual backup for the activation of automatic systems. • Provisions for periodic inspection of interior drainage systems and periodic operation of any mechanized portions for testing and training purposes. No more than 1-year shall elapse between either the inspections or the operations.
Other Operations Plans and Criteria: Other operating plans and criteria may be required by FEMA to ensure that adequate protection is provided in specific situations. In such cases, sound emergency management practice will be the standard upon which FEMA determinations will be based.

Maintenance Plans and Criteria

Levee systems must be maintained in accordance with an officially adopted maintenance plan, and a copy of this plan must be provided to FEMA by the owner of the levee system when recognition is being sought or when the plan for a previously recognized system is revised in any manner. All maintenance activities must be under the jurisdiction of a federal or State agency, an agency created by federal or State law, or an agency of a community participating in the NFIP that must assume ultimate responsibility for maintenance. This plan must document the formal procedure that ensures that the stability, height, and overall integrity of the levee and its associated structures and systems are maintained. At a minimum, maintenance plans shall specify the maintenance activities to be performed, the frequency of their performance, and the person by name or title responsible for their performance.

5.1.2.6 Repair and Strengthen-in-Place through Geotechnical Remediation, 9.0 Miles of DWR MA 9 Sacramento River Left Bank Levee Between Freeport and RD 755

This element builds on the previous collection of elements by improving and strengthening the entirety of the MA 9 east/left bank Sacramento River levee between Freeport and the northeasterly boundary of RD 755, Randall Island, (a total of 9.0 miles) in accordance with FEMA standards for freeboard, seepage, erosion, and stability and settlement concerns pursuant to 44 CFR §65.10. These improvements include addressing all 9 DWR FSRP critical and serious seepage sites within the boundaries of the Hood study area and within RD 744. This element repairs and strengthens the entirety of the MA 9 left bank Sacramento River levee between Freeport and RD 755 using the remediations proposed for NULE Segment 106 (reach 106-A), as shown in Figure 5-9. Further geotechnical investigations are needed north of the Hood study area in RD 744 and south of the Hood study area in RD 813 - Ehrhardt Club, to confirm the remediations specified for reach 106-A adequately address any and all vulnerabilities on the levee segments north and south of the Hood study area boundary. In addition to these proposed structural remediations, certain FEMA design criteria, O&M requirements, and documentation requirements specified in 44 CFR §65.10 would also be addressed, as summarized previously in Section 5.1.2.5.

Appendix A-2 is a Technical Memorandum (TM) assessing levee vulnerability of the Sacramento River non-urban levee in Sacramento and Yolo Counties downstream of the Sacramento and West Sacramento Urban levee systems. The TM was prepared by GEI Consultants in May of 2017 on behalf of SAFCA to assess the vulnerabilities of the non-urban left and right bank levees that could potentially fail and pose threats of flooding the adjoining, upstream urban areas. The TM (including its accompanying Figure 6 excerpted and included herein as Figure 5-11) clearly indicates that the Sacramento River left bank DWR MA 9 levees (NULE Segment 106) between Freeport, Hood, and RD 755 are much more susceptible and vulnerable to potential levee failure than the right bank levees in Yolo County. It should be noted if a levee failure were to occur along the left bank of the Sacramento River between Freeport, Hood, and/or RD 755, devasting flooding could incur, resulting in potential inundation of Hood, portions of Interstate 5, Point Pleasant, and portions of Elk Grove, east of Interstate 5.

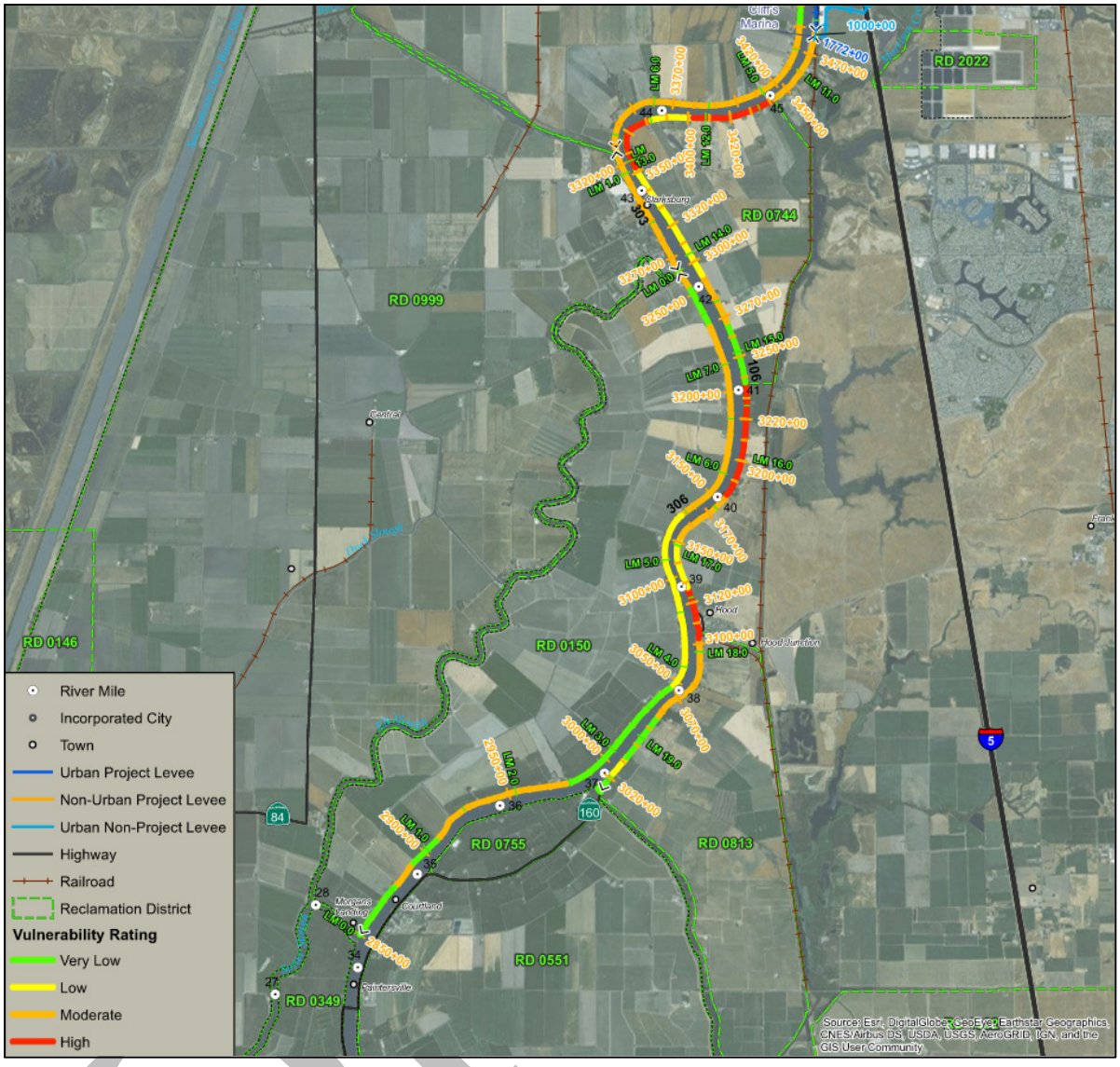


Figure 5-11. Sacramento River Left and Right Bank Levee Vulnerability (GEI Consultants Inc., 2017)

5.2 Non-Structural Measures

Non-structural measures improve flood system performance and reduce exposure, vulnerability, and consequences of flooding. The suite of non-structural measures can be implemented in most cases with or without modifying the existing levee and flood control system. The full suite of non-structural measures considered in this feasibility study for the community of Hood and the adjoining North Delta Legacy Communities within Sacramento County are described in detail in Appendix H and summarized below:

1. Flood Fight Berm or a Ring Levee System
2. Voluntary Elevation of Structures
3. Wet or Dry Floodproofing

4. Acquisition and Relocation
5. Flood Emergency Safety Plans
6. Sacramento County OES Decision Support Tool
7. Local Hazard Mitigation Plan and Relief Cuts
8. Alternatives to FEMA NFIP – Private, Community-Based Flood Insurance
9. NFIP Flood Insurance Enhancements via AFOTF
10. Mokelumne River Conveyance Improvements & Staten Island Overflow Area
11. Improve FEMA CRS Score for Sacramento County/Isleton
12. Land Use Regulations and Limitations
13. Improved Governance Between Neighboring LMAs/RDs
14. System-Wide Improvement Frameworks (SWIFs) & Period Inspections with USACE
15. Public Education/Public Awareness

The key non-structural measures identified above and within Appendix H that are community-specific to the Hood Study Area and warrant further discussions and descriptions are described in more detail below. All of the above non-structural measures identified above were presented to the Hood Study Area planning committee with most measures deemed acceptable, as summarized in Section 7.3. Appendix H also provides a description of why some measures may be more applicable to neighboring Delta Legacy Communities or why they may not be applicable to each specific Delta Legacy Community.

5.2.1 Voluntary Elevation of Structures

The voluntary structural elevation program collectively administered by FEMA and Sacramento County (and possibly others) is a flood risk reduction measure that involves physically raising existing structures to an elevation 1.5 feet or greater above the FEMA BFE resulting from natural overland flows and/or a levee breach. For the Hood study area, the current BFE is set at 18 feet NAVD 88. This is a common and effective way to minimize damage from flooding and is a key flood protection provision of the NFIP.

Hydraulics and hydrologic modeling of the Lower Sacramento River system indicates that the structures in the study area would require raising between 5 and 10 feet to be elevated to or above the maximum floodplain. Elevations of this height may require additional seismic (and other practical) considerations to ensure stability and continued utility of the structures in question.

Below is a summary table (excerpted from Appendix H) that indicates the number and types of structures located within the community of Hood (SAC 45). The table also indicates the likely minimum cost of raising each of the noted structures, acknowledging that commercial and

industrial structures will undoubtedly be more than the current estimate of $170,000/ea. to raise residential structures.

Table 5-9: Total Count and Cost to Elevate Structures in the Hood Study Area

Community	CVFPP Impact Area	Total Structure Count and Cost to Elevate at $170,000/Structure				
		Residential	Commercial	Industrial	Public	Total
Community of Hood	SAC 45	104	4	7	2	117
		$17,680,000	$680,000	$1,190,000	$340,000	$19,890,000

5.2.2 Wet or Dry Floodproofing

Damages to structures behind levees can be greatly reduced through effective floodproofing. Floodproofing can be cost effective for most structures where maximum depths of potential flooding are not expected to exceed 5 feet However, agricultural-related structures have been known to be flood-proofed for flood depths far exceeding 5 feet If the flood depth at a site is above the practical height limits of available floodproofing barriers, an alternate mitigation method, such as raising of structures should be considered.

Though the base flood depth in the Hood study area is 18 feet NAVD 88, wet or dry floodproofing could be implemented for select structures in the study area where maximum potential flood depths are not expected to exceed 5 feet

5.2.3 Acquisitions or Relocations

This flood risk reduction element involves acquiring land or relocating dwelling units, businesses, or agricultural structures to reduce flood risk. This element is included for comparison purposes, but it is not a preferred action for the subject Delta Legacy Community of Hood due to relocations of homes and businesses being disruptive to residents and the overall community. DWR and others have suggested select communities subject to either deep or repetitive flooding should consider relocation to higher ground that is not subject to flooding. Relocating entire communities within the Delta, particularly Delta Legacy Communities, is inconsistent with the goals and objectives of both the Delta Plan and the SSJDNHA designation.

5.2.4 Improved Emergency Response – Flood Emergency Safety Plans and County OES Decision Support Tool

Flood ESPs are one tool aimed at improving emergency response within Sacramento County. Public information posted on Sacramento County's webpage, includes the following for individual RD ESPs: a Delta Area Flood Map, flood depth maps, how long it will take to flood the individual RDs, evacuation routes, and time tables indicating the duration of time in hours,

days, weeks, or months to pump-out and entirely drain the individual RDs, depending upon the rate of pumping capacity.

The Flood Operation Decision Support System (FODSS) tool is another effort aimed at improving emergency response within Sacramento County. Funded by DWR and sponsored by Sacramento County , Governor's Office of Emergency Services, the FODSS tool aims to improve emergency response, emergency management and coordination during high water and flood emergencies within the county.

5.2.5 Local Hazard Mitigation Plan and Relief Cuts

The Sacramento County Local Hazard Mitigation Plan (LHMP) is a multi-jurisdictional plan that geographically covers the entire area within Sacramento County's jurisdictional boundaries (planning area), including the Hood study area. The LHMP identifies hazards within Sacramento County, including those from floods and levee failure, assesses the vulnerability of the planning area to these hazards, and identifies mitigations to reduce or eliminate long-term risk to life loss and property damage from these hazards. The County of Sacramento developed the initial LHMP in 2005 and was last updated in 2016. The Sacramento County LHMP is updated every 5 years and is currently scheduled for a new update in 2021.

As a mitigation measure which can be used to reduce risk to life loss and property damage as a result of flooding or levee failure, potential locations of relief cuts could be formalized within the LHMP. The levee system protecting the Hood study area acts somewhat as a bowl with the water filling up to the top of the lowest downstream levee, typically at the lowest elevations in the study area. However, a carefully planned relief cut excavated into the levee at the lower downstream end would allow the water to escape or drain out of the study area before filling up the entire basin. For example, if there is 5 feet of freeboard at the lower downstream end of the study area, the relief cut could potentially reduce flood depths by as much as 5 feet over the entirety of the basin, while waiting for the lower, downstream levee reach to overtop (*see* Figure 5-12 below in comparison with Figure 3-1). The MA 9 personnel along with adjoining downstream Districts will determine if a relief cut will be necessary should flooding occur; however, in most cases there is no written description nor agreement for a planned relief cut. Potential relief cut locations should be identified, further evaluated, and formalized while updating the LHMP.

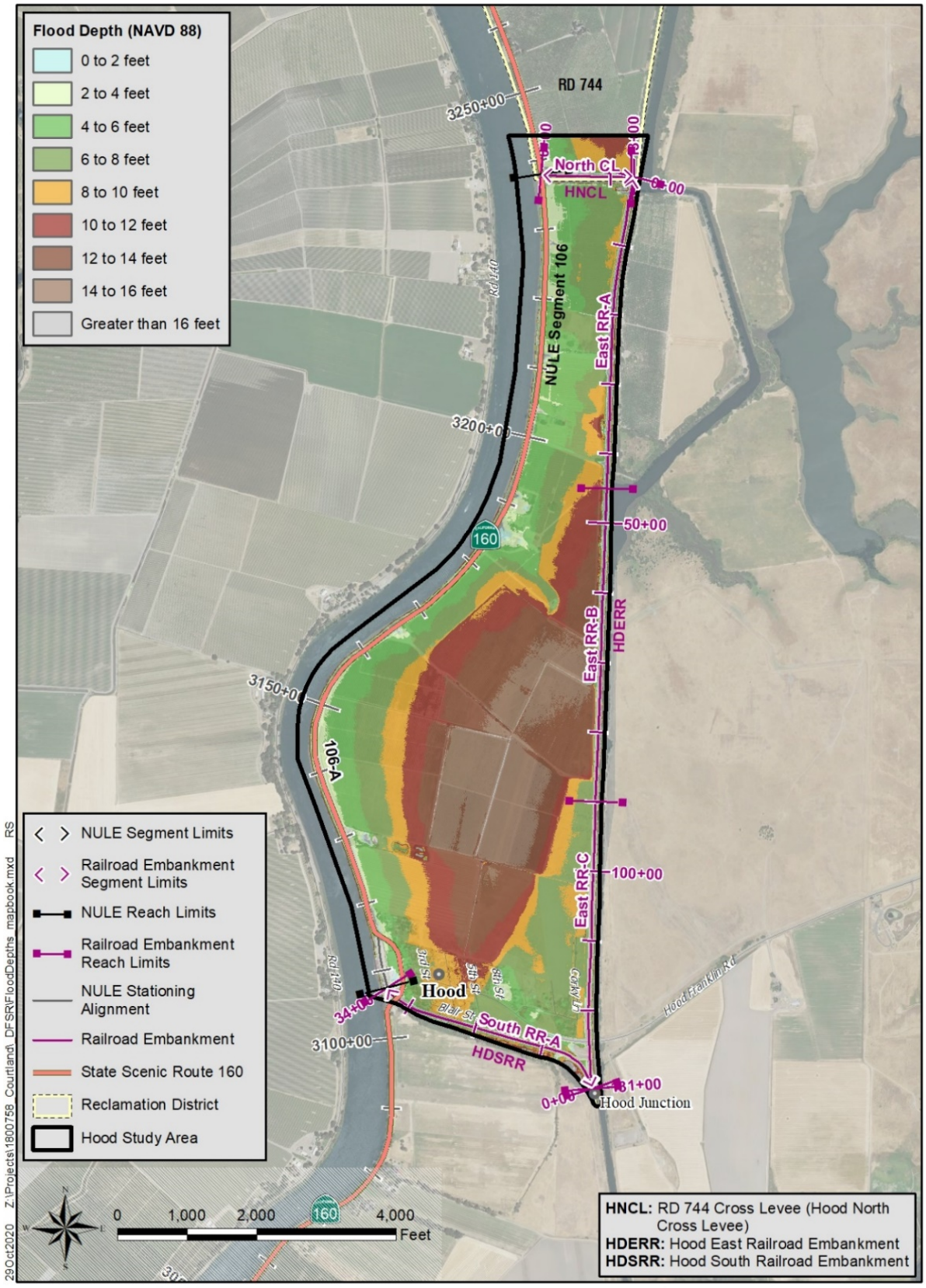


Figure 5-12. Maximum Flood Depths in Hood Study Area Following a Potential Relief Cut of East Railroad Embankment.

5.2.6 Alternatives to NFIP – Community and Flood-Risk Based Insurance Programs

The NFIP is managed by FEMA through its subcomponent, known as the Federal Insurance and Mitigation Administration (FIMA). It is currently the only federally-backed flood insurance program, so the introduction of alternative flood insuring options for homeowners (such as private community-based flood insurance) carries the advantage of offering potentially more favorable terms to residents within any of the noted Delta Legacy Communities of Sacramento County, including the city of Isleton.

A review of FEMA's current and planned mapping procedures, insurance, requirements, insurance rates, and policies indicates that agricultural facilities in leveed areas of the Sacramento Valley, including the Courtland, have been bearing a disproportionately large share of the financial burden of the NFIP. Private sector involvement in the flood insurance industry could protect this area's flood insurance premiums by matching rates to risk through an emerging market for private community-based flood insurance policies.

Potential Benefits of a Community-Based Flood Insurance Program

- Potential source for project finance to reduce risk to community and assets
- Improved understanding of underlying risks and resilience opportunities
- Communities could renegotiate contracts every 5- to 7-years and decide how much risk to retain and how much to transfer
- Project financing would not be accounted for as debt on the community's balance sheet, providing added flexibility to the community
- Insurance could cover additional items such as funding for continuity of services, community equipment, and other items that are currently self-insured
- See Appendix J for further details for a Community-Based Flood Insurance Program for Courtland and other nearby Delta Legacy Communities

As NFIP premiums continue to increase for residents in Hood, private insurers are entering the market. They are taking advantage of better flood mapping, modeling, the accessibility of increasingly high-resolution national data sets, innovations in statistical analysis, and sophisticated global financial markets to fill the affordability gap. In 2019, over 10,000 private insurance policies were written in California (Wholesale & Specialty Insurance Association, 2019).

Private insurers use their own models to establish the price of a policy. For example, the nonprofit First Street Foundation recently released a nationwide flood model accessible from any mobile device similar to many used by private insurers. It is an easily understood, easily accessible nationwide tool for presenting flood risk information. By visiting FloodFactor.com[1] a resident in Hood can easily get a general picture of their flood risk. Flood risk is specified by assigning a risk score from 1 to 10. The score is based on cumulative likelihood of flooding at different flood depths based on riverine analyses which indicate flood depths can exceed 10 feet in certain North Delta Communities.

[1] Find your homes flood factor: https://www.floodfactor.com/

Flood risk information obtained from sites like FloodFactor.com will be different than flood information produced by DWR or FEMA because the methods to assess risk are different.

An alternative to NFIP individual homeowner policies is a community-based flood insurance program. A community-based flood insurance program would have the opportunity to lower flood insurance costs by working with an insurer to provide better risk information and by actively implementing agreed upon mitigation measures. A community might choose to: (1) sell their risk to an insurer; (2) finance the risk through capital markets; or (3) implement a combination of risk financing mechanisms. By actively managing the flood risk, the community flood risk program would provide the opportunity to both reduce flood insurance premiums and finance levee improvements and/or implement non-structural measures identified herein in Section 5.2, and in Section 7.3 - Non-Structural Measures Recommended for Implementation.

One way that a community might choose to implement a community-based flood insurance program is through the establishment of a Homeowners Association (HOA) or a Geologic Hazard Abatement District (GHAD). A GHAD is a state-level public agency for the purpose of providing prevention, rapid response, and funding to address hazardous geologic conditions. They were established in 1979 by the Beverly Act to allow local residents to develop self-funding mechanisms that address the long-term abatement and maintenance of structures that protect real property from geologic hazards.

The city of Isleton has already taken the initial steps in June-July of 2021 to formalize a path for property owners within its city limits to aggregate their resources and establish a community-based flood insurance program that can be used to augment and/or replace the current set of NFIP policies held within the city of Isleton. Sacramento County is also encouraging the unincorporated North Delta Legacy of Courtland to consider alternatives to the current NFIP, including a community-based flood insurance program that could be administered with or without developing a GHAD. A similar community-based flood insurance program is being considered for the San Francisquito Creek Joint Power Authority, located in the south Bay Area. (See separate Appendix J – Community-Based Flood Insurance, prepared by Kathleen Schaefer, P.E., CFM, former FEMA regional administrator of NFIP.)

5.2.7 NFIP Flood Insurance Enhancements via AFOTF

The AFOTF, *via* its TM of December 28, 2016, has recommended as many as seven administrative refinements of the NFIP to sustain agriculture as a wise use of the floodplain in leveed SFHAs. The NFIP administrative refinements (and amendments proposed by H.R. 830 - Flood Insurance for Farmers Act of 2019) are focused on improving agricultural sustainability while collectively reducing flood risks. The recommendations address how rules and practices could be modified to: (1) reduce or remove elevation and floodproofing requirements for new and substantially improved agricultural structures, and (2) reduce the cost of flood insurance for agricultural structures with a federally backed mortgage to a more appropriate risk-based portion

of the financial risk in the NFIP. The key elements include the following, of which most are applicable to the agricultural-based community of Hood and the surrounding Hood study area:

a) Levee relief cuts with emergency operation plans and floodplain management ordinance
b) Zone X for certified levee reaches: the partial accreditation of a basin or levee reach could potentially lead to lower NFIP insurance rates as portions of levee systems are approved
c) Wet floodproofing rules for agricultural structures
d) Insurance rates for nonaccredited levees: the AFOTF recommends that FEMA use sound actuarial science to amend its insurance rates to reflect flood protection provided by a non-accredited levee as documented by a civil engineer
e) Insurance rates for agricultural structures
f) Insurance rates for wet floodproofed structures
g) Add levee risk management activities to FEMA CRS

5.2.8 Mokelumne River Conveyance Improvements/Flood Easements

In October 2010, a Final Environmental Impact Report (EIR) was published by DWR for the North Delta Flood Control and Ecosystem Restoration Project. The purpose of this project was to implement flood control improvements in a manner that benefits aquatic and terrestrial habitats, species, and ecological processes. Specifically, improvements were sought which were expected to reduce damage to land uses, infrastructure, and the Bay-Delta ecosystem resulting from overflows caused by insufficient channel capacities and catastrophic levee failures in the North Delta study area. One option analyzed and presented in this EIR included dredging components of the channel along the North and South Forks of the Mokelumne River. Dredging is expected to directly reduce flood stages in the Mokelumne River and Snodgrass Slough providing a flood risk reduction benefit to the adjoining nearby communities, including Hood. Another option yielding similar results involves raising levee segments along these reaches. The implementation of these screened alternatives has the potential to directly reduce flood risk for the Hood study area which is impacted by high water stages in Snodgrass Slough.

