Lower Guadalupe River Capacity Restoration Project

Project No. 30154019

Planning Study Report

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EXECUTIVE SUMMARY

PURPOSE OF REPORT

This report documents the planning phase of the Lower Guadalupe River Capacity Restoration Project (Project), spanning from Gold Street to interstate 880. The goal is to ensure that Valley Water's Board of Directors and staff, the public, and stakeholders gain a clear understanding of the Project. The information contained in this report will serve as the basis for Project design.

PROBLEM DEFINITION

During high-flow events, Valley Water staff monitors and records high-water marks in the Guadalupe River, comparing them to the design water surface elevation of the previously designed and constructed Lower Guadalupe River Project (LGRP); LGRP construction was completed in 2004. Measurements from 2014, 2017, and 2019 revealed that the Guadalupe River does not convey the 1% flood for which it was originally designed. Staff estimated in 2019[1] that the river channel had a 4% flood (25-year) capacity with freeboard (the vertical distance between the design water surface elevation and the top of a flood mitigation structure such as a levee or a floodwall) or a 2% flood (50-year) capacity without freeboard. This capacity reduction was identified as primarily being between Tasman Drive and U.S. Route 101 (US 101), spanning about three miles in total. The Project's primary objective is defined as restoring the 1% flood protection Level of Service (LOS) to the Lower Guadalupe River.

PROJECT DEVELOPMENT

The Planning Study Team undertook the following tasks to select a final Project alternative:

- Defined the project problem and objectives.
- Developed conceptual alternatives that align with project goals and schedule.
- Collected input from the public and stakeholders on these conceptual alternatives.
- Refined conceptual alternatives and established criteria for assessing feasibility.
- Identified feasible alternatives.
- Refined the feasible alternatives and evaluated them using Valley Water's Natural Flood Protection framework.
- Selected the recommended alternative.
- Communicated the recommended alternative to the public and stakeholders and incorporated their input.

RECOMMENDATIONS

Valley Water staff recommends a two-part Project:

1. Transition Alternative C.a to the Design Phase.
2. Continue to study forecast-informed reservoir operations (FIRO) for flood risk reduction in Lexington and Almaden Reservoirs, as well as Guadalupe Ponds.

[1] Valley Water. 2019. Lower Guadalupe Hec Ras Model Calibration and Channel Capacity Updates

With this recommendation, Valley Water staff can initiate the design phase more swiftly for an alternative that ensures a 1% flood flow LOS to the Lower Guadalupe River without the uncertainty of flow detention/FIRO elements. Simultaneously, staff can continue to study reservoir modifications and FIRO's potential to enhance adaptability in the Guadalupe watershed and potentially across all of the watersheds managed by Valley Water.

RECOMMENDED PROJECT

The recommended Project alternative includes multiple flood risk mitigation measures such as constructing structural elements like levees, headwalls, and retaining walls. A summary of the proposed flood mitigation measures is included in Table ES-1. It should be noted that the hydrology for the 1% flood event was updated during this study, and the measures in the table were developed in accordance with the updated hydrology.

Table ES-1: Summary of Proposed Flood Mitigation Measures for Recommended Project

Element	Location	Description
Levees	Reach B	Raise levees an average of 1.0 ft
	Reach C	Raise levees an average of 2.4 ft
	Reach D	Raise levees an average of 2.0 ft
	Reach E	Raise levees an average of 1.0 ft
Retaining Walls	As Needed	Install retaining walls on outboard slopes of levees as needed to not encroach on neighboring properties
Bridge Headwalls	Trimble Road	Add 1.25 ft to existing 3-ft tall headwall
	Montague Expwy	Add 3 ft to existing 4-ft tall headwall

PROJECT COSTS

Capital costs, operations and maintenance costs, and life cycle costs are estimated for the Project. A summary of all costs is included in Table ES-2 below.

Table ES-2: Estimated Planning-Level Cost for the Project

Cost Type	Estimated Amount
Capital Cost	$95,495,000 [a]
Estimated Annual O&M Cost	$855,000 [b]
Useful Life (years)	74 [c]
O&M Over Useful Life	$63,270,000

Notes: a. Estimated amount is in 2023 dollars
b. Based on FY 24 three-year average O&M cost
c. Assuming Project would be completed in the year 2030

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SECTION 1. INTRODUCTION

The completion of a Planning Study Report (PSR) is the culmination of the planning phase of a capital project at the Santa Clara Valley Water District (Valley Water). Completion of a PSR is part of the Quality and Environmental Management System (QEMS) Planning Phase Work Breakdown structure as outlined in document W-730-124, Item 12-I. The PSR serves to fully document the project formulation process during the planning phase so that the public and the Valley Water Board of Directors can fully understand the proposed project and its development process. The PSR presents the proposed project and all supporting information for the Project Owner's approval. As recommended in QEMS document W-730-124, this Lower Guadalupe River Capacity Restoration Project (Project) PSR is organized as follows:

- Chapter 1: Introduction
- Chapter 2: Study Background
- Chapter 3: Problem Definition
- Chapter 4: Formulation of Alternatives
- Chapter 5: Recommended Project
- Chapter 6: Operations and Maintenance Program
- Chapter 7: Project Cost, Funding, and Schedule
- Chapter 8: Conclusions and Recommendations

1.1. PROJECT ORIGIN

The Lower Guadalupe River is the portion of the Guadalupe River between Interstate 880 and the San Francisco Bay (Figure 1-1). It has been the subject of several Valley Water flood protection projects over the years, the latest of which was the Lower Guadalupe River Project (LGRP) completed in 2004. The LGRP provided protection from a 1% annual chance flood (also known as the 100-year flood) along Guadalupe River from the UPRR bridge in Alviso, near the San Francisco Bay to Interstate 880. It was designed and constructed in conjunction with the Downtown Guadalupe River Project (DGRP), in which Valley Water partnered with the U.S. Army Corps of Engineers (USACE) to provide flood protection along Guadalupe River between Interstate 880 and Interstate 280. Valley Water committed to USACE that the LGRP would convey the 1% design flows from the DGRP, 17,000 cubic feet per second (cfs), as well as an additional 1,350 cfs from interior drainage inflow[2]. The largest recorded river flow since completion of both projects was in February 2017, with a recorded peak of 6,340 cfs[3] or approximately 20% flood (5-year) measured at the USGS Gauge Guadalupe River at San Jose.

During high flow events, Valley Water staff observes and records high-water marks in the Guadalupe River and compares them to the LGRP design water surface elevation. High-water marks in the Lower Guadalupe River were measured in 2014, 2017, and 2019[4]. Based on these measurements, it was determined that the Lower Guadalupe River does not convey

[2] USACE. 2005. U.S. Army Corps of Engineers to Santa Clara Valley Water District. December 15.
[3] U.S. Geological Survey. n.d. *National Water Information System data available on the World Wide Web (USGS Water Data for the Nation).* Accessed May 29, 2019. https://nwis.waterdata.usgs.gov/ca/nwis/peak?site_no=11169025&agency_cd=USGS&format=html
[4] Valley Water. 2019. Lower Guadalupe Hec Ras Model Calibration and Channel Capacity Updates

the 1% flood for which it was designed. Staff estimated that the river channel has 4% flood (25-year) capacity with freeboard, or 2% flood (50-year) capacity without freeboard. The capacity is most reduced between Tasman Drive and US 101.

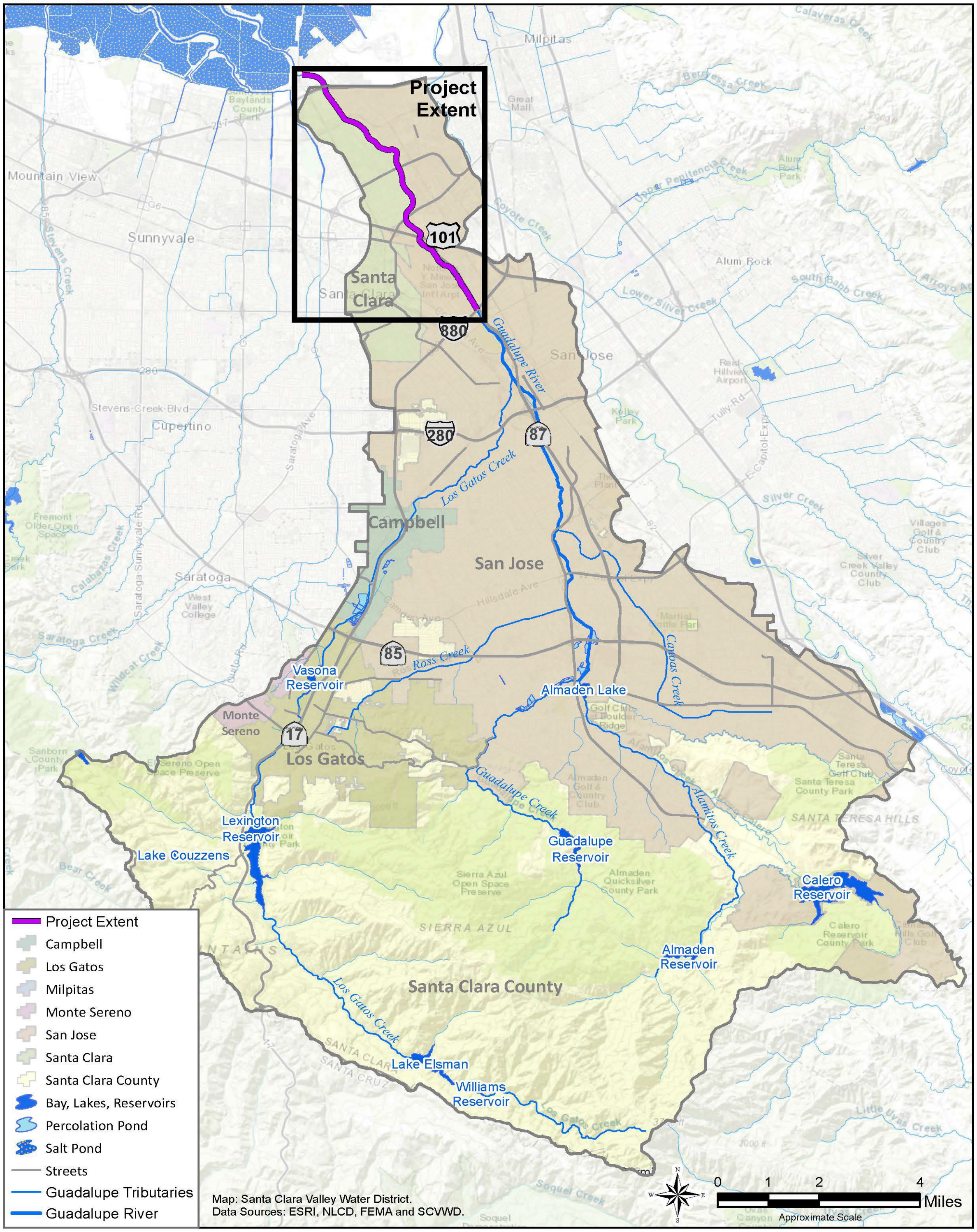

Figure 1-1: Lower Guadalupe River within the Guadalupe Watershed

1.2. RELEVANT BOARD GOVERNANCE POLICIES

Per the Santa Clara Valley Water District Act, and as described in Board Governance Policy GP-1, the purpose of the Valley Water Board of Directors is to see that Valley Water provides Silicon Valley with safe, clean water for a healthy life, environment, and economy, on behalf of the people of Santa Clara County[5]. In line with this purpose, the Board adopts policies to govern its own processes, delegate its power, communicate Valley Water's mission, general principles and Ends, and provide constraints on executive authority. These Board policies are collectively called Board Governance Policies.

In pursuit of Valley Water's mission of providing Silicon Valley with safe, clean water for a healthy life, environment and economy, the Board has established six main Ends to be accomplished:

- **Governance Policy E-1 Mission and General Principles**: Provide Silicon Valley safe, clean water for a healthy life, environment, and economy.
- **Governance Policy E-2 Water Supply (WS) Services**: Valley Water Provides a reliable, safe, and affordable water supply for current and future generations in all communities served.
- **Governance Policy E-3 Natural Flood Protection (NFP)**: Natural flood protection is provided to reduce risk and improve health and safety for residents, business, and visitors, now and into the future.
- **Governance Policy E-4 Water Resources Stewardship (WRS)**: Water resources stewardship protects and enhances ecosystem health.
- **Governance Policy E-5 Climate Change Mitigation and Adaptation**: Valley Water is carbon neutral and provides equitable, climate-resilient water supply, flood protection, and water resource stewardship to all communities in Santa Clara County. This will be accomplished through the implementation of the Climate Change Action Plan.
- **Governance policy E-6 Encampments of Unsheltered People (EUP)**: Valley Water is committed, through a regional approach, to address the human health, safety, operational and environmental challenges posed by encampments of unsheltered people on Valley Water lands along waterways and at water supply and flood risk reduction facilities.

Each of the six main Ends described above is associated with specific goals and objectives which can be found in the Board Governance Policies, Section III. All capital projects planned, designed, and constructed by Valley Water are to follow the Board Governance Policies. The Project described in this report complies with Board Governance Policies E-1 through E-6.

1.3. PROJECT OBJECTIVES

The primary objective of the Project is to restore the 1% flood Level of Service (LOS) to the Guadalupe River reach between Gold Street and Interstate 880.

The Project also aims to:

1. Maintain and/or enhance ecological conditions.
2. Minimize the need for future operations and maintenance activities.

[5] Santa Clara Valley Water District. 2023. *Governance Policies of the Board. I. Governance Process*. San Jose, Valley Water

3. Maintain and/or enhance public recreation and access.
4. Obtain community support and participation for the Project.

It should be noted that the 1% LOS flow has been updated over time based on updated hydrology. This is described further in Section 2.4.

1.4. LOCATION AND STUDY LIMITS

The Project study's extent comprises 6.5-mi of the Guadalupe River between Gold Street and Interstate 880 near Airport Parkway (Figure 1-2). The Norman Y. Mineta San Jose International Airport is directly adjacent to the west bank of the river. Near the downstream end of the project area, the Ulistac Natural Area borders the west bank. This is a 40-acre, dedicated open space preserve with a diverse suite of native California plants. The Guadalupe River Trail runs along the west levee from Interstate 880 to US 101, and on the east levee from Airport Parkway to Gold Street. The trail is paved, and heavily used by the community for commuting and recreational purposes, with up to 2,470 users a day[6].

The land use surrounding the project area is heavily urbanized, with very little undeveloped land. Since the LGRP's completion in 2004, additional development has occurred in the area, partially due to the 1% level of flood protection provided by the LGRP. To the west of the river, in the City of Santa Clara (Trimble Road to Tasman Drive), land use is over half residential, with the other half primarily industrial and open space. To the west, in the City of San Jose (Interstate 880 to Trimble Road), is the Norman Y. Mineta San Jose International Airport. To the east of the river, all within the City of San Jose, land use is almost entirely industrial, with the rest primarily residential. The Alviso neighborhood downstream of State Route 237 is designated as a disadvantaged community[7].

To better study and define the problem area, the 6.5-mi extent is divided into seven reaches, the limits for which are summarized in Table 1-1 and illustrated in Figure 1-2. These are the same reaches used in the 2004 LGRP and are further described in Section 2.2.

Table 1-1: Project Study Reaches

Reach	Limits
A	Interstate 880 to US 101
B	US 101 to Trimble Road
C	Trimble Road to Montague Expressway
D	Montague Expressway to Hetch Hetchy Pipelines
E	Hetch Hetchy Pipelines to Tasman Drive
F	Tasman Drive to State Route 237
G	State Route 237 to Gold Street

[6] City of San Jose. 2019. Trail Count.
[7] Valley Water. n.d. What is considered a disadvantaged community? Accessed May 1, 2024. https://www.valleywater.org/accordion/what-considered-disadvantaged-community

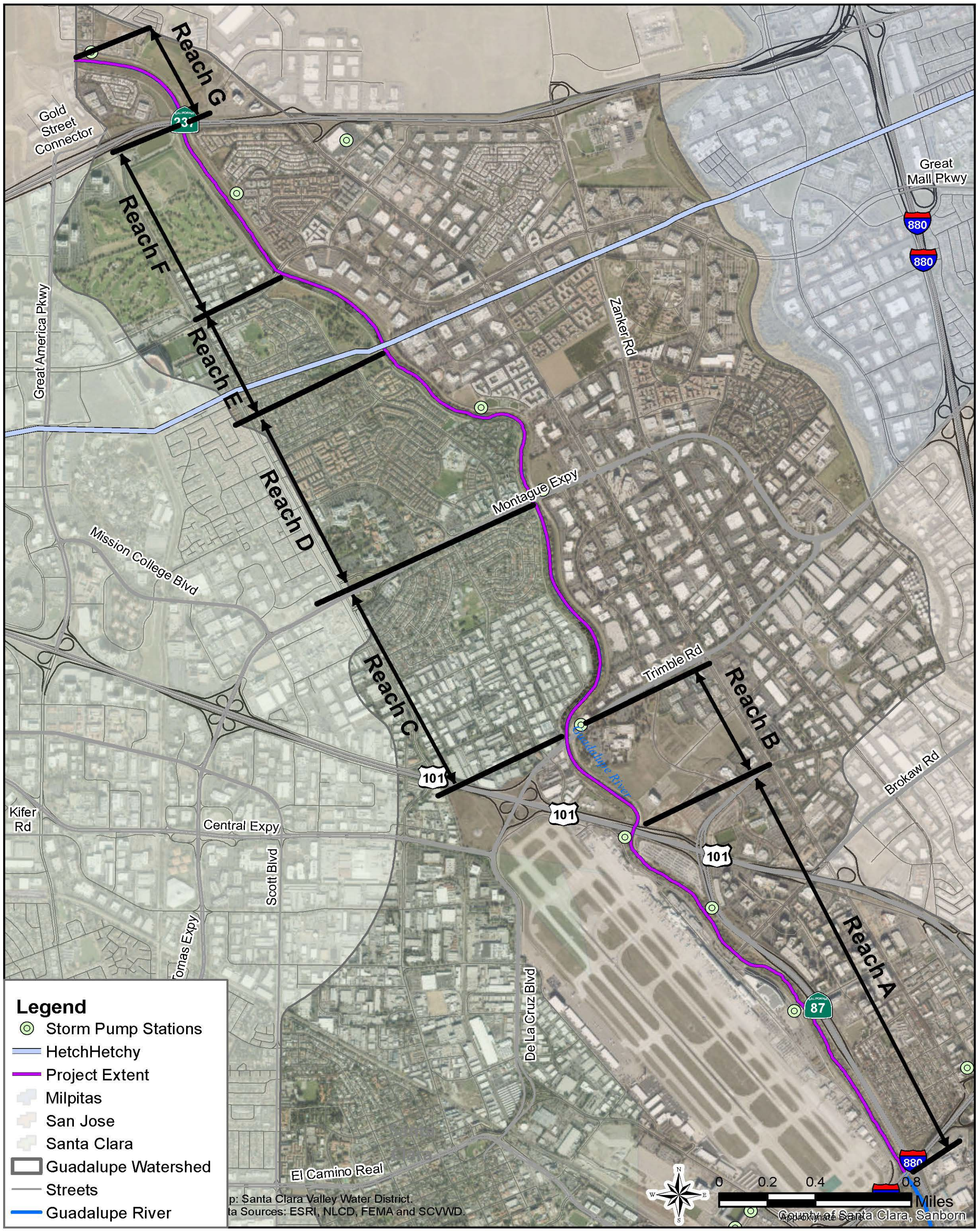

Figure 1-2: Project Study's Extent with Pipelines and Pump Stations Shown

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SECTION 2. STUDY BACKGROUND

This chapter provides historical data as well as descriptive information on the Guadalupe watershed, the entire Guadalupe River, and the extent of the Project. The main purpose of this chapter is to see beyond the scope of the Project and consider the entire watershed, following the integrated watershed management approach directed by the Board. This approach looks to balance environmental quality and protection from flooding within the entire watershed context as outlined in Board Ends Policy E-3. The information in this chapter will help to assess the appropriateness of the Project to its location within the watershed.

2.1. GUADALUPE WATERSHED DESCRIPTION

The Guadalupe watershed, covering about 170 square miles, originates in the eastern Santa Cruz Mountains near Loma Prieta's summit. The upper watershed is characterized by forests with scattered residential areas, transitioning to higher density residential on the valley floor and commercial development along major streets. Industrial areas increase in number and density closer to the Bay. The Guadalupe River begins on the valley floor at the confluence of Alamitos Creek and Guadalupe Creek near Coleman Road in San Jose, flowing north for approximately 14-mi until it reaches South San Francisco Bay via Alviso Slough (Figure 2-1). The river passes through the cities of Los Gatos, San Jose, Campbell, and Santa Clara, receiving contributions from three tributaries: Ross, Canoas, and Los Gatos creeks.

Six major reservoirs are present in the watershed: Calero Reservoir, Guadalupe Reservoir, Almaden Reservoir, Vasona Reservoir, Lexington Reservoir, and Lake Elsman. Valley Water owns the first five of these reservoirs, which are operated for water supply purposes. However, their presence provides some incidental flood protection by capturing and temporarily storing peak storm flows. Groundwater recharge ponds operated by Valley Water within the Guadalupe watershed include those along Los Gatos Creek downstream of State Route 85 and along Guadalupe River near State Route 85.

2.2. GUADALUPE RIVER DESCRIPTION

The Guadalupe River serves as a boundary between the cities of Santa Clara and San Jose. Due to its history of flooding, flood protection measures have been implemented by Valley Water along various parts of the river, most recently providing 1% flood risk reduction to the river downstream of Interstate 280 in 2004 (DGRP and LGRP). The river offers recreational opportunities like hiking, biking, and birdwatching, with scattered parks and trails providing an escape from the urban environment. The Guadalupe River Park and Gardens in downtown San Jose is a popular destination with walking and biking trails, community gardens, and public art installations. Ulistac Natural Area in the City of Santa Clara is a dedicated natural open space boasting diverse California native plant habitats and supporting ecosystems. The river supports diverse wildlife, including serving as a migratory corridor for the federally threatened Central California Coast steelhead (*Oncorhynchus mykiss)*. Through the Fish and Aquatic Habitat Collaborative Effort (FAHCE), a collaborative process to identify actions to balance fish and aquatic habitat needs with Valley Water's water supply operations, Valley Water seeks to improve aquatic habitat and fish passage for migration. In addition, various environmental stewardship initiatives along the river include a number of organizations and community groups working to improve water quality, restore habitats, and enhance the overall health of the river.