Another option specific to this area which could reduce flood risks to the study area involves allowing flood stages along the North and South Forks of the Mokelumne River to overtop into Staten Island, or portions thereof, and serve as a flood relief overflow area. This option's feasibility stems largely from the fact that this area is sparsely populated, and its use for a flood easement would allow for significant lowering of water stages in the North Delta Region adjoining and upstream of the North and South Forks of the Mokelumne River.

In addition to the 2010 Final EIR published by DWR for the North Delta Flood Control and Ecosystem Restoration Project there have been a series of other documents developed by DWR and the California Federal Bay Delta Program to reduce flood risks and improve water

conveyance through the North Delta following the flooding of the RD 563 portion of Walnut Grove (East) and Thornton within the New Hope Tract during February of 1986. These documents are described in more detail in Appendix H – Identification of Non-Structural Elements for the Delta Legacy Communities of Hood, Courtland, Locke, East Walnut Grove, and West Walnut Grove & Ryde, and the city of Isleton. The documents suggest improving channel capacity in the Mokelumne River on either side of Staten Island and/or securing flood easements on Staten Island to accept excess flood waters would significantly reduce flood stages upstream in Snodgrass Slough for the nearby communities of East Walnut Grove, Locke, and possibly as far upstream as Courtland and Hood.

5.2.9 Improve FEMA Community Rating System Score for Sacramento County

Sacramento County, *via* its floodplain administrator program, is a very active participant of the NFIP, and through its county-wide Flood Protection Ordinance the County strives to reduce flood risks throughout the unincorporated areas of Sacramento County while also attempting to reduce NFIP premium policy rates. Through different flood mitigation activities outlined within the NFIP, Sacramento County has been able to reduce flood insurance through the FEMA CRS. Since 1992, Sacramento County has steadily improved its CRS score and as of May 2017, Sacramento County has maintained a Class 2 designation, which has yielded a 40 percent reduction of NFIP insurance premiums for SFHAs (an average reduction of $547 in annual NFIP premiums), within Sacramento County, including the entire Hood study area. Sacramento County currently has the opportunity to improve their CRS score to achieve the highest possible Class 1 designation by implementing and participating in Emergency Action Plans (EAPs) and associated Table Top Exercises for nearby, upstream dams/reservoirs (namely Folsom Reservoir, and possibly others) that could have a sizeable impact on flooding portions of Sacramento County if said reservoir(s) were to fail and cause flooding. This last jump from a CRS Class 2 to Class l designation would result in the last available 5 percent decrease in NFIP premiums and would place Sacramento County as the 2nd highest ranked CRS community in the entire Country behind Placer County.

5.2.10 Improved Governance between Neighboring LMAs and RDs and Community

The RDs in the North Delta are protected by a system of leveed channels, multipurpose reservoirs, and other structures that now comprise the SRFCP. The goal of the SRFCP is to reduce the chance of flooding for the communities in Sacramento County. Under the Standardized Emergency Management System (SEMS), Sacramento County establishes an Operational Area (OA). Traditionally, LMAs have not been included in planning or exercises. LMAs have relied mainly on DWR as their primary flood fight trainer, resources provider, and the next link in the SEMS chain of command rather than the local OA management structure. The Sacramento County Delta Flood ESP, written in June 2017, is an effort to improve communication between Sacramento County and the Delta LMAs, including DWR MA 9, by

providing a better understanding of the river system, providing rescue and evacuation mapping, laying out the flood emergency response process, formulating detailed hazard information for LMAs, and providing flood response trainings.

The community of Hood is not encompassed or represented by a local RD to maintain its non-SPFC levees and drainage/pumping system. The Hood study area was formerly represented by RD 746; and the study area is presently limited to the DWR Sacramento Maintenance Yard conducting annual maintenance and inspections limited to just the east/left bank of the Sacramento River in MA 9. DWR does not have maintenance responsibilities for the former railroad embankments, nor the existing RD 744 cross levee.

The community of Hood, including the HCC, Sacramento County, and DWR MA 9 are encouraged to collectively engage in flood preparedness, and potential response/recovery action plans on an annual basis that could be deployed in advance of any flooding event within or east of MA 9. The HCC should also consider taking on the role as a default RD particularly in connection with improving and ultimately maintaining the non-SPFC railroad/embankment levee reaches south and east of Hood and a potential new cross levee north of Hood. The HCC may also consider expanding its scope with other nearby Delta Legacy Communities to explore and potentially implement community-based flood insurance programs as an alternative or partial replacement to the current FEMA NFIP. Framework exists for community-specific assessments for a locally based flood insurance program for the community of Hood similar to the County assessments that are in place for regional sanitation services, water supply and storm drainage services that are provided by the County.

5.2.11 Public Education and Awareness

There are currently three programs within the Delta that provide public education, awareness, and notifications about flood risk. One is the Delta Flood Preparedness Week hosted annually by the DPC. As part of this effort the DPC provides calendars that consolidate important flood-related information specific to the Delta including emergency phone numbers and websites with flood education as well as safety information.

A second is the Sacramento County Program for Public Information that aims to increase awareness through informational materials (such as the Storm Ready Booklets) and multiple levels of outreach, ranging from radio spots to specific stakeholder engagement. This program can act as a conduit of flood risk information and coordination directly with the community members of Hood.

The third program is the California DWR Flood Risk Notification Program that includes sending annual notices in advance of the flood season to every property owner who is located behind a SPFC levee within the Delta. The individual notices include the property owner’s address and informs the owners their property may be exposed to potential flood risk from the failure of the levee system. The notice also suggests each property owner visit DWR's Flood Risk

Notification[2] website and enter their address to get the most information on State-federal levees in their area.

5.3 Multi-Objective Components

There are several opportunities for including multi-objective components during construction of structural elements and implementation of select non-structural measures. Multi-objective options could offer benefits outside of the Hood Legacy Community boundary and benefit the broader community within and beyond the larger study area.

5.3.1 Water Quality and Water Supply, including Through-Delta Conveyance Reliability and Operational Flexibility

Repairing and strengthening the SPFC levee reaches along the east, left bank of the Sacramento River between Freeport and the Delta Cross Channel (which includes MA 9, RD 755 – Randall Island, RD 551 – Pearson District, RD 369 – Libby McNeil/Locke, RD 554 – East Walnut Grove, and RD 3 – West Walnut Grove/Ryde) would also improve the reliability and resiliency of conveying through-Delta CVP and SWP water in the Lower Sacramento River to the Delta Cross Channel. Improving the 2.5 mile stretch of SPFC levees located along the left bank of the Sacramento River within the study area would improve 4 percent of the SPFC levees which comprise the freshwater corridor within the Delta (total of 62 miles). Similarly, improving the 2.5 miles of SPFC levees located along the left bank of the Sacramento River within the study area would improve nearly 7 percent of the SPFC levees located between Freeport and the Delta Cross Channel (total of 37 miles). Additionally, improving the entire 9-mile stretch of SPFC levees along the left bank of the Sacramento River between Freeport and RD 755 would constitute improving 15 percent of the SPFC levees which comprise the freshwater corridor within the Delta, and 24 percent of the SPFC levees located between Freeport and the Delta Cross Channel.

5.3.2 Ecosystem Restoration/Enhancement

Ecosystem restoration opportunities must be balanced with flood management requirements and in support of continued agricultural land uses in the Delta. Restoration opportunities adjacent to Hood include:

1) Creating wetland habitat within areas used for borrow during levee improvements or construction, particularly lands already in State ownership on the southern portion of the study area (known as Hood Junction).
2) Enhancing or creating additional Shaded Riverine Aquatic (SRA) habitat along the Sacramento River in connection with addressing erosion concerns and/or replenishing rocks slope protection at known erosion sites within the study area.

[2] https://water.ca.gov/myfloodrisk

3) If borrow material is need for improving levees within the Hood study area, project proponents could work with other regional entities, and consider borrowing material from the Stone Lakes Wildlife Refuge (south and north of Hood-Franklin Road) that may create opportunities for enhancing tidal-influenced Delta habitat while also marginally reducing flood stages in the Franklin Pond areas east of Snodgrass Slough.

The opportunity for SRA habitat enhancement of the right bank of the Sacramento River could be a potential extension and offer greater connectivity to the SRA opportunities outlined in the 2014 RFMP between Sacramento RM 35 and RM 46 within MA 9 between Freeport and Courtland. *See* Appendix D for a detailed discussion of ecosystem opportunities.

5.3.3 Public Recreation and Education Multi-Benefit Opportunities

The Delta Legacy Communities and encompassing study areas provide a unique mix of modern working agricultural lands, wildlife habitat and viewing opportunities, pastoral landscapes, and a glimpse into history. This provides an opportunity to encourage public education and recreation opportunities for community residents and visitors from outside the Delta and to provide economic stimulus from Delta-centric tourism.

Cross Levee Community/Regional Trail

Either of the previously proposed cross levee alignments on the north side of Hood could be modified slightly to act as a community or regional destination, multi-use trail for walking, biking and potentially equestrians. A circular loop around the community of Hood would allow trail users to easily avoid traffic on Scenic Route (SR) 160 and create greater opportunities to visit the adjoining Stone Lakes Area as well as the DWR-owned property just south of Hood, adjoining the south railroad embankment.

This cross levee trail (either alignment) could also connect to the Sacramento River levee, to the existing railroad embankments south and east of Hood (currently owned in fee title by State Parks), to create a circular public access around the community. The trail could include trailheads at the east and/or south sides, where the trail would connect to existing railroad spur embankments (owned by State Parks) and open space is available off Hood-Franklin Road. A trailhead could also be created to the south of the River Road Exchange building, on the east side of SR 160 where an existing paved area could be improved for parking. These further connections could ultimately allow users to access other Delta Legacy Communities to the south. Additionally, users could access Stone Lakes National Wildlife Refuge to the east without the need to walk/ride along the SR 160 where pedestrian and bike access is difficult, due to narrow road shoulders. The cross levee trail could also include signage and interpretive information for users regarding the rich history of the area.

Regional Connection Trail

With slight modifications, the planned remediation of the RD 744 south cross levee could include all-weather surface and signage. It could also be included in a trail network, with a connection to the railroad embankment (owned by State Parks) along the east side of the Hood study area and SR 160 along the west side.

Fix-in-place levee improvements could also be combined with a slight widening of the Sacramento River levee crest along Scenic Highway 160, which would allow the levee to accommodate a walking/bike trail. With this additional improvement, residents and visitors would be able to safely walk/ride around the entire perimeter of the Hood study area.

The former railroad embankments along the east side and south sides of the Hood study area are collectively owned by State Parks and other public entities. These same former railroad embankments extend over seven miles to the north through Freeport, and over eight miles to the south into Locke and Walnut Grove. Developing trailheads in Hood to these former railroad embankments could serve as the beginning of a North Delta trail system consistent with the goals of developing regional trails within the Delta as identified in the Delta Protection Commission's 2020 Update to the Economic Sustainability Plan for the Sacramento - San Joaquin Delta - Recreation and Tourism Chapter. The Recreation and Tourism Chapter Update also mentions the development of the Great California Delta Trail that is intended to connect San Francisco Bay trails with Sacramento River corridor trails. Developing trailheads and trail improvements around the community of Hood that could eventually extend north to Freeport and south to Locke and Walnut Grove would be consistent with the goals and objectives of developing the Great California Delta Trail as well as the latest 2020 updates to the Delta Protection Commission's Economic Sustainability Plan.

These recreational trail concepts must be balanced with maintaining the quality of life for residents and agricultural practices of the greater Hood community and require further refinement and discussion with landowners and stakeholders, including the HCC, State Parks and Sacramento County. However, Hood has much to share with visitors, as detailed on the Story Map for the community, accessible here: Hood Story Map - Sacramento County Small Communities Flood Risk Reduction Program.[3]

[3] Hood Story Map - Sacramento County Small Communities Flood Risk Reduction Program: https://sacramentocounty.maps.arcgis.com/apps/MapJournal/index.html?appid=cda6eb30ff4943ffbae895e122c8791e

6. Identification and Trade-Off Analysis of Flood Risk Reduction Management Actions

This Section uses the structural elements and non-structural measures previously described in Section 5 to develop and prioritize management actions based on risk reduction and responsiveness to planning objectives, as well as constraints regarding funding, implementation, and capital costs. These management actions are recommended to be implemented in a successive fashion as funding is collectively identified and secured. This Section also provides the capital costs associated with each management action, as well as a trade-off analysis using the planning objectives identified above in Section 4.1.

The structural elements and non-structural measures identified in Section 5 were prioritized into nine management actions based on the most efficient approaches to reducing risk and achieving the previously identified objectives of:

- Reducing risk to life
- Reducing risk to property damage
- Reducing probability of levee failure
- Limitation of high insurance premiums
- Improved preparedness and response
- Enhancing resiliency and reliability of through-Delta water conveyance
- Prioritizing environmental stewardship and multi-benefit projects

As previously discussed, risk reduction is defined as the product of the probability of levee failure and the consequences of failure. The consequences of levee failure are defined in this study in terms of life loss and property damage. Of the nine management actions, those which resulted in the greatest risk reduction by reducing the probability of levee failure of the weakest levee segments and reducing the consequences of levee failure through reduced life loss and property damage were given priority. However, funding, implementation, and capital cost are also considered during the prioritization process.

6.1 Identification of Flood Risk Reduction Management Actions

The nine structural-based management actions are summarized below. These management actions are compared against the no action, future without project condition to quantify and qualify how well each management action addresses the objectives of this study using the planning objectives identified above in Section 4.1.

6.1.1 No Action, Future Without Project

Future without project conditions represents the current level of flood protection within the study area, does not incorporate any structural or non-structural flood risk reduction elements, and incorporates expected changes to the study area from climate change, sea level rise, and future land uses. These conditions do not include any flood management improvements that have been authorized and have funding, or that have started construction or implementation.

Without any changes to the flood management system or implementation of non-structural elements:

- The study area remains at a high risk of flooding. As previously discussed, according to ongoing and previous studies conducted by DWR and the DSC DLIS, it is estimated that the community of Hood has an estimated level of flood protection of less than 10 years, largely due to the presence of known FSRP critical and serious sites previously identified by DWR.
- There is a high risk of life loss for the densely populated community of Hood. Currently, the levee fronting the community of Hood along the left bank of the Sacramento River, as documented by DWR in the NULE GAR, is estimated to have a high risk of levee failure or the need to flood fight based on potential vulnerability to underseepage, through seepage, slope stability, and erosion. In the event of a levee failure at this location, significant life loss is likely as a result of high floodwater stages and velocities which would leave little time to evacuate.
- There is also a high risk of property damage for the community of Hood, the larger study area, RD 744, and the adjacent communities of Elk Grove and Point Pleasant outside the immediate study area. As discussed above, the levee along the left bank of the Sacramento River is estimated to have a high risk of levee failure or the need to flood fight based on high vulnerability to underseepage and through seepage. This is further evident by the DWR FSRP sites along the levee, which have not been fully repaired to date. A levee breach along this segment of levee could result in significant property damage to the community, the larger study area, and the adjacent communities of Elk Grove and Point Pleasant on the order of $9.49B, largely as a result of flood depths ranging from 10 feet to 27 feet outside the immediate study area. With the current level of flood protection noted above, this equates to an EAD of nearly $8.6M for the aggregated SAC 44 and SAC 45 impact areas under existing conditions, and up to $71.5M under future conditions with the effects of inland climate change and sea level rise.
- The larger study area remains susceptible to high NFIP annual premium increases, which could result in a net reduction of insured homes, further increasing flood risk.

- Levees within the Delta remain at risk of failure, which could significantly impact the agricultural economy within and adjacent to the community of Hood and the conveyance of water to SWP and CVP water contractors south of the Delta.

6.1.2 Management Action 1: Repair DWR FSRP Critical and Serious Sites within Hood Study Area Portion of DWR MA 9

The four combined critical and serious seepage sites within the Hood study area on the left bank of the Sacramento River along NULE Segment 106 within DWR MA 9 and pose imminent flood threats to the community of Hood, the larger study area, and to areas outside of the study area including RD 744, Elk Grove, Point Pleasant, and portions of Interstate 5 (Figure 6-1). These sites were identified under the DWR FSRP in 2013 and remain unrepaired. Two of the three critical sites and the single serious site are located upstream from the community of Hood. The remaining critical seepage site is located south of the southern boundary of the study area, downstream of the community of Hood. As previously discussed, a levee failure at any of these locations could result in life loss in the Hood study area *via* high floodwater depths and velocities. Property damage is also of concern in the Hood study area, and within RD 744, Elk Grove, and Point Pleasant east of Interstate 5, in the event of a levee failure at any of the four FSRP sites as a result of deep flooding. Repairing these previously identified FSRP sites would not only reduce the probability of levee failure, but also reduce the risk of life loss and property damage (both inside the Hood study area and in RD 744, Elk Grove, and Point Pleasant), resulting in a net reduction in flood risk.

Considering capital cost, implementation, and funding, the repair of the DWR FSRP critical and serious sites located within the Hood study area was selected as the most efficient, no regrets means to reducing flood risk to the community of Hood and the larger study area and was thus prioritized as Management Action 1. Proposed remediations for the four FSRP critical and serious sites in the Hood study area are described in Section 5.1.1.1, Table 5-1.

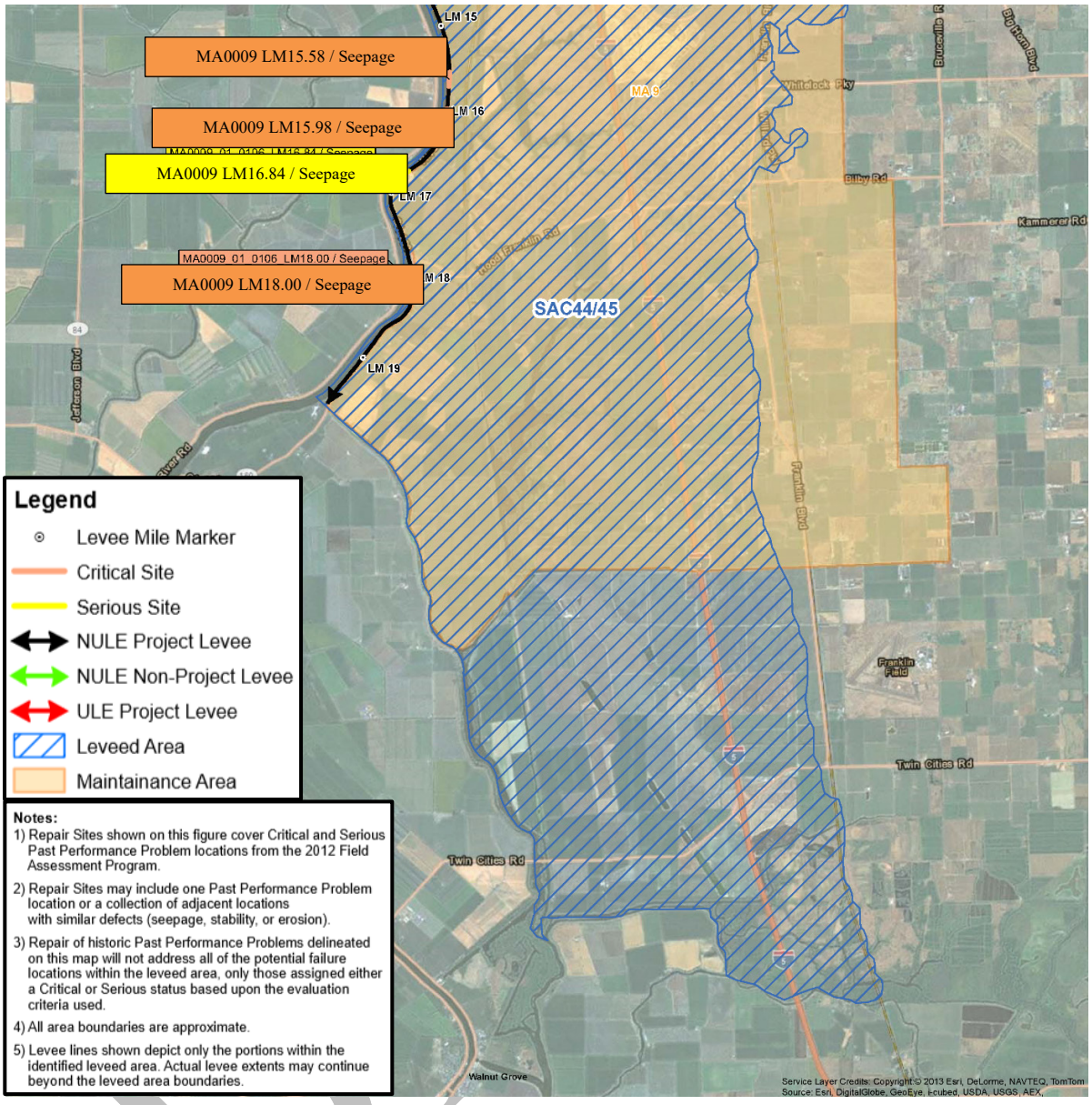


Figure 6-1. Management Action 1 - Repair of DWR FSRP Sites in Hood Study Area portion of MA 9 (URS, 2013a), updated in 2020 by Sacramento County

6.1.3 Management Action 2: Raise and Repair/Strengthen-in-Place RD 744 South Cross Levee

As previously discussed, a levee breach on the left bank of the Sacramento River upstream of the Hood study area in the RD 744 portion of MA 9 is estimated to result in flood depths between 10 and 20 feet in Hood, and up to 27 feet in the larger study area, northeast of Hood. Repairing, strengthening, and raising the 0.25 mile RD 744 south cross levee at the northern boundary of the study area would prevent floodwaters originating from a levee breach along the Sacramento River east, and left bank levee upstream in RD 744 from entering the community of Hood and

the larger study area, reducing the overall risk to life loss and property damage, and resulting in a net reduction in flood risk. Repairing, raising and strengthening-in-place the RD 744 south cross levee along the northern boundary of the Hood study area was selected as the next most efficient means to reducing flood risk to the community of Hood and the Hood study area, considering capital cost, implementation, and funding constraints. Proposed remediations for Management Action 2 are described in Section 5.1.2.1 and Table 5-5.

6.1.4 Management Action 3: Repair DWR FSRP Critical and Serious Sites North of the Hood Study Area within DWR MA 9

Repair of the five collective critical and serious seepage sites along the left bank of the Sacramento River upstream of the Hood study area within DWR MA 9 was selected as the next most efficient means of reducing flood risk to the community of Hood and the larger study area (Figure 6-2). Repair of these sites also reduces flood risk to the adjoining areas of Elk Grove/Point Pleasant to the east, including portions of Interstate 5. As previously noted, these sites are located along the left bank of the Sacramento River along NULE Segment 106 (MA 9) which is estimated to have a high likelihood of failure. A levee breach upstream of the Hood study area in RD 744 could result in flood depths in Hood up to 15 feet, with the larger study area experiencing flood depths up to 30 feet. Property damage is likely in this scenario due to high flood depths, and the potential for loss of life exists within RD 744 and greater area within MA 9 south of Freeport due to high floodwater velocities and little evacuation time. The repair of the five collective FSRP critical and serious sites on the left bank of the Sacramento River upstream of the Hood study area would reduce these risks and the overall flood risk for both the Hood study area, and areas outside of and adjacent to the study area and was selected as Management Action 3. Proposed remediations for Management Action 3 are described in Section 5.1.1.1, Table 5-2.

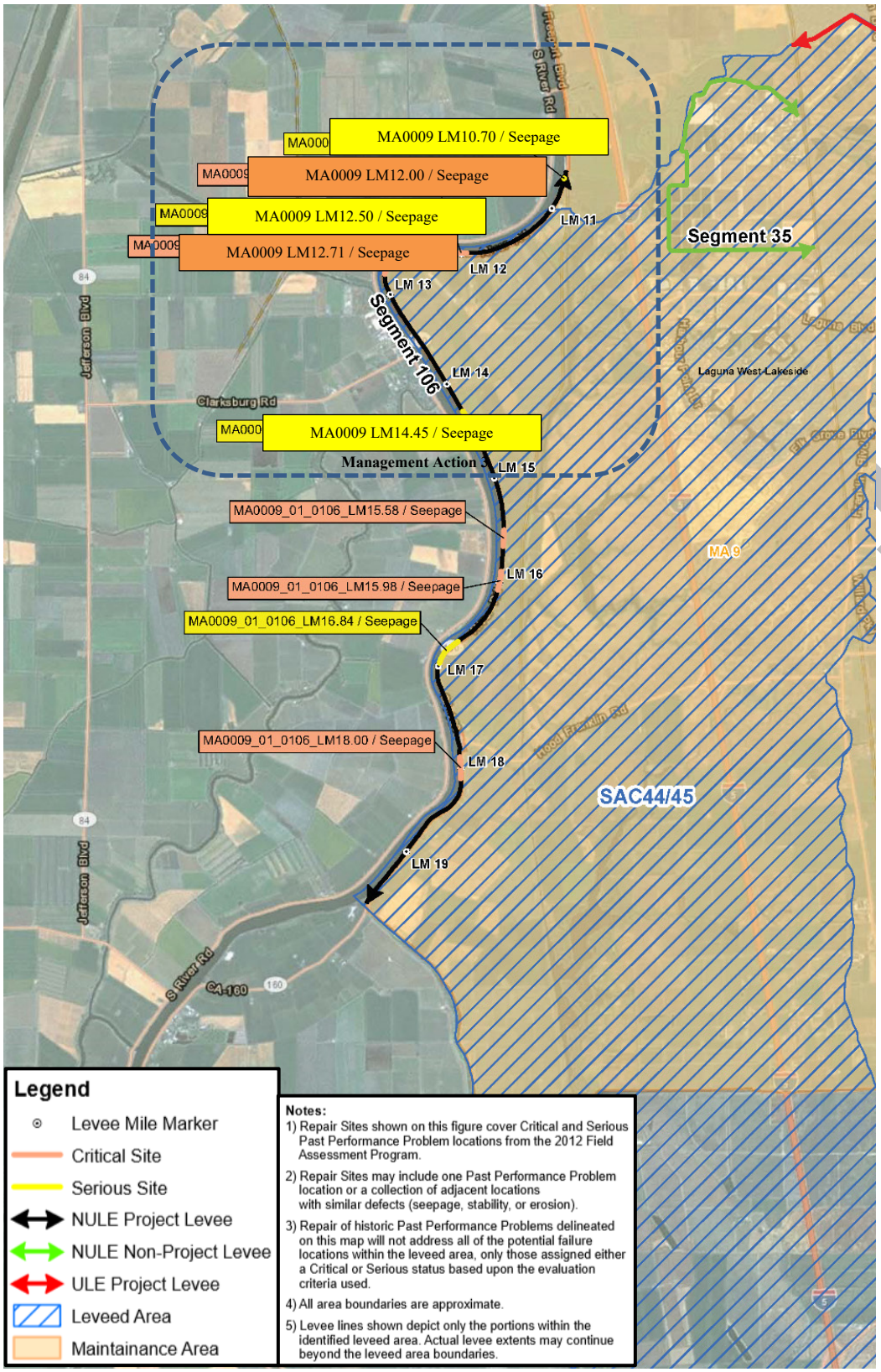


Figure 6-2. Management Action 3 - Repair of DWR FSRP Sites in MA 9 Upstream of Hood Study Area (URS, 2013a), updated in 2020 by Sacramento County

6.1.5 Management Action 4: Previously Proposed Cross Levee North of Hood Paired with: Repair and Strengthen-in-Place MA 9 SPFC Levee Adjacent to Hood; and Repair and Strengthen Existing Non-SPFC Levee South of Hood (2012 CVFPP and 2014 RFMP Configuration)

Constructing the levee system described in Section 5.1.1.2, which consists of strengthen-in-place improvements and repairs to the levees to the west and south of Hood, as well as a new cross levee north of Hood, as described in the 2012 CVFPP and 2014 RFMP, would greatly reduce flood risks for the community of Hood. This levee system would effectively eliminate the probability of levee failure to the west and south of Hood and prevent floodwaters from inundating the community from the north. The risk of life loss and property damage within the community would be greatly reduced, thereby reducing the overall flood risk. Considering the capital cost of these improvements, this flood risk reduction element was prioritized as Management Action 4. Proposed remediations for Management Action 4 are described in Section 5.1.1.2 and Table 5-3.

6.1.6 Management Action 5: Community-Preferred Cross Levee Alignment North of Hood Paired with: Repair and Strengthen-in-Place MA 9 SPFC Levee Adjacent to Hood; and Repair and Strengthen Existing Non-SPFC Levee South of Hood

Constructing the levee system described in Section 5.1.2.2, which consists of strengthen-in-place improvements and repairs to the levees to the west and south of Hood, as well as a new cross located further north than the levee described in the 2012 CVFPP and 2014 RFMP as preferred by local interests and landowners, would greatly reduce flood risk for the community of Hood. This levee system would effectively eliminate the probability of levee failure to the west and south of Hood and prevent floodwaters from inundating the community from the north. The risk of life loss and property damage within the community would be greatly reduced, thereby similarly reducing the overall flood risk. Considering the capital cost of these improvements, this flood risk reduction element was prioritized as Management Action 5. Proposed remediations for Management Action 5 are described in Section 5.1.2.2 and Table 5-6.

6.1.7 Management Action 6: Repair and Strengthen-in-Place Sacramento River Left Bank MA 9 SPFC Levee in Hood Project Area (Multi-Benefit Component to Improve Reliability and Resiliency of Through-Delta Conveyance)

Repair and strengthen-in-place of all 2.5 miles of SPFC levees within the Hood study area within DWR MA 9 would greatly reduce the probability of levee failure along the entire left bank of the Sacramento River of MA 9 and protect lives and property within both the community of Hood, the larger study area, and areas outside of the study area such as Elk Grove and Point Pleasant, including portions of Interstate 5. Management Action 6 also provides the multi-benefit of

improving the resiliency and reliability of through-Delta water conveyance by improving nearly 7 percent of the non-urban SPFC levees located within the Delta between Freeport and the Delta Cross Channel (total of 37 miles) and 4 percent of the total non-urban SPFC levees downstream of Freeport (total of 62 miles), which comprises the freshwater corridor along SPFC levees within the North Delta. This flood risk reduction element was prioritized as Management Action 6 due to funding, capital cost, and implementation considerations. Capital costs are described further in Section 6.2.5. Management Action 6 repairs and strengthens the entirety of the SPFC levees (NULE Segment 106) located along the left bank of the Sacramento River within the immediate Hood Study area consistent with the proposed remediations described in Section 5.1.2.3

See Appendix K for further details in support of the multi-benefit opportunities identified by the Sacramento County Delta Legacy Communities associated with reducing flood risks combined with improving SWP water conveyance through the Delta.

6.1.8 Management Action 7: Repair and Strengthen-in-Place – Non-SPFC Levees/Former Railroad Embankments

Similar to Management Action 6, repair and strengthen-in-place of all 3.25 miles of the non-SPFC former railroad embankment/levee system would greatly reduce the probability of levee failure along the north, east, and south side of the study area, which would result in reduced life loss and property damage within the Hood study area, as well as to areas outside of the study area boundaries including Elk Grove, Point Pleasant, and portions of Interstate 5. The levees along the Sacramento River are of greater concern when it comes to protecting people and property. As a result, this flood risk reduction element was prioritized after the repair and strengthen-in-place of the SPFC levees along the Sacramento River. Management Action 7 repairs and strengthens the entirety of the non-SPFC levees located along the border with RD 744 to the north, as well as former railroad embankments to the east and to the south of Hood, consistent with the proposed remediations described in Section 5.1.2.4.

6.1.9 Management Action 8: Secure 100-Year FEMA Certification for Community and Entire Hood Study Area

FEMA certification of the perimeter levee system ensures 100-year flood protection for the community of Hood and the larger study area, helps to limit high NFIP flood insurance premiums and enhances the resiliency and the reliability of through-Delta water conveyance by improving nearly 7 percent of the non-urban SPFC levees located within the Delta between Freeport and the Delta Cross Channel (total of 37 miles), and 4 percent of the total non-urban SPFC levees downstream of Freeport (total of 62 miles), which comprise the freshwater corridor in the North Delta. However, FEMA certification of the entire perimeter levee system may be cost-prohibitive without support from through- and south-of-Delta water conveyance interests associated with the CVP and SWP. As a result, securing 100-year FEMA certification for the entire perimeter levee system within the Hood study area was prioritized as Management Action

8. FEMA accreditation could be obtained once the perimeter levee system is remediated and improved to FEMA criteria for erosion, through seepage, underseepage, slope stability, and freeboard. All design criteria, O&M requirements, and documentation requirements included in 44 CFR §65.10 would also need to be addressed to secure 100-year FEMA certification for the entire study area.

6.1.10 Management Action 9: Repair and Strengthen-in-Place 9.0 miles of Sacramento River Left Bank MA 9 SPFC Levee between Freeport and RD 755 (Multi-Benefit Component to Improve Reliability and Resiliency of Through-Delta Conveyance)

Repairing and strengthening the 9 miles of MA 9 SPFC levees between Freeport and RD 755 provides the multi-benefit of improving the resiliency and the reliability of through-Delta water conveyance by improving 24 percent of the non-urban SPFC levees located within the North Delta between Freeport and the Delta Cross Channel (total of 37 miles) and 15 percent of the total non-urban SPFC levees downstream of Freeport (total of 62 miles), which comprises the freshwater corridor in the North Delta. However, repairing and strengthening this segment of levee may be cost-prohibitive without support from through- and south-of-Delta water conveyance interests associated with the CVP and SWP. As a result, repairing and strengthening the MA 9 SPFC levees between Freeport and RD 755 was prioritized as Management Action 9.

As previously noted above in Section 5.1.2.6, the noted 9 mile reach of the Sacramento River left bank MA 9 SPFC levee reach between Freeport and RD 755 (near Courtland) is much more susceptible and vulnerable to potential levee failure than the opposite right bank levees in Yolo County. Refer to Appendix A-2, which is a TM assessing levee vulnerability of the Sacramento River Non-Urban levee in Sacramento and Yolo Counties downstream of the Sacramento and West Sacramento Urban levee systems. This TM was prepared by GEI Consultants in May of 2017 on behalf of SAFCA to assess the vulnerabilities of the non-urban left and right bank levees that could potentially fail and pose threats of flooding the adjoining, upstream urban areas. Figure 5-11 included above in Section 5.1.2.6, and excerpted from Appendix A-2, clearly indicates that the Sacramento River left bank DWR MA 9 levees (NULE Segment 106) between Freeport, Hood, and RD 755 are much more susceptible and vulnerable to potential levee failure than the right bank levees in Yolo County. As such, the entire MA 9 levee system downstream of Freeport warrants comprehensive remediation actions to reduce obvious flood risks.

See Appendix K for further details in support of the multi-benefit opportunities identified by the Sacramento County Delta Legacy Communities associated with reducing flood risks combined with improving SWP water conveyance through the Delta.

6.2 Capital Costs

Cost estimates were developed for each of the structural elements identified in Section 5.1. Where possible, these cost estimates were developed in concert with previous estimates prepared

by DWR. Table 6-1 provides a range of capital cost estimates by levee reach using the previously identified remediation alternatives. These estimates are used as the basis to develop the range of costs for each of the repair/strengthen-in-place structural elements, with the exception of repair of the DWR FSRP critical and serious sites and the new cross levee as detailed in Sections 5.1.1.2 and 5.1.2.2. The estimated cost to repair the DWR MA 9 FSRP sites was developed in DWR's 2013 Pre-Feasibility Report and updated to July 2020 dollars and is detailed in Section 6.2.1 below. The estimated cost to construct the new cross levees as part of Management Actions 4 and 5 are detailed in Sections 5.1.1.2 and 5.1.2.2. Costs presented in this Section are intended to be Class 4 (Feasibility Level) estimates as defined by the Association for Advancement of Cost Engineering International. Additional geotechnical explorations and analysis are recommended to further refine these cost estimates. Costs for all approaches are escalated to a cost basis of July 2020 using the 20 cities average from the Engineering News-Record Construction Cost Index. Further description of the development of the capital costs can be found in Appendix F.

Table 6-1. Repair/Strengthen-in-Place Cost Estimates by Levee Reach for Hood Study Area

Levee Segment Location	Reach	Start Station	End Station	Length (ft)[1]	Remediation Alternative 1	Remediation Alternative 1 Cost Estimate	Remediation Alternative 2	Remediation Alternative 2 Cost Estimate
Left Bank Sacramento River	106-A	3107+39	3237+92	13,100	80-ft.-deep cutoff wall	$98,357,000	80-ft.-wide, 9-ft.-tall combination seepage and stability berm	$34,529,000
RD 744 South Cross Levee	North CL	0+00	5+00	500	50-ft.-deep cutoff wall 1 ft. levee raise	$1,631,000	85-ft.-wide, 16-ft.-tall combination seepage and stability berm 1 ft. levee raise	$1,538,000
		5+00	13+00	800	50 ft. deep cutoff wall 2.5 ft. levee raise	$2,768,000	85-ft.-wide, 16-ft.-tall combination seepage and stability berm 2.5 ft. levee raise	$2,636,000
Hood East Railroad Embankment	East RR-A	0+00	45+00	4,500	15 ft. deep cutoff wall 105-ft. wide RSP (4,500 ft.)	$14,013,000	12-ft.-tall, 15-ft- wide drained stability berm 105-ft.-wide RSP (4,500 ft.)	$11,204,000
	East RR-B	45+00	90+00	4,500	60 ft. deep cutoff wall 140 ft. wide RSP (3,500 ft.) 1.0 ft. levee raise	$20,880,000	140-ft.-wide, 19-ft.-tall combination seepage and stability berm 140-ft.-wide RSP (3,500 ft.) 1.0 ft. levee raise	$26,618,000
	East RR-C	90+00	131+25	4,100	-	$0	-	$0
Hood South Railroad Embankment	South RR-A	0+00	34+21	3,400	15 ft. deep cutoff wall 105 ft. wide RSP (3,000 ft.)	$10,696,000	13 ft. tall, 15. ft wide drained stability berm 105 ft. wide RSP (3,000 ft.)	$14,692,000
Totals for Entire Levee Perimeter System of Hood Study Area				30,900 ft. 5.85 mi.		$148,345,000 ($25M/mile)		$91,217,000 ($16M/mile)

Note: [1]Reach lengths rounded to the nearest 100 feet

6.2.1 Repair of DWR FSRP Critical and Serious Sites within MA 9 Downstream of Freeport (Management Actions 1 and 3)

The estimated c

ost to repair all nine of the combined DWR FSRP critical and serious site within DWR MA 9, as documented in DWR's 2013 FSRP Pre-Feasibility Report, escalated to July 2020 dollars, is $13,937,000. Repairing the four critical and serious sites within and just south of the Hood study area (Management Action 1) comprise $7,729,000 of this total, with the remaining $6,208,000 allocated to repairing the five critical and serious sites north of the Hood study area in RD 744 (Management Action 3).

6.2.2 Raise and Repair/Strengthen-in-Place RD 744 South Cross Levee (Management Action 2)

The range of cost estimates to raise and repair/strengthen the RD 744 south cross levee located at the northern boundary of the study area was developed using the costs provided for reach North CL in Table 6-1. The cost estimate for this element ranges from $4,174,000 (85-ft.-wide, 16-ft.-tall combination seepage/stability berm and 1 to 2.5 ft. levee raise) to $4,399,000 (50-ft.-deep cutoff wall, and 1 to 2.5 ft. levee raise).

6.2.3 Previously Proposed Cross Levee North of Hood Paired with: Repair and Strengthen-in-Place MA 9 SPFC Levee Adjacent to Hood; and Repair and Strengthen Existing Non-SPFC Levee South of Hood (2012 CVFPP and 2014 RFMP Configuration) (Management Action 4)

The range of cost estimates to repair and strengthen the levees to the west and south of Hood were developed using the costs provided for reaches 106-A and South RR-A in Table 6-1.

1. 106-A: Assuming that the levee fronting the community totals 0.25 miles in length, the cost to repair this segment of levee ranges from $3,492,000 (80-ft.-wide, 9-ft.-tall combination seepage/stability berm) to $9,946,000 (80 ft. deep cutoff wall). However, it is expected that a cutoff wall would be implemented along this segment of levee to reduce physical impacts associated with a stability berm that would displace structures within the community that are located on and/or directly adjacent to the landward toe of the existing levee system.
2. South RR-A: The estimated cost to repair the railroad embankment located south of Hood ranges from $10,696,000 (15-ft.-deep cutoff wall and 105 ft. of RSP for 3,000 ft.) to $14,692,000 (13-ft.-tall, 15-ft.-wide drained stability berm and 105 ft. of RSP for 3000 ft.) However, it is expected that a cutoff wall would be implemented along this segment of levee to reduce physical impacts associated with a stability berm that would displace

structures within the community that are located adjacent to the landward toe of the existing levee, former railroad embankment system.

3. The cost associated with constructing the cross levee alignment previously identified in the 2012 CVFPP and 2014 RFMP is presently estimated at $14,910,000.

The total estimated cost to secure FEMA accreditation for this entire cross levee system ranges between $34.7M to $37.3M as summarized in Table 6-2 below. As described above, a range of costs is provided, as the repair and strengthen-in-place repairs to the west and south of Hood can be remediated through a cutoff wall or stability berm.

Table 6-2. Estimated Range of Costs for Construction of a Cross Levee System per the 2012 CVFPP/ 2014 RFMP and FEMA Certification

Cost Component	Estimated Cost
1. Construction of a Cross Levee Identified in 2012 CVFPP and 2014 RFMP	$14,910,000
2. Repair and Strengthen-in-Place MA 9 Levee Immediately Fronting the Community of Hood	$3,492,000 -$9,946,000
3. Repair and Strengthen-in-Place Railroad Embankment South of Hood (including RSP)	$10,696,000 - $14,692,000
4. FEMA Certification (5 percent of items 1-3 above)	$1,655,000 - $1,778,000
Total	**$34,749,000 - $37,330,000**

In comparison, as detailed in the 2014 RFMP and escalated to July 2020 dollars, DWR estimated a total cost of $36,368,000 to construct a new cross levee and perform SPFC and non-SPFC levee repairs associated with this flood risk reduction element.

6.2.4 Community-Preferred Cross Levee Alignment North of Hood Paired with: Repair and Strengthen-in-Place MA 9 SPFC Levee Adjacent to Hood; and Repair and Strengthen Existing Non-SPFC Levee South of Hood (Management Action 5)

The range of cost estimates to repair and strengthen the levees to the west and south of Hood were developed using the costs provided for reaches 106-A and South RR-A in Table 6-1.

1. 106-A: Assuming that the levee fronting the community totals 0.50 miles in length, the cost to repair this segment of levee ranges from $5,587,000 (80 ft. wide, 9 ft. tall combination seepage/stability berm) to $15,914,000 (80 ft. deep cutoff wall). However, it is expected that a cutoff wall would be implemented along this segment of levee to reduce physical impacts associated with a stability berm that would displace structures within the community that are located on and/or directly adjacent to the landward toe of the existing levee system.

2. South RR-A: The estimated cost to repair the railroad embankment located south of Hood ranges from $10,696,000 (15-ft.-deep cutoff wall and 105 ft. of RSP for 3,000 ft.) to $14,692,000 (13-ft.-tall, 15-ft.-wide drained stability berm and 105 ft. of RSP for 3,000 ft.). However, it is expected that a cutoff wall would be implemented along this segment of levee to reduce physical impacts associated with a stability berm that would displace structures within the community that are located adjacent to the landward toe of the existing levee system.
3. The cost associated with constructing the community-preferred cross levee alignment is estimated at $16,310,000.

The estimated cost to secure FEMA accreditation for this entire cross levee system ranges between $38.4M to $45.0M as summarized in Table 6-3 below. As described above, a range of costs is provided, as the repair and strengthen-in-place repairs to the west and south of Hood can be remediated through a cutoff wall or stability berm.

Table 6-3. Estimated Range of Costs for Construction of a Hood Cross Levee System with Community-Preferred Alignment and FEMA Certification.

Cost Component	Estimated Cost
1. Construction of a New Cross Levee with Community-Preferred Alignment	$16,310,000
2. Repair and Strengthen-in-Place Levee Immediately Fronting the Community of Hood	$5,587,000 - $15,914,000
3. Repair and Strengthen-in-Place Railroad Embankment South of Hood (including RSP)	$10,696,000 - $14,692,000
4. FEMA Certification (5 percent of items 1-3 above)	$1,829,000 - $2,146,000
Total	**$38,419,000 - $45,066,000**

6.2.5 Repair and Strengthen-in-Place Sacramento River Left Bank – DWR MA 9 SPFC Levee for Hood Study Area Only (Management Action 6)

The range of cost estimates to repair and strengthen the SPFC levee segments located along the left bank of the Sacramento River were developed using the costs provided for reach 106-A in Table 6-1. The cost estimate for this element ranges from $34,529,000 or $14M per mile (80-ft.-wide, 9-ft.-tall combination seepage/stability berm) to $98,357,000 or $39M per mile (80-ft.-deep cutoff wall).

In comparison, as detailed in the 2011 Remedial Alternatives and Cost Estimates Report for the North NULE study area, DWR estimated a total cost of $152,038,000 to remediate the entirety of NULE Segment 106 (total of 9.0 miles), which extends from one mile south of Freeport to the northeasterly boundary of RD 755, south of Hood. Escalating this cost estimate to July 2020 dollars equates to $191,754,000, or $21M per mile. With an estimated length of 2.5 miles,

DWR's estimated cost to remediate the left bank of the Sacramento River in the Hood study area is $53,265,000.

6.2.6 Repair and Strengthen-in-Place – Non-SPFC Levees/Former Railroad Embankments in Hood Study Area (Management Action 7)

The range of cost estimates to repair and strengthen the non-SPFC levee segments, including former railroad embankments, located to the north, east, and south of Hood were developed using the costs provided for reaches North CL, East RR-A, East RR-B, and South RR-A in Table 6-1. The cost estimate for this element ranges from $49,988,000 or $15M per mile (assuming cutoff walls are implemented for each reach) to $56,688,000 or $17M per mile (assuming berms are implemented for each reach).

6.2.7 Secure 100-Year FEMA Certification for Community and Entire Study Area (Management Action 8)

The cost of securing 100-year FEMA certification for the community of Hood and the entire study area is the summation of all the costs associated with: (1) repairing and strengthening the entirety of the perimeter levees (SPFC and non-SPFC levees) to current FEMA standards identified above in Sections 6.2.5 and 6.2.6 and collectively identified above in Table 6-1; (2) addressing any reaches that contain an immediate freeboard issue (RD 744 south cross levee) or long-term settlement issues (unknown) as noted above in Section 5.1.2.5; (3) correcting all encroachments (closures, pipelines, and structures) within and/or adjacent to the entirety of the perimeter levee system that pose a threat to the structural and/or operational integrity of the levee system pursuant to 44 CFR §65.10, as noted above in Section 5.1.2.5; (4) conducting the applicable interior drainage studies and operational plans as noted above in Section 5.1.2.5; and (5) updating applicable operation and maintenance plans following all repairs and improvements and modifications to ensure the entirety of the perimeter levee system is operated and maintained in accordance with FEMA, USACE, and CVFPB standards. For cost estimating purposes, FEMA certification items (2) through (5) noted herein and described in more detail within Section 5.1.2.5, are estimated at 5 percent of the total combined cost of item (1) herein associated with repairing and strengthening the entirety of the perimeter levee system. The estimated cost to secure 100-year FEMA certification for the community of Hood and the larger study area ranges from $95,778,000 (assuming berms are implemented to repair/improve the entire perimeter levee system) to $155,762,000 (assuming cutoff walls are implemented to repair/improve the entire perimeter levee system)(Table 6-4).

Table 6-4. Estimated Range of Costs for 100-Year FEMA Certification for the Community of Hood and Entire Study Area.