2.2.1. Lower Guadalupe River Description

The Lower Guadalupe River, between San Francisco Bay and Interstate 880, can be divided into two distinct flow regimes: tidal and nontidal. The tidal zone extends upstream from the Bay to Montague Expressway. Within the Project area, the nontidal zone extends from Montague Expressway to Interstate 880. As the Guadalupe River enters the tidal zone, where its elevation is within the influence of bay tides, its slope abruptly shallows, causing a decrease in sediment transport capacity that results in significant gravel disposition between Trimble Road and Montague Expressway. The tidal zone exhibits a continued reduction in channel slope with distance downstream and is characterized by tranquil low-flow conditions with fine to very fine-grained bed and bank material. Typical cross-sections show relatively flat, narrow strips of tidal marsh bordering the low-flow channel, particularly downstream from Tasman Drive. In contrast, the upstream section has more irregular topography. The nontidal zone exhibits channel invert elevations above tidal influences and a steeper channel slope with higher energy conditions, reflected by the gravel bed material in the low-flow channel and small gravel bars.

Tidal conditions also affect vegetation; in freshwater areas upstream from Montague Expressway, riparian woodland consisting largely of willow, cottonwood, and box elder is dominant. Freshwater marsh is found from Montague Expressway to the Hetch Hetchy Pipelines, characterized by abundant bulrushes, areas of cattails along the channel bottom, and decreasing riparian tree cover. Salt marsh species become increasingly apparent downstream of Hetch Hetchy Pipelines, where cord grass and pickleweed replace freshwater marsh species.

Utilities

There are several known large utilities that cross under the river, all crossing between Tasman Drive and Montague Expressway. There are two large-diameter pipelines owned by the San Francisco Public Utilities Commission (SFPUC) called the Bay Division Pipelines #3 and #4. These pipelines, 72-in and 90.5-in diameters respectively, carry water from Hetch Hetchy Reservoir, and are one of the raw water sources of drinking water for the San Francisco Bay Area. The other large pipe that crosses under the river is a PG&E 24-in high-pressure gas line[8].

Due to the leveed nature of the river, local runoff must be pumped for adequate drainage. Pump stations in the project reaches are summarized in Table 2-1 and mapped in Figure 1-2: Project Study's Extent with Pipelines and Pump Stations Shown.

[8] CH2MHill. 2002. Lower Guadalupe River Planning Study Engineer's Report.

Table 2-1: Pump Stations in the Project Area

No	Stormwater Pump Station	Capacity (cfs)[9,10]	Owner
1	Skyport	6	City of San Jose
2	Airport Parkway	7	City of San Jose
3	Airport	64	City of San Jose
4	Rincon 2	600	City of San Jose
5	Gateway	7	City of San Jose
6	Laurelwood & Victor	130	City of Santa Clara
7	Nelo & Victor	170	City of Santa Clara
8	Rincon 1	360	City of San Jose
9	Lick Mill	230	City of Santa Clara
10	River Oaks	67	City of San Jose
11	Fairway Glen	250	City of Santa Clara
12	Oakmead	730	City of San Jose
13	Eastside Retention Basin	110	City of Santa Clara

Sediment Deposition Reaches

The LGRP established Sediment Deposition Reaches (SDR) that were specifically designed to catch sediment. The SDRs range from 30-ft to 90-ft in width and 50-ft to 250-ft in length and are located between Tasman Drive and US 101 (Figure 2-1). The SDRs were designed to be cleared out when they reach 2-ft of deposited sediment. This has proven to be difficult to carry out in practice. Because of unanticipated breaches of the berm that separates the low-flow channel from the SDRs, Valley Water has encountered greater-than-anticipated summertime flows in the SDRs, making both the identification of sediment accumulation and the sediment removal work itself in those prescribed locations challenging. The river has been known to reroute into the SDRs after they have been cleared, jeopardizing the levee toe and lower maintenance roads.

Mitigation Planting

As part of the LGRP, native riparian forest and shaded riverine aquatic (SRA) cover habitat were established as part of compensatory mitigation for project impacts (Figure 2-2). The mitigation areas were monitored annually to ensure mitigation goals were achieved. After determining that the compensatory mitigation had successfully established and had met all the monitoring requirements, the San Francisco Bay Regional Water Quality Control Board (Regional Board) issued notice that further monitoring was no longer required, apart from Valley Water's regular maintenance assessment programs[11]. There is currently only one actively monitored mitigation site in the project area, upstream of Airport Parkway to Interstate 880, which is mitigation for the Downtown Guadalupe River Project.

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[9] Schaaf & Wheeler. 2015. City of Santa Clara Storm Drain Master Plan.
[10] GIS. 2019. City of San Jose Utility Viewer.
[11] Regional Board. 2018. Regional Board to Valley Water

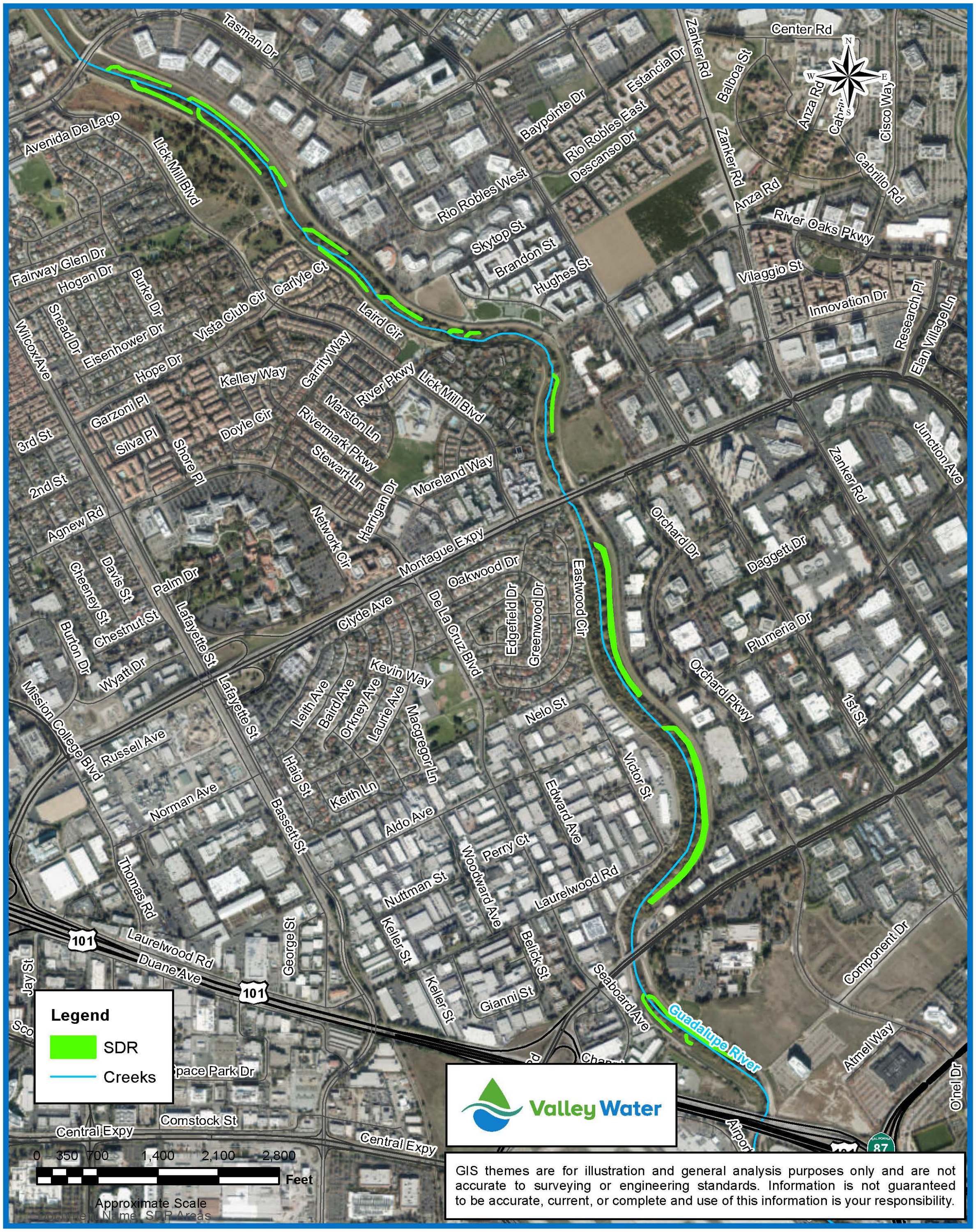

Figure 2-1: SDR Locations in Project Area

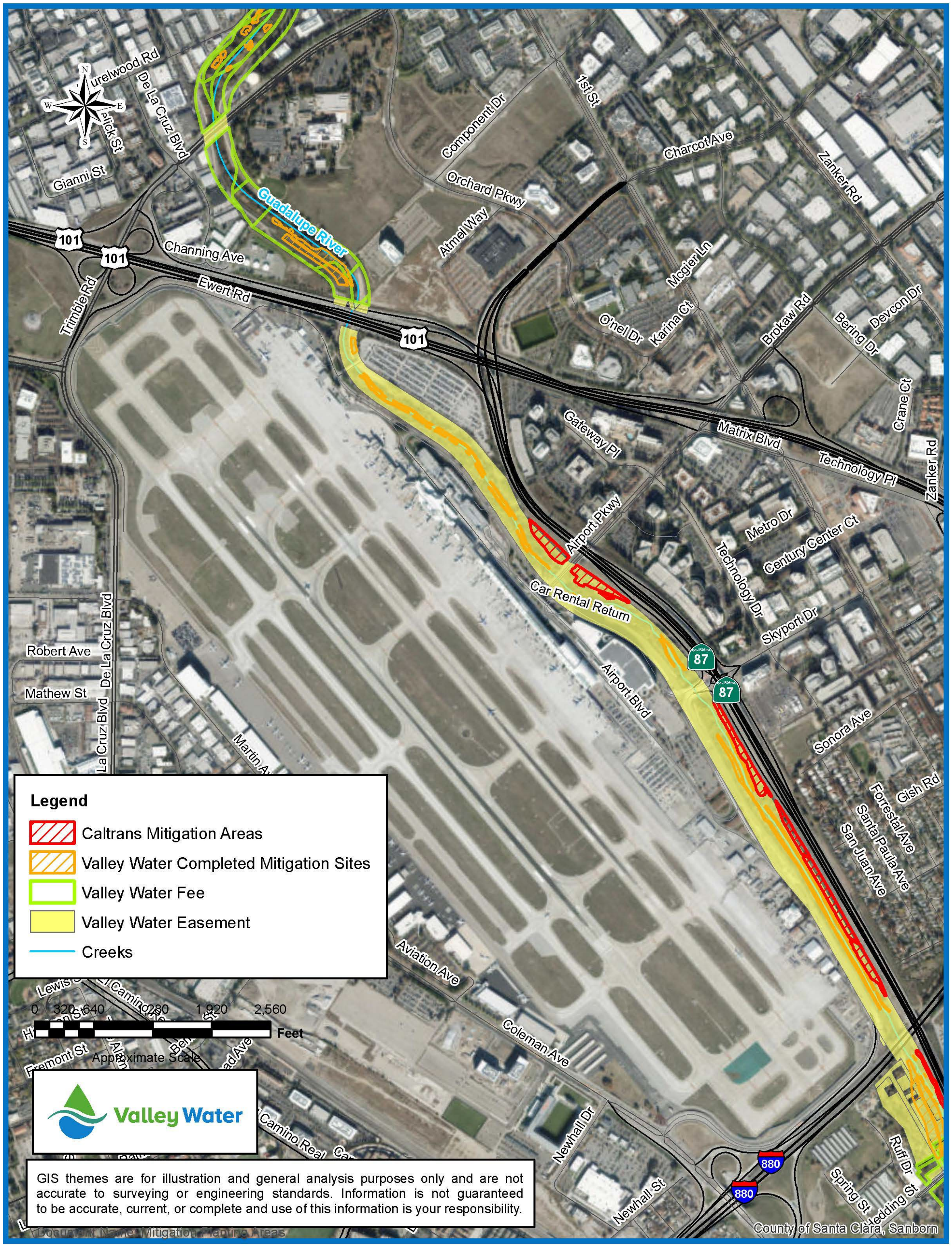

Figure 2-2: Mitigation Planting in the Project Area

Bridges

There are 13 bridges within the project area, summarized below (Table 2-2).

Table 2-2 Bridges in the Project Area

Bridge	Length (ft)	Year Built[12]	Owner
Gold Street	300	1964	City of San Jose
State Route 237 West	208.8	1994	Caltrans
State Route 237 East	210	2006	Caltrans
Tasman Drive	289	1994	City of San Jose
Pedestrian Bridge (River Oaks)	230	2006	City of San Jose
Montague Expressway	200	1964	Santa Clara County
Trimble Road	210	1961	City of San Jose
Highway 87 Northbound Off-Ramp	177	2005	Caltrans
US 101	141	1937	Caltrans
Airport Green Lot Parking Access	183	1988	City of San Jose
Airport Parkway	164	1958	City of San Jose
Skyport Drive	236	2001	City of San Jose
Interstate 880	203	1960	Caltrans

2.2.2. Project Reach Descriptions

Reach A: Interstate 880 to US 101

Reach A (Figure 2-3) is a 1.9-mi section of the river, bounded at the south end by Interstate 880, and at the north end by US 101. The channel ranges from 200-ft to 300-ft wide and is 20-ft deep. It is mainly an excavated channel, with a small portion of levees upstream of US 101. Reach A includes an abundance of native shrubs and trees, partially as a result of plantings that were installed starting in 1999 as part of mitigation for the DGRP. As of mitigation requirement completion for this reach in 2015, a total of 1.86 acres of riparian plantings had been established. The paved Guadalupe River Trail runs along the west bank and a portion of the east bank from Airport Parkway to US 101. To the east of the river is State Route 87, which parallels the channel alignment. East of State Route 87 is a mixture of residential and business/industrial use, all within the City of San Jose. To the west of the river is Norman Y. Mineta San Jose International Airport, which spans the entirety of Reach A. There are five bridges in this reach: Interstate 880 on the upstream end, followed by Skyport Drive, Airport Parkway, Airport Green Lot Parking Access, and US 101.

[12] GIS. 2019. National Bridge Inventory (NBI) Bridges.

Reach B: US 101 to Trimble Road

Reach B (Figure 2-4) is a 0.5-mi section of the river, bounded to the south by US 101, and to the north by Trimble Road. The channel is 300-ft wide, narrowing to 200-ft at bridge crossings. The channel is 20-ft deep and has a levee on both the east and west bank. There are large native shrubs and trees in the center of the channel, and the floodplains are sparsely vegetated with grass. Riparian plantings were installed in this reach as part of the mitigation for LGRP. As of mitigation requirement completion for this reach in 2015, a total of 1.75 acres of riparian plantings had been established. The paved Guadalupe River Trail runs along the east levee, and the west levee is surfaced with gravel. There is also a depressed secondary gravel maintenance road on the west bank, providing access to the floodplain. An 8-in jet fuel pipeline crosses 25-ft under the river downstream of US 101. Both sides of the channel are heavy industrial land use types within the City of San Jose. There are two bridges in this reach: US 101 to the south, and Trimble Road to the north.

Reach C: Trimble Road to Montague Expressway

Reach C (Figure 2-4) is a 1.2-mi section of the river, bounded to the south by Trimble Road, and to the north by Montague Expressway. The channel is 350-ft wide, narrowing to 200-ft at bridge crossings. The channel is 20 to 25-ft deep and has a levee on both the east and west bank. The channel in this reach is heavily vegetated with native shrubs and trees, except for the lower gravel maintenance road on the east bench. Riparian plantings were installed in this reach as part of the mitigation for LGRP. As of mitigation requirement completion for this reach in 2015, a total of 2.91 acres of riparian plantings had been established. The paved Guadalupe River Trail runs along the east levee, and the west levee is surfaced with gravel. The east side of the river is zoned for industrial use in the City of San Jose, and the west side of the river is a mixture of industrial and single-family zones in the City of Santa Clara. There are two bridges in this reach: Trimble Road to the south, and Montague Expressway to the north.

Figure 2-3: Reach A – Interstate 880 to US 101

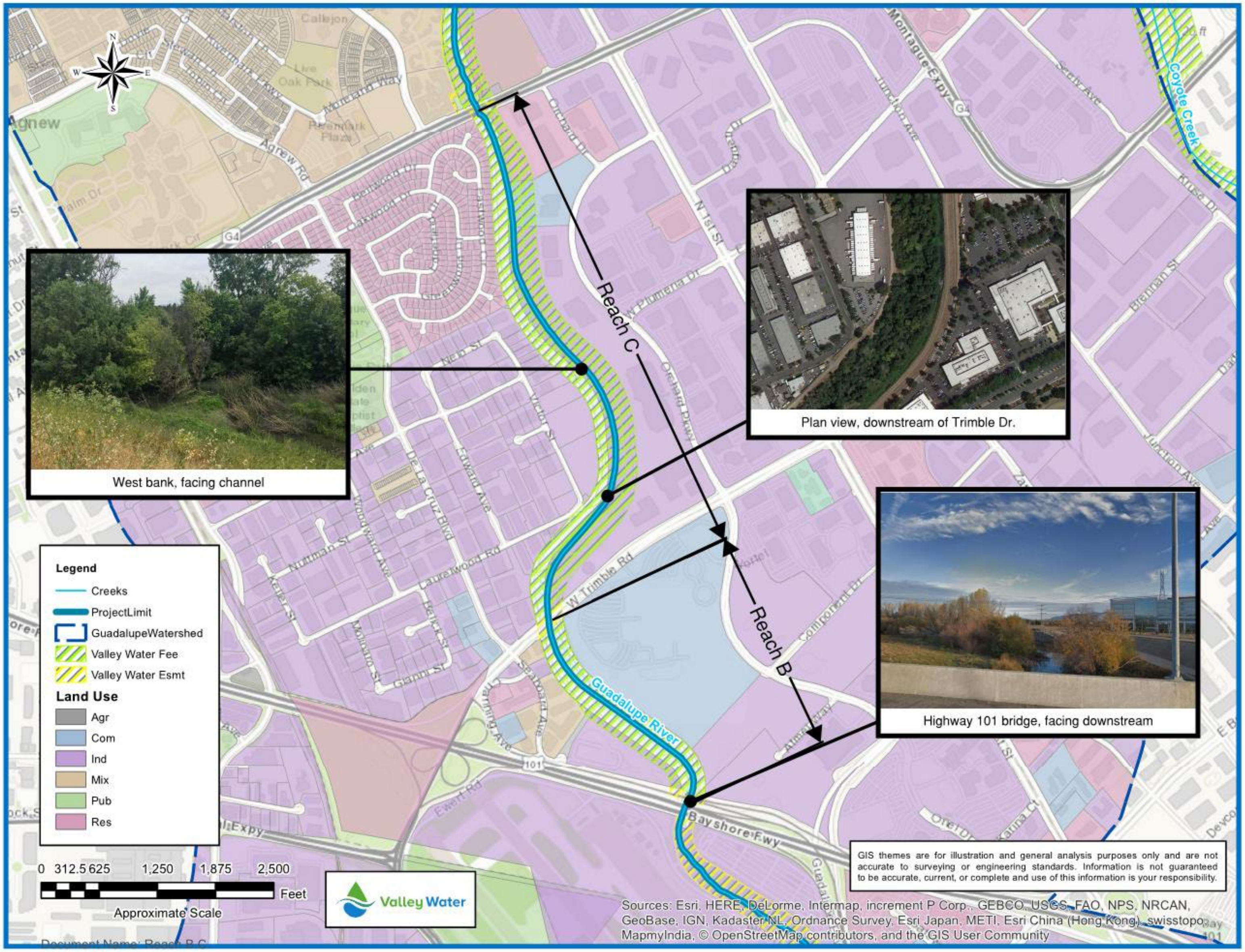

Figure 2-4: Reaches B & C - US 101 to Montague Expressway

Reach D: Montague Expressway to Hetch Hetchy Pipelines

Reach D (Figure 2-5) is a 1.1-mi section of the river, between Montague Expressway and the Hetch Hetchy pipeline crossing, near the south end of Ulistac Natural Area. The channel is 300-ft wide and 28-ft deep and has a levee on both sides of the channel. The channel is tidally-influenced in this reach, which is evident by the transition to tidal marsh vegetation. There are some willows, native and non-native, as well as tules and shrubs. The paved Guadalupe River Trail runs along the east levee, and there is a depressed gravel maintenance road for floodplain access. The west levee is also paved with gravel for maintenance and pedestrian access. To the east in San Jose, land use is zoned as industrial. To the west in Santa Clara, land use is classified as “planned development zoning” with high-density residential and some mixed-use commercial. There are two bridges in this reach: Montague Expressway to the south, and a pedestrian bridge adjacent to River Oaks Parkway.

Reach E: Hetch Hetchy Pipelines to Tasman Drive

Reach E (Figure 2-5) is a 0.6-mi section of the river, between the Hetch Hetchy pipeline crossing and Tasman Drive. The Hetch Hetchy pipelines are 72-in and 90.5-in in diameter, crossing under the Guadalupe River just north of the Fairway Glen pump station. The pipes are encased in concrete, the top of which begins about 2.5-ft below the channel. The channel in this reach is 300-ft wide and 28-ft deep, with levees on both sides of the channel. Vegetation is similar to that of Reach D, with large tules and scattered large willows. The paved Guadalupe River Trail runs along the east levee, and the west levee is paved with gravel for maintenance vehicle and pedestrian access. There are additional depressed gravel maintenance access roads on both sides of the channel. To the east in San Jose, land use is zoned as industrial. To the west in Santa Clara, the Ulistac Natural Area extends the entire length of the reach. The only bridge in this reach is the Tasman Drive bridge at the downstream end of the reach.

Reach F: Tasman Drive to State Route 237

Reach F (Figure 2-6) is a 0.8-mi section of the river, between State Route 237 and Tasman Drive, all located in the City of San Jose. Land east of the river is heavily populated with residential properties. On the west side of the river, land is less developed and used as a golf course and BMX track. There are plans to develop this area into a mixed-use, high-density residential and commercial complex. The channel in this reach is fairly straight and is 300-ft wide and 28-ft deep. It has a levee on both sides of the channel with floodwalls installed on top of the levee toward inboard side. The vegetation in this reach is characterized by bulrushes in the channel and ruderal upland vegetation along the levees. There are three bridges in this reach: Tasman Drive to the south, and State Route 237 (eastbound and westbound) to the north.

Reach G: State Route 237 to Gold Street

Reach G (Figure 2-6) is a 0.6-mi section of the river, between Gold Street and State Route 237, all located in the City of San Jose. This reach is urbanized with over half of the surrounding land used for residential and industrial purposes. A large open space exists to the east of this section of river, which is used as a golf practice facility (Top Golf). Recently, this area has been further developed with a hotel and another public access connection proposed to the Guadalupe River Trail as part of further development. The channel in this reach is 350-ft wide and has levees on both sides of the channel. Floodwalls about 1-ft tall are installed on top of both levees. Tidal areas at or below high tide level have historically filled with bay mud as fine silt and organic material settles out. The river channel on either side of the low-flow channel generally develops low tidal marsh type vegetation, which promotes the deposition of silts and limits the erosion of silts during high flow events. There are three bridges in this reach: State Route 237 (eastbound and westbound) to the south, and Gold Street to the north.

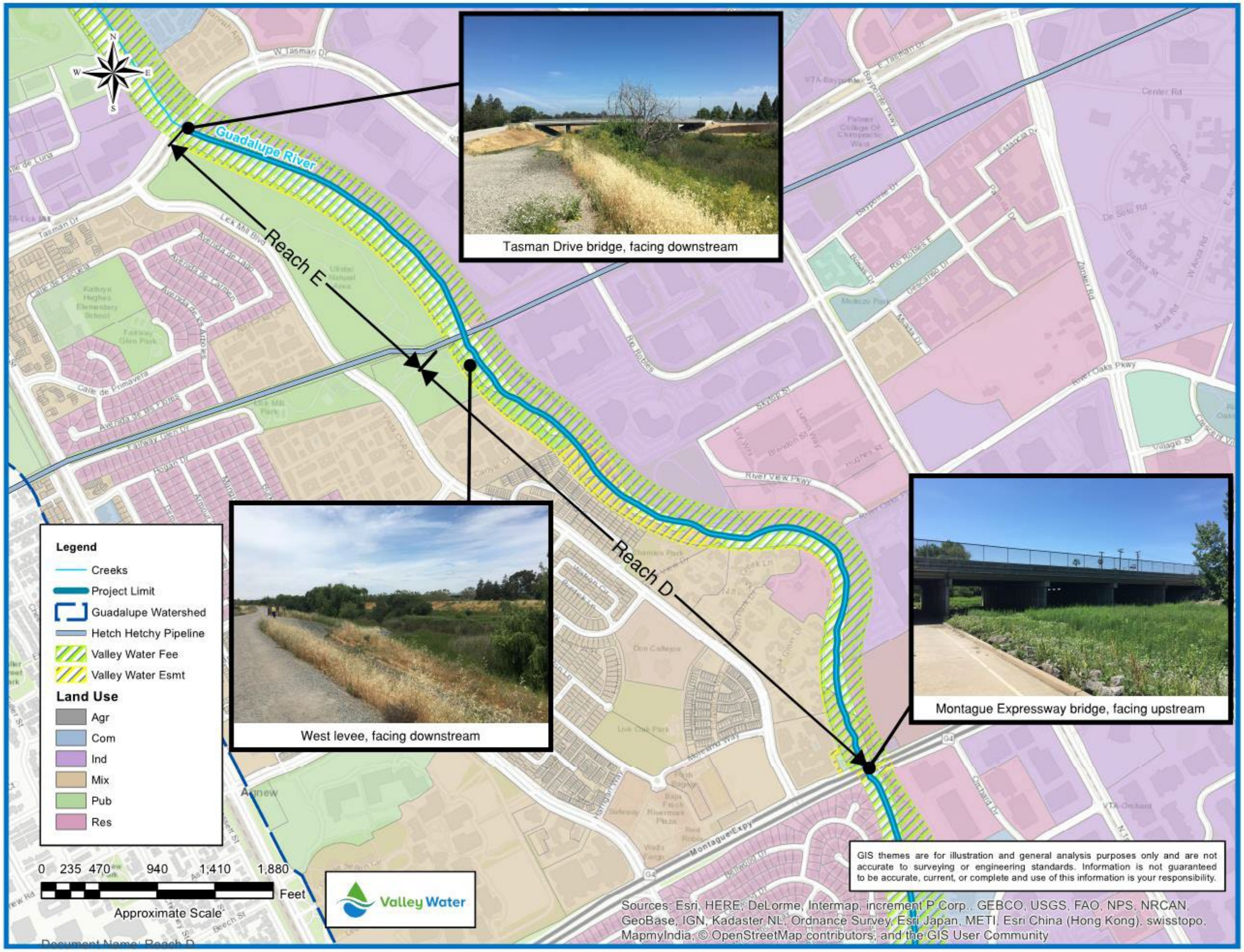

Figure 2-5: Reaches D & E - Montague Expressway to Tasman Drive

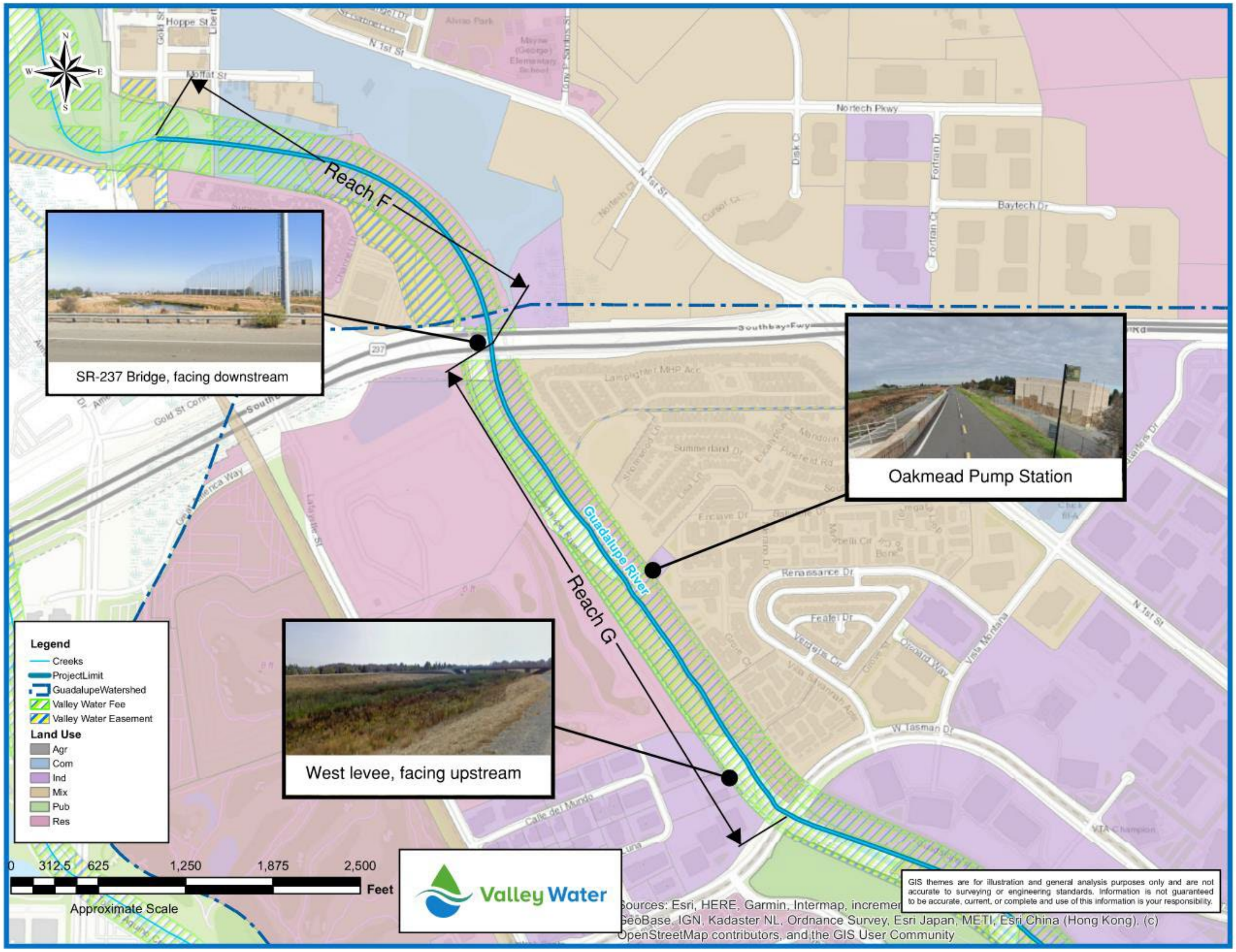

Figure 2-6: Reaches F & G - Tasman Drive to Gold Street

2.3. HISTORY OF FLOODING

The Guadalupe River has a long history of flooding, with the earliest recorded event occurring in the winter of 1852-1853. Table 2-3 and Figure 2-7 summarize the river's known flood events throughout history.

Table 2-3: Historical Flood Events in Guadalupe River

Flood Event Date	Summary of Event	Peak Discharge at USGS San Jose Gage[13] (cfs)
Winter 1852 - 1853[14]	Downstream from Montague Expressway, Guadalupe River merges with Coyote Creek	Unknown
Winter 1861 - 1862[14]	Known as the Great Flood of 1862, it affects most of the State of California. Historical documentation indicates extensive flooding along Guadalupe River and Coyote Creek	Unknown
March 7-9, 1911[14]	Guadalupe River and Coyote Creek merge together at various points	Unknown
February 27, 1940	Unknown	8,680
February 2, 1945	Unknown	6,600
January 12, 1952	Unknown	8,000
April 2, 1958	Unknown	9,150
February 19, 1980[15]	Minor local flooding	7,910
March 31, 1982[16]	Guadalupe overbanks, causing evacuations, and 1-10 ft of flooding. 20 homes and 5 businesses report damage	7,340
January 24, 1983[17]	River overbanks in two locations, causing up to 10-ft of flooding.	7,130 (8,400[17])
February 18, 1986[18]	River overbanks at four locations, primarily street flooding	9,140
January 9, 1995[19]	River overbanks at three locations, flooding portions of Highway 87 with up to six feet of water.	9,290
March 10, 1995[19]	Highest flow on record, flooding Highway 87 and portions of downtown. Many residences and businesses are evacuated	11,000
February 1998[20]	River overbanks in two locations, flooding Highway 87	7,541

[13] U.S. Geological Survey. n.d. *National Water Information System data available on the World Wide Web (USGS Water Data for the Nation).* Accessed May 29, 2019. https://nwis.waterdata.usgs.gov/nwis/peak?site_no=11169000&agency_cd=USGS&format=html.
[14] Grossinger, RM, et al. 2006. *Coyote Creek Watershed Historical Ecology Study: Historical Condition, Landscape Change, and Restoration Potential in the eastern Santa Clara Valley, California.* A Report of SFEI's Historical Ecology, Watersheds, and Wetlands Science Programs, San Francisco Estuary Institute, Oakland: Prepared for the Santa Clara Valley Water District.
[15] Valley Water. 1980. "Flood Emergency Report: Feb. 13 through Feb. 22, 1980." Flood Report. San Jose.
[16] Valley Water. 1982. "Report on Flooding and Flood Related Damages: January 1 to April 30, 1982." Flood Report. San Jose.
[17] Valley Water. 1983. "Report on Flooding and Flood Related Damages: January 1 to April 30, 1983." Flood Report. San Jose.
[18] Valley Water. 1986. "Report on Flooding and Flood Related Damages: February 12th thru 20th, 1986." Flood Report. San Jose.
[19] Valley Water. 1995. "Report on Flooding and Flood Related Damages: Santa Clara County, January 3 to March 11,1995." Flood Report. San Jose.
[20] Valley Water. 1998. "Report on Flooding and Flood Related Damages in Santa Clara County February 2-9, 1998." Flood Report. San Jose.

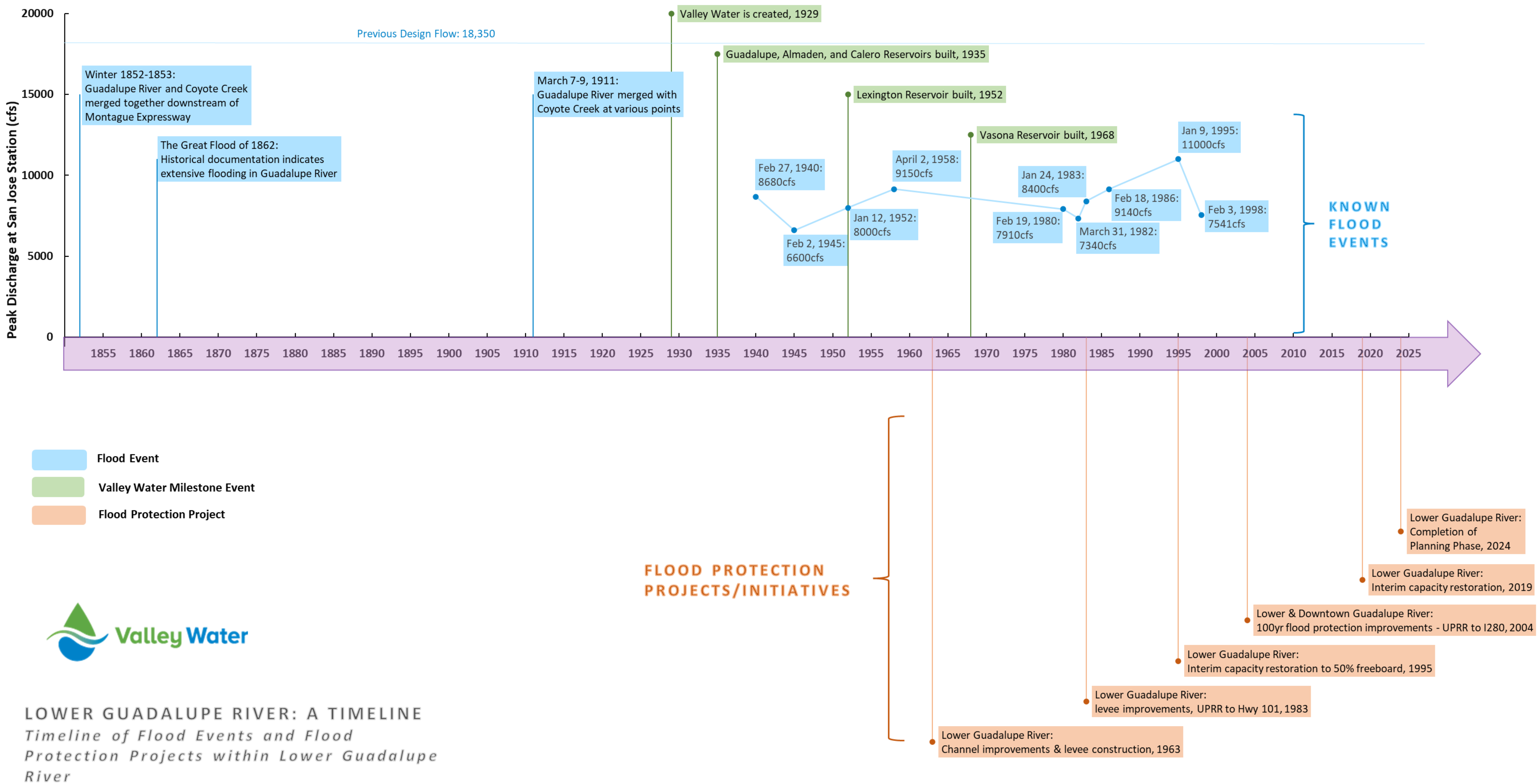

Figure 2-7: Timeline of Events in the Lower Guadalupe River

2.4. HISTORY OF FLOOD MANAGEMENT EFFORTS

The Guadalupe River has been the subject of many flood management projects and studies, starting with the Flood Control Act of 1941. Notable flood management events in the Lower Guadalupe River are summarized below.

1941 Preliminary examination and survey of the river authorized as part of the Flood Control Act of 1941[21].

1945 USACE completes the Preliminary Examination Report and authorizes flood control investigations for all streams in the south San Francisco Bay[21].

1963 Santa Clara County passes a bond, funding flood protection projects in the Central Flood Control Zone. Valley Water constructs improvements to Lower Guadalupe River, including channel modifications and levee installation[21].

1977 USACE completes the Hydrologic Engineering Office Report for Guadalupe River and Coyote Creek[22].

1982 Valley Water completes the Guadalupe River Planning Study, Union Pacific Railroad (UPRR) in Alviso to US 101, which was intended to provide 1% flood protection[23].

1983 Construction is completed on the improvements listed above[21].

1992 March 30: Valley Water signs a Local Cooperative Agreement (LCA) with USACE, in which Valley Water agrees to operate and manage the Lower Guadalupe River to provide 1% flood protection when the DGRP is complete[21].

1995 Based on winter storm events, a hydraulic analysis shows that the Lower Guadalupe River does not have the planned conveyance capacity as required by the 1992 LCA. Both vegetation growth and sediment deposition were identified as the main causes of reduction in channel capacity.

Summer: interim levee restoration project was constructed to carry design flow with 50% freeboard[24].

2002 Valley Water completes the Lower Guadalupe River Planning Study (LGRP) Engineer's Report. Construction begins.

2004 Valley Water completes flood protection improvements along the Lower Guadalupe River from Alviso Marina to Interstate 880 (LGRP). USACE, in partnership with Valley Water, completes flood protection improvements from Interstate 880 to Interstate 280 (DGRP)[25].

November 5: USACE sends a letter verifying that both LGRP and DGRP meet USACE criteria for passing the 1% flood[26].

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[21] USACE. 2007. Draft Lower Guadalupe and Downtown Guadalupe River Flood Protection Project San Jose, Santa Clara County, California: Operation, Maintenance, Repair, Replacement, & Rehabilitation Manual.
[22] USACE. 1977. Hydrologic Engineering Office Report Guadalupe River and Coyote Creek Santa Clara County, California.
[23] Valley Water. 1982. Planning Study Consisting of the Engineer's Report and Focused Environmental Impact Report for Guadalupe River, Southern Pacific Railroad to Highway 101.
[24] CH2MHill. 2002. Lower Guadalupe River Planning Study.
[25] Valley Water. 2019. Lower Guadalupe River Project from the Alviso Marina County Park to Interstate 880. Board Agenda Memo.
[26] USACE. 2004. Department of the Army to Santa Clara Valley Water District. November 5.

2005 November 15: USACE sends a letter certifying construction of the LGRP[27].

December 15: USACE sends a letter verifying that the LGRP satisfies USACE criteria for Federal Emergency Management Agency (FEMA) certification[28].

- The FEMA certification letter states: "The 100-year design flow used for certification of the LGRP is 18,350 cfs. This flow rate includes 17,000 cfs from the DGRP project and another 1,350 cfs from interior drainage inflow along the LGRP during the peak of the flood wave." And "The Corps certifies that both the LGRP and DGRP have been designed and constructed to safely pass the 100-year FEMA base flood event when operated and maintained according to the OMRR&R (Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual)"

2007 USACE issues Valley Water a draft "Operations, Maintenance, Repair, Replacement, & Rehabilitation Manual for the Guadalupe River Project" (O&M manual)[29].

2013 Valley Water staff requests that the LGRP be added to the USACE Flood Central and Coastal Emergencies (FCCE) Program, with an active status in USACE's Rehabilitation and Inspection Program (RIP)[30].

2017 Large storms prompt Valley Water staff to re-examine design flow conveyance capacity in Guadalupe River. Valley Water staff collects high water marks, topographic surveys, and information on vegetation.

2018 Staff completes hydraulic analyses to re-evaluate the flow conveyance capacity of the Lower Guadalupe River. Results indicate that a section of the Lower Guadalupe River no longer has conveyance capacity for the 1% flood event for which it was designed.

2019 March 12: Valley Water staff presents these findings to the Board.

2021 December 7: Valley Water Staff sends letter to the Watersheds Chief Operating Officer with a preliminary staff recommended alternative to address the reduced flow conveyance.

2023 August 21: Valley Water Staff presents an update on the staff recommended alternative to the CIP committee.

2.5. HYDROLOGY

The upper and lower extents of the Guadalupe watershed are very distinct hydrologically. The average annual rainfall ranges from 15-in at the downtown San José rain gage to 61-in at the Lexington gage[31]. Elevation ranges from sea level at San Francisco Bay to 3,800-ft at Loma Prieta in the mountains. The valley and foothill areas are heavily urbanized, but the steep mountain areas are mostly well-vegetated open space.

[27] USACE. 2005. Lower Guadalupe River Flood Control Construction Certification. November 15.
[28] USACE. 2005. Department of the Army to Santa Clara Valley Water District. December 15.
[29] Valley Water. 2019. Lower Guadalupe River Project from the Alviso Marina County Park to Interstate 880. Board Agenda Memo.
[30] USACE. 2013. Department of the Army to Santa Clara Valley Water District. August 05.
[31] PRISM Climate Group, Oregon State University n.d. https://prism.oregonstate.edu/

2.5.1. Reservoirs

Much of the runoff from the headwaters of the watershed is collected by one of four major reservoirs: Almaden, Calero, Lexington, and Guadalupe. Details of the six largest reservoirs in the watershed are presented in Table 2-4.

Table 2-4: Reservoirs in Guadalupe Watershed

Reservoir	Year Built[32]	Capacity (ac-ft)[33]	Outlet Capacity (cfs)[33]	Owner
Almaden	1935	1,555	190	Valley Water
Calero	1935	9,738	185	Valley Water
Lexington	1952	18,534	410	Valley Water
Guadalupe	1935	3,320	235	Valley Water
Vasona	1968	463	125	Valley Water
Lake Elsman	1950	6,200	Unknown	San Jose Water Co

The operation rules and policies for Valley Water reservoirs have changed significantly over the years. Originally, reservoirs were operated solely for water supply. In 1997, Valley Water implemented new operating strategies for Almaden, Calero, Guadalupe, and Lexington Reservoirs to reduce flood damage while minimizing impact to water supply. However, the existing operating strategies for these reservoirs are not associated with flood management project design considerations further downstream in the Lower Guadalupe River[34].

2.5.2. Design Flows

There are two scenarios considered when determining storm flood flows in the Guadalupe watershed. One scenario is a 72-hour storm over Lexington Reservoir, and the other is a 72-hour storm over Guadalupe, Almaden, and Calero reservoirs. The Guadalupe-centered storm creates higher peak flows than the Lexington-centered storm.

In 1992, Valley Water signed a Local Cooperation Agreement (LCA) with USACE, committing Valley Water to operating and managing the LGRP "in such a way to convey design flood flows." The Downtown and Lower Guadalupe Projects used 1% design flood flows including inflow from the adjacent pump stations. The 1% design flows for the LGRP and DGRP were determined by USACE and ranged from 17,000 cfs at the upstream end of the LGRP (from the DGRP), and 18,325 cfs at the downstream end (Table 2-5[35]). The LGRP's 1% flood flows were determined using the 1977 Hydrologic Engineering Office Report, authored by USACE (17,000-18,325cfs).