Cost Component	Estimated Cost
Remediation and Improvement Alternative 1 (Cutoff Walls) Implemented for Entire Perimeter Levee System of Hood Study Area (5.85 miles)	
1. Repair and Strengthen-in-Place Repairs to the Entire Perimeter Levee System: Remediation Alternative 1 (Cutoff Walls and RSP)	$148,345,000
2. FEMA Certification (5% of item 1 above)	$7,417,000
Total	$155,762,000 ($27M/mile)
Remediation and Improvement Alternative 2 (Berms) Implemented for Entire Perimeter Levee System of Hood Study Area (5.85 miles)	
1. Repair and Strengthen-in-Place Repairs to the Entire Perimeter Levee System: Remediation Alternative 2 (Berms and RSP)	$91,217,000
2. FEMA Certification (5% of item 1 above)	$4,561,000
Total	**$95,778,000 ($16M/mile)**

6.2.8 Repair and Strengthen-in-Place – Sacramento River Left Bank – DWR MA 9 SPFC Levee between Freeport and RD 755 (Multi-Objective Component to Improve Reliability and Resiliency of Through-Delta Conveyance) (Management Action 9)

The range of cost estimates to repair and strengthen the 9 miles of SPFC levee between Freeport and RD 755 were developed using the costs provided for reach 106-A in Table 6-1. The cost estimate for this element ranges from $125,704,000 or $14M per mile, (80-ft.-wide, 9-ft.-tall combination seepage/stability berm) to $358,072,000 or $40M per mile (80-ft.-deep cutoff wall).

As discussed above, DWR's estimated cost to repair the entirety of the SPFC levee between one mile south of Freeport and RD 755 (total of 9 miles) utilizing seepage/stability berms is estimated at $191,754,000, or $21M per mile, in 2020 dollars.

6.2.9 Capital Cost Summary

The estimated capital cost associated with Management Actions 1 to 9 are summarized in Table 6-5 below.

It should be noted there are regional preferences, regulations, and policies within the Primary Zone of the legal Delta that encourage the preservation of productive agricultural lands as well as the Delta Legacy Communities. Thus, there is a regional preference in the Primary Zone of the Delta, inclusive of the Hood Study Area, to use vertical cutoff walls versus horizontal berms that displace productive agricultural lands and structures for remediating the predominant through- and under-seepage issues identified for levees in and near the project study area of Hood.

Table 6-5. Estimated Range of Costs for Management Actions 1-9 including FEMA Certification for the Community of Hood

Hood Management Action	Cutoff Walls	Berms	Cross Levee	RSP	FEMA Certification	Total
1: Repair DWR FSRP Critical and Serious Sites within the Hood Study Area	$0	$7,729,000	--	$0	--	$7,729,000
2: Raise and Repair/Strengthen-in-Place RD 744 South Cross Levee	$4,399,000	$4,174,000	--	$0	--	$4,174,000 - $4,399,000
3: Repair DWR FSRP Critical and Serious Sites North of the Hood Study Area	$0	$6,208,000	--	$0	--	$6,208,000
4: Cross Levee North of Hood paired with Repair and Strengthen-in-Place Existing SPFC and Non-SPFC Levees adjacent to Hood (2012 CVFPP and 2014 RFMP Configuration)	$16,298,000	$13,840,000	$14,910,000	$4,344,000	$1,655,000- $1,778,000	$34,749,000 - $37,330,000
5: Cross Levee North of Hood with Community-Preferred Alignment paired with Repair and Strengthen-in-Place Existing SPFC and Non-SPFC Levees adjacent to Hood	$22,266,000	$15,935,000	$16,310,000	$4,344,000	$1,829,000- $2,146,000	$38,419,000 - $45,066,000
6: Repair and Strengthen-in-Place DWR MA 9 Sacramento River Left Bank SPFC Levee in Hood Study Area (2.5 miles)	$98,357,000	$34,529,000	--	$0	--	$34,529,000 - $98,357,000
Total Cost per Mile for Management Action 6						$14M-$39M
7: Repair and Strengthen-in-Place Non-SPFC Levees/Former Railroad Embankments in Hood Study Area (3.35 miles)	$32,369,000	$39,069,000	--	$17,619,000	--	$49,988,000 - $56,688,000
Total Cost per Mile for Management Action 7						$15M-$17M
8: Secure 100-Year FEMA Certification for Community and Entire Hood Study Area (5.85 miles)	$130,726,000	$73,598,000	--	$17,619,000	$4,561,000- $7,417,000	$95,778,000 - $155,762,000
Total Cost per Mile for Management Action 8						$16M-$27M
9: Repair and Strengthen-in-Place 9.0 miles of DWR MA 9 Sacramento River Left Bank SPFC Levee between Freeport and RD 755	$358,072,000	$125,704,000	--	$0	--	$125,704,000 - $358,072,000
Total Cost per Mile for Management Action 9						$14M-$40M

Notes: *Management Action 9 – Repair and Strengthen 9.0 miles of DWR MA 9 Sacramento River Left Bank SPFC Levee Between Freeport and RD 755 is considered a Multi-Objective Component to the Sacramento River North Delta Conveyance Corridor.

6.3 Trade-Off Analysis of Flood Risk Reduction Management Actions

Management actions were compared in a trade-off analysis against the study goal of obtaining 100-year flood protection for the Hood study area and against the objectives described in Section 4. Other considerations, such as agricultural sustainability, local support, cost, cultural resources, ecosystem, and consistency with existing Delta regulations and policies were also used to compare each of the management actions. The trade-off analysis also incorporates the net reduction in EAD values determined for most structural-based management actions.

6.3.1 Planning Objectives

6.3.1.1 Reducing Risk to Life

A breach within the levee fronting the community could contain high instantaneous floodwater velocities and depths of imminent danger within the community that would most likely result in life loss in Hood. Management Actions 4, 5, 6, 8, and 9 are the only Management Actions which fortify the levee fronting the community. As a result, these 5 Management Actions would result in the greatest measurable reduction in life loss. Management Action 1 (DWR FSRP critical and serious sites within the Hood study area) results in the next greatest reduction in life loss, as levee failure at any of the 4 FSRP critical and serious sites located along the left bank of the Sacramento River could result in life loss in Hood and the greater study area as a result of high floodwater depths and velocities. Management Action 2 results in the next greatest reduction in life loss by fortifying the RD 744 cross levee to fend off floodwaters originating in RD 744. Management Action 2 is likely to result in a greater reduction in life loss than Management Action 3 (DWR FSRP critical and serious sites north of the Hood study area), since a levee breach on the RD 744 cross levee is likely to result in less evacuation time than a levee breach upstream in RD 744 where the remaining 5 FSRP critical and serious sites are located. Management Action 7 (repairing and strengthening the non-SPFC levees within the study area) is estimated to result in the smallest reduction in life loss of all 8 management actions.

6.3.1.2 Reducing Risk to Property Damage

As previously discussed, EAD represents the annualized expected damages through the consideration of potential flooding conditions and is one of the primary drivers for flood management funding within the Delta. EAD includes potential flood damages to structures, structure contents, land improvements, adjoining crops, regional infrastructure, and vehicles. Reduction in EAD is a common metric used to evaluate flood risk reduction measures and is used in this feasibility study to evaluate how well each management action meets the objective of reducing risk to property damage. Further details on the EAD analysis performed as part of this study are provided in Appendix E.

As shown previously in Table 3-7, baseline (or without project) EAD for the community of Hood under existing and future conditions (with climate change adjustments) is approximately $2M and $6M, respectively. Existing without project conditions represents the current level of flood protection within the study area and does not incorporate any new structural or any new proposed non-structural flood risk reduction elements. Future without project conditions represent the current level of flood protection within the study area, does not incorporate any structural or non-structural flood risk reduction elements, and incorporates expected changes to the study area from climate change, sea level rise, and future land uses. These baseline conditions do not include any flood management improvements in the study area that have been authorized and have funding, or that have started construction or implementation.

Table 6-6 and Table 6-7 below provide the estimated net reduction in EAD to the Hood study area under existing and future conditions as a result of implementing Management Actions 1 to 5 and 9. The net reduction in EAD in each table is formulated by subtracting the estimated EAD value for each impact area, which is estimated assuming a fractional, partial, or full improvement, from the baseline (or without project) EAD. The pay-back period in years (excluding interest) is then calculated using the estimated cost of each management action.

Overall, the greatest reduction in EAD for the Hood study area is provided by Management Action 9 (repairing and strengthening the 9 miles of DWR MA 9 SPFC levee between Freeport and RD 755). As shown in Table 6-6, implementing Management Action 9 would result in a net reduction in EAD for the study area of over $8.4 million under existing conditions. On an annualized basis, this represents an annualized EAD of $94,000 for the entirety of SAC 44 and an EAD of $20,000 for the community of Hood. However, at a cost of up to nearly $360M, the flood risk reduction payback period is over 40 years (excluding interest).

Repairing the nine DWR FSRP critical and serious sites within the Hood study area and north of the Hood study area (collectively Management Actions 1 and 3) results in a similar net reduction in EAD. By repairing these sites, EAD in the community of Hood is estimated at $76,000 under existing conditions, with EAD for the larger SAC 44 impact area estimated at $242,000 under existing conditions, presenting a total net reduction to the study area of $8.3M. With an estimated cost of nearly $14M, the flood risk reduction pay-back period is less than two years.

FEMA certification of a cross levee system within the Hood study area as part of Management Actions 4 and 5 also provides direct measurable value to the community of Hood. These management actions would result in a net reduction in EAD to the Hood study area of over $2.3M, with annualized EAD in the community of Hood reduced to $20,000. At an estimated cost of over $37M (Management Action 4) and $45M (Management Action 5), the flood risk reduction payback periods for these management actions ranges from five years to 16 years. Notably, as shown in Table 6-6 and Table 6-7, repairing the DWR FSRP critical and serious sites within the Hood study area (Management Action 1) combined with raising/repairing the RD 744 south cross levee (Management Action 2) provides similar value to the community of Hood. When these management actions are collectively implemented in tandem, the net reduction in

EAD to the Hood study area is nearly $2.3M, but at an estimated cost of $12M, the flood risk reduction payback period is only 5 years.

The discussion above also applies under future conditions as shown in Table 6-7. As shown in Table 6-7, the effects of climate change and sea level rise result in both an increase in the baseline EAD for the Hood study area ($72M increased from nearly $9M under existing conditions), and a greater benefit from each of the management actions as seen by the higher net reductions in EAD.

In general, when considering the estimated capital cost to construct or implement each management action, repairing the DWR FSRP critical and serious sites within the Hood study area and north of the Hood study area in MA 9 (Management Actions 1 and 3) provides the largest incremental value to the community of Hood and the larger study area. With the implementation of these management actions, the total net reduction in EAD for the Hood study area is estimated at $8.3M under existing conditions and nearly $69M under future conditions. Repairing the DWR FSRP critical and serious sites within the Hood study area in tandem with raising and repairing the RD 744 south cross levee (Management Actions 1 and 2) provides the next largest incremental value to the community, with a total net reduction of nearly $2.3M under existing conditions and over $5.6M under future conditions. Notably, as shown in Table 6-6 and Table 6-7, repairing the DWR FSRP critical and serious sites in the Hood study area combined with raising/repairing the RD 744 cross levee (at an estimated cost of $12M) provides similar value to the community of Hood as constructing and certifying a cross levee system (at an estimated cost of $37 to $45M). In both cases, the net reduction in EAD to the Hood study area is around $2.3M.

Table 6-6. Hood Study Area EAD Values for Existing Conditions Consistent with the 2022 CVFPP Update

Scenarios for Select Structural-Based Management Actions	Estimated Cost	Stone Lake SAC 44 EAD	Hood SAC 45 EAD	Total Net Reduction to Hood Study Area	Flood Risk Reduction Pay Back Period in Years (excluding interest)
Baseline EAD, SAC 44 (Stone Lake): **$6,254,000** [(1)] Baseline EAD, SAC 45 (Hood): **$2,331,000** [(1)] Total Baseline EAD for SAC 44 & SAC 45: **$8,585,000** [(1)]					
Repair DWR FSRP critical and serious sites within the Hood study area and in MA 9 north of the Hood Study Area **(MA 1 & 3)** [(3)]	$13,937,000	$242,000	$76,000	$8,585,000 - $242,000 - $76,000 = $8,267,000	$13,397,000/$8,267,000 = 1.7 years
Repair DWR FSRP critical and serious sites within the Hood study area and raise and repair/strengthen-in place RD 744 south cross levee **(MA 1 & 2)** [(3)]	$11,903,000 - $12,128,000	N/A	$76,000	$2,331,000 - $76,000 = $2,255,000	$12,128,000/$2,255,000 = 5.4 years
Cross levee north of Hood paired with repair and strengthen-in-place existing SPFC and Non-SPFC levees adjacent to Hood **(MA 4)** [(4)]	$34,749,000 - $37,330,000	N/A	$20,000	$2,331,000 - $20,000 = $2,311,000	$37,330,000/$2,311,000 = 16.2 years
Cross levee north of Hood with community-preferred alignment paired with repair and strengthen-in-place existing SPFC and Non-SPFC levees adjacent to Hood **(MA 5)** [(4)]	$38,419,000 - $45,066,000	N/A	$20,000	$2,331,000 - $20,000 = $2,311,000*	$45,066,000/$2,311,000 = 19.5 years
Repair and strengthen-in-place 9 miles of DWR MA 9 Sacramento River left bank SPFC levee between Freeport and RD 755 **(MA 9)** [(4)]	$125,704,000 - $358,072,000	$94,000	$20,000	$8,585,000 - $94,000 - $20,000 = $8,471,000**	$358,072,000/$8,471,000 = 42.3 years

Notes:
Levee Performance Data Curve for EAD Values: [(1)] Baseline without Improvement [(2)] Fractional Improvement [(3)] Partial Improvement [(4)] Full Improvement Improvements
* Net reduction in EAD would be slightly higher for MA 5 through the protection of additional farmland north of Hood
** Net reduction in EAD to the Hood study area for MA 9 could be as high as a fully improved condition for SAC 44 & SAC 45

Table 6-7: Hood Study Area EAD Values for Future Conditions Consistent with the 2022 CVFPP Update

Scenarios for Select Structural-Based Management Actions (MAs)	Estimated Cost	Stone Lake SAC 44 EAD	Hood SAC 45 EAD	Total Net Reduction to Hood Study Area	Flood Risk Reduction Pay Back Period in Years (excluding interest)
Future conditions Baseline EAD, SAC 44 (Stone Lake): **$65,688,000**(1) Future conditions Baseline EAD, SAC 45 (Hood): **$5,829,000**(1) Future conditions Total Baseline EAD for SAC 44 & SAC 45: **$71,517,000**(1)					
Repair DWR FSRP critical and serious sites within the Hood study area and in MA 9 north of the Hood Study Area **(MA 1 & 3)** (3)	$13,937,000	$2,472,000	$192,000	$71,517,000 - $2,472,000 – $192,000 = $68,853,000	$13,397,000/$68,853,000 = 0.2 years
Repair DWR FSRP critical and serious sites within the Hood study area and raise and repair/strengthen-in place RD 744 south cross levee **(MA 1 & 2)** (3)	$11,903,000 - $12,128,000	N/A	$192,000	$5,829,000 - $192,000 = $5,637,000	$12,128,000/$5,637,000 = 2.2 years
Cross levee north of Hood paired with repair and strengthen-in-place existing SPFC and Non-SPFC levees adjacent to Hood **(MA 4)** (4)	$34,749,000 - $37,330,000	N/A	$52,000	$5,829,000 - $52,000 = $5,777,000	$37,330,000/$5,777,000 = 6.5 years
Cross levee north of Hood with community-preferred alignment paired with repair and strengthen-in-place existing SPFC and Non-SPFC levees adjacent to Hood **(MA 5)** (4)	$38,419,000 - $45,066,000	N/A	$52,000	$5,829,000 - $52,000 = $5,777,000*	$45,066,000/$5,777,000 = 7.8 years
Repair and strengthen-in-place 9 miles of DWR MA 9 Sacramento River left bank SPFC levee between Freeport and RD 755 **(MA 9)** (4)	$125,704,000 - $358,072,000	$962,000	$52,000	$71,517,000 - $962,000 - $52,000 = $70,503,000**	$358,072,000/$70,503,000 = 5.1 years

Notes:

Levee Performance Data Curve for EAD Values: (1) Baseline without Improvement (2) Fractional Improvement (3) Partial Improvement (4) Full Improvement Improvements

* Net reduction in EAD would be slightly higher for MA 5 through the protection of additional farmland north of Hood

** Net reduction in EAD to the Hood study area for MA 9 could be as high as a fully improved condition for SAC 44 & SAC 45

6.3.1.3 Reducing Probability of Levee Failure

Management Action 1 results in a high reduction in the probability of levee failure through the repair of the DWR FSRP critical and serious sites within DWR MA 9 located within the study area. Repair of the 4 DWR FSRP critical and serious seepage sites within DWR MA 9 would significantly reduce the probability of levee failure along the segment of levee on the left bank of the Sacramento River (NULE Segment 106), since this levee segment is estimated to have a high likelihood of failure due to underseepage, slope stability, through seepage, and erosion vulnerabilities.

Management Action 2 raises and repairs/strengthens the RD 744 cross levee at the northern boundary of the study area, upstream of Hood. This levee is estimated to be vulnerable to underseepage, slope stability, through seepage, and erosion, and 100 percent of the levee is estimated to also have freeboard deficiencies. As a result, Management Action 2 also results in a high reduction in the probability of levee failure.

Management Action 3 repairs the five DWR FSRP critical and serious sites located upstream of the study area within the RD 744 portion of DWR MA 9. Similar to Management Action 1, repair of these sites would significantly reduce the probability of levee failure along the segment of levee on the left bank of the Sacramento River (NULE Segment 106), since this levee segment is estimated to have a high likelihood of failure due to underseepage, slope stability, through seepage, and erosion vulnerabilities.

Management Actions 4 and 5 join a new cross levee north of Hood with repairs and improvements to the existing levees located to the west and south of Hood. These levee systems would likely eliminate the probability of an instantaneous levee failure immediately adjacent to the community of Hood and south of Hood. As a result, Management Actions 4 and 5 result in a high reduction in the probability of levee failure.

Management Action 6 repairs the SPFC levees along the left bank of the Sacramento River. Improving this segment of levee (NULE Segment 106) would likely eliminate the potential of a levee failure, both immediately adjacent to the community and along the entirety of NULE Segment 106. As a result, Management Action 6 results in a high reduction in the probability of levee failure.

Management Action 7 repairs the non-SPFC levees located to the north, east, and south of Hood. Similar to Management Action 6, improving and repairing these levees would likely eliminate the potential of a levee failure to the north, east and south of Hood and as a result, Management Action 7 results in a high reduction in the probability of levee failure.

Management Action 8 includes repairing and improving all of the SPFC and non-SPFC levee reaches surrounding the community and entire study area and includes certification of the entire perimeter levee system to FEMA standards. The collection of improving the entire perimeter

levee system and certifying said perimeter levee system results in a high reduction in the probability of levee failure.

Management Action 9 includes repairing and improving the 10 miles of SPFC levees located along the east/left bank of the Sacramento River between Freeport and RD 755, south of Hood. Improving this segment of levee would result in the highest reduction in the probability of levee failure of all management actions under consideration.

6.3.1.4 Reduction of High Insurance Premiums

Those management actions which result in 100-year FEMA certification could result in a net reduction in NFIP insurance premiums. Management Actions 4, 5, and 8 are the only solutions which result in 100-year FEMA certification. However, implementation of the structural and non-structural elements as part of Management Actions 1-3, 6, 7, and 9 in concert with a community- or risk-based insurance program, could also result in a net reduction in flood insurance premiums for the community. *See* Section 5.2.5 and Appendix J for greater discussions and potential options for Hood and other nearby Delta Legacy Communities to pursue community-based flood insurance programs.

6.3.1.5 Improved Preparedness and Response

Placeholder to describe current updates to local hazard mitigation planning, inclusive of further identification of relief cut options.

6.3.1.6 Enhancing Resiliency and Reliability of Through-Delta Water Conveyance

Management Actions 6, 8 and 9 would provide the greatest multi-benefit enhancement of the resiliency and reliability of through-Delta water conveyance. Under Management Actions 6 and 8, improving the entire SPFC levee system located along the Sacramento River within the study area equates to improving 7 percent of the SPFC levees between Freeport and the Delta Cross Channel and 4 percent of the total SPFC levees along the freshwater corridor in the Delta. Under Management Action 9, improving the entire 10 miles of SPFC levees located along the Sacramento River between Freeport and RD 755 south of Hood equates to improving 24 percent of the SPFC levees between Freeport and the Delta Cross Channel, and 15 percent of the total SPFC levees along the freshwater corridor in the Delta. Management Actions 1, 3, 4, and 5, which fortify various segments of the SPFC levee system within the study area also enhance through-Delta water conveyance to a lesser degree. Management Actions 2 and 7 do not improve through-Delta water conveyance.

6.3.1.7 Environmental Stewardship and Multi-Benefits

Under Management Actions 1, 3, 6, and 7, ecosystem restoration and enhancement, primarily creation/enhancement of SRA, conducted in concert with improvements proposed for the Hood study area along the Sacramento River levees, could be implemented along with any structural

management actions proposed for that reach. For any of the management actions where borrow material may be required, the possibility to create wetland habitat within areas used for borrow, particularly lands already in State ownership on the southern portion of the study area (known as Hood Junction) is a possibility, as is coordinating with other regional entities, to ascertain the availability and suitability of borrowing material from the Stone Lakes Wildlife Refuge (south and north of Hood-Franklin Road) that may create opportunities for enhancing tidal-influenced Delta habitat while also marginally reducing flood stages in the Franklin Pond areas east of Snodgrass Slough, which would indirectly benefit the Hood study area.

Under Management Actions 2, 4, and 5, a recreation component could be implemented along with construction of the cross levee options to the north of Hood or in concert with improvements to the RD 744 cross levee, in the form of a multi-use trail that would include signage and interpretive information for users regarding the rich history of the area and potentially connect to other legacy communities and wildlife areas to the north and south. These same trails could be linked to the trail systems within the Stone Lakes National Refuge Area. This concept could also be combined with improvements proposed for the adjacent communities. This could be an option under most of the Management Actions, which may or may not include the cross levee components. Signage and interpretive facilities developed for potential trails within with study area could also include an ecosystem education component, focused on Delta endemic species users are likely to encounter.

6.3.2 Other Considerations

6.3.2.1 Agricultural Sustainability

Under Management Actions 1 to 8, agricultural sustainability could be affected if the repair and strengthen-in-place via cutoff walls (Remediation Alternative 1) are not implemented, since the proposed stability or combination berms (proposed as Remediation Alternative 2) could range from 15 to 140 feet wide, resulting in displacement of productive permanent crops (orchards and vineyards) and seasonal row or field crops. The estimated displacement of acreage associated with implementing cutoff walls versus stability or combination berms as part of Management Actions 1 to 8 is summarized below in Table 6-8. Implementing a combination berm on the SPFC levees located on the Sacramento River as part of Management Action 6 would displace an estimated 48 acres of permanent and seasonal crops and implementing the proposed stability or combination berms on the non-SPFC levees as part of Management Action 7 would displace an estimated 41 acres of permanent and seasonal crops. If the community was to implement stability or combination berms for the entire levee system as part of Management Action 8, an estimated 89 acres of productive permanent crops and seasonal row or field crops would be displaced. As shown in Table 6-8, these impacts are reduced and/or eliminated when implementing cutoff walls for each of the proposed management actions. Further investigation is needed to estimate the displaced agricultural acreage associated with implementing a cutoff wall or a berm along the entire 10-mile-stretch of SPFC levees located along the left bank of the Sacramento River between Freeport and RD 755, south of Hood.

Table 6-8. Estimated Displaced Acreage with Remediation Alternatives 1 or 2.

Management Action	Estimated Displaced Agricultural Acreage: Remediation 1 (Vertical Cutoff Walls)	Estimated Displaced Agricultural Acreage: Remediation 2 (Horizontal Stability or Combination Berms)
Management Action 1: DWR FSRP critical and serious sites within the Hood study area	4	17
Management Action 2: Raise and repair/strengthen-in-place through geotechnical remediation, RD 744 cross levee	0	6
Management Action 3: DWR FSRP critical and serious sites north of the Hood study area	3[1]	16[2]
Management Action 4: Cross levee north of Hood; repair and strengthen-in-place through geotechnical remediation, adjacent to Hood; repair and strengthen existing Non-SPFC Levees south of Hood (2012 CVFPP and 2014 RFMP configuration)	0	8
Management Action 5: Cross levee north of Hood; repair and strengthen-in-place through geotechnical remediation, adjacent to Hood; repair and strengthen existing Non-SPFC levees south of Hood	0	11
Management Action 6: Repair and strengthen-in-place through geotechnical remediation, Sacramento River – SPFC levees	0	48
Management Action 7: Repair and strengthen-in-place through geotechnical remediation – Non-SPFC levees	0	41
Management Action 8: Secure 100-Year FEMA certification for community and entire study area	0	89

Notes: [1] Assuming an 80 ft. deep cutoff wall as proposed for reach 106-A in this feasibility study
[2] Estimated using the proposed remediations specified in the 2013 FSRP Pre-Feasibility Report for Leveed Area SAC44/45: Stone Lake and Hood

6.3.2.2 Local Support

Those management actions which result in the least impacts to agricultural sustainability garner the most local support. Consequently, under Management Actions 1 to 9 local support is given to vertical remediations (cutoff walls) over horizontal remediations (stability or combination berms) since a cutoff wall would be installed entirely within the existing levee prism and would not result in a net reduction in agricultural land. Additionally, between Management Actions 4 and 5, local support is greater for Management Action 5, since the new cross levee under Management Action 5 would result in less viewshed impacts to the community of Hood.