32 Valleywater.org. Local Dams and Reservoirs. 2019
33 Valley Water. 2023. Protection and Augmentation of Water Supplies FY 2023-24.
34 USACE. 2009. Guadalupe Watershed Hydrologic Assessment.
35 NHC. 2000. Lower Guadalupe River Flood Protection Study – Draft Existing Conditions Report

Table 2-5: 1% Flood Design Flows for Previous Lower Guadalupe River Project

Location Along Guadalupe River	1% Design Flows (cfs)
D/S of Los Gatos Creek Confluence (USGS Gage 11169000)	16,000
Interstate 880	17,000
US 101 (USGS Gage 11169025)	17,312
Trimble Road	17,478
Montague Expressway	17,864
Tasman Drive	18,104
State Route 237	18,325

The 1% design flows in Table 2-5 assume an “ultimate” condition in the watershed, in which all tributaries and creeks have been modified to contain the full 1% flood within the creek channels. This is not the current condition of the watershed, as many tributaries in the upper watershed are not able to convey the 1% flood. Although the 72-hour, Guadalupe-centered storm creates higher peak flows, the flows currently spill in the upper watershed and do not reach the Lower Guadalupe River. It is estimated that the highest peak flow that currently comes from the Upper Guadalupe River is about 8,000 cfs.

Since the design of the LGRP, there have been two updates to the Guadalupe watershed’s hydrology and design flows. The first was completed by the USACE in 2009. In 2009, USACE released an updated hydrology study based on a simplified HEC-HMS model that found higher flows reaching the Guadalupe River (17,967-19,292 cfs).

The second was completed in 2023 and identified the design flows for Guadalupe River that were used for this Project. The update included a detailed InfoWorks Integrated Catchment Model (ICM) hydrologic and hydraulic model. The calibrated ICM models have consistently performed well with gage data in historical storms during calibration and in peak flow analyses by Valley Water. These models have demonstrated greater reliability and accuracy compared to prior flow calculation methods. The detailed models accurately represent urban storm drain systems, overland street networks, and open channels, reflecting precise flow and storage routing, as well as peak flow reduction along open channels[36]. Furthermore, the calibrated detailed models align with flow frequency curves developed from longer-term gage data, ensuring statistically accurate design flows for corresponding storm frequencies. Consequently, the refined and reduced peak channel flows from the ICM models estimate the flows that would actually reach the channel through the storm drain network during a high flow event more accurately than the HEC-HMS models developed in both the 1977 and 2009 Hydrologic Assessments, which estimate flows for “ultimate” conditions. The updated 2023 ICM model peak channel flows are used as the 1% design flows for the Lower Guadalupe River Capacity Restoration Project and are shown in Table 2-6.

[36] Wood Rogers 2023. Guadalupe River ICM Model Development.

Table 2-6: Updated 2023 1% Design Flows - ICM Peak Channel Flows (Guadalupe Storm Centering)

Location Along Guadalupe River	1% Peak Flows (cfs)
D/S of Los Gatos Creek confluence (USGS Gage 11169000)	13,925
Interstate 880	14,100
US 101 (USGS Gage 11169025)	13,986
Trimble Road	13,986
Montague Expressway	13,930
Tasman Drive	14,004
State Route 237	14,160
Gold Street	14,160

2.6. GEOLOGY

The Santa Clara Valley is a northwesterly trending alluvial-filled basin characterized by thick accumulations of alluvial sediment. The basin is situated over older Mesozoic rock formations from the Santa Cruz Mountains and the Diablo Range. These alluvial sediments consist of the lower, older Santa Clara Formation and the upper, younger surficial deposits of alluvium and alluvial fan. The Santa Clara Valley is positioned in a structural depression of the Coast Range, gradually filled over time with sediments. This geological process has created a broad alluvial valley floor with deposits measuring several tens of meters in thickness. The earliest deposits in the South San Francisco Bay area date back to the early Pleistocene, approximately 1.5 million years ago[37].

The levees for the LGRP were constructed with imported engineered levee fill, designed to be resilient to hydraulic influence. A geotechnical study was conducted for the LGRP in 2002.

2.7. GROUNDWATER

Groundwater is a crucial part of Santa Clara County's water supply, providing approximately half of the county’s potable water. Valley Water serves as the Groundwater Sustainability Agency (GSA) for the county's interconnected groundwater subbasins, namely the Santa Clara Subbasin and the Llagas Subbasin, overseeing sustainability efforts. The Santa Clara Plain and Coyote Valley are two groundwater management areas within the Santa Clara Subbasin, both part of the Guadalupe watershed. The Santa Clara Plain, more than 25-mi long and 15-mis wide, is a significant groundwater storage area with an estimated operational capacity of 350,000 acre-feet. While the northern part is a confined aquifer beneath a clay layer limiting recharge, the southern part is an unconfined aquifer suitable for groundwater recharge. Natural recharge from precipitation and runoff is insufficient to meet current demands, with an average of 7,500 acre-feet per year (AFY) in the Guadalupe watershed between 2010 and 2019, compared to an average groundwater pumping of 75,500 AFY during the same period[38].

[37] CH2MHill. 2002. Lower Guadalupe River Planning Study.
[38] Valley Water 2021. Groundwater Management Plan for the Santa Clara and Llagas Subbasins

To counterbalance the deficit, Valley Water employs a managed aquifer recharge program, focusing on two primary recharge systems in the Guadalupe watershed: the Guadalupe and Los Gatos Recharge Systems. The Guadalupe Recharge System, with a total capacity of 25,100 AFY, includes both in-stream (creeks) and off-stream (ponds) recharge components. The Los Gatos Recharge System, with a total capacity of 29,700 AFY, follows a similar pattern[39]. This managed recharge program is vital for maintaining groundwater levels, optimizing conjunctive use, and preventing land subsidence. Valley Water has established a subsidence rate threshold of no more than 0.01-ft per year and monitors water levels at subsidence index wells to ensure a low risk of unacceptable land subsidence. The conjunctive use programs are essential for sustaining current groundwater elevations and preventing a reduction in water supply.

2.8. WILDLIFE, FISHERIES, AND VEGETATION

Habitat types in the project area include estuarine, marsh and wetlands, riverine, riparian forest and scrub, and ruderal uplands (see Figure 2-8 and Figure 2-9). The lower portion of the Guadalupe River, from the bay up to approximately Montague Expressway, is tidally-influenced estuarine habitat, supporting herbaceous perennial vegetation and is largely characterized by bulrush. Occasional trees, such as weeping willow and oak, and shrubs are mixed into this herbaceous vegetation upstream of Tasman Drive, transitioning to denser tree cover moving upstream. The margins of both the river channel and SDRs are characterized by a dense mix of mature native and non-native riparian trees and shrubs from Montague Expressway to I-880 due in part to mitigation plantings from LGRP. Upstream of the Airport Parkway bridge crossing, native vegetation was planted as mitigation for the DGRP. Floodplain uplands and levee slopes are dominated by ruderal/weedy upland herbs and grasses. The Guadalupe River supports perennial, or year-round, surface water. Riffle habitats generally support coarse substrate consisting of boulders, cobbles, and gravels, while deep pools tend to support fine silt or sandy substrates. The SDRs contain surface water seasonally and have fine-textured soils. When surface water is absent in the SDRs, they are unvegetated or sparsely vegetated with seasonal wetland vegetation. However, due to unanticipated breaches of the berm that separates the low-flow channel from the SDRs, Valley Water has encountered greater-than-anticipated summertime flows in the SDRs, supporting greater-than-anticipated levels of vegetation development.

Figure 2-8: Examples of habitats along levee slopes and bases and SDRs upstream of Montague Expressway

[39] Valley Water 2022. Protection and Augmentation of Water Supplies Annual Report

Figure 2-9: Examples of marsh habitat downstream of Montague Expressway

Due to the range of habitat types present within the Project area, a variety of common native and non-native fish and wildlife species, including migratory and nesting bird species, occur in the Project area. Based on habitat conditions in the Project area, California Natural Diversity Database searches, local knowledge and best professional judgement, the following special-status species have been identified as having potential to occur in the Project area or its vicinity at least seasonally or for part of their life cycle; the current conservation status of each species is included:

- Central California Coast (CCC) steelhead (*Oncorhynchus mykiss*) - federally threatened (FT), state Species of Special Concern (SSC)
- Central Valley fall-run Chinook salmon (*Oncorhynchus tshawytscha*)[40] - SSC
- Pacific lamprey (*Entosphenus tridentatus*) - SSC
- Southern coastal roach (*Hesperoleucus venustus subditus)* - SSC
- White sturgeon (*Acipenser transmontanus*) - SSC
- Western pond turtle (*Actinemys marmorata pallida*, now identified by USFWS as northwestern pond turtle (*Actinemys marmorata*)) - proposed FT, SSC, Valley Habitat Plan (VHP)
- California red-legged frog (*Rana draytonii*) - FT, SSC, VHP
- Pallid bat (*Antrozous pallidus*) - SSC
- Saltmarsh harvest mouse (*Reithrodontomys raviventris*) - federally endangered (FE), state endangered (SE)
- San Francisco dusky-footed woodrat (*Neotoma fuscipes annectens*) - SSC
- Townsend's big-eared bat (*Corynorhinus townsendii*) - SSC
- Western red bat (*Lasiurus frantzii*) - SSC

[40] According to the CDFW Special Animals List (April 2024), the Central Valley fall/late fall-run evolutionarily significant units refers to populations spawning in the Sacramento and San Joaquin rivers and their tributaries.

- Alameda song sparrow (*Melospiza melodia pusillula*) - SSC
- American peregrine falcon (*Falco peregrinus anatum*), delisted (nesting)
- Bald eagle (*Haliaeetus leucocephalus*) - SE, fully protected (FP) (nesting and wintering)
- Bryant's savannah sparrow (*Paserculus sandwichensis alaudinus*) - SSC
- California black rail (*Laterallus jamaicensis coturniculus*) - state threatened (ST), FP
- California Ridgway's rail (*Rallus obsoletus obsoletus*) - FE, SE, FP
- Loggerhead shrike (*Lanius ludovicianus*) - SSC (nesting)
- Northern harrier (*Circus hudsonius*) - SSC (nesting)
- Western burrowing owl (*Athene cunicularia*) - SSC (burrow sites & some wintering sites)
- Saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*) - SSC
- Short-eared owl (*Asio flammeus*) - SSC (nesting)
- Swainson's hawk (*Buteo swainsoni*) - ST (nesting)
- Tricolored blackbird (*Agelaius tricolor*) - ST (nesting colony), VHP
- Vaux's swift (*Chaetura vauxi*) - SSC (nesting)
- White-tailed kite (*Elanus leucurus*), FP (nesting)
- Crotch's bumble bee (*Bombus crotchii*) - state candidate endangered (SCE)
- Congdon's tarplant (*Centromadia parryi* ssp. *congdonii*) - CNPS List 1B

Steelhead and Chinook salmon are known to occur in the Guadalupe River and could occur throughout the Project area. Steelhead typically use mainstem Guadalupe River as a migratory corridor, and due to its location in the watershed the species would not be expected to spawn in the Project area. Spawning activity by Chinook salmon has been observed in a Valley Water gravel augmentation site upstream of the Project area and West Virginia Street. While steelhead are native to the Guadalupe watershed, Chinook salmon were not detected in the Guadalupe River prior to the 1980s[41], but the species has been observed in the system in recent years. Genetic analyses found that Chinook salmon in the Guadalupe River are closely related to fall-run Central Valley stock with a genetic affinity to the Feather River Hatchery and are genetically differentiated from coastal Chinook[42] [43].

Pacific lamprey have also been documented in Guadalupe River, and as an anadromous species could occur throughout the Project area. Southern coastal roach are known to occur in freshwater reaches of the Guadalupe River and may be present year-round.

White sturgeon could occur in estuarine waters near the bay but do not ascend Santa Clara County streams to spawn.

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[41] Smith, Jerry J. 2013. "Northern Santa Clara County Fish Resources." San Jose.
[42] Garza, J.C. and D. Pearse. 2008 Population Genetics of *Oncorhynchus mykiss* in the Santa Clara Valley Region. Final Report to the Santa Clara Valley Water District.
[43] Garcia-Rossi, D. and D. Hedgecock. 2002. Prevenance analysis of Chinook salmon (*Oncorhynchus tshawytscha*) in the Santa Clara Valley watershed. Bodega. Marine laboratory, University of California at Davis. Santa Clara Valley Water District, San Jose, CA.

Western pond turtles inhabit near permanent to nearly permanent freshwater ponds, rivers, creeks, wetlands, and marshes with aquatic vegetation in woodland or grassland habitats. They may also occur in brackish estuarine water and prefer slow-moving water with deep pools and woody debris, rocks, vegetation mats, or exposed banks for basking. The species could occur throughout the Project area where suitable habitat is present.

California red-legged frog utilize freshwater aquatic habitats adjacent to upland dispersal habitats with suitable microhabitat (e.g., rodent burrows, crevices, fallen logs) for cover. The species could occur throughout the Project area where suitable habitat is present but would not be expected to occur in highly brackish or highly urbanized habitats with limited connectivity between aquatic and upland sites.

Townsend's big-eared bat, pallid bat, and western red bat may use the Guadalupe River as a migratory corridor between the foothills and the bay and may occur as foragers over open habitats near the bay, in parks, or along the riparian corridor at night. Townsend's big-eared bat and pallid bat tend to roost in groups and are very sensitive to disturbance. Roost habitat in the Project area could include bridges, buildings, hollow trees, exfoliating bark, or rock crevices. Maternity or winter roosting by these species in the Project area would be limited by lack of suitable habitat and anthropogenic disturbance (e.g., nighttime lighting), but individuals could stop to roost during the day while transitioning between habitats. Western red bat are solitary foliage roosters and not known to have strong roost site fidelity. They tend to be associated with mature trees such as cottonwood/sycamore riparian, eucalyptus, orchards or other non-native trees, and could be roosting in these habitats during the day. They could occur in low numbers on a transient basis and have been known to forage in areas with nighttime lighting. Western red bat is considered to be absent as a maternity rooster in Santa Clara County.

San Francisco dusky-footed woodrat tend to occur in oak woodlands and riparian areas with dense shrubs, such as poison oak and blackberry, and could occur where suitable habitat in present throughout the Project area.

Saltmarsh harvest mouse are restricted to tidal and brackish marsh habitats. They may be associated with a variety of vegetation, but often occur in dense pickleweed and other salt and brackish marsh vegetation, such as saltgrass and alkali bulrush, with adjacent grasslands where there is suitable cover to avoid predation during high tides. Habitat in the Project area would be marginal for saltmarsh harvest mouse, but suitable habitat is present in the Project vicinity downstream near the bay.

Alameda song sparrows prefer tidally-influenced habitats. They forage on open ground, including paths through pickleweed, and may nest in tall salt marsh vegetation, primarily marsh gumplant and cordgrass adjacent to tidal sloughs, and bulrush in brackish marshes.

Bryant's savannah sparrow are associated with pickleweed-dominant habitat with adjacent grasses in salt marshes and open grasslands lacking tree cover. They may nest in vegetation such as pickleweed, grasses on the ground, or low in shrubs. Saltmarsh common yellowthroat occur in brackish or freshwater marshes and wetlands and nest in dense herbaceous vegetation or shrubs such as bulrush, cattails, coyote brush, or poison hemlock.

California black rail occur in saltwater or brackish tidal marshes dominated by pickleweed. Adjacent vegetated upland habitat is required for escape cover from predators during high tides. Nests are built in mature marsh plants above the high tide line. Ridgway's rail use salt marshes and brackish marshes with tidal sloughs, and access to mudflats or shallow waters for foraging, that are adjacent to high marsh for refugia during high tides. They occur in cordgrass-pickleweed dominant habitats near the bay and nest in the lower areas of marshes in dense vegetation such as cordgrass, pickleweed, or gumplant. Ridgway's rail have been detected at the downstream end of Alviso Slough. Habitat in the Project area would be considered marginal for rails, but suitable habitat is present downstream near the bay and the species could occur as a forager in the Project vicinity.

Bald eagles tend to occur near large bodies of water with abundant fish and waterfowl prey adjacent to snags or other structures for perching. They nest in tall trees or structures near permanent water sources, and their occurrence in most of the Project area would be limited by lack of suitable nesting and foraging habitat; however, they may occur near the bay. Northern harrier occur in open grasslands, wetlands, and salt marshes dominated by pickleweed, or brackish marsh dominated by bulrush. They nest on the ground in tall vegetation, such as grass or cattails, in freshwater marshes or wet meadows.

Loggerhead shrike may be found in open habitats with scattered shrubs and trees, or open areas around salt marshes. They nest in clumps of dense trees or shrubs near open foraging areas and hunt from low perches.

Tricolored blackbirds are associated with freshwater marshes and agricultural lands and nest in colonies in dense emergent vegetation such as cattails, tules, willow, blackberry, thistles, or wild rose.

White-tailed kite forage in open grasslands, agricultural and marsh habitats with abundant small mammal prey and may nest in isolated trees or forest edges near suitable foraging habitat.

Swainson's hawk would only be expected to occur in the area as a rare spring migrant.

Short-eared owl occur in open grasslands and marshes with abundant small mammal prey. They roost on the ground in weedy habitats or grass and have been observed in the baylands.

Vaux's swift may occur as foragers over the bay. They typically nest in large hollow trees or chimneys.

American peregrine falcon tend to occur in open areas near water and may nest on tall buildings in urban areas, bridges, or transmission towers. They may hunt near the bay mainly for birds or small mammals. A pair has been known to nest on top of San Jose City Hall in recent years, upstream of the Project area.

Burrowing owl nest and forage in open grasslands and ruderal habitats with short vegetation and unobstructed views. They roost in burrows, typically those made by California ground squirrels. The species has been documented near Gold Street and the San Jose Mineta International Airport.

Crotch's bumble bee tend to occur in dry open grasslands, shrublands, and scrub communities with floral resources (e.g., milkweed, lupine, sage, poppies, buckwheat). While most documented occurrences of the species in the county have been near the foothills, they are presumed to have potential to occur in suitable habitat throughout the county. There is a recent (2021) verified observation of a Crotch's bumble bee from near the Guadalupe River at Coleman Avenue, upstream of the Project area[44].

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[44] Xerces Society. 2021. Bumble Bee Watch. Accessed May 7, 2024. https://www.bumblebeewatch.org/

Congdon's tarplant is an annual herb that occurs in valley and foothill grasslands, particularly those with alkaline substrates, and in sumps or disturbed areas where water collects. The blooming period extends from June through November. The range of this species includes Alameda, Monterey, San Luis Obispo, and Santa Clara counties, and it has been extirpated from three others. There are recent records for this species in Alviso and Sunnyvale Baylands Park. Surveys for this species during the blooming period are warranted along levees, within ditches, and in mesic ruderal uplands within the Project area.

Additional special-status plant species were addressed in the EIR for LGRP but were presumed to be absent for reasons including lack of suitable habitat, extirpation from the county, limited existing distribution, and a lack of local records.

2.9. PAST AND PRESENT PROJECTS OR STUDIES

In addition to the flood management efforts described in Section 2.4, many studies conducted in the Project area were completed prior to 2002 as part of the LGRP Planning Study. This included a geotechnical investigation, cultural resources assessment, hazardous materials assessment, as well as hydrology, hydraulics, and geomorphology studies.

There are also several ongoing projects or studies that include the Lower Guadalupe River project area:

- FAHCE
  - The Fisheries and Aquatic Habitat Collaborative Effort (FAHCE) is an ongoing program that aims to improve fish passage and aquatic spawning and rearing habitat in the Guadalupe River, Coyote Creek, and Stevens Creek watersheds through a Fish Habitat Restoration Plan (FHRP). Under the program, restoration activities specified in the FAHCE Settlement Agreement will be implemented and adaptively managed consistent with Valley Water's water rights and water supply commitments. Measures developed through FAHCE are intended to modify instream flow and improve habitat conditions. The management objective for the Guadalupe watershed is to restore and maintain healthy steelhead and Chinook salmon populations. In mainstem Guadalupe River, this includes adequate passage for adult steelhead and Chinook salmon to reach suitable spawning and rearing habitat in the upper watershed, and for juvenile outmigration. In 2023, FAHCE reservoir operations were fully implemented in the Guadalupe Watershed. The final FAHCE program Environmental Impact Report (EIR) was posted on June 30, 2023.
- Calabazas/San Tomas Aquino Creek-Marsh Connection Project
  - The Calabazas/San Tomas Aquino Creek-Marsh Connection Project aims to restore the salt ponds adjacent to Alviso Slough by depositing sediment from surrounding streams[45]. Through this partnership with the South Bay Salt Pond Restoration Project (SBSPRP), U.S. Fish and Wildlife Service (USFWS), Valley Water is conducting the San Tomas Aquino and Calabazas Creek Realignment Study. San Tomas and Calabazas creeks currently make 90 degree turns just south of Pond A8, where they are routed into Guadalupe Slough, west of the pond, and ultimately discharge to South San Francisco Bay. The study seeks to restore the San Tomas Aquino and Calabazas creeks to a more natural creek alignment, which would release flow directly into Pond A8. Guadalupe River is immediately upstream of Pond

[45] Valley Water. 2019. D8: South Bay Salt Ponds Restoration Partnership.

A8 and drains to the bay via Alviso Slough, east of the pond, but is connected to Pond A8 via the A8 notch. Thus, any modifications to Pond A8 may affect the water surface elevation in lower Guadalupe River during floods or influence sediment transport and water quality[46] (e.g., tidal prism, salinity, temperature).

- South San Francisco Bay Shoreline Protection Project
  - The San Francisco Bay Shoreline Protection Project aims to provide protection from coastal flooding between San Francisquito Creek and Coyote Creek. The project is constructing coastal levees and ecotones in the area west of Guadalupe River, near Alviso, as part of Phase I; construction began in December 2021 and is estimated to until 2025. Phase II would focus on the area between San Francisquito Creek in Palo Alto to Permanente Creek in Mountain View. Phase III (also known as the Shoreline (Sunnyvale) Feasibility Study) would focus on the area from Permanente Creek in Mountain View to Guadalupe River in San Jose. The Phase III Feasibility Study was initiated in August 2023. The USACE is developing a hydraulic model and project alternatives.
- Upper Guadalupe River Flood Protection Project
  - The Upper Guadalupe River Flood Protection Project plans to bring flood risk reduction to the Upper Guadalupe River between Interstate 280 and Blossom Hill Road in partnership with the USACE. Improvements would include channel widening, construction of floodwalls and levees, replacement of road crossings, and planting of streamside vegetation. The Project has lacked adequate federal funding since 2015. In 2021, the USACE began a General Re-evaluation Study to make the project more competitive for federal funding. The new preferred project is expected to complete the planning process in 2025.