6.3.2.3 Cost

Management Action 2 (raise and repair/strengthen-in-place RD 744 cross levee) is the lowest cost solution to reducing flood risk in the study area at nearly $4.4M. The next lowest cost solution is Management Action 3 (repair DWR FSRP critical and serious sites north of the Hood study area) at $6M, followed by Management Action 1 (repair DWR FSRP critical and serious sites within the Hood study area) at just over $7.7M. Management Actions 4 to 7, which include cross levee systems and repairing/strengthening the SPFC and non-SPFC levees in the study area, range on the order of $35M to $98M, depending on whether berms or cutoff walls are implemented to remediate the respective reaches associated with each Management Action. Management Action 8, which repairs and strengthens-in-place the entire perimeter levee system and secures FEMA accreditation for the study area, is the second highest cost solution ranging between $96 M and $156M. Management Action 9, which repairs and strengthens-in-place the levees located along the left bank of the Sacramento River between Freeport and RD 755, is the highest cost solution ranging between $126M to $358M.

6.3.2.4 Cultural Resource Considerations

Under all Management Actions, cultural resources could potentially be affected since the study area is considered an area of high sensitivity, with several previously documented cultural resources in the vicinity. Installation of a cutoff wall or placement of riprap can disturb previously unknown archeological resources and repair/strengthen-in-place remediations (including a seepage, stability, or combination berm up to 85-ft.-wide) may require grading or foundational work. Additionally, under Management Actions 2, 4, and 5, cultural resources could also be affected by construction of the foundation of the new cross levee north of Hood (either alignment) and the improvements to the existing RD 744 cross levee. However, built-environmental resources, such as historic buildings, on adjacent land would not be permanently affected.

6.3.2.5 Ecosystem Considerations

Under Management Actions 1 and 3, it is unlikely that biological resources would be substantially affected, since a cutoff wall would be installed entirely within the existing levee prism and riprap would be placed on the existing levee, which is reasonably clear of vegetation except for some large trees. Under Management Action 2, 4, and 5, a small amount of open space could be affected by improvements to the RD 744 cross levee, either Hood cross levee alignment, and required adjacent easements. However, since these areas are adjacent to residential or agricultural lands, and are previously disturbed, these repairs could likely be implemented if appropriate work window restrictions, monitoring, and species and habitat avoidance and mitigation measures are in place. Any repair and strengthening-in-place improvements implemented along the railroad embankments would likely result in biological resource impacts due to the density and extent of existing vegetation along these reaches.

The restoration activities possible in the study area would be consistent with Delta Plan Strategy 4.2 “Restore Habitat” and Strategy 4.4 “Prevent Introduction of and Management of nonnative Species Impacts”. These actions would provide benefits to the following species: Sacramento splittail and Delta smelt, western pond turtle, multiple waterbird guilds (waders, dabblers, and divers), tricolored blackbird, other songbird species. The actions described at a conceptual level, above, would also provide critical regional habitat connectivity between Cosumnes River Preserve, Delta Meadows, Staten Island, and Stone Lakes National Wildlife Refuge.

6.3.2.6 Consistency with Existing Delta Regulations and Policies

As mentioned previously, there are several agencies with regulatory, flood management, and/or land use authority over projects in the Delta, including the Sacramento County Delta Legacy Community of Hood that is located in the Primary Zone of the Delta. Due to the large number of broad policies and goals contained in the many DPC, DSC, and Conservancy planning documents applicable to the study area, an exhaustive matrix comparing the various proposed flood management elements against the many broad goals and policies of Delta agencies is contained in Appendix G.

Generally, all proposed management actions indirectly support the various Delta agencies plans and policies regarding sustainability and viability of the Delta agricultural economy, preservation of the Delta Legacy Community’s unique history and sense of place, and opportunities for public recreation and ecosystem enhancement (where feasible). The only management action components that could conflict with existing regulations could be those that propose combination seepage/stability berms if their final configuration would affect a substantial acreage of important farmland of regional and statewide significance within the study area. Although most restrictions regarding agricultural land conversion address conversion to urban uses, the concept of taking agricultural land out of production due to flood management facilities would need to be explored further before implementation of any management action.

Historically, levee repairs can induce population growth and encourage development within the floodplain. Although levee repairs are proposed under all various management actions, development within the Delta is constrained by the Delta Plan and SPA ordinances which limit new residential, commercial, and industrial development within the Primary Zone of the Delta. As such, future floodplain development within the study area is not expected to be substantial. By protecting Hood and adjacent working agricultural lands with better flood protection, and providing multi-benefit opportunities, when possible, Hood can reasonably thrive as a community within the confines of existing regulations.

6.3.3 Trade-Off Analysis Summary

A summary of the trade-off analysis is provided in Table 6-9 below.

Table 6-9. Trade-Off Analysis Summary Table.

Management Action	Flood Risk Reduction				Limitation of High Insurance Premiums	Estimated Displacement of Agricultural Acreage (Cutoff Walls/Berms)	Enhancing Resiliency and Reliability of through-Delta Water Conveyance	Local Support	Multi-Benefit, Eco-System Enhancements	Cost
	Reducing Risk to Life	Reducing Risk to Property Damage	Reduced Probability of Levee Failure	Net Reduction in EAD to Hood Study Area (Existing Conditions/Future Conditions) ($)						
1	High	High	High	**MA 1 & 3 combined:** $8,267,000 -$68,853,000 **MA 1 & 2 combined:** $2,255,000 -$5,637,000	No	4/17	No	High	Medium	Medium
2	Medium	High	High		No	0/6	No	Medium	High	Low
3	Medium	High	High		No	3/16	No	High	Medium	Medium
4	High	High	High	$2,311,000 - $5,777,000	Yes	0/8	No	Low	High	High
5	High	High	High	$2,311,000 - $5,777,000	Yes	0/11	No	Medium	High	High
6	High	High	High	N/A	No	0/48	Yes	High	Medium	High
7	Medium	High	High	N/A	No	0/41	No	Low	High	High
8	High	High	High	N/A	Yes	0/89	Yes	High	Medium	High
9	High	High	High	$8,471,000 - $70,503,000	No	Additional investigation required	Yes	High	Medium	High

7. Recommendations

Section 7 details the suite of management actions recommended for implementation. Stakeholder and public input on these management actions is also provided, along with other non-structural measures that are recommended for implementation. Following these recommendations, right-of-way, and easements considerations, as well as considerations for operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) are discussed, as well as regulatory requirements and financial feasibility.

7.1 Recommended Suite of Structural-Based Management Actions

Of the nine management actions previously identified, Management Actions 1, 2, 3, and 5 are recommended for timely, near-term implementation. This includes:

- **Management Action 1**: Repair DWR FSRP Critical and Serious Sites within the Hood Study Area Portion of DWR MA 9
- **Management Action 2**: Raise and Repair/Strengthen-in-Place RD 744 South Cross Levee
- **Management Action 3**: Repair DWR FSRP Critical and Serious Sites North of the Hood Study Area within DWR MA 9
- **Management Action 5**: Community-Preferred Cross Levee Alignment North of Hood Paired with: Repair and Strengthen-in-Place MA 9 SPFC Levee Adjacent to Hood; and Repair and Strengthen Existing Non-SPFC Levee South of Hood

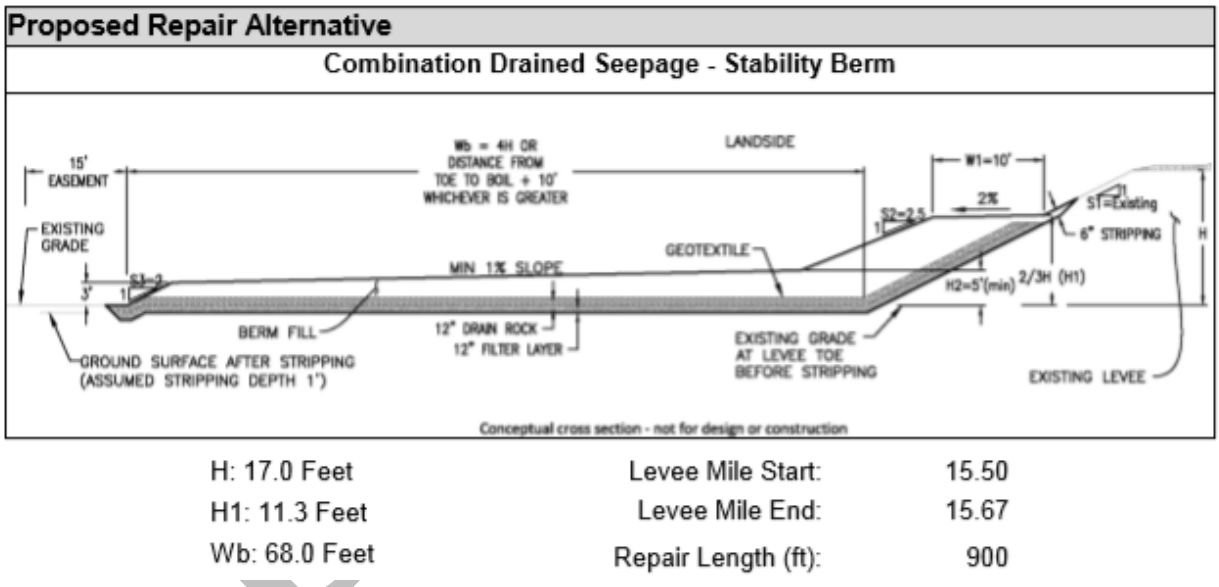
Long-term management actions include the long-term goal of securing a 100-year level of flood protection for the entire study area by repairing and improving both the SPFC levee along the Sacramento River and the non-SPFC levees to the north, east, and south of Hood, particularly if Management Action 5 is not implemented.

As previously mentioned above, repairing and improving the SPFC levee along the left/east bank of the Lower Sacramento River would also improve the resiliency and reliability of the through-Delta water conveyance system upstream of the Delta Cross Channel. Provided the community can also garner support from in-Delta and South of Delta water export interested parties, including but not limited to, the DCA, DWR, CVP, Metropolitan Water, and State Water Contractors, it is recommended that Management Action Items 6 through 8 and/or 9 be implemented over time to improve and modernize the perimeter levee systems that also serve to improve the resiliency and reliability of the through-Delta conveyance system as it currently exists today and into the future with conveyance of water through the Delta upstream of the Delta Cross Channel.

It is also recommended that all above recommended structural-based management actions be coupled with the noted suite of non-structural measures identified and prioritized in Section 7.3 below. The conceptual designs and estimated costs for this suite of management actions are provided below.

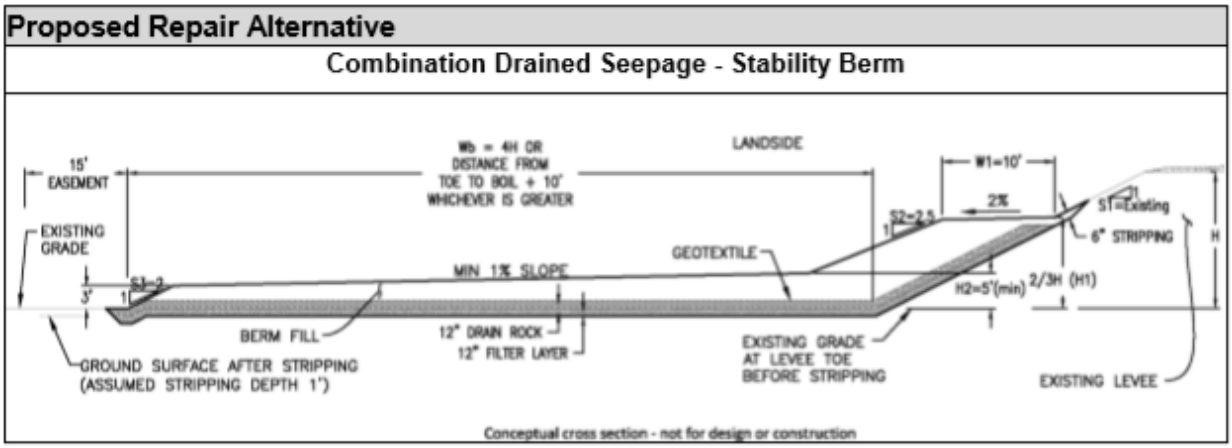
7.1.1 Management Action 1: Repair DWR FSRP Critical and Serious Sites within the Hood Study Area Portion of DWR MA 9

As discussed in Section 5.1.1.1 and shown in Table 5-1, combination drained seepage/stability berms were recommended by DWR to repair the four DWR FSRP critical and serious sites located along the left bank of the Sacramento River within and just south of the Hood study area. Proposed specifications for these sites as provided in the 2013 Pre-Feasibility Report are shown in Figure 7-1 through Figure 7-4 below. While combination drained seepage/stability berms were proposed by DWR in the 2013 Pre-Feasibility Report, it is expected that a cutoff wall would be implemented along this segment of levee to remediate the four FSRP critical and serious sites to reduce physical impacts associated with a stability berm that would displace structures within the community that are located on and/or directly adjacent to the landward toe of the existing levee system.



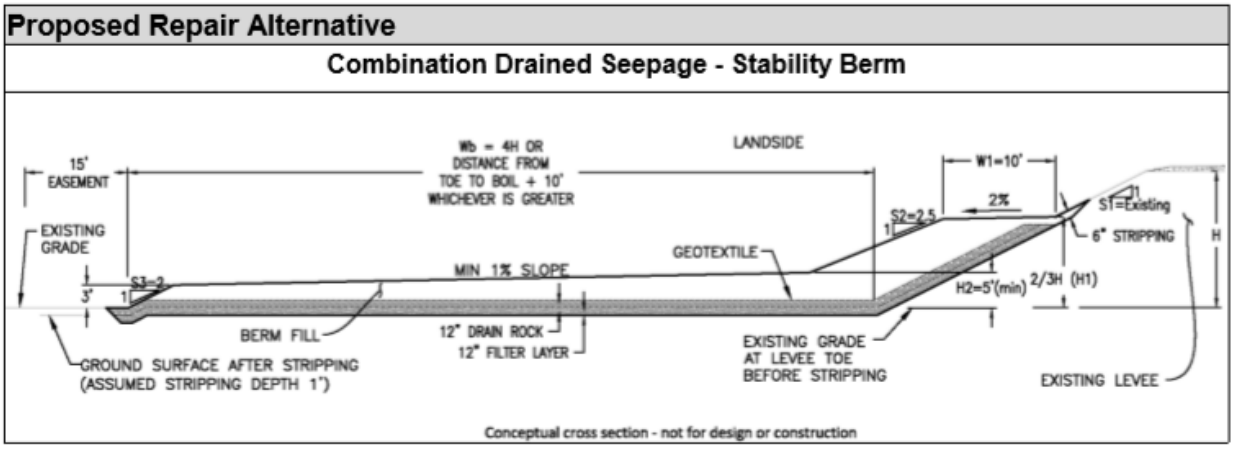
H: 17.0 Feet	Levee Mile Start:	15.50
H1: 11.3 Feet	Levee Mile End:	15.67
Wb: 68.0 Feet	Repair Length (ft):	900

Figure 7-1. Proposed Combination Drained Seepage/Stability Berm Specifications for Repair of Critical Seepage Site Located at LM 15.50 to 15.67(URS, 2013b)



H: 16.0 Feet	Levee Mile Start:	15.89
H1: 10.7 Feet	Levee Mile End:	16.07
Wb: 64.0 Feet	Repair Length (ft):	1,100

Figure 7-2. Proposed Combination Drained Seepage/Stability Berm Specifications for Repair of Critical Seepage Site Located at LM 15.89 to 16.07 (URS, 2013b).



H: 16.0 Feet	Levee Mile Start:	16.70
H1: 10.7 Feet	Levee Mile End:	16.97
Wb: 64.0 Feet	Repair Length (ft):	1,600

Figure 7-3. Proposed Combination Drained Seepage/Stability Berm Specifications for Repair of Serious Seepage Site Located at LM 16.70 to 16.97 (URS, 2013b).

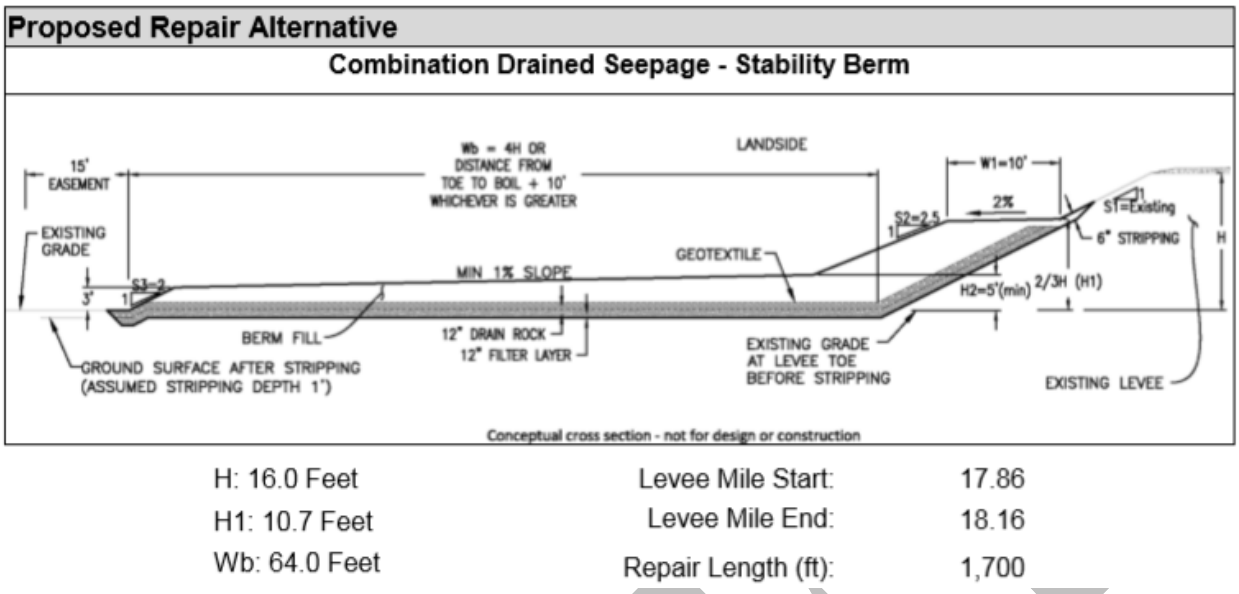


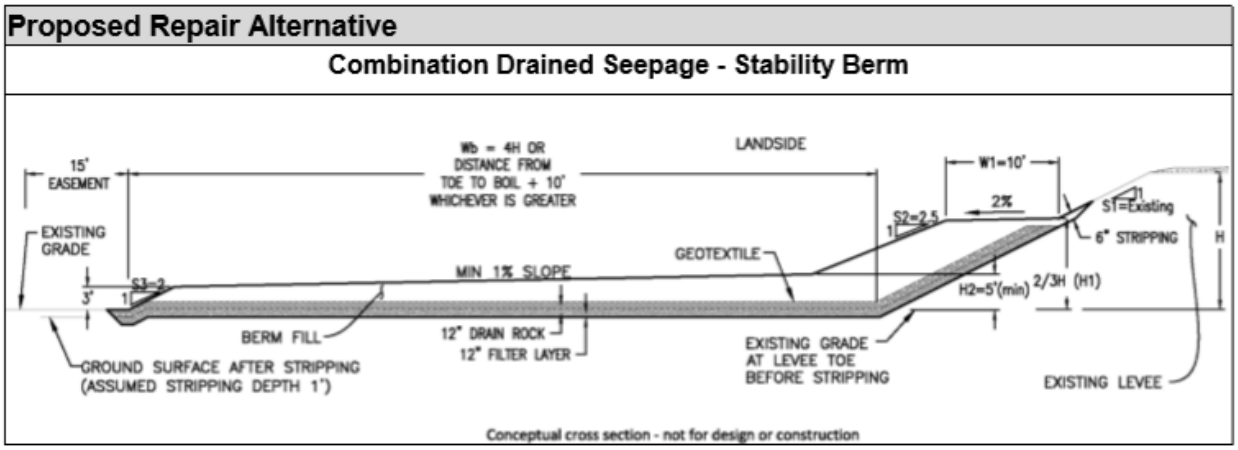
Figure 7-4. Proposed Combination Drained Seepage/Stability Berm Specifications for Repair of Critical Seepage Site Located at LM 17.86 to 18.16 (URS, 2013b).

7.1.2 Management Action 2: Raise and Repair/Strengthen-in-Place RD 744 South Cross Levee

As described in Section 5.1.2.1, remedial alternatives to repair/strengthen the RD 744 cross levee include a 20 foot-deep cutoff wall or a 85-foot-wide, 16-foot-tall combination seepage/stability berm. RSP with a width of 105 feet for a total of 4,500 feet is also proposed as part of each remedial alternative to address erosion vulnerabilities. To address freeboard deficiencies, the levee would be raised by 1 foot from station 0+00 to 5+00, and by 2.5 feet from station 5+00 to 13+00. The 20 feet deep cutoff wall was selected as the recommended remedial alternative to improve the RD 744 cross levee in an effort to reduce the impacts to agricultural lands. A conceptual cross section for this remediation is provided in Section 5, Figure 5-1. A typical RSP detail is provided in Section 5, Figure 5-4.

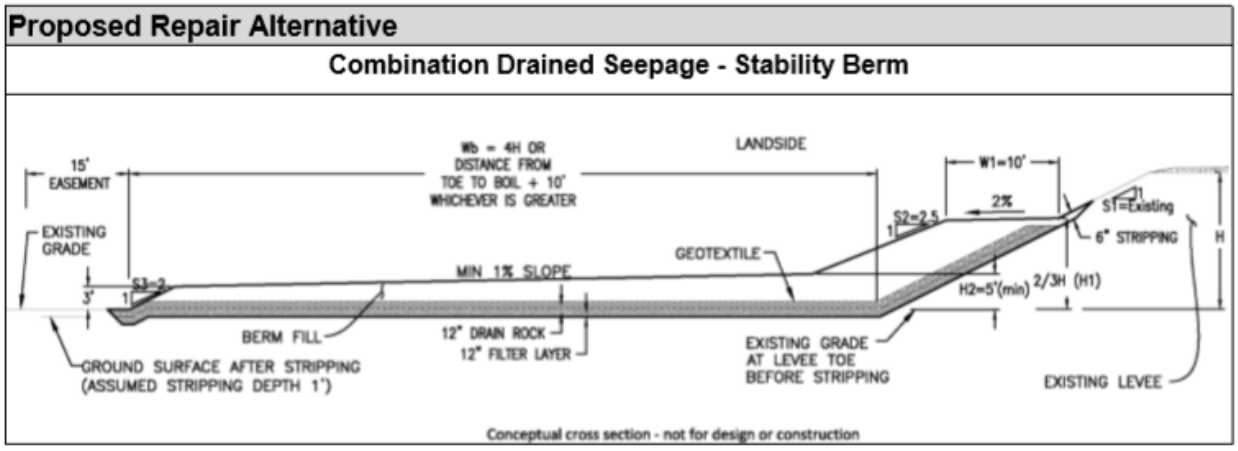
7.1.3 Management Action 3: Repair DWR FSRP Critical and Serious Sites North of the Hood Study Area within DWR MA 9

As discussed in Section 5.1.1.1 and shown in Table 5-2, combination drained seepage/stability berms are recommended to repair the five DWR FSRP critical and serious sites located along the left bank of the Sacramento River north of the Hood study area. Proposed specifications for these sites as provided in the 2013 Pre-Feasibility Report are shown in Figure 7-5 through Figure 7-9 below. While combination drained seepage/stability berms were proposed by DWR in the 2013 Pre-Feasibility Report, it is expected that a cutoff wall would be implemented along this segment of levee to remediate the five DWR FSRP critical and serious sites to reduce physical impacts associated with a stability berm that would displace structures within the community that are located on and/or directly adjacent to the landward toe of the existing levee system.