2.10. COMMUNITY ELEMENTS

The Guadalupe River is a popular destination for recreation and commuter activities. The Guadalupe River Trail, which runs along the entire length of the project, is heavily used by pedestrians and cyclists. The City of San Jose and Valley Water have a Joint Trails Project Plan and Agreement, active since 2006[47]. A pedestrian bridge, known as the River Oaks Bridge, connects the Cities of San Jose and Santa Clara downstream of Montague Expressway. There are also several trail access points along both the east and west levees, allowing the public to access the trails for recreation and transportation. The trail, access points, and pedestrian bridge will need to be accounted for during design and construction.

Another community stakeholder is the Ulistac Natural Area Restoration and Education Project (UNAREP). UNAREP is a non-profit organization that seeks to create and maintain natural habitat and ecosystems within the open space boundaries. The Ulistac Natural Area has seen many changes throughout time, from its settlement by the Ohlone Indians many years ago, to its present restoration campaign. The Ulistac Natural Area is home to many native flora and fauna, and is open to the public for recreational use[48].

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[46] Anchor QEA. 2024. "Draft Hydrodynamic, Sediment Transport, and Water Quality Modeling of Seven Conceptual Alternatives."
[47] City of San Jose & Valley Water. 2006. Joint Trails Project Plan and Agreement for the Joint Trails Project Guadalupe River Trail – Reach A to E (From Gold Street to Highway 880)
[48] Ulistac Natural Area. 2019. http://www.ulistac.org/about

SECTION 3. PROBLEM DEFINITION

This chapter outlines the problems identified within the scope of the study, leading to the initiation of a capital improvement project. Additionally, it highlights any additional issues discovered within the Project's watershed during the Project's planning phase.

3.1. REDUCED CAPACITY

The main problem this Project aims to resolve is reduced capacity in the Lower Guadalupe River. The LGRP was completed in 2004 with the objective to provide 1% flood flow capacity. The original design flow was 17,000 cfs from Downtown Guadalupe with an additional 1,325 cfs inflow from interior drainage. High-water marks collected during recent storms indicated that the channel is not carrying the flows as designed, which prompted Valley Water to update the Lower Guadalupe River HEC-RAS hydraulic model.

Because the LGRP design HEC-RAS model predicted much lower water surface elevations than those measured during recent storms, the model was updated and calibrated. The calibration involved adjusting the channel geometry to match current conditions and adjusting the Manning's roughness values to match current vegetation levels[49]. Incorporating these changes allowed the model to match the water surface elevations observed during high flows more closely. Original design model cross-sections were modified with the following data:

1. 2014, 2017, 2019 high water marks: Observed high-water marks were used to calibrate the hydraulic model.
2. Site Visits in 2018 and 2019: Valley Water staff visited the project area to observe current channel conditions, including vegetation growth.
3. 2017 survey: A total of four scattered sample cross-section surveys were completed in 2017 for Lower Guadalupe River to provide a quick comparison to the design cross sections in HEC-RAS.
4. 2018 LiDAR: A LiDAR survey was completed in 2018 for the Lower Guadalupe River. This provides accurate elevation data for the areas not heavily shaded by trees or submerged by river flows.
5. LGRP as-builts (2008): The as-builts for Lower Guadalupe River cross-sections were compared with design model cross-sections.

To calibrate the model, Manning's n-values were updated based on field observations and aerial photos and then adjusted as needed to match high-water marks. The n-values were also peer-reviewed by an outside consultant[50]. The channel n-values increased by about 50% whereas the floodplain n-values more than doubled in certain areas, noting that doubling of the roughness was only found necessary in the 2018 memo/study, which placed the bank stations to the edges of the bankfull channel, consistent with the USACE model. Placement of bank stations at the top of levee vs at the bankfull channel edges, as done in the 2019 memo, treats

[49] Valley Water. 2019. Lower Guadalupe Hec Ras Model Calibration and Channel Capacity Updates
[50] Schaaf & Wheeler. 2019. Peer Review of Roughness Estimates for Lower Guadalupe River in San Jose between Interstate 880 and San Francisco Bay.

the entire channel as a single conveyance area, and can result in higher water surface elevations for the same roughness distribution. Figure 3-1 shows a sample cross-section where the channel design n-value has increased from 0.03 to 0.045 and a portion of the floodplain n-value has increased from 0.08 to 0.2. The widths of the roughness zones were also updated based on aerial photos and field observations[51].

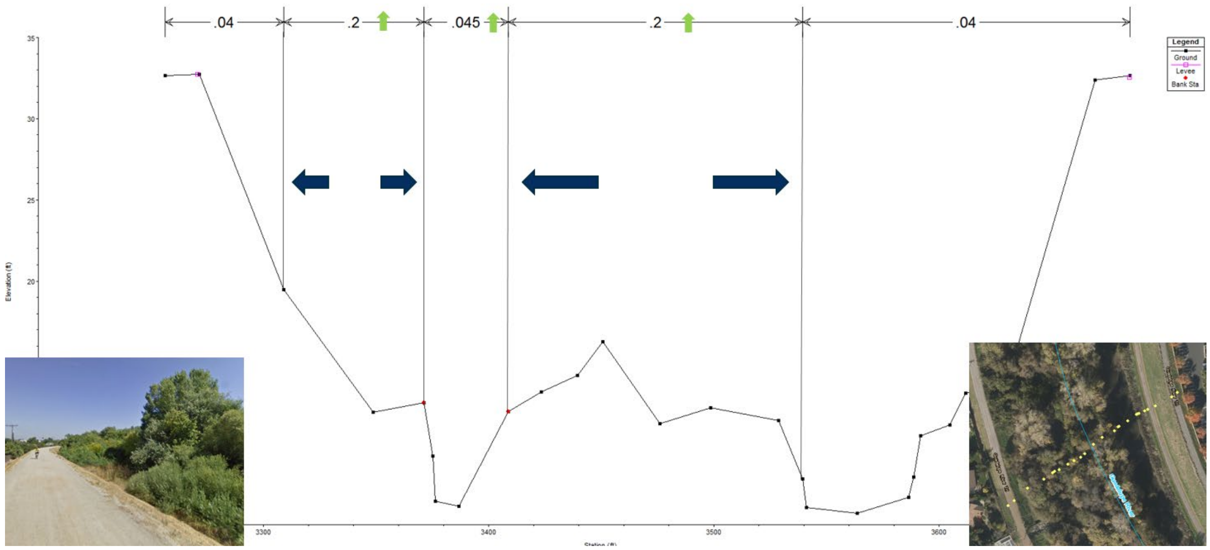

Figure 3-1: Typical Cross-Section with increased Manning's n values (Figure by John Yang, Technical Memorandum Draft Lower Guad Model Memo, October 31, 2018)

With calibrated roughness values in the HEC-RAS model, the results showed that the Lower Guadalupe River was unable to convey the design 1% flood, with some reaches overtopping and others not meeting freeboard criteria. Capacity exceedance (i.e., overtopping) based on Table 2-5 flows was predicted from Montague Expressway to upstream of US 101. The maximum exceedance occurred downstream of Trimble Road with a water surface elevation almost 2-ft above top of levee.

3.2. CHANGES TO PROJECT EXTENTS

Throughout the Project Planning Study, the Project's extents have changed due to new or updated information obtained by the planning team.

During the Problem Definition Study, the Project extents were from Interstate 880 to Tasman Drive. During that phase of the Project Planning Study, the planning team identified this area as having insufficient capacity to convey the original LGRP 1% flows (18,325 cfs) with adequate freeboard.

During the Conceptual Alternatives Study, the Project extents were expanded to the area between Interstate 880 and Gold Street. Early calibration of the 1D steady state HEC-RAS model during the Problem Definition Study showed that reduced channel capacity stopped at

[51] John Yang. 2018. Draft Lower Guadalupe Model Update. Tech Memo.

Tasman Drive. During the Conceptual Alternatives Study, peer-reviewed calibrations of Manning's n-values identified that freeboard deficiencies extended past Tasman Drive to Gold Street, including the Alviso neighborhood to the east of the river. The hydraulic model at this phase used the original LGRP design flow of 18,325-cfs with updated Manning's n-values.

During the Feasible Alternatives Study, the Project extents did not change and were from Interstate 880 to Gold Street. The hydraulic model at this phase used the original LGRP design flow of 18,325-cfs and hydromodification of the original LGRP design flow.

After completion of the Feasible Alternatives Study, Valley Water staff worked with a consultant to conduct a hydrology study for the Guadalupe watershed which redefined the 1% flow as discussed in Section 2.4 to 14,160-cfs for the Guadalupe River at State Route 237. As a result of the lower flows, the portion of the Guadalupe River with insufficient capacity was reduced and the Project extents changed from US 101 to Tasman Drive. It should be noted that this change to design flows would need to be coordinated with the USACE, due to Valley Water's commitment to convey design flood flows from the DGRP.

Changes to Project extents at each phase of the planning study are discussed in detail in the following reports:

- Appendix F: Problem Definition and Refined Objectives Report (December 2019)
- Appendix G: Conceptual Alternatives Report (November 2020)
- Appendix H: Feasible Alternatives Report and Staff Recommended Alternative Report (December 2022)
- Appendix I: Staff Recommended Alternative Report—Technical Memorandum (September 2023)

3.3. ROOT CAUSES OF REDUCED CAPACITY

The model calibration discussed above indicates that the channel roughness has increased significantly since the 2004 LGRP. The root causes of the increased roughness are described below. Channel geometry changes also contribute to reduced capacity when compared with the capacity estimates from the USACE hydraulic model used for the design of the 2004 LGRP.

3.3.1. Vegetation Growth and Sediment Deposition

Valley Water's capacity investigation determined that more and denser vegetation exists in the channel than was assumed in the LGRP design (see Figure 3-2 to Figure 3-4). Maintenance was regularly conducted but was not sufficient to maintain channel capacity. There are several reasons for this. In the period between the 1995 flood (when the HEC-RAS model was last calibrated) and project completion in 2004, the amount of vegetation in the channel greatly increased. Relatively high groundwater levels and year-round surface flows support vigorous vegetation establishment and growth in the project area. The SDRs in particular support vigorous vegetation growth.

Another factor was the change in permitting requirements of stream maintenance since LGRP was designed and constructed. Constraints on and mitigation requirements for vegetation removal activities have increased, making routine vegetation management more challenging and expensive to conduct.

It is also much more difficult to perform sediment removal activities. Because of unanticipated breaches of the berm that separates the low-flow channel from the SDRs, Valley Water has encountered greater-than-anticipated summertime flows in the SDRs, making both the identification of sediment accumulation and the sediment removal work itself in those prescribed locations challenging. In addition, many SDRs are now densely vegetated, and would require vegetation removal prior to sediment removal.

Facing Downstream to Trimble Road
Station 160+76

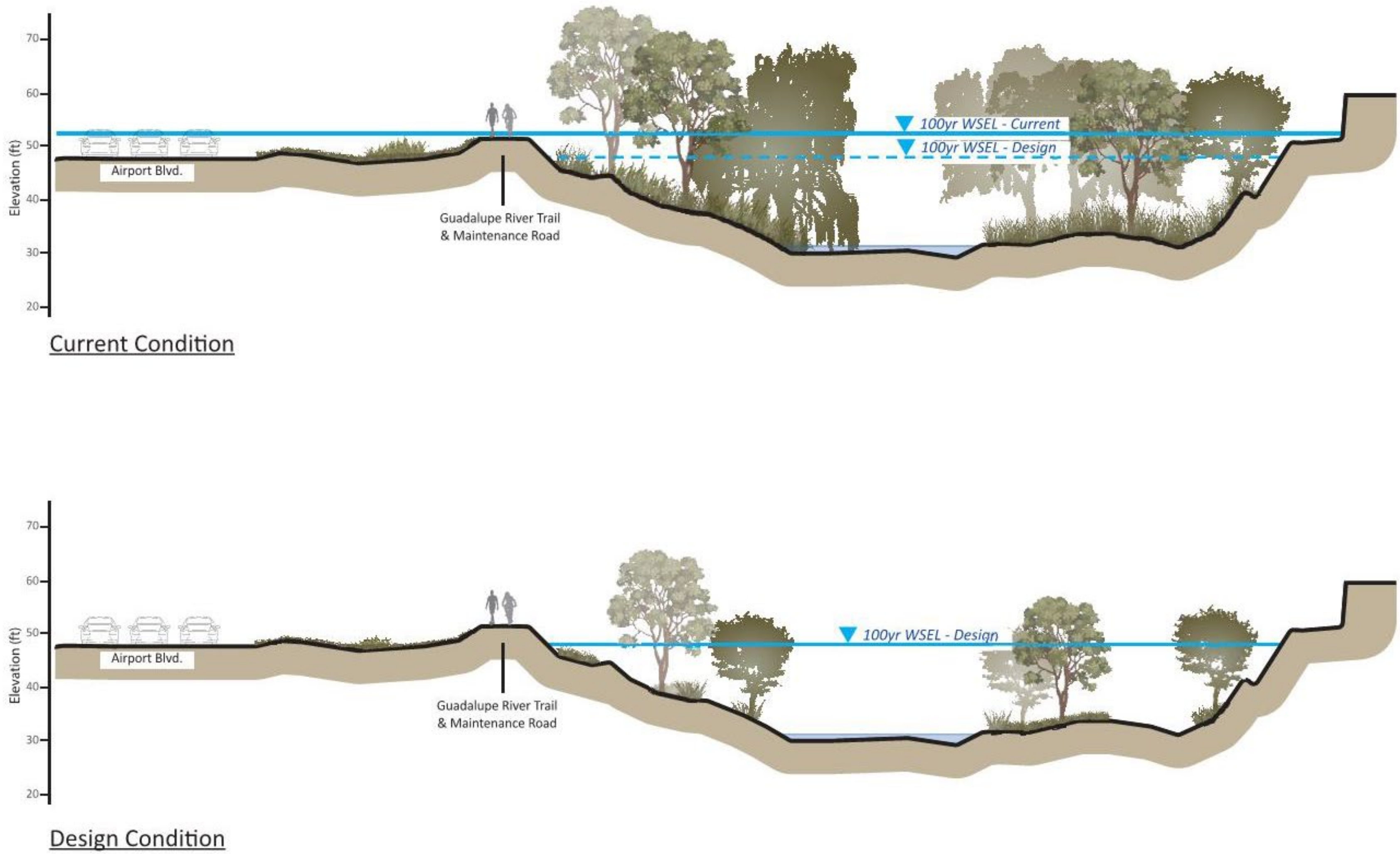

Figure 3-2: Typical Section – Interstate 880 to Trimble Road

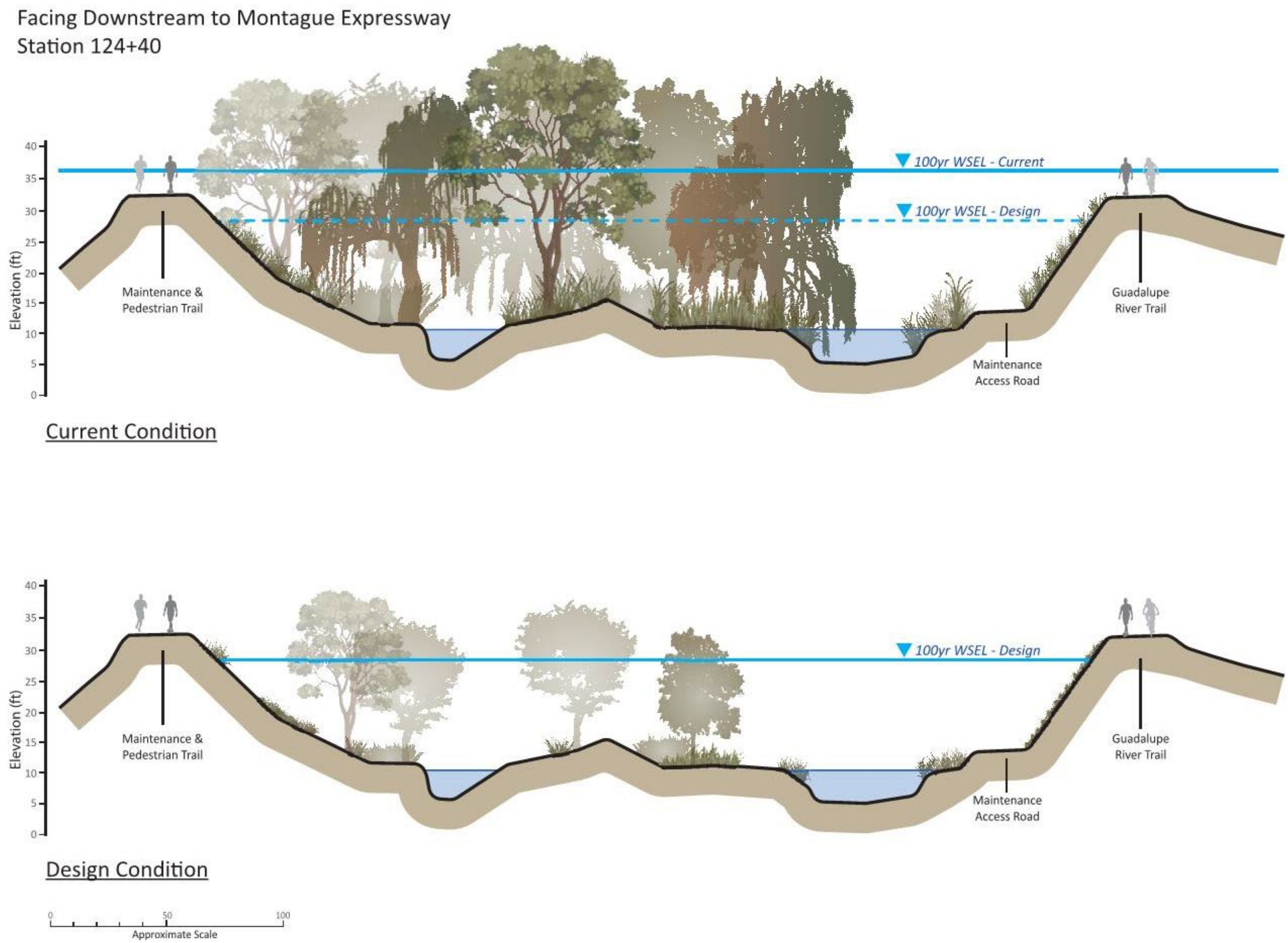

Figure 3-3: Typical Section -Trimble Road to Montague Expressway

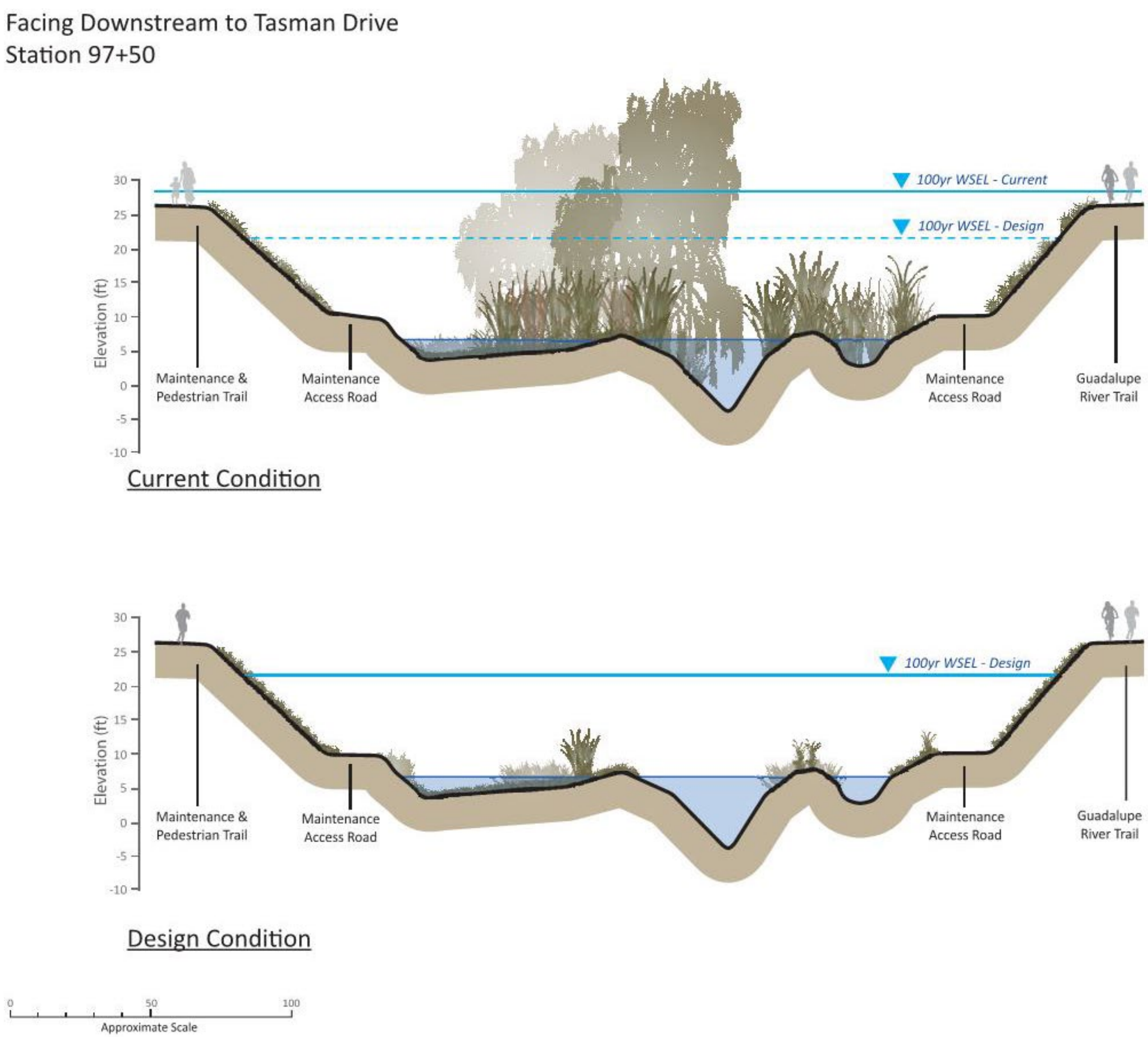

Figure 3-4: Typical Section - Montague Expressway to Tasman Drive

3.3.2. Channel Geometry

Routine vegetation removal alone will not be enough to achieve 1% flood flow capacity for the channel. Even if the channel is cleared, the river would not convey 1% flood flows in all locations and would require channel improvements beyond vegetation maintenance[52]. This is because the LGRP design hydraulic model did not account for the levee improvements constructed in 2004, which encroached on the cross-sectional area of the channel. This means that there is a smaller channel area than was accounted for in the hydraulic models that were the basis of the LGRP design.