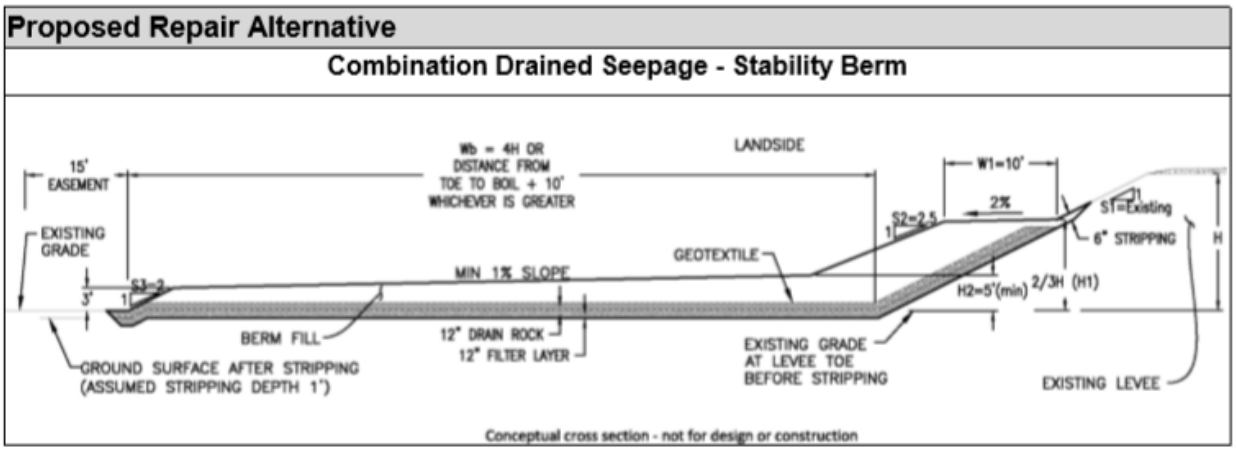
H: 15.0 Feet		Levee Mile Start:	10.68
H1: 10.0 Feet		Levee Mile End:	10.72
Wb: 60.0 Feet		Repair Length (ft):	250

Figure 7-5. Proposed Combination Drained Seepage/Stability Berm Specifications for Repair of Serious Seepage Site Located at LM 10.68 to 10.72 (URS, 2013b).



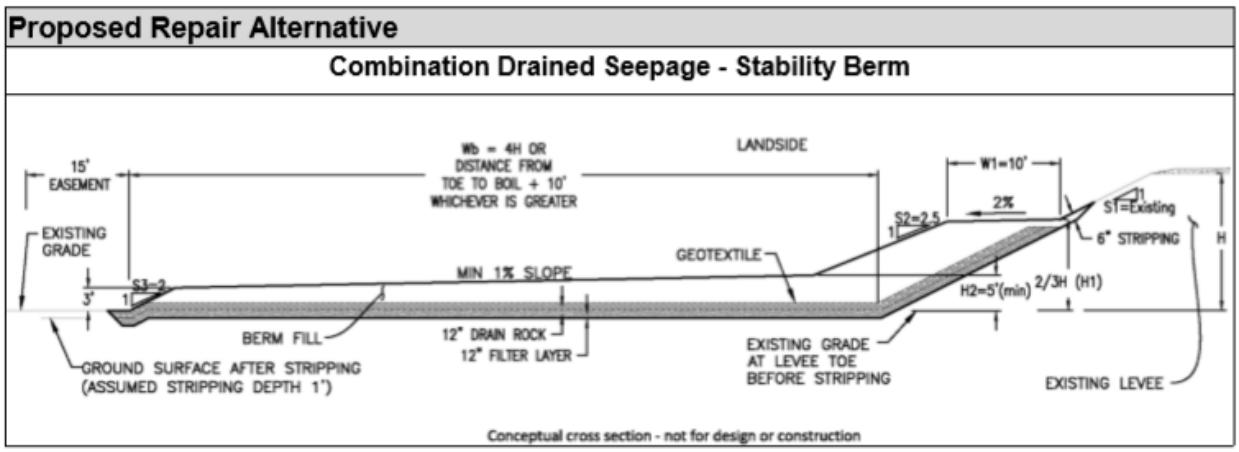
H: 17.0 Feet		Levee Mile Start:	11.95
H1: 11.3 Feet		Levee Mile End:	12.05
Wb: 68.0 Feet		Repair Length (ft):	600

Figure 7-6. Proposed Combination Drained Seepage/Stability Berm Specifications for Repair of Critical Seepage Site Located at LM 11.95 to 12.05 (URS, 2013b).



H: 14.0 Feet		Levee Mile Start:	12.48
H1: 9.3 Feet		Levee Mile End:	12.52
Wb: 56.0 Feet		Repair Length (ft):	200

Figure 7-7. Proposed Combination Drained Seepage/Stability Berm Specifications for Repair of Serious Seepage Site Located at LM 12.48 to 12.52 (URS, 2013b).



H: 13.0 Feet		Levee Mile Start:	12.62
H1: 8.7 Feet		Levee Mile End:	12.82
Wb: 52.0 Feet		Repair Length (ft):	1,100

Figure 7-8. Proposed Combination Drained Seepage/Stability Berm Specifications for Repair of Critical Seepage Site Located at LM 12.62 to 12.82 (URS, 2013b).

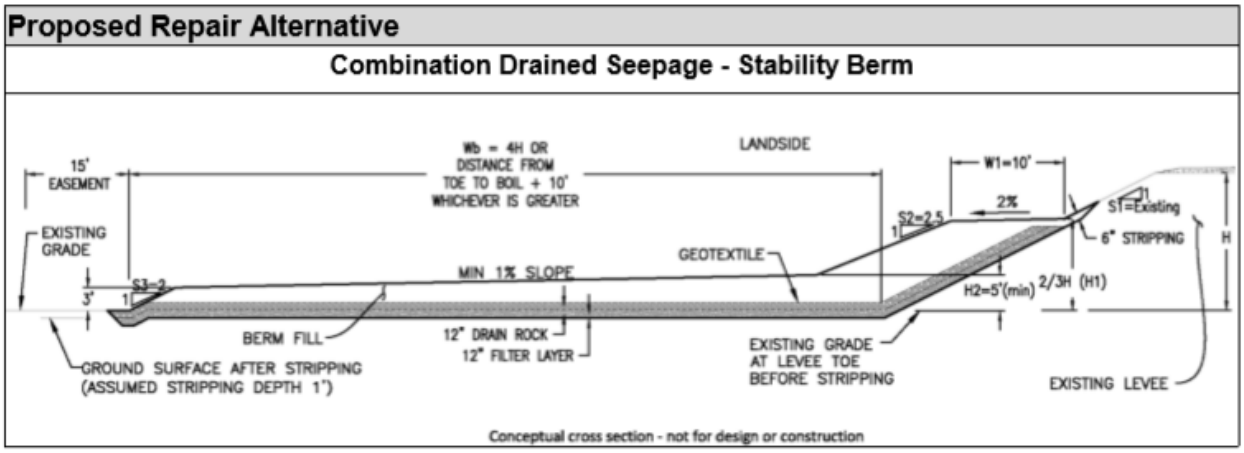


Figure 7-9. Proposed Combination Drained Seepage/Stability Berm Specifications for Repair of Serious Seepage Site Located at LM 14.30 to 14.60 (URS, 2013b).

7.1.4 Management Action 5: Community-Preferred Cross Levee Alignment North of Hood Paired with: Repair and Strengthen-in-Place MA 9 SPFC Levee Adjacent to Hood; and Repair and Strengthen Existing Non-SPFC Levee South of Hood

As described in Section 5.1.2.2, remedial alternatives to repair and strengthen the SPFC levees adjacent to Hood as part of Management Action 5 include a 80-foot-deep cutoff wall or a 80-foot-wide, 9-foot-tall combination seepage/stability berm. Remedial alternatives to repair and strengthen the non-SPFC levees south of Hood as part of Management Action 5 include a 15-foot-deep cutoff wall paired with 105-feet-wide RSP for a total of 3,000 feet or a 13-foot-tall, 15-foot-wide drain stability berm, also paired with similar RSP to address erosion vulnerabilities on this segment of levee.

The 80-foot-deep cutoff wall was selected as the recommended remedial alternative to repair and strengthen the segment of levee adjacent to the community in an effort to reduce physical impacts that would displace structures within the community. Similarly, the 15-foot-deep cutoff wall as selected as the recommended remedial alternative to improve the non-SPFC levee south of Hood. A conceptual cross section for this remediation is provided in Section 5, Figure 5-1.

7.2 Stakeholder and Public Input on Structural and Non-Structural Flood Risk Reduction Elements

The recommended suite of four management actions were informed by stakeholder and public feedback received following preparation of the draft feasibility study report in November 2020. Stakeholders and the public expressed support for repairing the weakest links in the perimeter

levee system of the Hood study area (Management Actions 1 and 3) and securing 100-year FEMA certification for the community of Hood with a potential cross levee (Management Action 5). No formal input was provided for Management Action 2.

7.3 Non-Structural Measures Recommended for Implementation

Out of the full suite of 15 non-structural measures described in detail in Appendix H, and further discussed in Section 5.2, the following non-structural measures are recommended to be carried forward to reduce flood risks within the Hood study area:

1. Voluntary Elevation of Structures
2. Wet or Dry Floodproofing
3. Flood Emergency Safety Plans
4. Sacramento County OES Decision Support Tool
5. Local Hazard Mitigation Plan and Relief Cuts
6. Alternatives to FEMA National Flood Insurance Program (NFIP) – Private, Community-Based Flood Insurance
7. NFIP Flood Insurance Enhancements via Agricultural Floodplain Ordinance Task Force (AFOTF)
8. Mokelumne River Conveyance Improvements & Staten Island Overflow Area
9. Improve FEMA CRS Score for Sacramento County/Isleton
10. Land Use Regulations and Limitations
11. Improved Governance Between Neighboring LMAs/RDs
12. SWIFs & Periodic Inspections with USACE
13. Public Education/Public Awareness

The only non-structural measure previously identified but not carried forward is acquisitions and relocations. Acquisitions and relocations were not carried forward at the request of the Hood Community Council. Relocating entire communities within the Delta, particularly Delta Legacy Communities, such as Hood, is inconsistent with the goals and objectives of both the Delta Plan and the Sacramento-San Joaquin Delta National Heritage Area designation.

The recommended suite of the key non-structural measures and timeline status are summarized below. Of these, a portion are currently ongoing within the Hood study area, with the remaining recommended for implementation in the near term and long-term as summarized in Table 7-1. Associated recommendations and costs, as applicable, are summarized below Table 7-1.

Table 7-1. Recommended Timeline for Implementation of Other Non-Structural Measures

Non-Structural Measure	Ongoing	Recommended: Near Term	Recommended: Long Term
Voluntary Structural Elevation		X	X
Wet or Dry Floodproofing		X	X
Flood Emergency Safety Plans	X	X	X
Sacramento County OES Decision Support Tool	X	X	X
Local Hazard Mitigation Plan and Relief Cuts		X	X
Alternatives to NFIP – Community and Flood-Risk Based Insurance Program		X	X
NFIP Flood Insurance Enhancements via AFOTF		X	X
Mokelumne River Conveyance Improvements/Flood Easements			X
Improve FEMA Community Rating System for Sacramento County	X	X	
Improved Governance between Neighboring LMAs/RDs & Community		X	X
SWIFs & Periodic Inspections with USACE		X	X
Public Education and Awareness	X	X	X

Below are brief descriptions of each of the non-structural measures that are proposed for implementation, most of which have been previously described in Section 5.2 and are described in detail in Appendix H.

7.3.1 Voluntary Elevation of Structures

It is recommended that voluntary raising of structures, on a case-by-case basis, be carried forward as a non-structural solution for reducing flood risks within the Hood study area. The County should continue to encourage residential and business owners to participate in the voluntary raising of structures by offering potential cost-sharing incentives (50% or greater cost share reductions) available through Federal and state cost-sharing programs.

As described previously, there are a total of 117 structures in Hood. As previously presented in Table 5-9 in Section 5.2.1, this represents a total cost of at least $20M to elevate all structures within the community of Hood. Note that this cost could be greater when assuming commercial, industrial, and public buildings may be more costly to elevate than single family residential structures.

The cost to raise all structures to these heights may be feasible with federal and State participation but may not be desirable for the entire community. However, elevating structures is encouraged on a case-by-case basis wherever feasible with Federal and state assistance. This non-structural measure would need to be voluntary for residential structures as expressed during public outreach meetings, but it could be mandatory for essential facilities in the event the preferred management actions are not fully implemented. This measure is recommended for implementation, on a case-by-case basis, in the long term.

7.3.2 Wet or Dry Floodproofing

Please *refer to* Section 5.2.2 for a more detailed description of this non-structural measure that would be voluntary in nature for individual homeowners and business owners, similar to voluntary elevation of structures. Similar to elevating structures, wet or dry floodproofing would be done a case-by-case-basis and could be implemented during the short- and long-term.

7.3.3 Improved Emergency Response – Flood Emergency Safety Plans and County OES Decision Support Tool

As the ESPs are intended to be guiding documents to save lives and reduce potential flood damages if a flood emergency were to occur, it is imperative that they are updated as needed with the best available and most up-to-date information. In particular, updates to the ESPs may include detailed relief cut locations for each RD – *see* Section 7.3.5 below for more information. Coordination on the plan update began in September 2020 and the final plan update is scheduled for completion before the end of 2021.

It is recommended that the Delta Flood ESP for Hood be updated every 5 years and/or as needed.

7.3.4 Local Hazard Mitigation Plan and Relief Cuts

Sacramento County began public outreach to update the 2016 LHMP in 2020. The next 5-year update to the LHMP is planned to be complete by the end of 2021. As part of this update, Sacramento County has the opportunity to reevaluate the impacts of flooding and levee failure to the people and assets of the Sacramento County planning area, inclusive of the Hood study area maintained by MA 9, and to establish updated goals and prioritize projects to reduce these impacts on people and property within the Hood study area. It is recommended that Sacramento County continue to update the LHMP every 5 years.

Relief cuts properly executed in the study area could result in a reduction in flood depths in excess of 4 feet (Figure 5-12). The updated LHMP may be a place to formalize relief cuts. As discussed above, Sacramento County RDs will be updating their ESPs and are looking at incorporating a relief cut if feasible.

7.3.5 Alternatives to NFIP – Community and Flood-Risk Based Insurance Program

Please *refer to* Section 5.2.6 for a more detailed description of this non-structural measure of a community-based flood insurance program that has been recommended for implementation for the short- and long-term as a viable supplement and/or alternative to FEMA's current NFIP.

Hood and other Delta Legacy Communities might choose to implement a community-based flood insurance program through the establishment of an HOA or a GHAD. A GHAD is a State-level public agency for the purpose of providing prevention, rapid response, and funding to address hazardous geologic conditions. They were established in 1979 by the Beverly Act to allow local residents to develop self-funding mechanisms that address the long-term abatement and maintenance of structures that protect real property from geologic hazards.

The city of Isleton has already taken the initial steps in June and July of 2021 to formalize a path for property owners within its city limits to aggregate their resources and establish a community-based flood insurance program that can be used to augment and/or replace the current set of NFIP policies held within the city of Isleton. The County is also encouraging the unincorporated North Delta Legacy of Hood to consider alternatives to the current NFIP, including a community-based flood insurance program that could be administered with or without developing a GHAD (for further details see Appendix J – Community-Based Flood Insurance Program TM, largely prepared by Kathleen Schaefer, P.E., CFM, former FEMA regional administrator of NFIP).

7.3.6 NFIP Flood Insurance Enhancements via AFOTF

Please *refer* to Section 5.2.7 for a more detailed description of this non-structural measure that is an ongoing, long-term non-structural measure that could be beneficial to all unincorporated, agriculturally-based areas within Sacramento County including the community of Hood.

This non-structural measure developed by the AFOTF via its TM of December 28, 2016, has recommended as many as seven administrative refinements of the NFIP to sustain agriculture as a wise use of the floodplain in leveed SFHAs. The seven administrative refinements listed below are consistent with other non-structural measures that have been recommended for implementation. The key elements include the following, of which are applicable to the agricultural-based community of Courtland and the surrounding study area within RDs 551 and 755:

a) Levee relief cuts with emergency operation plans and floodplain management ordinance
b) Zone X for certified levee reaches: The partial accreditation of a basin or levee reach could potentially lead to lower NFIP insurance rates as portions of levee systems are approved
c) Wet floodproofing rules for agricultural structures

d) Insurance rates for nonaccredited levees: The AFOTF recommends that FEMA use sound actuarial science to amend its insurance rates to reflect flood protection provided by a non-accredited levee as documented by a civil engineer.

e) Insurance rates for agricultural structures

f) Insurance rates for wet floodproofed structures

g) Add levee risk management activities to FEMA CRS

7.3.7 Mokelumne River Conveyance Improvements/Flood Easements

Please *refer* to Section 5.2.8 for a more detailed description of this non-structural measure that is a long-term non-structural measure that may have flood stage reduction benefits to the community of Hood by potentially lowering flood stage levels along Snodgrass Slough located south of Hood.

The documents referenced in Appendix H strongly suggest improving channel capacity in the Mokelumne River on either side of Staten Island and/or securing flood easements on Staten Island to accept excess flood waters would significantly reduce flood stages upstream in Snodgrass Sough for the nearby communities of East Walnut Grove, Locke, and possibly as far upstream as Courtland and Hood.

A regional solution for reducing flood stages in the North and South Forks of the Mokelumne River would be beneficial to lower flood stages in nearby Snodgrass Slough and the Franklin Pond, Point Pleasant area, and the Cosumnes River, all of which are impacted by high flood stages downstream on the Mokelumne River on either side of Staten Island.

7.3.8 Improve FEMA Community Rating System Score for Sacramento County

Please *refer* to Section 5.2.9 for a more detailed description of this non-structural measure that is an ongoing, long-term non-structural measure that has been beneficial to all unincorporated areas within Sacramento County including the community of Hood.

Sacramento County, *via* its floodplain administrator program, is a very active participant of the NFIP, and through its county-wide Flood Protection Ordinance the County strives to reduce flood risks throughout the unincorporated areas of Sacramento County while also attempting to reduce NFIP premium policy rates. Through different flood mitigation activities outlined within the NFIP, Sacramento County has been able to reduce flood insurance through the FEMA CRS. The County currently has the opportunity to improve their CRS score to achieve the highest possible Class 1 designation by implementing and participating in Emergency Action Plans (EAPs) and associated Table Top Exercises for nearby, upstream dams/reservoirs (namely Folsom Reservoir, and possibly others) that could have a sizeable impact on flooding portions of Sacramento County if said reservoir(s) were to fail and cause flooding. This last jump from a

CRS Class 2 to Class l designation would result in the last available 5 percent decrease (from 40 to 45%) in NFIP premiums and would place Sacramento County as the 2nd highest ranked CRS community in the entire Country behind Placer County.

7.3.9 Improved Governance between Neighboring LMAs/RDs and Community

Please *refer* to Section 5.2.10 for a more detailed description of this non-structural measure that is a long-term non-structural measure that could be beneficial to the community of Hood and MA 9 as they come together to potentially work with the HCC.

The community of Hood is not encompassed or represented by a local RD to maintain its non-project levees and drainage/pumping system. The Hood study area was formerly represented by RD 746, and the study area is presently limited to the DWR Sacramento Maintenance Yard conducting annual maintenance and inspections limited to just the east/left bank of the Sacramento River in MA 9. DWR does not have maintenance responsibilities for the former railroad embankments, nor the existing RD 744 cross levee.

The community of Hood, including the HCC, Sacramento County, and DWR MA 9 are encouraged to collectively engage in flood preparedness, and potential response/recovery action plans on an annual basis that could be deployed in advance of any flooding event within or east of MA 9. The HCC should also consider taking on the role as a default RD particularly in connection with improving and ultimately maintaining the non-project railroad/embankment levee reaches south and east of Hood and a potential new cross levee north of Hood. The HCC may also consider expanding its scope with other nearby Delta Legacy Communities to explore and potentially implement community-based flood insurance programs as an alternative or partial replacement to the current FEMA NFIP. Framework exists for community-specific assessments for a locally based flood insurance program for the community of Hood similar to the County assessments that are in place for regional sanitation services, water supply and storm drainage services that are provided by the County.

7.3.10 Public Education and Awareness

Please *refer to* Section 5.2.11 and Appendix H for a more detailed description of this non-structural measure that includes three ongoing public education and awareness programs for the Delta Legacy Communities. The noted public education/awareness programs are administered by: (1) the DPC via their Delta Flood Preparedness Week hosted each fall season prior to the beginning of each flood season; (2) the Sacramento County Program for Public Information increases flood awareness through informational materials (such as the Storm Ready Booklets) and multiple levels of outreach, ranging from radio spots to specific stakeholder engagement; and (3) the DWR Flood Risk Notification Program that includes sending annual notices in advance of the flood season to every property owner who is located behind a SPFC levee within the Delta. The individual notices include the property owner's address and informs the owners

their property may be exposed to potential flood risk from the failure of the levee system. The DWR also suggests each property owner visit DWR's Flood Risk Notification[1] and enter their address to get the most up-to-date information on State and federal levees in their area.

These programs all act as an ongoing, long-term conduit of flood risk information and coordination directly with the community members of Hood and other nearby Delta Legacy Communities protected by a combination of SPFC and non-SPFC levees.

7.4 Right-of-Way and Easement Considerations/Recommendations

Local preference and planning guidelines in the Delta encourage retention of agricultural lands as much as possible and the Delta Plan encourages preservation of agricultural land and uses versus displacement for commercial or residential uses. The structural-based management action components that could conflict with existing regional regulations of preserving agricultural lands in the Delta could be those that include seepage/stability as noted above in Section 6.3.2.1: Agricultural Sustainability. Table 6-8 in Section 6.3.2.1 provides a summary of each structural-based management action and the corresponding acreage of agricultural lands that may be displaced with a seepage/stability or combination berms.

If the final configuration of structural-based management actions would displace or affect a substantial acreage of important farmland of regional and statewide significance within the study area it may be deemed inconsistent with the Delta Plan and policies as administered by the DSC and DPC. It should be noted any major construction activity within the Delta would be considered a "Covered Action" under the Delta Reform Act of 2009 within Delta and the CEQA lead agency would be required to submit a written certification of consistency with detailed findings as to whether the covered action is consistent with the Delta Plan. Any person who claims that a proposed "Covered Action" is inconsistent with the Delta Plan may appeal a certification of consistency to the Council. (Calif. Water Code, § 85225.10).

It should be noted that most landowners in the study area adjoining the existing SPFC and non-SPFC levee systems actually own fee-title land under the levee prism and up to the ordinary high water mark on the water-side of the levee to maintain their riparian water rights to the Sacramento River and adjoining sloughs. The State and the Sacramento-San Joaquin drainage district retain easements for the SPFC levees; and Caltrans and Sacramento County also retain easements in most locations (*vs*. fee title) where highway and or roadway are overlain on the top of the levee crowns.

Right-of-way (ROW) acquisition quantities were estimated for the multitude of structural-based management actions (*see* Appendix F). In addition to determining costs for acquiring fee title or dedicated easements for various management actions, estimates were also developed for any temporary roadways to divert traffic. ROW was estimated based on review of aerial photography of existing land use and visual ground-truthing to confirm some of the different agricultural uses.

[1] https://water.ca.gov/myfloodrisk

ROW acquisition costs as summarized below in Table 7-2 only accounts for the required alignment and doesn't include purchase of full parcels.

The impact of known utilities to be relocated is considered minimal to the larger scope of the project. Unidentified utility relocations are assumed part of the allowance for unlisted items costs. Costs do not include removal and relocation of any existing structure on the landside of the levee, including but not limited to pump stations, residences, etc. The impact of utility crossings on the stability of the levee foundation, embankments and refinements to associated costs for mitigation and/or relocation of these crossings will need to be considered during the project design phase.

Table 7-2: Permanent Right-of-Way Cost Estimates per Acre and Structure

Permanent Right-of Way (fee title) or Structures	Unit	Cost
Permanent Right-of Way (fee title) - Seasonal Agricultural Field/ Row Crops	AC	$25,000
Permanent Right-of Way (fee title) - Orchard/ Vineyard	AC	$40,000
Permanent Right-of Way (fee title) - Commercial/ Industrial	AC	$240,000
Permanent Right-of Way (fee title) - Residential	AC	$180,000
Residential structures	Ea.	$250,000
Other structures	Ea.	$75,000

7.5 OMRR&R Considerations

O&M is the traditional term used to describe the routine activities necessary for a functioning flood management system. OMRR&R is a more recently developed term used to describe and include the comprehensive set of non-routine activities that realistically need to occur for the system, and also includes rehabilitation, repair, and replacement.

LMA activities are guided, in part, by O&M manuals developed by the USACE in the mid-1950s and associated hydraulic design criteria. The original project assurances provided to the federal government in the 1950s make no mention of repair, rehabilitation, and replacement (RR&R). The term was first introduced in the Water Resources Development Act of 1986. Responsibility for the RR&R of SPFC facilities is not widely agreed upon across agencies. As the responsibility for portions of OMRR&R has shifted, funding issues have become more pronounced, requiring additional interpretation of SPFC assurance agreements, O&M manuals, and governing codes and regulations. Accordingly, interpretations of responsibility and necessary funding can differ.

LMAs are not only faced with insufficient funding to conduct the activities needed to maintain and operate SPFC facilities, but they are also working under conditions, design standards, and environmental regulations that have changed since the flood infrastructure was constructed. These changes have complicated OMRR&R and affected the ability to perform necessary activities needed to ensure a fully functioning flood system. Historically, this was not a major

issue because federal programs, including PL 84-99 administered by USACE, were relied on to fund necessary repairs associated with damages from significant flood events. However, federal funding is becoming more difficult to obtain and eligibility requirements for post-event assistance through PL 84-994 are becoming increasingly more difficult to meet.

As part of the 2017 CVFPP Update, DWR prepared an OMRR&R cost estimate to account for more stringent USACE O&M standards, additional USACE RR&R responsibilities, increasing mitigation costs, and correcting original system design deficiencies. In the TM, the State communicates that although the State may provide investment in levees, the responsibility for maintenance lies with LMAs. To support the continued increase in O&M and additional burden of RR&R responsibilities, an assessment will likely be necessary.

OMRR&R costs in the Hood study area will increase in connection with the implementation and OMRR&R of a potential new cross levee north of Hood (Management Action 5). This is a management action that will not likely be pursued by DWR MA 9 unless there is large support and financial assistance from the community beneficiaries, namely the residences and business owners of the Hood community. The community will need to conduct a benefit assessment for not only the implementation and construction of the cross levee but also for the long-term OMRR&R. The community beneficiaries of said cross levee may not be the likely candidate to perform the OMRR&R, but they need to be prepared to compensate DWR MA 9 (or another applicable O&M entity) for any incremental cost of OMRR&R over and above what MA 9 may incur without the added presence of a cross levee.

No new substantial OMRR&R costs are anticipated by DWR MA 9 with the implementation of Management Actions 1to 3 associated with repairing the known FSRP critical and serious sites within and north of the Hood study area and raising/repairing the RD 744 south cross levee.

Repairing and strengthening-in place the entire 9 miles of the SPFC levee system in MA 9, including addressing any non-compliant encroachments, along the left bank of the Sacramento River (Management Action 9 containing multiple benefits) will not likely increase OMRR&R costs for DWR MA 9.

7.6 Regulatory Requirements

Environmental requirements associated with implementation of the preferred management action would include preparation of a CEQA/NEPA document, permits, endangered species consultations, Tribal consultation, and cultural resource assessments and consultations.

The level of CEQA/NEPA documentation required for the preferred structural-based management actions is dependent on many factors, including the project extent and severity of associated environmental impacts including biological and cultural resources, and air quality and greenhouse gas emissions. Under CEQA, if all impacts can be avoided or mitigated for, then a Mitigated Negative Declaration would suffice for the project. However, in areas where extensive habitat or air quality impacts are unavoidable, then an EIR would need to be prepared. More

extensive CEQA documentation would result in a higher cost for analysis and preparation. The required level of NEPA documentation generally follows CEQA, but in certain instances, a less extensive analysis may be appropriate, depending on the lead Federal agency.

Permits such as Clean Water Act Section 404 and 401 permits, approvals under the federal Endangered Species Act and California Endangered Species Act, and a Streambed Alteration Agreement from the CDFW (Section 1600 permit) will be needed, depending on what levee elevation is affected (if work is below Mean High Water or Ordinary High Water) and if upland work is conducted in sensitive areas. Prior to beginning the regulatory process for implementation of a proposed element, the following studies would be needed: a wetland delineation of the study area in accordance with the 1987 USACE Wetland Delineation Manual and Sacramento District standards, and focused habitat classification and assessments to determine the potential impacts of the project on special-status species. Conducting the delineation and focused surveys incurs a cost as may any avoidance or minimization measures that may need to be incorporated into project design. Additionally, mitigation for unavoidable effects to sensitive vegetation and wildlife would likely incur a cost associated with on-site or off-site mitigation.

As described previously, a total of 16 resources were identified during the records search and from information provided by the County of Sacramento. The majority of these have not been formally evaluated for their eligibility for listing in either the NRHP or CRHR. Many of the identified resources are along the Sacramento River levee and within and adjacent to the community of Hood, and therefore near to elements of the proposed management actions, including remediation of levees along the Sacramento River. Further evaluation of these resources, including cultural and historic resources, would need to be conducted to inform final project design and implementation. See Appendix C for additional information on cultural resources within the study area.

7.7 Federal, State and Local Funding Sources and Financial Strategies

The potential federal, state, and local funding sources for the flood risk reduction MAs and non-structural measures identified for the Delta Legacy of Hood identified below in Sections 7.7.1 through 7.7.3 are largely excerpted and updated from the suite of funding sources previously identified in the 2014 Lower Sacramento/Delta North RFMP and the 2017 CVFPP Update. One new additional key federal funding source is FEMA's Building Resilient Infrastructure and Communities (BRIC) program that can channel competitive funds to the small Delta Legacy Communities through Cal OES for both structural and non-structural flood risk reduction measures.

7.7.1 Federal Funding Sources

The process for garnering federal funding for flood risk reduction projects requires that a federal interest in the project be identified. Federal interest has generally been identified and evaluated within feasibility studies prepared by the USACE, which evaluate various criteria and generally emphasize the flood damage-reduction benefits typically associated with larger urban area projects. Unfortunately, the small communities and rural areas generally lack the necessary flood risk reduction benefits alone to justify a significant federal interest, unless there are sizeable multi-objectives/benefits that can also be attached to the smaller benefits normally associated with small, rural communities that exist in the North Delta. One sizeable multi-benefit component that has been identified in most all of the Sacramento County Delta Legacy communities is repairing and strengthening-in-place the SPFC levee system along the Sacramento River for the entirety of the community's study area (Hood's structural-based Management Actions 6 and 9) will also improve the reliability and resiliency of the through-Delta conveyance of SWP and CVP water through the Delta. Given the constrains of the current approach for evaluating and garnering federal investment for stand-alone flood risk reduction projects, coupled with constrained federal budgets, it may be difficult to secure significant federal investment in the region through the USACE. Furthermore, the evaluation, project identification and appropriation process for USACE projects can be protracted, expensive and can lead to higher project costs that may, in some cases, not be in the best economic interest of local project proponents.

Greater opportunities for federal funding may exist via FEMA's emerging BRIC program that can channel competitive funds to small communities through Cal OES. FEMA's BRIC program supports flood risk reduction programs and projects for small, rural communities with smaller, local cost-sharing requirements, particularly for disadvantaged communities. It also enables large multi-benefit infrastructure projects that could possibly be combined with reducing flood risks in the noted North Delta Legacy Communities, including the benefit of improving the long-term reliability and resiliency of through-Delta conveyance of SWP and CVP water through the Delta adjoining the communities. This is particularly applicable for the federal- and state-authorized SPFC levee system in the North Delta adjoining the chain of six Delta Communities, namely Hood, Courtland, Locke, Walnut Grove (East and West) directly adjacent to the Sacramento River SPFC levee system, and the City of Isleton adjacent to the Georgiana Slough SPFC levee system.

Table 7-3 provides a summary of potential federal funding sources to fund both structural-based management improvements and non-structural flood risk reduction measures. The table outlines the general uses of the funding source and the attributes and applicability of the mechanism for flood management.

Table 7-3: Potential Federal Funding Programs

Agency	Program Name (Acronym)	Program Summary	Status	Who is Eligible to Apply	Cost Share Range
FEMA	Building Resilient Infrastructure and Communities (BRIC)	The BRIC program supports hazard mitigation projects, reducing the risks faced from disasters and natural hazards. (Approximately $919M available for local projects spread across entire nation for fiscal year 2021)	Relatively New	Federally Recognized Native American Tribes, State governments; City or township governments, County governments via Cal OES	Varies 75%-90% Highest for small disadvantaged communities (DACs)
FEMA	Flood Mitigation Assistance (FMA)	The FMA grant program provides funding to reduce or eliminate the risk of repetitive flood damage to buildings and structures insurable under the National Flood Insurance Program (NFIP).	Ongoing	Federally Recognized Native American Tribes, State governments; City or township governments, County governments via Cal OES	Varies 75%-100%
FEMA	Pre-Disaster Mitigation (PDM)	The PDM Grant Program is designed to implement a sustained pre-disaster natural hazard mitigation program to reduce overall risk from future hazard events, while also reducing reliance on Federal funding from future disasters.	Ongoing	Federally Recognized Native American Tribes, State governments; City or township governments, County governments via Cal OES	75% 90% for small disadvantaged communities (DACs)
USACE /State	USACE/CVFPB Feasibility Studies (USACE FS)	A feasibility report is developed to identify the recommended plan: project scope, economic benefit, and an accurate cost and schedule baseline identified with potential project risks.	Ongoing	CVFPB with a local Sponsor	50% USACE, 50% State and Locals Split
USACE /State	USACE/CVFPB Civil Works Projects (USACE CW)	Upon completion of a USACE feasibility study a Chief's Report is provided to congress. If the Chief's Report is authorized by Congress a local agency can advance a project with the USACE upon securing federal appropriations.	Ongoing	CVFPB with a local Sponsor, 25%	35% Split between CVFPB and local Sponsor

Agency	Program Name (Acronym)	Program Summary	Status	Who is Eligible to Apply	Cost Share Range
USACE	Sacramento River Bank Protection Project (SRBPP)	The Sacramento River Bank Protection Project is a long-term flood risk management project designed to enhance public safety and help protect property along the Sacramento River and its tributaries.	Phasing Out	Project Levees authorized in the SRFCP	0%

7.7.2 State Funding Sources

In the near term, the State plans to utilize the remaining Proposition 1E bonds authorized to fund projects consistent with the CVFPP last adopted in July 2017 and being updated at 5-year intervals with the next update scheduled for 2022. Within the latest 2017 CVFPP updates, the State identified remaining Proposition 1E and 84 bond funds were not sufficient to meet all of the flood protection goals and identified an ongoing need for flood risk reduction within the Central Valley. Additional bond authorizations and greater utilization of State general funds will be needed to meet the goals identified in the CVFPP, particularly for the SCFRRP flood risk reduction components. The SCFFRP component measures for the entire CVFPP study area were estimated between $1.5B to $1.9B in the 2017 CVFPP update for the Sacramento Basin alone compared to only $310M to $370M for the San Joaquin Basin. The State Legislature will need to play a significant role, with respect to how State and local funding can be generated particularly within the Delta region, as it considers legislation associated with planned updates to the CVFPP and the associated financing/funding plan recommendations.

Below is an abbreviated excerpt from Section 3.13.1 of California's Flood Future Report of November 2013 that suggests levee improvements in the Delta should be orchestrated with improving the conveyance of SWP and CVP water through the Delta to areas south of the Delta where water demands are significantly greater than available water supplies south of the Delta.

> "The Sacramento-San Joaquin Delta provides a major source of water supply to more than 60 percent of California residents and is a vital source of water supply for agriculture. The Delta is a unique place defined by its ecological value as the transitional ecosystem from fresh to salt water and by its extensive levee system *(including SPFC levees in the north Delta and several non-SPFC levees in the central and south Delta that convey water to the SWP and CVP pumps in the south Delta)*. The Delta consists of approximately 70 major islands and tracts encompassing approximately 700,000 acres located behind levees. Virtually all assets and attributes of the Delta are dependent upon this large levee system. The levees reduce flood risk to land areas near and below sea level and provide for a network of channels that direct movement of *(SWP and CVP)* water across the Delta. The State of California has significant interest in the benefits provided by Delta levees, which have been legislated in the California Water Code (§ 12981, for example).

> The Delta is unique, not only as a levee system but also as an influence on existing DWR flood management programs within the Delta. The Delta is a prime example of why Integrated Water Management (IWM) is important in California. Due to its location, importance for much of California's water supply, deteriorating ecosystem conditions, questions about levee integrity and feasibility for improvements, and other issues, flood management cannot be considered in isolation of other resource needs. The importance of the Delta and its levees to the State has been included many times in legislation and codes. In addition, multiple Federal and State processes are underway to solve a variety of resource management problems in the Delta, and several include consideration of levee improvements or other flood management actions. These plans, *including the DCA's current efforts that consider a single-purpose isolated conveyance facility* and the Delta Stewardship Council (DSC) Delta Plan, *may* alter Delta conditions and will influence the future of IWM in the Delta. Implementation of these programs would alter ecosystem conditions and water infrastructure, which would influence Delta flood risk; therefore, flood management in the Delta needs to be considered as part of these larger planning efforts."

Given the above perspective within California's Flood Future Report there should be a larger financial interest in reducing flood risks in Delta by the USACE, USBR, FEMA, DWR, CVFPB, and Delta water users south of the Delta. This holds true particularly for improving the SPFC levees in the subject north Delta Legacy Community study areas adjoining the SWP and CVP freshwater conveyance corridor along the Sacramento River upstream of the Delta Cross channel, and portions of both Snodgrass and Georgiana Sloughs immediately downstream of the Delta Cross Channel.

Other policy efforts that could potentially generate future State funding include the recommendations presented within the current Governor's Water Resiliency Portfolio Water Action Plan. These recommendations include providing support and expanding funding for Integrated Water Management Planning and Projects, creating incentives for multi-benefit projects, providing assistance to disadvantaged communities, and prioritizing funding to reduce flood risk and improve flood response. In addition to recommendations that could direct State funding to the region, the former Governor's Water Action Plan also identified recommendations that could make it easier to generate local funding including removing barriers to local and regional funding for water projects. One of the key concepts in the Water Action Plan called for the development of a water financing strategy that leverages various sources of water-related project funding and proposes options for eliminating funding barriers, including barriers to co-funding multi-benefit projects.

Table 7-4 provides a summary of potential State funding sources applicable to Delta Legacy Communities protected by SPFC levees. The State funding programs can fund both structural-based management improvements and non-structural flood risk reduction measures. The table outlines the general uses of the funding source and the attributes and applicability of the mechanism for flood management.

Table 7-4: Potential State Funding Programs

Agency	Program Name (Acronym)	Program Summary	Status	Who is Eligible to Apply	Cost Share Range
State DWR	Delta Special Projects	Cost share grant program for levee maintaining agencies in the Delta to rehabilitate non-SPFC and eligible SPFC levees.	Ongoing	LMA's within the Primary and Secondary Zones of the Legal Delta and limited areas within the Suisun Marsh.	75 to 95% Up to 100% for Habitat Projects
State DWR	Delta Levees Subventions	Cost share program for the maintenance and rehabilitation of non-SPFC and eligible SPFC levees in the Delta.	Ongoing	LMA's within the Primary and Secondary Zones of the Legal Delta.	Up to 75%
State DWR	Flood System Repair Projects (FSRP)	Evaluate (feasibility), design, and construct repairs of non-urban SPFC Facility (levees, channels, structures, etc.) deficiencies	Phasing Out	Eligible applications are local public agencies or Joint Powers Authority	50 to 90%
State DWR	Small Community Flood Risk Reduction Program (SCFRRP)	Projects to reduce flood risk in small, rural, and agricultural communities in the Central Valley. Funds support non-routine O&M, O&M plan updates, evaluations, feasibility studies, design, and construction of proactive repairs to flood control facilities of the SPFC and appurtenant non-SPFC levees.	Current	Local agencies: evaluate SPFC facilities must protect small and rural communities in the Central Valley designated by the CVFPP to have a High or Moderate-High Flood Threat Level.	50 to 90%
State-California Natural Resource Agency	California River Parkways Program	The Proposition 50 California River Parkways Grant Program in the Resources Agency is a competitive grant program for river parkways projects.	Ongoing	Public Agencies and California Nonprofit Organizations	50 to 90%
State DWR	Proposition 68	Proposition 68 authorizes $4.1 billion for state and local parks, natural resources protection, climate adaptation, water quality, and flood protection.	Ongoing	Public agencies, non-profit organizations, public utilities, Native American Tribes, and mutual water companies	50% Up to 100% for DACs

Agency	Program Name (Acronym)	Program Summary	Status	Who is Eligible to Apply	Cost Share Range
State DWR	Flood Maintenance Assistance Program	Program that provides State funds for eligible maintenance activities to Local Maintaining Agencies and Maintenance Areas.	Ongoing	Local Maintaining Agencies	50 to 75%
State IRWM	Integrated Regional Water Management (IRWM)	Grant funds for development and revisions of IRWM Plans, and implementation of projects in IRWM Plans. Goals of Projects: to assist local public agencies to meet long- term water management needs of the State.	Ongoing	Applicant must be a local public agency or nonprofit representing an accepted IRWM Region. Other IRWM partners may access funds if their projects are identified in the Applicable IRWM Plan	Up to 75%

7.7.3 Local Cost Share Financing and Assessment Strategies

The cities, counties, LMAs and the regional flood management agencies have played a significant part in funding the local share of flood management improvements and operations and maintenance. Funding by local agencies within the region is largely limited due to constitutional and statutory constraints to the way local governments can fund and finance capital improvements and services. As noted previously, Attachment I to California's Flood Future Report provides a detailed description of funding mechanisms available to local agencies to fund flood management improvements. In general, revenues for flood management within the North Delta are generated mostly by RDs or LMAs from property-based taxes, fees and assessments. In California, a local agency's ability to provide ongoing services and invest in its infrastructure is limited by voter-approved initiatives, such as Proposition 13 (1978) (limiting property tax increases) and Proposition 218 (1996) (requiring voter approval for new assessments) as previously discussed above in Constraints Sections 3.3.1 and 3.3.2.

Limited Availability of Local Funding Sources

Presently the RDs and LMAs in the North Delta largely assess O&M and repair of the levee systems on an agricultural acreage basis, and do not necessarily assess on a land improvement basis that accounts for residential, commercial, or industrial structures. The acreage-based only assessment approach is in large part due to the assessment constrictions presented by Proposition 218 as further discussed above in Section 3.3.2. An exception to the acreage-only assessment in the North Delta is RD 563 - Tyler Island who experienced flooding in 1986 and has had subsequent flood fights in 2007 and 2017. RD 563 (encompassing a portion of the East

Walnut Grove study area) successfully executed a Proposition 218 benefit assessment in the early 2010's. Following their detailed Proposition 218 benefit assessment study RD 563 now assesses anywhere from $45 to $65/year for agricultural acreage, $550 to $600/year for residential structures, and anywhere from $1,000 to $1,500/year for commercial/industrial groupings of multiple structures, all dependent upon the benefit received from maintenance, repair and improving the levee system designed to eliminate or reduce variable flood depths within RD 563. To improve the local cost-sharing participation by the Delta Legacy Communities for smaller community-specific flood risk reduction measures such as a flood fight berm, a ring levee, or a cutoff levee system for the community of Hood within DWR MA 9, it is recommended that the community of Hood assess themselves on a combined acreage- and structural-benefit basis, similar to RD 563. A benefit assessment study to support improvements that only benefit the community and not the balance of the larger study area will be likely be required; and it may be advisable for the community to consider the development of a GHAD that could also incorporate a community-based flood insurance program. The community-based flood insurance program coupled with the suggested structural-improvement assessment approach can further enhance the community's ability to buy-down known flood risks (*see* Appendix J regarding a community-based flood insurance program for the Delta Legacy Communities in Sacramento County coupled with a community benefit assessment to generate local cost-share funds and assist with financing flood risk reduction measures).

Table 7-5 provides a summary of the local funding methods used by many agencies in California and the region to fund flood management improvements and services. The table describes the general uses of the funding source and the attributes and applicability of the mechanism for flood management. Included within these sources, many LMAs and RDs within the Delta, such as RDs 554 and 563 where the community of East Walnut Grove is located, fund ongoing O&M and repairs of levees via the Delta Levee Subventions program and/or the Delta Levees Special Projects, both of which are administered by DWR. These programs are reimbursement based administered by DWR and have minimum deductible cost per levee mile, and can include substantial local, up-front cost-share cashflow requirements. Thus, it is important to the communities within the existing RDs and LMAs to know that they may need to assist with said RD levee improvements that provide direct and/or indirect flood risk reduction benefits to the community.

Table 7-5: Potential Local Funding Programs and Assessment Strategies

Potential Local Funding Programs and Assessment Strategies						Pros, Cons, and Notes		
Item	**Use**	**Voter Approval**	**Bonds Allowed**	**Long/ Short Term**	**Entity**	**Pro**	**Con**	**Notes**
Geological Hazard Abatement Districts (GHAD)	O&M/ Capital Improvements	50% of Property Assessed	Yes	Long-Term	Independent District / Community	Broad scope of works, locally autonomous, Simple Majority Approval, Ongoing Funding Source. Some CEQA exemptions	Must prepare Plan of Control. Creates new responsible independent entity (similar to JPA), Prop 218 applies with respect to assessments levied.	Alternative to RD. Can fund reserves & Community-Based Insurance Program
Various Water Code Sections	O&M/ Capital Improvements	50% by Property Assessed	No	Long-Term	RDs & Community	Simple Majority Approval, Ongoing Funding Source	Applicability of Prop 218 - Must Show Benefit	Can fund maintenance or capital works. Can be used to finance improvements.
Benefit Assessment District Act of 1982	O&M/ Capital Improvements	50% of Property Assessed	No	Long-Term	Flexible	Simple Majority Approval, Ongoing Funding Source	Must Show Benefit Improvements/Services must be within the Boundary	Could provide some reimb. of Advance Funding
Municipal Imprvmt. District Act of 1913/1915	Capital Improvements	50% of Property Assessed	Yes	Long-Term	Flexible	Simple Majority Approval, Ongoing Funding Source	Must Show Benefit Improvements/Services must be within the Boundary	Could provide some reimb. of Advance Funding
Community Facilities Districts	O&M/ Capital Improvements	2/3's (See Note)	Yes	Long-Term	Flexible	Benefit not Needed, Flexible in Forming District, Improvements located anywhere	2/3 Approval Difficult to Obtain	Voting requirements change depending on presence of registered voters within boundary.
Advance Funding	Planning & Capital Improvements	NA	NA	Short-Term	N/A	Can cover upfront planning and operations costs	Limited/Uncertain Availability	Could be subject to reimb. from various sources over time.

7.8 Financial Feasibility and Local Cost Share Requirements for Key Management Actions

7.8.1 Financial Feasibility Summary Utilizing EAD Evaluations

The net reductions in EAD and financial feasibility values (in pay-back periods) for most of the key recommended short-term and long-term structural-based management actions are described above in Section 6.3.1.2. The evaluations, inventory values, and methodology are presented in Appendix E.

The summary of the EAD results indicating net reductions in EAD values and the return period(s) of investment (in years) for various structural based management actions are summarized in Table 6-6 for existing conditions without climate change adjustments, and Table 6-7 for future conditions that include adjustments for climate change.