To raise the levees, the 2004 LGRP improvements included the placement of fill on the inboard side of the existing levees. This encroachment into the cross-sectional area was unaccounted for in the LGRP design and as-builts, and effectively, has reduced the flow conveyance area of the river.

The LGRP HEC-RAS design model was created from a HEC2 model that used surveyed cross-sections and photogrammetry from 1996[53]. Minimal additional surveys were conducted in the project area until the high-water marks surveyed in 2017 indicated that the channel was not performing as expected. A small number of cross-sections were gathered in 2017, which showed that the current channel geometry was significantly different than the cross-sections in the HEC-RAS design model. A LiDAR survey was conducted in 2018 over the entire project area to gather more data about the channel's current geometry. This information was compared to the LGRP as-built drawings, completed in 2008[54]. The as-built drawings align with the 2017 and 2018 survey data, which confirms that the HEC-RAS model was not properly updated after construction. A typical section is shown in Figure 3-5, with original HEC-RAS model, 2008 as-builts, 2017 data, and 2018 data included.

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[52] Valley Water. 2018. Business Case Report for Guadalupe River Freeboard Restoration, Montague Expressway to Airport Parkway
[53] NHC. 2000. Lower Guadalupe River Flood Protection Study – Draft Existing Conditions Report
[54] John Yang. 2018. Draft Lower Guadalupe Model Update

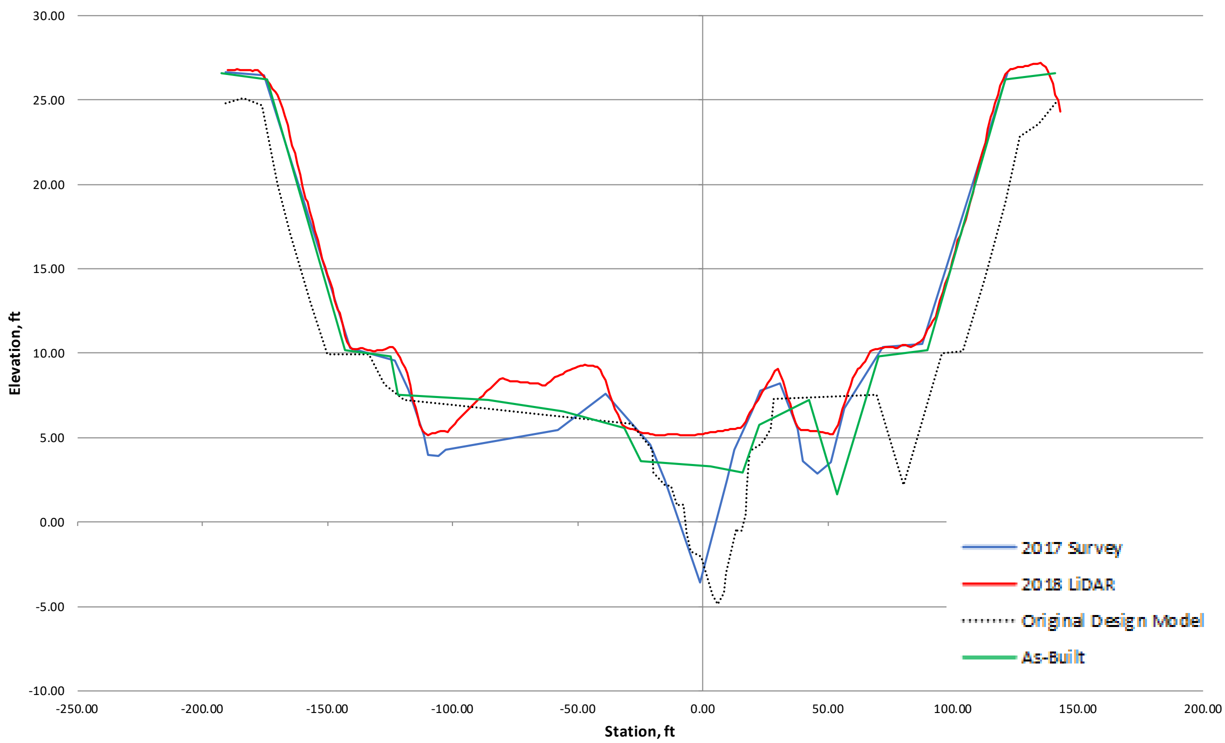

Figure 3-5: Comparison of Cross-Section Data at Station 97+50, Upstream of Tasman Drive

3.4. RISKS AND IMPACTS

Since the LGRP was constructed in 2004, the number of homes and businesses has grown, adding increased economic risk of flooding. Upon completion of the LGRP, most of the homes and businesses in the pre-project, 1% floodplain were removed from the 100-year floodplain on the Federal Emergency Management Agency's (FEMA's) Flood Insurance Rate Maps (FIRMs) and, as such, were no longer required to purchase flood insurance if purchased with federally-backed loans. If the channel is unable to carry a 1% flow and/or meet FEMA freeboard criteria, some of these residences and businesses could be added back to the 100-year floodplain on FEMA's FIRMs from a FEMA-enforced map change or be subjected to flooding with no insurance to aid in recovery.

Limited river channel capacity and higher water surface elevations in Guadalupe River could also affect the following features in the project area:

- Bridges: 1% return period storm levels could overtop the existing headwalls at bridges and reduce the integrity of bridges in the Project area.
- Pump stations: A higher water surface could translate to a higher pumping head that the pumps would need to accommodate during a large storm.

Sea-level rise could exacerbate flooding to higher levels than originally designed. This project planning study accounts for sea level rise, incorporating extreme tide events based on the San Francisco Bay Area Regional Sea Level Rise and Extreme Tide Matrix (regional matrix) as shown in Table 3-1. Values in the regional matrix provide estimates of the predicted increased height in bay water levels above mean higher high water (MHHW) for different combinations of coastal flood events (e.g., 1-yr, 5-yr, etc.) and future values of sea level rise. Similar values are highlighted with the same color to show that the same rise amount can occur for different events (e.g., 36-in of rise could occur today with a 50-year coastal flood event, or in the future with 18-in of sea level rise and a 2-year coastal flood event). The regional matrix uses existing MHHW, daily tides, and predicted sea level rise to extrapolate a single water level above MHHW for each extreme tide event (e.g., 1-yr, 5-yr, 25-yr, etc.). Sea level rise was not considered as part of the LGRP. However, this Project is designed to meet FEMA freeboard criteria for the 100 year flows with a coincident 10 year coastal flood event, with up to 2.6 ft of sea level rise.

Table 3-1: San Francisco Bay Area Regional Sea Level Rise and Extreme Tide Matrix[55]

Sea Level Rise Scenario	Daily Tide +SLR (in)	Extreme Tide (Storm Surge)						
		1-year	2-year	5-year	10-year	25-year	50-year	100-year
		Water Level above MHHW (in)						
Existing Conditions	0	14	18	23	27	32	37	42
MHHW + 6”	6	20	24	29	33	38	43	48
MHHW + 12”	12	26	30	35	39	44	49	54
MHHW + 18”	18	32	36	41	45	50	55	60
MHHW + 24”	24	38	42	47	51	56	61	66
MHHW + 30”	30	44	48	53	57	62	67	72
MHHW + 36”	36	50	54	59	63	68	73	78
MHHW + 42”	42	56	60	65	69	74	79	84
MHHW + 48”	48	62	66	71	75	80	85	90
MHHW + 52”	52	66	70	75	79	84	89	94
MHHW + 54”	54	68	72	77	81	86	91	96
MHHW + 60”	60	74	78	83	87	92	97	102
MHHW + 66”	66	80	84	89	93	98	103	108
MHHW + 72”	72	86	90	95	99	104	109	114
MHHW + 77”	78	92	96	101	105	110	115	120
MHHW + 84”	84	98	102	107	111	116	121	126
MHHW+90”	90	104	108	113	117	122	127	132
MHHW+ 96”	96	110	114	119	123	128	133	138
MHHW+ 102”	102	116	120	125	129	134	139	144
MHHW+ 108”	108	122	126	131	135	140	145	150

“ = in = inch(es)
MHHW = Mean Higher High Water
SLR = sea level rise

55 Kris May. Silvestrum Climate Associates. 2018 “Regional Bay Area Sea Level Rise Matrix”

SECTION 4. FORMULATION OF ALTERNATIVES

The alternatives development approach for the Project was as follows:

- Identify all conceptual project elements capable of meeting some aspect of the Project objectives, whether reach-oriented (e.g., channel improvements, levee adjustments) or regional (e.g., flood detention, reservoir operations).
- Identify conceptual alternatives made up of one or more of the project elements identified, providing possible solutions to the Project's objectives.
- Conduct conceptual alternatives public outreach to gather public input.
- Conduct preliminary screening of conceptual alternatives (Level 1 Screening), identifying which alternatives are feasible for further consideration.
- Develop the feasible alternatives in further detail, including maintenance considerations, detailed costs, and other data needed for analysis.
- Conduct feasible alternatives public outreach to gather public input.
- Rate the feasible alternatives against each other using Valley Water's Natural Flood Protection (NFP) evaluation methodology.
- Select a recommended alternative based on the outcome of the NFP objectives rating.

As the planning study progressed, updates to hydrology, hydraulic modeling, and construction costs were encountered. With these updates, some information gathered at the conceptual and feasible analysis levels became outdated. To ensure accuracy and avoid misleading stakeholders, this chapter provides a summary of key findings. For detailed information on the various phases of the planning study, please refer to the following reports found in the appendices:

- Appendix F: Problem Definitions and Refined Objectives Report (December 2019)
- Appendix G: Conceptual Alternatives Report (November 2020)
- Appendix H: Feasible Alternatives Report and Staff Recommended Alternative Report (December 2022)
- Appendix I: Staff Recommended Alternative Report—Technical Memorandum (September 2023)

4.1. CONCEPTUAL PROJECT ELEMENTS

The Project team identified a variety of approaches to meet the Project's flood LOS restoration requirements. These various solutions were called conceptual project elements (CPEs). Some of the CPEs are capable of being stand-alone solutions, while others are intended to be used like building blocks in combination with other elements to build a comprehensive solution. A total of 22 CPEs were identified (CPE 1 to CPE 22), and are listed below:

1. No Action

This project element kept the river channel in its current condition (max capacity of 10,200 cfs between Montague and Trimble) and continued the maintenance activities that have been conducted since the construction of the LGRP.

2. Modify Guadalupe, Almaden, and/or Calero Dams

This project element increased the capacity of Guadalupe, Almaden, and/or Calero reservoirs to store more of the peak flow and reduce flows that ultimately reach the Lower Guadalupe River. At the time the conceptual project elements were considered in 2019, the target peak flow was 10,200 cfs at Interstate 880, the estimated flow that the calibrated channel could carry with appropriate freeboard under future maintenance conditions and the 2009 USACE hydrology. Greater or less flow reduction was also investigated to optimize the targeted peak flow. Guadalupe, Almaden and Calero reservoirs are both currently under capacity restrictions due to seismic concerns.

3. Raise Lenihan Dam (Lexington Reservoir)

This CPE increased the capacity in Lexington Reservoir by raising the Lenihan Dam, thereby creating a volume reserved for flood protection to retain more of the peak flow and reduce flows that reach the Lower Guadalupe River. The initial target peak flow was 10,200 cfs at Interstate 880. Greater or less flow reduction was also investigated to optimize the targeted peak flow.

4. Re-operate Lexington Reservoir

This CPE re-operated Lenihan Dam at Lexington Reservoir to release more water prior to large storms, thus increasing the volume available to store the peak flow. As in CPE 3 above, the initial target peak flow was 10,200 cfs at Interstate 880. The current dam outlet structure has a 16-in pipe for regular flows, and two 36-in pipes for drawdown when needed. The maximum outlet capacity of all outlet pipes combined is 500 cfs. Greater or less flow reduction was also investigated to optimize upstream storage and minimize downstream peak flow.

5. Add Outlet Capacity to Lexington Reservoir

This CPE added outlet capacity to Lenihan Dam at Lexington Reservoir to reduce the time needed to draw down the reservoir prior to a large storm, increasing the volume available to store the peak flow. As with CPEs 3 and 4, the initial target peak flow was 10,200 cfs at Interstate 880. Greater or less flow reduction was also investigated to optimize upstream storage and minimize downstream peak flow.

6. Modify Vasona Reservoir

This CPE used Vasona Reservoir as a detention basin to capture some of the peak flow from Lexington Reservoir. The initial target peak flow was 10,200 cfs at Interstate 880. Vasona Reservoir's maximum capacity is 495 acre-feet (ac-ft).

7. Fluvial Geomorphological Alignment

This project element created a stable, multi-staged river channel based on the historical floodplain and meander belt. This element was also considered by the LGRP and was determined to be around 1,600-ft wide, based on historical data of the Lower Guadalupe River.

8. Channel Widening

This project element widened the river channel by 150-ft from Tasman Drive to US 101, approximately three miles in length. This scenario assumed widening would occur only on the east bank levee to avoid altering the remainder of the river channel.

9. Off-stream Storage at Coleman Loop

This project element diverted peak storm flows into a temporary storage basin, thereby reducing the peak flow in the channel. Project staff identified underutilized land in the Guadalupe Gardens portion of the Coleman Loop area, just south of the San Jose Airport in San Jose. Up to 86 acres could be available for this use. This land is not owned by Valley Water and would require coordination with the City of San Jose and the San Jose Mineta International Airport.

10. Off-stream Storage at Los Gatos Creek Recharge Ponds

This project element used the Los Gatos Creek Recharge Ponds, owned and operated by Valley Water, as a detention basin to store peak flows. The ponds are located downstream of Vasona Reservoir and contain about 30 acres of available area. The target peak flow was 10,200 cfs at Interstate 880.

11. Levee/Channel Paving

This project element paved the entire channel with concrete to decrease the channel's roughness value and increase flow velocity and capacity.

12. Raise Levees

This project element raised the existing levees. Raising the levees contained all flow for 1% storm and maintained the original freeboard. Raising the levees increased the total levee footprint, which was assumed to be added to the outboard side to avoid reducing channel capacity. This would encroach upon nearby properties in many areas unless retaining walls were constructed to contain the additional levee slope.

13. Floodwalls

This project element installed floodwalls to provide additional capacity and freeboard. The project team assumed concrete floodwalls and a spread footing for the initial concept. Several variations of floodwalls were considered, including constructing walls on the outboard side of the existing levees and walls that replace the levees entirely.

14. Passive Barriers

This project element installed passive barriers, buoyant panels that use hydrostatic forces to raise themselves without active intervention. The barriers lie flat, recessed in the ground during normal creek flows, and only deploy when water levels are high enough to pour into a storage container and activate the barriers into a vertical position. Traditional floodwalls can block views and hinder access. These barriers provide an attractive, unobtrusive alternative to structural floodwalls when water levels are low.

15. Setback Levee at Ulistac

This project element used the Ulistac Natural Area to create a setback levee. The existing levee bordering Ulistac would be set back to Lick Mill Boulevard to include the natural area in the floodplain for additional conveyance.

16. Lengthen Bridges

This project element lengthened existing bridges that cross the Guadalupe River, widening the river channel and increasing the cross-sectional area available for flows to pass through. The bridges at Montague Expressway, Trimble Road, and US 101 are bottlenecks that restrict flow and are therefore particularly suited to this project element.

17. Bridge Headwalls

This project element installed or raised headwalls on existing bridges where needed to contain the 1% flood flows with adequate freeboard. Adding headwalls increases the pressurized flow under the bridges and results in an uplift force. Affected bridges would need to be analyzed to determine if the existing structure is able to resist the increased uplift force. Additional bridge restraints may be required if the existing structure does not have adequate capacity to resist the uplift forces. This CPE would require coordination with the agencies that own the bridges, including the City of San Jose, Santa Clara County, and Caltrans.

18. Raise Bridges

This project element raised bridges crossing Guadalupe River to allow the 1% flow to pass underneath the bridge decks unimpeded. Deck soffits would be raised to allow one foot of freeboard between the water surface and the bridge soffit. This CPE would require coordination with the agencies that own the bridges, including the City of San Jose, Santa Clara County, and Caltrans.

19. Sediment Removal

This project element removed sediment from the channel in designated areas to restore capacity to the channel. The LGRP maintenance guidelines specify Sediment Depositional Reaches (SDRs) that should be cleared when sediment reaches a certain threshold.

20. Vegetation Removal

This project element removed vegetation to achieve various channel roughness values, as specified by the project design. One such scenario would remove vegetation to the LGRP design condition. This would involve removing many large trees, have extensive environmental impacts, and likely require significant mitigation.

21. Channel Bypass

This project element added a box culvert inside or under one or both existing levees to redirect some of the design flow from the channel through the bypass. To reduce the peak flow to 10,200 cfs in the channel at Interstate 880, the bypass would need to be able to carry up to 8,100 cfs.

22. Close Road Crossings with Passive Barriers

This project element temporarily closed through-traffic over bridges to allow floodwaters to pass over the bridge decks and return to the channel on the other side. This could be achieved by installing passive barriers in the roadway that would tie-in to structural flood barriers along the rest of the river channel. The passive barriers would only deploy when activated by the hydrostatic forces of the floodwaters and would contain the water in the river channel as water flowed over the bridge deck. This would eliminate the need to raise bridges or headwalls to protect the roadway from floods. Roads would be closed for a few hours as the peak flow passes over the bridge, plus any additional time needed to clear debris before opening the bridge to traffic.

All CPEs were individually evaluated. The following CPEs were rejected from further analysis and not included in the creation of conceptual alternatives:

- CPE 2: Modify Guadalupe, Almaden, and/or Calero Dams
- CPE 6: Modify Vasona Reservoir
- CPE 7: Fluvial Geomorphological Alignment
- CPE 15: Setback Levee at Ulistac
- CPE 16: Lengthen Bridges
- CPE 19: Sediment Removal

For detailed evaluation of each CPE refer to Appendix G Conceptual Alternatives Analysis.

4.2. CONCEPTUAL ALTERNATIVES

Conceptual alternatives were developed by combining the CPEs in various combinations to maximize their effectiveness at meeting the Project objectives. Cost estimates were tabulated for all alternatives using rough, order-of-magnitude costs, and the quantities and costs are reflective of the point in time in which they were evaluated (2019). The following table summarizes key descriptions of each conceptual alternative. The information contained in Table 4-1 reflects project conditions at the time the conceptual analysis was completed. Refer to Appendix G Conceptual Analysis Report for detailed information on each conceptual alternative.

Table 4-1: Conceptual Alternative Summary Table

	Alternative	CPEs	Outside Project Area	A *Interstate 880 to US 101*	B *US 101 to Trimble Road*	C *Trimble Road to Montague Expressway*	D *Montague Expressway to Hetch Hetchy Pipeline*	E *Hetch Hetchy Pipeline to Tasman Drive*	F *Tasman Drive to State Route 237*	G *State Route 237 to UPRR Bridge*	Estimated Capital Cost	Estimated Maintenance Cost (annual)
Conceptual Alternative	A - No Project	• CPE 1 - No Action	NA	No Action	No Action	No Action	No Action	No Action	No Action	No Action	$0	$180,000
	B - Floodwall and Headwalls	• CPE 13 - Floodwalls • CPE 17 - Bridge Headwalls	NA	• Add headwalls at Airport Pkwy bridge • 3,300-ft of floodwalls on east bank • 4,000-ft of floodwalls on west bank • Raise headwalls at US 101 bridge	• Raise headwalls at Trimble Rd bridge • 5,200-ft of floodwalls	• Rebuild headwalls at Montague Expwy bridge • 12,000-ft of floodwalls	11,000-ft of floodwalls	6,000-ft of floodwalls	8,000-ft of floodwalls	5,300-ft of floodwalls	**$47,000,000**	$450,000
	B.1 - Floodwalls, Passive Barriers, and Headwalls	• CPE 13 - Floodwalls • CPE 14 - Passive Barriers • CPE 17 - Bridge Headwalls	NA	Same as B	Same as B	• Same as B • 12,200-ft of passive barriers	• 9,000-ft of floodwalls • 2,000-ft of passive barriers	Same as B	Same as B	Same as B	**$180,000,000**	$450,000
	B.2 - Floodwalls, Passive Barriers, Closed Roadways	• CPE 13 - Floodwalls • CPE 17 - Bridge Headwalls • CPE 22 - Closed Road Crossing with Passive Barriers	NA	• Same as B • Add Passive Barriers to close Airport Pkwy Bridge • 3,900-ft of floodwalls on west bank • 3,100-ft of floodwalls on east bank	• Same as B • Add Passive Barriers to close Trimble Rd Bridge	• Same as B • Add Passive Barriers to close Montague Expwy Bridge	Same as B	Same as B	Same as B	Same as B	**$60,000,000**	$450,000

Alternative	CPEs	Outside Project Area	A *Interstate 880 to US 101*	B *US 101 to Trimble Road*	C *Trimble Road to Montague Expressway*	D *Montague Expressway to Hetch Hetchy Pipeline*	E *Hetch Hetchy Pipeline to Tasman Drive*	F *Tasman Drive to State Route 237*	G *State Route 237 to UPRR Bridge*	Estimated Capital Cost	Estimated Maintenance Cost (annual)
C - Levees with Retaining Walls, and Headwalls	• CPE 12 - Raise Levees • CPE 17 - Bridge Headwalls	NA	• Add headwalls at Airport Pkwy bridge • 3,300-ft of levee on east bank • 4,000-ft of levee on west bank • Raise headwalls at US 101 bridge	• Raise headwalls at Trimble Rd bridge • Raise 5,200-ft of levee	• Rebuild headwalls at Montague Expwy bridge • Raise 12,000-ft of levee	Raise 11,000-ft of levee	Raise 6,000-ft of levee	Raise 8,000-ft of levee	Raise 5,300-ft of levee	**$80,000,000**	$450,000
C.1 - Levees, Floodwalls, and Headwalls	• CPE 12 - Raise Levees • CPE 13 - Floodwalls • CPE 17 - Bridge Headwalls	NA	• Same as B • Raise 1,400-ft of levee	• Same as B • Raise 5,000-ft of levee	• Rebuild headwalls at Montague Expwy bridge • 12,000-ft of floodwalls • Raise 12,000-ft of levee	Same as B & C	• Same as B • Raise 4,000-ft of levee	• Same as B • Raise 100-ft of levee	• Same as B • Raise 600-ft of levee	**$70,000,000**	$450,000
D - Guadalupe Gardens Detention Areas 1 and 3 at 5' Depth, Headwalls, Floodwalls	• CPE 9 - Off-stream Storage at Guadalupe Gardens • CPE 13 - Floodwalls • CPE 17 - Bridge Headwalls	5-ft deep, 85-ac detention basin upstream of I-880 at Guadalupe Gardens	Same as B	Same as B	Same as B	Same as B	Same as B	7,000-ft of floodwalls	4,000-ft of floodwalls	**$160,000,000**	$500,000
D.1 - Guadalupe Gardens Detention Areas 1 and 3 at 25' Depth, Headwalls, Floodwalls	• CPE 9 - Off-stream Storage at Guadalupe Gardens • CPE 13 - Floodwalls • CPE 17 - Bridge Headwalls	25-ft deep, 85-ac detention basin upstream of I-880 at Guadalupe Gardens	Same as B	Same as B	Same as B	Same as B	4,600-ft of floodwalls	500-ft of floodwalls	700-ft of floodwalls	**$200,000,000**	$500,000

Alternative	CPEs	Outside Project Area	A *Interstate 880 to US 101*	B *US 101 to Trimble Road*	C *Trimble Road to Montague Expressway*	D *Montague Expressway to Hetch Hetchy Pipeline*	E *Hetch Hetchy Pipeline to Tasman Drive*	F *Tasman Drive to State Route 237*	G *State Route 237 to UPRR Bridge*	Estimated Capital Cost	Estimated Maintenance Cost (annual)
D.2 - Guadalupe Gardens Detention Area 1 at 5' Depth, Headwalls, Floodwalls	• CPE 9 - Off-stream Storage at Guadalupe Gardens • CPE 13 - Floodwalls • CPE 17 - Bridge Headwalls	NA	• Add headwalls at Airport Pkwy bridge • 2,700-ft of floodwalls on east bank • 3,300 ft of floodwalls on west bank • Raise headwalls at US 101 bridge	Same as B	Same as B	Same as B	Same as B	Same as D	1,800-ft of floodwalls	**$85,000,000**	$500,000
E - Raise Bridges and Floodwalls	• CPE 13 - Floodwalls • CPE 18 - Raise Bridges	NA	• Add headwalls at Airport Pkwy bridge • 3,300-ft of floodwalls on east bank • 4,000-ft of floodwalls on west bank • Raise US 101 bridge	• 5,200-ft of floodwalls • Raise Trimble Rd bridge	• 12,000-ft of floodwalls • Raise Montague Expwy bridge	Same as B	Same as B	Same as B	Same as B	**$190,000,000**	$450,000
F - Channel Bypass	• CPE 13 - Floodwalls • CPE 21 - Channel Bypass	NA	• 300-ft of floodwalls on west bank • Construct 5-mi of culvert from Airport Pkwy to Gold St	Construct 5-mi of culvert from Airport Pkwy to Gold St	Construct 5-mi of culvert from Airport Pkwy to Gold St	Construct 3.8-mi of culvert from Airport Pkwy to Tasman Dr inside the existing west levee	Construct 5-mi of culvert from Airport Pkwy to Gold St	• 200-ft of floodwalls • Construct 5-mi of culvert from Airport Pkwy to Gold St	• 1,500-ft of floodwalls • Construct 5-mi of culvert from Airport Pkwy to Gold St	**$300,000,000**	$450,000
G - Replace West Levee with Floodwall and Headwalls	• CPE 13 - Floodwalls • CPE 17 - Bridge Headwalls	NA	• Add headwalls at Airport Pkwy bridge • 1,900-ft of floodwalls on east bank • 3,600-ft of floodwalls on west bank • Raise headwalls at US 101 bridge	• Raise headwalls at Trimble Rd bridge • 1,200-ft of floodwalls on east levee • Replace west levee with a floodwall and paved corridor for 3.1-mi from US 101 to Trimble Rd	• Rebuild headwalls at Montague Expwy bridge • 6,000-ft of floodwalls on east levee • Replace west levee with a floodwall and paved corridor for 3.1-mi from Trimble Rd to Montague Expwy	• 5,600-ft of floodwalls on east levee • Replace west levee with a floodwall and paved corridor for 3.1-mi from Montague Expwy to Hetch Hetchy Pipeline	• 2,800-ft of floodwalls on east levee • Replace west levee with a floodwall and paved corridor for 3.1-mi from Hetch Hetchy Pipeline to Tasman Dr	Same as B	Same as B	**$190,000,000**	$400,000

Alternative	CPEs	Outside Project Area	A *Interstate 880 to US 101*	B *US 101 to Trimble Road*	C *Trimble Road to Montague Expressway*	D *Montague Expressway to Hetch Hetchy Pipeline*	E *Hetch Hetchy Pipeline to Tasman Drive*	F *Tasman Drive to State Route 237*	G *State Route 237 to UPRR Bridge*	Estimated Capital Cost	Estimated Maintenance Cost (annual)
H - Add Outlet Capacity to Lexington in New Tunnel	• CPE 5 - Add Outlet Capacity to Lenihan Dam • CPE 13 - Floodwalls • CPE 17 - Bridge Headwalls	New 60-in outlet pipe in new tunnel at Lenihan Dam	200-ft of floodwalls on west bank	Same as B	Same as B	10,000-ft of floodwalls	1,700-ft of floodwalls	100-ft of floodwalls	Same as D.1	**$110,000,000**	$450,000
H.1 - Add Outlet Capacity to Lexington in Existing Tunnel	• CPE 5 - Add Outlet Capacity to Lenihan Dam • CPE 13 - Floodwalls • CPE 17 - Bridge Headwalls	Replace 54-in outlet pipe with 72-in outlet pipe in existing tunnel at Lenihan Dam	Same as H	Same as B	Same as B	Same as H		Same as H	Same as D.1	**$32,000,000**	$450,000
I - Raise Lenihan Dam	• CPE 3 - Raise Lenihan Dam • CPE 13 - Floodwalls • CPE 17 - Bridge Headwalls	Add 11-ft of height to top of Lenihan Dam	Same as H	Same as B	Same as B	Same as H	Same as H	Same as H	Same as D.1	**$110,000,000**	$450,000
J - Re-Operate Lenihan Dam	• CPE 4 - Re-Operate Lexington Reservoir • CPE 13 - Floodwalls • CPE 17 - Bridge Headwalls	NA	Same as H	Same as B	Same as B	Same as H	Same as H	Same as H	Same as D.1	**$11,000,000**	$450,000 Other Cost: $2,000,000

	Alternative	CPEs	Outside Project Area	A *Interstate 880 to US 101*	B *US 101 to Trimble Road*	C *Trimble Road to Montague Expressway*	D *Montague Expressway to Hetch Hetchy Pipeline*	E *Hetch Hetchy Pipeline to Tasman Drive*	F *Tasman Drive to State Route 237*	G *State Route 237 to UPRR Bridge*	Estimated Capital Cost	Estimated Maintenance Cost (annual)
	K - Widen Channel	• CPE 8 - Channel Widening • CPE 13 - Floodwalls • CPE 17 - Bridge Headwalls	NA	Same as B	Same as B	Same as B	Same as B	5,300-ft of floodwalls	7,300-ft of floodwalls	3,800-ft of floodwalls	**$640,000,000**	$670,000
	L - Vegetation Removal	CPE 20 - Vegetation Removal	NA	Remove vegetation to return the channel to its design condition	Remove vegetation to return the channel to its design condition	Remove vegetation to return the channel to its design condition	Remove vegetation to return the channel to its design condition	Remove vegetation to return the channel to its design condition	Remove vegetation to return the channel to its design condition	Remove vegetation to return the channel to its design condition	**$840,000,000**	$800,000
	M - Levee Paving	• CPE 11 - Levee Paving • CPE 20 - Vegetation Removal	NA	Pave channels and levee from I-880 to Gold St	Pave channels and levee from I-880 to Gold St	Pave channels and levee from I-880 to Gold St	Pave channels and levee from I-880 to Gold St	Pave channels and levee from I-880 to Gold St	Pave channels and levee from I-880 to Gold St	Pave channels and levee from I-880 to Gold St	**$170,000,000**	$240,000

4.3. CONCEPTUAL ALTERNATIVES SCREENING METHODOLOGY (LEVEL 1)

Screening during the conceptual alternatives phase of the Project is defined as Level 1 screening, which focuses on the Project objectives, costs, technical feasibility, and right-of-way availability. The Level 1 screening criteria are described below.

Project Objectives: Conceptual alternatives must satisfy the Project objectives to be carried forward to the feasible analysis stage. Thus, each alternative was analyzed as to whether it met the Project's objectives.

Project Cost: The Project's budget for detailed design and construction is approximately $80 million. Alternatives that meet the Project objectives and cost under $88 million ($80 million with 10% upper tolerance) were considered for feasibility. Conceptual costs were evaluated in 2020.

Technical Feasibility: All Project elements must be able to be built using widely available construction materials and knowledge. Alternatives that are deemed technically feasible can be allowed to continue to the feasible alternatives phase.

Right-of-Way Availability: All right-of-way not owned by Valley Water and required by the alternative must be available for the intended Valley Water use. Conceptual alternatives that would likely have available right-of-way can be carried forward into the feasible analysis stage.

4.3.1. Level 1 Screening

The screening criteria were applied to the conceptual alternatives to determine which alternatives would progress to the feasible alternatives analysis. The screening results are summarized in Table 4-2 below:

Table 4-2: Level 1 Screening Matrix

Conceptual Alternative	Meets Project Objectives	Within Project Budget	Technically Feasible	Right-of-Way Availability	Overall
A - No Project	✗	✓	✓	✓	✗
B - Floodwalls and Headwalls	✓	✓	✓	✓	✓
B.1 - Floodwalls, Passive Barriers, and Headwalls	✓	✗	✓	✓	✗
B.2 - Floodwalls, Passive Barriers, Closed Roadways	✓	✓	✓	✓	✓
C - Levees with Retaining Walls, and Headwalls	✓	✓	✓	✓	✓
C.1 - Levees, Floodwalls, and Headwalls	✓	✓	✓	✓	✓
D - 5 Foot Detention, Floodwalls, and Headwalls	✓	✗	✓	✓	✗
D.1 - 25 Foot Detention, Floodwalls, and Headwalls	✓	✗	✓	✓	✗
D.2 - 5 Foot Detention, Less ROW Acquisition	✓	✓	✓	✓	✓
E - Raise Bridges, Floodwalls, and Headwalls	✓	✗	✓	✓	✗
F - Channel Bypass	✓	✗	✓	✓	✗
G - Replace West Levee with Floodwall	✓	✗	✓	✓	✗
H - Add Outlet Capacity to Lexington in New Tunnel	✓	✗	✓	✓	✗
H.1 - Add Outlet Capacity to Lexington in Existing Tunnel	✓	✓	✓	✓	✓
I - Raise Lenihan Dam	✓	✗	✓	✓	✗
J - Re-Operate Lenihan Dam	✓	✓	✓	✓	✓
K. Channel Widening	✓	✗	✓	✗	✗
L. Vegetation Removal	✓	✗	✓	✗	✗
M - Levee Paving	✓	✗	✓	✓	✗

4.3.2. Selection of Feasible Alternatives

With the exception of Alternative A (No Project), the following alternatives met the Level 1 screening criteria; all of the following were evaluated in the feasible alternatives analysis:

Alternative A – No Project

Alternative B – Floodwalls and Headwalls

Alternative B.2 – Floodwalls, Passive Barriers, Closed Roadways

Alternative C – Levees with Retaining Walls and Headwalls

Alternative C.1 – Levees, Floodwalls and Headwalls

Alternative D.2 – Off-Stream Detention with Minimal ROW Acquisition

Alternative H.1 – Add Outlet Capacity to Lenihan Dam in Existing Tunnel

Alternative J – Re-Operate Lenihan Dam

4.4. FEASIBLE ALTERNATIVES

The alternatives that passed the Level 1 screening were further developed and refined as part of the feasible alternatives process. Additional modeling was done to a higher level of detail, cost estimates were re-calculated, and preliminary plans and profiles were drawn. The following sections briefly describe the feasible alternatives. Feasible alternative quantities and costs are reflective of the point in time in which they were evaluated (2020-2021). For detailed information on feasible alternatives, please refer to Appendix H Feasible Alternatives Report.

4.4.1. Alternative A – No Project

Although this alternative does not meet the Project's objectives and does not pass the Level 1 screening, it was still included during the feasible analysis. Considering a No Project alternative is an important part of determining the Least Environmentally Damaging Practicable Alternative (LEDPA), which is crucial for obtaining permits for construction of any project. This alternative would leave the river channel in its current condition and make no changes to the maintenance activities specified in the original LGRP. This level of activity has already proven to be ineffective and unsustainable but is still the official maintenance level specified in the LGRP. The project elements for this alternative are briefly summarized in Table 4-3.

Table 4-3: Alternative A – No Project Summary

Elements	• This alternative leaves the river channel in its current condition and makes no changes to maintenance activities
Technical Feasibility	• This alternative is technically feasible.
Costs	• Capital costs: $0 • Maintenance costs: $180,000 per year (based off average amount spent over the years since project completion)
Strengths	• No capital cost • The existing public trails are preserved
Weaknesses	• Does not meet project objectives • River is still at risk of levee overtopping, levee/floodwall breaching, and flooding • Intensive vegetation management is required to maintain project to intended condition, mitigation costs would be very high • Ongoing environmental impacts from vegetation removal

4.4.2. Alternative B – Floodwalls and Headwalls

This alternative installed new floodwalls or raises existing floodwalls on the outboard side of the existing levees, using the LGRP design flows. Floodwalls were assumed to be concrete with spread footings. Concrete headwalls and wingwalls would be constructed on bridges. Connections between outboard floodwalls and inboard wingwalls could be closed with passive barriers, or with graded earthen ramps. The project elements for this alternative are briefly summarized in Table 4-4.

Table 4-4: Alternative B - Floodwalls and Headwalls Summary

Elements	• Construct floodwalls on outboard side of existing levees • Construct/re-construct headwalls and wingwalls at bridges • Install bridge modifications as needed to support additional headwall height
Technical Feasibility	• All project elements are technically feasible.
Costs[a]	• Capital costs: $85,900,000 • Maintenance costs: $450,000 per year
Strengths	• The existing public trails are preserved • Floodwalls are typically considered less maintenance than levees of similar height • Comparatively lower capital cost, and close to provided budget of $80 million
Weaknesses	• Floodwalls present a visual barrier, create safety issues on trails, attract graffiti, and affect maintenance access/space for vehicles. They are not favored by the public, based on feedback from public meetings • Floodwalls risk greater catastrophic flooding if a higher-than-design event overtops them • High headwalls limit sight distance of drivers and visually disconnect residents from natural area. They are not favored by the public, based on feedback from public meetings • Coordination and permitting would be needed with Caltrans, City of San José, Santa Clara County to construct headwalls. In feasibility meetings with bridge owners, high headwalls were not viewed favorably • Montague Expressway would require extensive modifications • US 101 bridge modifications may trigger Caltrans to request additional retrofits

Notes: a. Costs are in 2020-2022 dollars. See Appendix H Feasible Alternatives Report for detailed cost breakdown.

4.4.3. Alternative B.2 – Floodwalls, Passive Barriers, Closed Roadways

This alternative installed new floodwalls or raised existing floodwalls on the outboard side of the existing levees, using the LGRP design flows. Concrete headwalls and wingwalls were raised or replaced on Airport Parkway and US 101 bridges. Connections between outboard floodwalls and inboard wingwalls were closed with passive barriers, or with graded earthen ramps. Instead of building headwalls at Trimble Road and Montague Expressway, the roadways had passive barriers installed that would deploy during a flood to allow flows to pass over the bridge deck. The project elements for this alternative are briefly summarized in Table 4-5.

Table 4-5: Alternative B.2 - Floodwalls, Passive Barriers, Closed Roadways Summary

Elements	• Construct floodwalls on outboard side of existing levees • Construct/re-construct headwalls and wingwalls at bridges • Install bridge modifications as needed to support additional headwall height • Install passive barriers in roadways at Trimble Road and Montague Expwy. bridges
Technical Feasibility	• All project elements are technically feasible.
Costs[a]	• Capital costs: $96,400,000 • Maintenance costs: $450,000 per year
Strengths	• The existing public trails are preserved • No headwalls needed on Trimble Road and Montague Expressway bridges, which create a visual barrier, prohibit safety officers from viewing the creek and trails from the public roadway, attract graffiti, and create disconnection from the public and the natural waterway
Weaknesses	• Floodwalls present a visual barrier create safety issues on trails, attract graffiti, and affect maintenance access/space for vehicles. They are not favored by the public, based on past feedback from public meetings • Floodwalls risk greater catastrophic flooding if a higher-than-design event overtops them • Capital cost is above the $80 million budget limit. • Coordination and permitting would be needed with Caltrans, City of San José, Santa Clara County to construct headwalls and passive barriers • US 101 bridge modifications may trigger Caltrans to request additional retrofits. High headwalls limit sight distance of drivers and visually disconnect residents from natural area • Passive barriers require different maintenance than floodwalls and introduce an element of potential mechanical failure as a risk factor • Traffic impacts when passive barriers are deployed. Two major roadways would be temporarily closed until the water level recedes.

Notes: a. Costs are in 2020-2022 dollars. See Appendix H Feasible Alternatives Report for detailed cost breakdown.

4.4.4. Alternative C – Levees with Retaining Walls and Headwalls

This alternative raised the existing levees to provide additional capacity in the river channel, using the LGRP design flows. The levees were raised on the outboard side of the existing levee slope to maximize capacity and minimize impact in the river channel. Retaining walls were constructed as needed on the outboard side of the levees to prevent encroachment onto other properties. The top of levee was assumed to be a constant 18-ft wide with side slopes of 2:1 (horizontal: vertical). Concrete headwalls needed to be raised or replaced at four bridges. The project elements for this alternative are briefly summarized in Table 4-6.

Table 4-6: Alternative C - Levees with Retaining Walls and Headwalls Summary

Elements	• Raise existing levees • Construct retaining walls at levees as needed • Construct/re-construct headwalls at four bridges • Install bridge modifications as needed to support additional headwall height • Raise and extend existing pedestrian bridge downstream of Montague Expwy.
Technical Feasibility	• All project elements are technically feasible.
Costs[a]	• Capital costs: $153,100,000 • Maintenance costs: $450,000 per year
Strengths	• The existing public trails are preserved • Levees minimize visual barriers and do not inhibit wildlife access to and from the river corridor the way that floodwalls would • Minimal additional maintenance is required, since maintenance crews are familiar with maintaining the existing levee system • Retaining walls may reduce pioneer trails from neighborhoods, which damage the outboard levee slopes
Weaknesses	• Capital cost is above the $80 million budget limit. This alternative would need approval to spend more than originally budgeted • Levees risk greater catastrophic flooding if a higher-than-design event overtops them • Retaining walls and grading may create access issues for maintenance crews and the public. • Retaining walls create a fall risk, so fences would be needed. They also have the potential to disrupt wildlife movement to and from the river corridor. • Retaining walls and floodwalls provide more area for graffiti • Coordination and permitting with Caltrans, City of San José, Santa Clara County to construct headwalls. In feasibility meetings with bridge owners, high headwalls were not viewed favorably. • Montague Expressway requires extensive modifications • US 101 bridge modifications may trigger Caltrans to request additional retrofits • Trees, some of which have been planted by adjacent landowners, may interfere with retaining walls and need to be removed

Notes: a. Costs are in 2020-2022 dollars. See Appendix H Feasible Alternatives Report for detailed cost breakdown.

4.4.5. Alternative C.1 – Levees, Floodwalls and Headwalls

This alternative constructed concrete floodwalls on the outboard side of the existing levees, using the design LGRP flows. Floodwall height were limited to 3-ft and levees were raised for the additional height needed. The levees were raised on the outboard side of the existing levee slope to maximize capacity and minimize impact in the river channel. Retaining walls were constructed on the outboard side of the levees to prevent encroachment on other properties. Concrete headwalls were raised or replaced at four bridges. The project elements for this alternative are briefly summarized in Table 4-7.

Table 4-7: Alternative C.1 - Levees, Floodwalls and headwalls Summary

Elements	• Construct floodwalls to a maximum height of 3-ft along existing levees • Raise existing levees if height is needed beyond the 3-ft floodwall • Construct/re-construct headwalls at four bridges • Install bridge modifications as needed to support additional headwall height
Technical Feasibility	• All project elements are technically feasible.
Costs[a]	• Capital costs: $116,100,000 • Maintenance costs: $450,000 per year
Strengths	• The existing public trails are preserved • Lower floodwalls minimize visual impacts • Levees minimize visual barriers and do not inhibit wildlife access to and from the river corridor the way that floodwalls would • Retaining walls may reduce pioneer trails from neighborhoods, which damage the outboard levee slopes • Minimal additional maintenance is required
Weaknesses	• Capital cost is above the $80 million budget limit • Levees risk greater catastrophic flooding if a higher than design event overtops them • Retaining walls and grading may create access issues for maintenance crews and the public. • Retaining walls create a fall risk, so fences would be needed. They also have the potential to disrupt wildlife movement to and from the river corridor. • Coordination and permitting would be needed with Caltrans, City of San José, Santa Clara County to construct headwalls. In feasibility meetings with bridge owners, high headwalls were not viewed favorably. • Montague Expressway requires extensive modifications • US 101 bridge modifications may trigger Caltrans to request additional retrofits • Vegetation maintenance and trash removal access is limited between the floodwall and retaining wall • Retaining walls and floodwalls provide more area for graffiti • Trees, some of which have been planted by adjacent landowners, may interfere with retaining walls and need to be removed

Notes: a. Costs are in 2020-2022 dollars. See Appendix H Feasible Alternatives Report for detailed cost breakdown.

4.4.6. Alternative D.2 – Off-Stream Detention with Minimal Right-of-Way (ROW) Acquisition

This alternative used off-stream detention upstream of the Project limits to store floodwaters and reduce the peak flows, minimizing improvements needed downstream. It also installed or raised existing floodwalls and raised or replaced concrete headwalls at four bridges. The project elements for this alternative are briefly summarized in Table 4-8.