The EAD values in Table 6-6 under existing conditions indicates there is a great net reduction in EAD values in the amount of $8.3M that could result from Management Actions 1 and 3 which consist of repairing all of the known DWR FSRP critical and serious sites within and north of the Hood study area. At an estimated cost of nearly $14M, the payback period is less than two years. Similarly repairing only the DWR FSRP critical and serious sites within the Hood study area combined with raising and repairing the RD 744 cross levee results in a net reduction in EAD of nearly $2.3M, with an estimated payback period of nearly five-and-a-half years. The challenge with implementing Management Actions 4, 5, and 9, with longer payback periods is the benefit area(s) coming up with the local cost-share components from not only the larger study area located within DWR MA 9, but also from the limited amount of citizens and businesses residing in the community of Hood who will benefit from said repairs or improvements.

Long-term Management Actions 4 and 5 (FEMA certification for the community of Hood with a cross levee system) and Management Action 9 (repairing and strengthening 9.0 miles of DWR MA 9 SPFC levee between Freeport and RD 755) are estimated at between $35M-$45M, and $358M, respectively, with payback periods ranging between 16 to 42 years.

7.8.2 Local Cost Share Financing and Assessment Strategies

Implementing any of the above management actions, including the flood risk reduction measure of a cross levee north of Hood, will still require a local cost share of at least 5 to 10 percent. This could be a large challenge, particularly if said management actions do not provide a direct benefit to the balance of the larger 820-acre study area or the greater combined area of 4,570 acres comprising the Hood study area, RD 744 to the north, and RD 813 to the south. Assessments can only be levied where there is direct benefit received from any one of the proposed management actions.

For management actions benefiting the entirety of the study area totaling approximately 740 acres, or the greater area of approximately 4,570 acres which also includes RDs 744 and 813, there still is a challenge with developing the required local cost-share to participate in the noted federal and State grant programs identified above in Sections 7.7.1 and 7.7.2. Assuming that 80 percent of a local cost-share could be financed with the other 20 percent acquired in accumulated proceeds from an assessment, only one to two percent of the total cost of each management action will be required from either DWR MA 9, the community Hood, or some combination thereof for those management actions which result in flood risk reduction either for the Hood study area, and/or additional areas north and south comprised of RD 744 and RD 813. As described above in Section 7.7.3, this local cost share could be generated through a conventional acreage-based assessment, as well as a structural benefit basis within the Hood study area similar to what RD 563 accomplished on Tyler Island in the early 2010's with their Proposition 218 benefit assessment to fund substantial levee repairs/improvements.

The local cost share for any of the management actions could be generated through an acreage assessment paired with a structural benefit assessment of the community of Hood located with DWR MA 9. By assessing the total acreage of the Hood study area, RD 744 to the north, and RD 813 to the south (4,570 total acres) at $5 per acre, an estimated $22,850 per year could be generated. Assessing residential structures within SAC 45 (community of Hood) at $400 per residential structure and the larger SAC 44 area (mostly east of Interstate 5 and subject to shallower flooding depths) at only $5 per residential structure a total annual assessment of $123,385 could be generated from residential structures. By assessing commercial/residential and public structures within Hood at an annual assessment for $500 per structure, and the larger SAC 44 area at only $7 per structure a total annual assessment of $11,288 could be generated from commercial/industrial structures. Collectively the combined MA 9 area (SAC 44) and the smaller community of Hood (SAC 45) could generate over $161,000 per year, with Hood generating approximately $52,000 per year or approximately 32% of the total annual assessment.

With these assessments totaling $161,000 per year, it would take less than one year combined to acquire cash to secure local cost share financing for Management Actions 1 and 3 and another three-and-a-half years combined to pay back the financed amount. These payback periods could be doubled if a 10 percent cost share requirement is needed instead of the nominal 5 percent local cost-share scenario that is presented in Table 7-6.

With the total annual assessments of approximately $52,000 from the community of Hood (SAC 45) the community could potentially finance a 5 percent cost-share for a preferred cross levees system with securing financing after 8 years of assessments, and a projected payback period of just over 40 years. Again, all of these periods could be doubled or the assessments may require doubling if a 10 percent cost share requirement is needed by this community. This could a challenge for Hood given the have been recently deemed a disadvantaged community as noted above in Section 2.1.3. Thus, there needs to be a long-range financial plan developed by the community of Hood and the greater North Delta interests on how they can seek additional funds to partner with other benefiting agencies, particularly for the multi-benefit Management Actions

6 and 9, but also for improving the collective study area SPFC and non-SPFC levee segments if it is ultimately desired to have the community meet FEMA's current 100-year levee accreditation standards.

Table 7-6: Conceptual Analysis of Hood & Stone lakes Local Cost-Share Assessments and Local Pay-Back Periods for Select Management Actions

		Management Action (MA)				
		Repair DWR FSRP Critical and Serious Sites within the Hood Study Area and in MA 9 North of the Hood Study Area **(MA 1 & MA 3)**	Cross Levee North of Hood paired with Repair and Strengthen-in-Place Existing SPFC and Non-SPFC Levees adjacent to Hood **(MA 4)**	Cross Levee North of Hood with Community-Preferred Alignment paired with Repair and Strengthen-in-Place Existing SPFC and Non-SPFC Levees adjacent to Hood **(MA 5)**	Repair and Strengthen-in-Place DWR MA 9 Sacramento River Left Bank SPFC Levee in Hood Study Area (**MA 6**)	Repair and Strengthen-in-Place 9.0 miles of DWR MA 9 Sacramento River Left Bank SPFC Levee between Freeport and RD 755 **(MA 9)**
Estimated Cost (Low)		$13,937,000	$34,749,000	$38,419,000	$34,529,000	$125,704,000
Estimated Cost (High)		$13,937,000	$37,330,000	$45,066,000	$98,357,000	$358,072,000
Net Reduction in EAD to Hood Study Area, Existing Conditions		$8,267,000	$2,311,000	$2,311,000	N/A	$8,471,000
Net Reduction in EAD to Hood Study Area, Future Conditions		$68,853,000	$5,777,000	$5,777,000	N/A	$70,503,000
Flood Risk Reduction Payback Period (in Years: Future – Existing Conditions)		0.2 to 1.7 years	6.5 to 16.2 years	7.8 to 19.5 years	N/A	5.1 to 42.3 years
Local Responsibility (Lead **Assessed**/Support)		**MA 9/ Community of Hood**	**Community of Hood**/MA 9	**Community of Hood**/MA 9	**MA 9/Community of Hood**	**MA 9/Community of Hood**
5% Local Cost Share Scenario	5% of Total Cost	$697,000	$1,867,000	$2,253,000	$4,918,000	$17,904,000
	80% Local Financed (4% Total Cost of MA)	$557,600	$1,493,600	$1,802,400	$3,934,400	$14,323,200
	20% Local Cash Needed (1% Total Cost of MA)	$139,400	$373,400	$450,600	$983,600	$3,580,800

	Management Action (MA)				
	Repair DWR FSRP Critical and Serious Sites within the Hood Study Area and in MA 9 North of the Hood Study Area **(MA 1 & MA 3)**	Cross Levee North of Hood paired with Repair and Strengthen-in-Place Existing SPFC and Non-SPFC Levees adjacent to Hood **(MA 4)**	Cross Levee North of Hood with Community-Preferred Alignment paired with Repair and Strengthen-in-Place Existing SPFC and Non-SPFC Levees adjacent to Hood **(MA 5)**	Repair and Strengthen-in-Place DWR MA 9 Sacramento River Left Bank SPFC Levee in Hood Study Area (**MA 6**)	Repair and Strengthen-in-Place 9.0 miles of DWR MA 9 Sacramento River Left Bank SPFC Levee between Freeport and RD 755 **(MA 9)**
Acreage Assessment[1]	$26,730	$3,880	$3,880	$68,550	$68,550
Residential Assessment[2]	$81,785 (SAC 44)	$41,600	$41,600	$81,785 (SAC 44)	$81,785 (SAC 44)
	$41,600 (SAC 45)			$41,600 (SAC 45)	$41,600 (SAC 45)
Commercial/Industrial Assessment[3]	$4,788 (SAC 44)	$6,500	$6,500	$4,788 (SAC 44)	$4,780 (SAC 44)
	$6,500 (SAC 45)			$6,500 (SAC 45)	$6,500 (SAC 45)
Total Annual Assessments	$161,403	$51,980	$51,980	$161,403	$161,403
Number of Years to Acquire Cash to Secure 5% local Cost-Share Financing	< 0.1 years	7.2 years	8.7 years	6.1 years	22.2 years
Number of Years to Pay Back Financed Amount	3.5 years	28.7 years	34.7 years	24.4 years	88.7 years
Total Payback Years	4.3 years	35.9 years	43.3 years	30.5 years	> 100 years

Notes: The assessed values indicated below are very preliminary in nature per acre and/or per the various structures. A full benefit assessment study will be needed to determine actual assessment values. Changing the acre-assessed values and and/or the structure benefit-assessed values will obviously impact the estimated pay back periods presented herein.

[1] Acreage assessment assessed at $5/acre for MA 9 (4,570 combined acreage for RD 744, Hood study area, & RD 813) and $40/acre for community of Hood (97 acres)

[2] Residential assessment utilizes the total number of residential structures located within the community of Hood from the 2022 CVFPP Update, assessed at $5 per structure with 16,357 residential structures in MA 9 (SAC 44), and $400 per residential structure with 104 residential structures in Hood (SAC 45)

[3] Commercial/industrial assessment utilizes the inventory of structures from the 2022 CVFPP Update, assessed at $7 per commercial and industrial structures with 684 structures in MA 9 (SAC 44), and $500 per commercial/industrial structures with 13 structures in Hood (SAC 45) (to be refined later based upon benefit values, that can be partially based upon sq. ft. and elevation of structures, and maximum potential depth of flooding)

8. Implementation of Recommendations

8.1 Implementation Schedule including Roles and Responsibilities

The community of Hood, acting through Sacramento County with support from DWR MA 9, has the opportunity to significantly reduce flood risks to Hood and its larger study area including a sizeable portion of MA 9. The community of Hood and Sacramento County intend to accomplish this by: (1) repairing and strengthening-in-place the greatest known and documented weaknesses in the perimeter SPFC levee system along the left bank of the Sacramento River (2) potentially raising and strengthening-in-place the RD 744 south cross levee, and (3) potentially constructing a cross levee north of Hood in conjunction with perimeter levee improvements to further protect the community in the event a levee breach were to occur in the study area but outside of the community.

As its highest priority (Management Action 1), the community of Hood would prefer to see the well documented DWR FSRP critical and serious sites in the Hood study area repaired by DWR within the next few years, preferably by 2024. The repair of the three critical sites (estimated at $5.6M) and the serious site (estimated at $2.1M), when combined with addressing the five DWR FSRP critical and serious sites north of the Hood study area (Management Action 3 presently estimated at $6.2M), will result in net reductions in EAD values of approximately $8.2M for the entire study area. This reduction is even greater 50 years into the future, up to $69M, when incorporating climate change and sea level rise adjustments.

Following remediation of the noted FSRP sites, the community would prefer to see the 0.25-mile-long RD 744 south cross levee raised and fortified to meet current FEMA accreditation standards within the next 5 to 10 years (Management Action 2) at a cost of approximately of $4.4M. This action alone would not represent a substantial, incremental reduction in EAD values within the study area, but it would substantially reduce the potential for life loss and property damage if a levee breach were to occur at this location or upstream in RD 744.

If the RD 744 south cross levee improvements do not materialize , the community would consider cross levee system consisting of a new cross levee north of Hood along with perimeter levee improvements constructed and accredited by FEMA within the next 10 to 15 years (Management Action 5). At a cost of $38 to $45M in 2020 dollars, this management action will result in a net reduction in EAD of approximately $2.3M for the community of Hood. However, this net reduction in EAD increases to nearly $5.8M 50 years into the future when incorporating climate change and sea level rise adjustments.

To achieve the noted reductions in flood risk, the following recommendations include full development of the structural-based management actions, including improving the SPFC levee system to meet current FEMA 100-year accreditation standards, advancing non-structural

measures, and developing multi-benefits that will improve the reliability and resiliency of conveying SWP and CVP water in the North Delta upstream of the Delta Cross Channel. They are outlined and planned to secure financial assistance and concurrence with DWR, the CVFPB, the USACE, and the Delta Conservancy and can confirm consistency with Delta Plans administered by the DPC and the DSC to reduce known flood risks in the North Delta. The following recommendations can be sequenced or phased in the order as listed below or amended based upon variable funding sources. However, it is recommended the first two recommendations take priority for initiating all short-term structural-based management actions, with all other recommendations not tied to any specific phasing or prioritization, with several non-structural measures already partially implemented.

1. In connection with executing repairs to the known FSRP critical and serious repair sites (structural-based Management Actions 1 and 3), the HCC and the Delta legacy Communities both notified DWR by letter in June of 2021 that they have a continued interest in DWR repairing the known, no-regrets, nine critical and serious FSRP repair sites in MA 9, and they need timely financial assistance and participation from DWR. Short of DWR providing assistance and funding for the full repairs for the five critical sites, DWR should consider providing assistance to fund the initial design and permitting for all nine FSRP critical and serious sites. It may be more cost-effective to design, permit and construct these nine known FSRP sites simultaneously or during back-to-back years, as the preferred repair solutions identified by DWR call for the installation of combination seepage/stability berms. With DWR funding most or all initial design, permitting, and CEQA/NEPA documentation, it would allow more time for MA 9 and the community of Hood to develop its applicable cost-share funds that may be necessary to actually execute the repairs at the known FSRP sites.
2. Consistent with the approach outlined above for correcting the known FSRP sites associated with Management Actions 1 and 3, RD 744 and possibly DWR should also earmark nominal funds, with the possible assistance from Sacramento County and the community of Hood, to raise and fortify the RD 744 south cross levee. Funds should also be earmarked by RD 744 and DWR to fund the design, permitting and CEQA/NEPA documentation for the applicable repairs so the repairs are shovel-ready when larger funding sources become available either through Delta Levees Special Projects and/or Subventions in addition to other grant programs that may be available.
3. The community of Hood, with support from Sacramento County and DWR MA 9, should seek funds via community block grants funds or other sources to fund a Proposition 218 election that may be required to raise local cost-share funds for developing the applicable local cost share for flood risk reduction actions that have community-specific benefits over and above those that are more beneficial to the larger Hood study area. The community-specific flood risk management actions that could significantly reduce life loss and potential damages in Hood due to flooding in the community include construction and implementation of a new cross levee system consisting of a cross levee north of Hood along with strengthening-in-place the Sacramento River SPFC levee

immediately fronting the community and perimeter levee improvements south of Hood (Management Action 5). The local cost share of said community-specific flood risk reduction measures could also be partially funded via a community-based flood insurance program as another relatively near-term non-structural measure, as noted further below.

4. To implement Management Action 5, geotechnical explorations will be required in advance of preparing preliminary designs and advancing permits and supporting CEQA/NEPA documentation. It is recommended that the community, with the support of Sacramento County and others, work with DWR to identify potential funding sources and advance said geotechnical explorations, remediation designs, and environmental documents so this management action is closer to shovel-ready when funds may become more readily available.
5. The community of Hood should work closely in the near-term with other Delta Legacy Communities in Sacramento County, particularly other DWR SCFRRP participants, including the city of Isleton, to establish a GHAD or HOA to advance a private, community-based flood insurance program that would effectively provide relief from the ever-increasing high NFIP rates. The city of Isleton has taken the initial steps in developing a community-based flood insurance program, and it will be more cost effective (resulting in significantly lower insurance premiums than offered by the NFIP) if there were more nearby communities pooling their resources together and aggregating or spreading their potential flood losses over a larger pool of insureds. The timely development of said GHAD or HOA would not only serve to substantially reduce flood insurance rates, but it could serve as a vehicle to generate local cost-share funds to buy-down flood risks within the community that is currently assessed on an acreage only basis, versus a flood risk value tied to structure improvements and content values. The private, community-based flood insurance program could also fund regional programs or local cost-share requirements to buy-down risks at the regional level, including larger, long-term multi-objective components such as improving the entire SPFC levee reaches not only in the Hood study area but also in the greater North Delta (Management Actions 6 and 9).
6. In connection with implementing the multiple-benefit projects of either improving the 2.5 miles of SPFC levee in the project area or within the greater MA 9 area between Freeport and RD 755, both of which will also improve the reliability and resiliency of conveying SWP and CVP in the North Delta (Management Actions 6 and 9), it is recommended that community representatives pool their resources together with other participating Delta Legacy Communities in the North Delta. Improving the SPFC levees to current, modern FEMA standards to address seepage, under seepage, and stability will also serve to improve the reliability and resiliency of conveying SWP and CVP water through the North Delta with or without the DCA's current tunnel and intakes proposal. The noted communities and regional stakeholders have been approached by the DCA regarding their Communities Benefits Program , and the Delta Legacy Communities have suggested improving the SPFC levee system, particularly upstream of the Delta Cross

Channel, is necessary with or without the proposed DCA. It is suggested that the Community of Hood and its neighboring Delta Legacy Communities, particularly in Yolo and Sacramento Counties, work with RFMP representatives, including SAFCA, WSAFCA, CVFPB, and DWR MA 9, to share and ideally implement their preferred alternative of how improving the limited number of SPFC levee miles in the North Delta along the Sacramento River in the North Delta will also improve the reliability and resiliency of conveying SWP and CVP water through the entire Delta, with or without an independent isolated conveyance facility.

(See Appendix K for additional background information related to improving water conveyance through the Delta in tandem with reducing flood risks to the Delta Legacy Communities within Sacramento County.)

7. Concurrently with implementing the near- and long-term structural-based management actions, the community of Hood, with assistance from Sacramento County, DWR MA 9, and others, can implement the following non-structural measures to further reduce residual flood risk in the Hood study area. All of the non-structural measures for implementation are described in more detail in Sections 5.2 and 7.3. The following non-structural solutions are highly recommended for implementation, some of which are already in the early stages of implementation:
    1) Voluntary Elevation of Structures
    2) Wet or Dry Floodproofing
    3) Flood Emergency Safety Plans
    4) Sacramento County OES Decision Support Tool
    5) Local Hazard Mitigation Plan and Relief Cuts
    6) Alternatives to FEMA National Flood Insurance Program (NFIP) – Private, Community-Based Flood Insurance
    7) NFIP Flood Insurance Enhancements *via* AFOTF
    8) Mokelumne River Conveyance Improvements & Staten Island Overflow Area
    9) Improve FEMA CRS Score for Sacramento County/Isleton
    10) Land Use Regulations and Limitations
    11) Improved Governance Between Neighboring LMAs/RDs
    12) SWIFs & Periodic Inspections with USACE
    13) Public Education/Public Awareness

8.2 Additional Studies, Reports, Permits, Approvals

8.2.1 DSC Consistency Determination Required with Delta Plan and Qualifying Covered Actions

The Sacramento-San Joaquin Delta Reform Act of 2009 (Delta Reform Act) established a certification process for demonstrating consistency with the Delta Plan. The Delta Reform Act requires any State or local agency proposing to undertake a qualifying action (covered action) must submit to the Delta Stewardship Council (DSC) a written certification of consistency with detailed findings as to whether the covered action is consistent with the Delta Plan (Wat. Code, § 85225). ***The certification of consistency needs to demonstrate the project or covered action is consistent with the Delta Plan's co-equals goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals are to be achieved in a manner that protects and enhances the unique cultural, recreational, natural resources and agricultural values of the Delta as an evolving place.***

As a component of demonstrating consistency of covered actions with the Delta Plan all levee projects must evaluate and where feasible incorporate alternatives, including the use of setback levees, to increase floodplains and riparian habitats. ***Evaluation of setback levees in the Delta shall be required along the Sacramento River between Freeport and Walnut Grove and other locations as shown in Appendix 8 of the Delta Plan.*** This Delta Plan policy considers construction of new levees or substantially rehabilitate or reconstruction of existing levee systems as covered actions. This policy language relative to expanding floodplains and riparian habitats in levee projects within the Delta was last amended by the DSC and included in the California Code of Regulations in 2019. Thus, prior to undertaking any substantial levee rehabilitation projects located between Freeport and Walnut Grove the project proponent, whether it is a local community, RD, LMA, or any other local/state entity, it should consult early with the DSC regarding the applicability of evaluating setback levee alternatives in tandem with substantial levee rehabilitation efforts as considered in this Feasibility Study Report; and then the project proponent should be prepared to file a consistency determination upon completion and adoption of the applicable final CEQA/NEPA documents.

8.2.2 Alignment with DSC's 3x3 Prioritization of State Investments in Delta Levees and Flood Risk Reduction

As previously highlighted in Section 4.1, the Delta Legacy Communities and their cost-share partners investing in substantial levee repairs, improvements, and rehabilitation efforts, including increased OMRR&R expenditures, should be structured as outlined in this feasibility study report, to be most responsive to the DSC's 3x3 Prioritization of State Investments in Delta Levees and Risk Reduction. The 3x3 prioritization table for levee investments is presented in Section 4 and is highlighted below in Table 8-1. The 3x3 table is highlighted below in five of the nine cells indicating that most structural-based management actions and non-structural measures proposed for implementation for the community of West walnut Grove are most responsive to the DSC's Prioritization of State Investments in Delta levees and risk reduction. West Walnut

Grove's Management Action 6, consisting of the multi-benefit project of repairing and strengthening-in-place 5.9 miles of the SPFC levee between Steamboat and Georgianna Sloughs also has the added benefit of improving the resiliency and reliability of the fresh water conveyance corridor aqueduct that conveys SWP and CVP water through the Delta.

See Appendix K for further details in support of the multi-benefit opportunities associated with MAs 6 and 9 identified by the Sacramento County Delta Legacy Communities associated with reducing flood risks combined with improving SWP water conveyance through the Delta.

Although not fully exhausted through this current feasibility study effort, it is recommended that West walnut Grove and its cost-sharing partners further explore ecosystem conservation opportunities that may protect existing and provide net enhancements to floodplain habitat.

Table 8-1: 3x3 Goals of the DSC for State Investment in Delta Integrated Flood Management.

Goals	Localized Network	Levee Network	Ecosystem Conservation
1	Protect existing urban and adjacent areas by providing 200-year flood protection.	Protect water quality and water supply conveyance in the Delta, especially levees that protect freshwater aqueducts and the primary channels that carry fresh water through the Delta.	Protect existing and provide for a net increase in channel-margin habitat.
2	Protect small communities and critical infrastructure of statewide importance (located outside of urban areas).	Protect floodwater conveyance in and through the Delta to a level consistent with the SPFC for project levees.	Protect existing and provide for net enhancement of the floodplain habitat.
3	Protect agriculture and local working landscapes.	Protect cultural, historic, aesthetic, and recreational resources (Delta as Place).	Protect existing and provide for net enhancement of wetlands.

8.2.3 Additional Ongoing Studies and Plans

CVFPP and Lower Sacramento-Delta North Regional Flood Management Plan (RFMP) Updates

Relief Cut Updates via Local Hazard Mitigation Plans (LHMP)

Great California Delta Trail Plan by DPC

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Appendix A-1: Geotechnical Data and Assessment Report

Appendix A-2: May 2017 Sacramento River Left Bank MA 9 SPFC Levee Vulnerability Assessment

Appendix B: Biological Resources Constraints Assessment for the Community of Hood

Appendix C: Cultural Resources Records Search Results for Hood, California

Appendix D: Ecosystem Multi-benefit Opportunities for the Sacramento County Delta Legacy Communities Small Communities Flood Risk Reduction Feasibility Studies

Appendix E: Expected Annual Damages Technical Memorandum for the Delta Legacy Community of Hood

Appendix F: Cost Estimate Development for the Flood Risk Reduction Feasibility Study for Delta Legacy Community of Hood, CA

Appendix G: DPC, DSC, and Delta Conservancy Master Comparison Matrix

Appendix H: Identification of Non-Structural Elements for the Communities of Hood, Courtland, Locke, East Walnut Grove, and West Walnut Grove & Ryde Flood Risk Reduction Feasibility Studies

Appendix I: Hydrology and Hydraulics Technical Memorandum for the North Delta Legacy Communities of Hood, Courtland, Locke, Walnut Grove (East), Ryde/Walnut Grove (West), and Isleton

Appendix J: Community-Based Flood Insurance Program Technical Memorandum

Appendix K: Multi-Benefit Project Opportunities Identified to Reduce Flood Risks and Improve SWR Water Conveyance Through the Delta by the Sacramento County Delta Legacy Communities