Table 4-8: Alternative D.2 - Off-Stream Detention with Minimal ROW Acquisition Summary

Elements	• Construct off-stream detention basin to store floodwaters • Construct floodwalls on outboard side of existing levees • Raise or replace headwalls at four bridges • Install bridge modifications as needed to support additional headwall height
Technical Feasibility	• This alternative is **not** technically feasible. • The detention basin at Guadalupe Gardens element is not feasible due to inadequate ground slope for drainage. Additionally, high groundwater levels pose further challenges. • Unless the slope requirement can be adjusted, this alternative is not viable.
Costs[a]	• Capital costs: $108,300,000 • Maintenance costs: $500,000 per year
Strengths	• The existing public trails are preserved • Headwall heights are reduced compared to Alternatives B and C • Opportunity to revitalize the Guadalupe Gardens Park and make it multi-beneficial to the public
Weaknesses	• Capital cost is above the $80 million budget limit • Grading of the basin and slope requirements for drainage makes this alternative infeasible

Notes: a. Costs are in 2020-2022 dollars. See Appendix H Feasible Alternatives Report for detailed cost breakdown.

4.4.7. Alternative H.1a – Add Outlet Capacity to Lexington Reservoir in Existing Tunnel and Floodwalls (No Upper Guadalupe Improvements)

This alternative replaced the existing outlet transmission pipe at Lenihan Dam with a larger outlet to allow Lexington Reservoir to partially empty before a storm event. This alternative assumed that Upper Guadalupe River remains in current restricted capacity and no flood improvements on the Upper Guadalupe River would be made in the future. Adding outlet capacity to Lenihan Dam increased the dam's ability to release water and provided additional storage to reduce the peak flow of a large storm.

The existing outlet conveyance system consists of a 54-in transmission pipe which carries water from the reservoir to three smaller outlet pipes (one 16-in outlet pipe and two 36-in outlet pipes). The 54-in transmission pipe system, which has a maximum capacity of 450 cfs, wase replaced with a 72-in pipe with a capacity of 800 cfs. A secondary 60-in intake was constructed adjacent to the existing 54-in sloping intake to carry the additional flow. The existing 54-in transmission pipe system can drain 4,000 ac-ft plus 200 cfs baseflow in 194 hours (about 8 days). The proposed 72-in pipe system could drain the same amount in 81 hours (about 3 and a half days).

To analyze the hydrologic impact of increasing storage capacity in Lexington Reservoir, the 2009 USACE HEC-HMS hydrology model was used. The Guadalupe watershed has two 100-year design storms: a 72-hour event centered over Lexington Reservoir or a 72-hour event centered over Guadalupe, Almaden, and Calero reservoirs. Several combinations of centering of storms and reservoir storage capacities were run through the model to determine which scenarios would be effective at reducing the peak flow downstream. Ultimately, a 100-year design storm centered over Lexington Reservoir with the reservoir volume starting at 12,000 ac-ft gave the maximum amount of flow reduction to the Lower Guadalupe River[56]. The design flows for this alternative are listed below Table 4-9.

Table 4-9: Design Flow of Hydromodification Alternative - No Change to Upper Guadalupe River

Location Along Guadalupe River	No Change to Upper Guadalupe Flows
D/S of Los Gatos Creek confluence	11,460cfs
Interstate 880	12,460cfs
US 101	12,772cfs
Trimble Road	12,938cfs
Montague Expressway	13,324cfs
Tasman Drive	13,564cfs
State Route 237	13,785cfs

There are two ways Lexington Reservoir could be operated to achieve this additional storage in the reservoir. The first is operating on a rule curve, which is how Valley Water currently operates all its reservoirs. Since 2019, Lexington Reservoir has been operated using a 13,500 ac-ft temporary rule curve as a precautionary measure while the Lower Guadalupe River is under capacity. To achieve the reduced 1% flood LGRP flow, the rule curve needs to be set at 12,000 ac-ft.

The second way to achieve additional storage in the reservoir is by using FIRO. This method uses the weather forecast to make informed decisions about releasing or storing water in the reservoir. This method is being studied in other California reservoirs with promising results that limit lost opportunities to store more water when compared to a traditional rule curve operating model. For Lexington Reservoir, the needed storage would still be 12,000 ac-ft, but the operating range would be between the 12,000 ac-ft rule curve and 10% above the 12,000 ac-ft rule curve.

Whether Lexington Reservoir can be operated for using FIRO is being studied further by Valley Water. A preliminary viability assessment was completed in 2022[57], and a watershed-wide sensitivity analysis is expected in 2024.

Because the reduced 1% LGRP flood flow is still higher than the channel's capacity, floodwalls would also be needed. Floodwalls are assumed to be concrete with spread footings, placed on the outboard side of the top of the levee. Headwalls must be constructed or re-constructed at two bridges. The project elements for this alternative are briefly summarized in Table 4-10.

[56] 2021. Design Flows for Alternatives. Jack Xu. Technical Memorandum.
[57] Jack Xu, Darshan Baral. 2022. "Non-Structural Alternatives to Flow Reduction". Technical Memorandum.

Table 4-10: Alternative H.1a - Add Outlet Capacity to Lexington Reservoir in Existing Tunnel and Floodwalls (No Upper Guadalupe Improvements) Summary

Elements	• Replace existing 54-in outlet transmission pipe (maximum 450 cfs capacity) with 72-in outlet transmission pipe (maximum capacity 800 cfs) • Construct secondary 60-in intake shaft • Update reservoir operation procedure to achieve additional storage • Construct floodwalls along existing levees • Construct/re-construct headwalls at two bridges • Install bridge modifications as needed to support additional headwall height
Technical Feasibility	• All structural project elements are technically feasible. • Presence of active landslides in the area may make reoperation of Lexington Reservoir infeasible. • Impacts of FIRO are currently being studied by Valley Water, and the feasibility of reoperating Lexington Reservoir using FIRO is currently unknown.
Conflicts	• Active landslides in the immediate area may be triggered by the rapid drawdown of Lexington Reservoir or by a future earthquake along the nearby San Andreas fault zone. This may threaten water supply and quality, and biological resources near the reservoir and downstream
Costs[a]	• Capital costs: $53,700,000 • Maintenance costs: $450,000 per year • Loss of water compared to normal operations would need to be reimbursed to the Water Utility Enterprise
Strengths	• The existing public trails are preserved • Floodwall heights and extents are reduced • Potential for increased water supply in the reservoir if operating using FIRO • Capital cost is lower than Project budget of $80 million
Weaknesses	• Relies on Upper Guadalupe River remaining in its current restricted capacity. If Upper Guadalupe River capacity is raised as currently planned, this alternative would need to be modified to include higher floodwalls and headwalls • Flood risk has shifted to an operational risk, since flood risk reduction now relies on reservoir operations • Potential for increased reservoir drawdown rate to trigger or exacerbate landslides, which could threaten existing homes and critical infrastructure • Reduced maintenance access to dam outlet tunnel due to larger pipe

Notes: a. Costs are in 2020-2022 dollars. See Appendix H Feasible Alternatives Report for detailed cost breakdown.

4.4.8. Alternative H.1b – Add Outlet Capacity to Lexington Reservoir in Existing Tunnel and Levees (No Upper Guadalupe Improvements)

This alternative replaced the existing outlet transmission pipe at Lenihan Dam with a larger outlet to allow the reservoir to partially empty before a storm event. This alternative assumed that Upper Guadalupe River remains in current restricted capacity and no flood improvements would be made in the future that would increase the capacity of the river. Adding outlet capacity to Lenihan Dam would increase Valley Water's ability to release water from the reservoir and provide additional storage to reduce the peak flow of a large storm.

The 1% design flows, planned reservoir reoperation, and proposed changes to the outlet conveyance system are the same as Alternative H.1a.

Because the reduced 1% flood LGRP flow is still higher than the channel's capacity, levees would be needed. The levees were raised on the outboard side of the existing levee slope to maximize capacity and minimize impact in the river channel. Retaining walls were constructed on the outboard side of the levees to prevent encroachment onto other properties, where needed. The top of levee was assumed to be a constant 18-ft wide with side slopes of 2:1 (horizontal: vertical). Headwalls needed to be constructed or re-constructed at two bridges. The project elements for this alternative are briefly summarized in Table 4-11.

Table 4-11: Alternative H.1b – Add Outlet Capacity to Lexington Reservoir in Existing Tunnel and Levees (No Upper Guadalupe Improvements) Summary

Elements	• Replace existing 54-in outlet transmission pipe (maximum 450 cfs capacity) with 72-in outlet transmission pipe (maximum capacity 800 cfs) • Update reservoir operation procedure to achieve additional storage • Raise levees along river • Construct retaining walls at levees where needed • Construct/re-construct headwalls at two bridges • Install bridge modifications as needed to support additional headwall height • Raise and extend existing pedestrian bridge downstream of Montague Expwy.
Technical Feasibility	• Same as Alternative H.1a
Conflicts	• Same as Alternative H.1a
Costs[a]	• Capital costs: $57,000,000 • Maintenance costs: $450,000 per year • Loss of water compared to normal operations would need to be reimbursed to the Water Utility Enterprise
Strengths	• The existing public trails are preserved • Levees minimize visual barriers • Minimal additional maintenance is required • Retaining walls may reduce pioneer trails from neighborhoods • Potential for increased water supply in the reservoir if operating using FIRO • Capital cost is lower than Project budget of $80 million
Weaknesses	• Coordination and permitting are needed with City of San José and Santa Clara County to raise headwalls • Relies on Upper Guadalupe River remaining in its current restricted capacity. If Upper Guadalupe River capacity is raised as currently planned, this alternative would need to be modified to include higher floodwalls and levees. • Trees, some of which have been planted by adjacent landowners, may interfere with retaining walls and need to be removed • Retaining walls create a fall risk, so fencing would be needed • Flood risk has shifted to an operational risk, since flood risk reduction now relies on reservoir operations • Potential for increased reservoir drawdown rate to trigger or exacerbate landslides, which could threaten existing homes and critical infrastructure • Reduced maintenance access to dam outlet tunnel due to larger pipe

Notes: a. Costs are in 2020-2022 dollars. See Appendix H Feasible Alternatives Report for detailed cost breakdown.

4.4.9. Alternative H.1c – Add Outlet Capacity to Lexington Reservoir in Existing Tunnel and Floodwalls (25-yr Upper Guadalupe Improvements)

This alternative replaced the existing outlet transmission pipe at Lenihan Dam with a larger outlet to allow the Lexington Reservoir to partially empty before a storm event. This alternative assumed that 25-year improvements to Upper Guadalupe River would be constructed in the future. Adding outlet capacity to Lenihan Dam would increase Valley Water's ability to release water from the reservoir and provide additional storage to reduce the peak flow of a large storm.

To analyze the hydrologic impact of increasing storage capacity in Lexington Reservoir, the 2009 USACE HEC-HMS hydrology model was used. The Guadalupe watershed has two 100-year design storms: a 72-hour event centered over Lexington Reservoir or a 72-hour event centered over Guadalupe, Almaden, and Calero reservoirs. Several combinations of storm locations and reservoir storage capacities were run through the model to determine which scenarios would be effective at reducing the peak flow downstream. Ultimately, a 100-year design storm centered over Lexington Reservoir with the reservoir volume starting at 12,000 ac-ft gave the maximum amount of flow reduction to the Lower Guadalupe River. Any additional storage does not lower the flow[58]. The design flows for this alternative are listed in the below Table 4-12.

Table 4-12: Design Flow of Hydromodification Alternative – 25yr improvements to Upper Guadalupe River

Location Along Guadalupe River	25-yr Improvements to Upper Guadalupe
D/S of Los Gatos Creek confluence	14,880cfs
Interstate 880	14,970cfs
US 101	15,330cfs
Trimble Road	-
Montague Expressway	15,400cfs
Tasman Drive	-
State Route 237	15,430cfs

The planned reservoir reoperations and proposed changes to the outlet conveyance system are the same as Alternative H.1a.

Because the reduced 1% flood LGRP flow is still higher than the channel's capacity, floodwalls were also needed. Floodwalls were assumed to be concrete with spread footings, placed on the outboard side of the top of levee. Headwalls needed to be constructed or re-constructed at two bridges. The project elements for this alternative are summarized in Table 4-13.

[58] 2021. Design Flows for Alternatives. Jack Xu. Technical Memorandum.

Table 4-13: Alternative H.1c – Add Outlet Capacity to Lexington Reservoir in Existing Tunnel and Floodwalls (25-yr Upper Guadalupe Improvements) Summary

Elements	• Replace existing 54-in outlet transmission pipe (maximum 450 cfs capacity) with 72-in outlet transmission pipe (maximum capacity 800 cfs) • Update reservoir operation procedure to achieve additional storage • Construct floodwalls along existing levees • Construct/re-construct headwalls at four bridges • Install bridge modifications as needed to support additional headwall height
Technical Feasibility	• Same as Alternative H.1a
Conflicts	• Same as Alternative H.1a
Costs[a]	• Capital costs: $89,100,000 • Maintenance costs: $450,000 per year • Loss of water compared to normal operations would need to be reimbursed to the Water Utility Enterprise
Strengths	• The existing public trails are preserved • Floodwall heights and extents are slightly reduced • Potential for increased water supply in the reservoir if operating using FIRO
Weaknesses	• Project capital cost is higher than $80 million desired range. • Coordination and permitting are needed with City of San José and Santa Clara County to raise headwalls • This alternative limits the capacity improvements the UGRP can make to 25-year flood risk reduction. If Upper Guadalupe River capacity provides higher than 25-year, this alternative would need to be modified to include higher headwalls and floodwalls • Flood risk has shifted to an operational risk, since flood risk reduction now relies on reservoir operations • Potential for increased reservoir drawdown rate to trigger or exacerbate landslides, which could threaten existing homes and critical infrastructure • Reduced maintenance access to dam outlet tunnel due to larger pipe

Notes: a. Costs are in 2020-2022 dollars. See Appendix H Feasible Alternatives Report for detailed cost breakdown.

4.4.10. Alternative H.1d – Add Outlet Capacity to Lexington Reservoir in Existing Tunnel and Levees (25-yr Upper Guadalupe Improvements)

This alternative replaced the existing outlet transmission pipe at Lenihan Dam with a larger outlet to allow the Lexington Reservoir to partially empty before a storm event. This alternative assumed that 25-year improvements to Upper Guadalupe River would be constructed in the future. Adding outlet capacity to Lenihan Dam would increase Valley Water's ability to release water from the reservoir and provide additional storage to reduce the peak flow of a large storm.

The 1% design flows were the same as Alternative H.1c. The planned reservoir reoperations and proposed changes to the outlet conveyance system were the same as Alternative H.1a.

Because the reduced 1% flood LGRP flow was still higher than the channel's capacity, levees were also needed. The levees were raised on the outboard side of the existing levee slope to maximize capacity and minimize impact in the river channel. Retaining walls were constructed on the outboard side of the levees to prevent encroachment onto other properties, where needed. The top of levee was assumed to be a constant 18-ft wide with side slopes of 2:1 (horizontal: vertical). Headwalls needed to be constructed or re-constructed at four bridges. The project elements needed for this alternative are summarized in Table 4-14.

Table 4-14: Alternative H.1d - Add Outlet Capacity to Lexington Reservoir in Existing Tunnel and Levees (25-yr Upper Guadalupe Improvements) Summary

Elements	• Replace existing 54-in outlet transmission pipe (maximum 450 cfs capacity) with 72-in outlet transmission pipe (maximum capacity 800 cfs) • Update reservoir operation procedure to achieve additional storage • Raise levees along river • Construct retaining walls at levees where needed • Construct/re-construct headwalls at four bridges • Install bridge modifications as needed to support additional headwall height • Raise and extend existing pedestrian bridge downstream of Montague Expwy.
Technical Feasibility	• Same as Alternative H.1a
Conflicts	• Same as Alternative H.1a
Costs[a]	• Capital costs: $125,600,000 • Maintenance costs: $450,000 per year • Loss of water compared to normal operations would need to be reimbursed to the Water Utility Enterprise
Strengths	• The existing public trails are preserved • Levees minimize visual barriers • Retaining walls may reduce pioneer trails from neighborhoods, which damage the outboard slope of levees • Potential for increased water supply in the reservoir if operating using FIRO
Weaknesses	• Project capital cost is higher than $80 million desired range. • Coordination and permitting with City of San José and Santa Clara County would be needed to raise headwalls • This alternative limits the capacity improvements the UGRP can make to 25-year flood risk reduction. If Upper Guadalupe River capacity provides higher than 25-year, this alternative would need to be modified to include higher headwalls and levees • Trees, some of which have been planted by adjacent landowners, may interfere with retaining walls and need to be removed • Flood risk has shifted to an operational risk, since flood risk reduction now relies on reservoir operations • Potential for increased reservoir drawdown rate to trigger or exacerbate landslides, which could threaten existing homes and critical infrastructure • Modifications to four bridges instead of two, like in Alternatives H.1a and b. US 101 bridge modifications may trigger Caltrans to request additional retrofits • Reduced maintenance access to dam outlet tunnel due to larger pipe

Notes: a. Costs are in 2020-2022 dollars. See Appendix H Feasible Alternatives Report for detailed cost breakdown.

4.4.11. Alternative J.a – Modify Lexington Reservoir Operations and Construct Floodwalls (No Upper Guadalupe Improvements)

This alternative re-operated Lexington Reservoir to increase the amount of storage available before a large storm using the existing outlet. Reservoir operations would be modified to release more water prior to a large storm, thus increasing the volume available to store the peak flow.

To analyze the hydrologic impact of increasing available storage capacity in Lexington Reservoir, the 2009 USACE HEC-HMS hydrology model was used. The Guadalupe watershed has two 100-year design storms: a 72-hour event centered over Lexington Reservoir or a 72-hour event centered over Guadalupe, Almaden, and Calero Reservoirs. Several combinations of centering of storms and reservoir storage capacities were run through the model to determine which scenarios would be effective at reducing the peak flow downstream. Ultimately, a 100-year design storm centered over Lexington Reservoir with the reservoir volume starting at 12,000 ac-ft gave the maximum amount of flow reduction to the Lower Guadalupe River. Any additional storage does not lower the flow[59]. The design flows for this alternative are listed in Table 4-15.

Table 4-15: Design Flows for Alternative J.a

Location Along Guadalupe River	No Change to Upper Guadalupe Flows
D/S of Los Gatos Creek confluence	11,460cfs
Interstate 880	12,460cfs
US 101	12,772cfs
Trimble Road	12,938cfs
Montague Expressway	13,324cfs
Tasman Drive	13,564cfs
State Route 237	13,785cfs

The specifics of Lexington Reservoir operations were identical to the H alternatives but used the existing dam outlet structure to drain the reservoir before a large storm. The current dam outlet structure has a 16-in pipe for regular flows and two 36-in pipes for drawdown when needed, with a combined maximum capacity of 450 cfs. With baseflow considered (200 cfs), it would take 8 days to drain 4,000 ac-ft from the reservoir to provide 7,000 ac-ft of storage for an incoming storm (12,000 ac-ft starting reservoir volume). Draining the reservoir to a 12,000 ac-ft starting volume would reduce the 1% flow at I-880 to 11,460 cfs. Increasing the size of the initial storage in the reservoir would not further reduce the 1% peak flow due to inflow downstream of the reservoir.

Because the reduced 1% flood LGRP flow was still higher than the channel's capacity, floodwalls were needed. Floodwalls were assumed to be concrete with spread footings, placed on the outboard side of the top of levee. Headwalls would need to be constructed or re-constructed at two bridges. The project elements needed for this alternative are summarized in Table 4-16.

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[59] 2021. Design Flows for Alternatives. Jack Xu. Technical Memorandum.

Table 4-16: Alternative J.a – Modify Lexington Reservoir Operations and Construct Floodwalls (No Upper Guadalupe Improvements) Summary

Elements	• Update reservoir operation procedure to achieve additional storage • Construct floodwalls along existing levees • Construct/re-construct headwalls at two bridges • Install bridge modifications as needed to support additional headwall height
Technical Feasibility	• Same as Alternative H.1a
Conflicts	• Same as Alternative H.1a
Costs[a]	• Capital costs: $25,600,000 • Maintenance costs: $450,000 per year • Loss of water compared to normal operations would need to be reimbursed to the Water Utility Enterprise
Strengths	• Same as Alternative H.1a
Weaknesses	• Same as Alternative H.1a

Notes: a. Costs are in 2020-2022 dollars. See Appendix H Feasible Alternatives Report for detailed cost breakdown.

4.4.12. Alternative J.b – Modify Lexington Reservoir Operations and Construct Levees (No Upper Guadalupe Improvements)

This alternative re-operated Lexington Reservoir to increase the amount of storage available in the reservoir before a large storm event using the existing outlet to release more water prior to a large storm, thus increasing the volume available to store the peak flow.

The 1% design flows were the same as Alternative J.a. The planned reservoir reoperations were the same as Alternative H.1a.

Because the reduced 1% flood LGRP flow was still higher than the channel's capacity, levees were also needed. The levees were raised on the outboard side of the existing levee slope to maximize capacity and minimize impact in the river channel. Retaining walls were constructed on the outboard side of the levees to prevent encroachment onto other properties, where needed. The top of levee was assumed to be a constant 18-ft wide with side slopes of 2:1 (horizontal: vertical). Headwalls would need to be constructed or re-constructed at two bridges. The project elements needed for this alternative are summarized in Table 4-17.

Table 4-17: Alternative J.b – Modify Lexington Reservoir Operations and Construct Levees (No Upper Guadalupe Improvements) Summary

Elements	• Update reservoir operation procedure to achieve additional storage • Raise levees along river • Construct retaining walls at levees where needed • Construct/re-construct headwalls at two bridges • Install bridge modifications as needed to support additional headwall height • Raise and extend existing pedestrian bridge downstream of Montague Expwy.
Technical Feasibility	• Same as Alternative H.1a
Conflicts	• Same as Alternative H.1a
Costs[a]	• Capital costs: $27,300,000 • Maintenance costs: $450,000 per year • Loss of water compared to normal operations would need to be reimbursed to the Water Utility Enterprise
Strengths	• Same as Alternative H.1b
Weaknesses	• Coordination and permitting with City of San José and Santa Clara County would be needed to raise headwalls • This alternative relies on Upper Guadalupe River remaining in its current restricted capacity. If the UGRP capacity is raised to 100-year as currently planned, this alternative would not work. • Flood risk has shifted to an operational risk, since flood risk reduction now relies on reservoir operations • Potential for increased reservoir drawdown frequency to trigger or exacerbate landslides, which could threaten existing homes and critical infrastructure. However, this risk is less than in Alternative H, because it is using the existing outlet and not increasing outlet flows • Uncertainty with weather forecasting and climate change • Potential for loss of water for water supply/recharge purposes • Uncertainty/fluctuations in reimbursement from year to year to address water loss (i.e., would be difficult to plan and budget for)

Notes: a. Costs are in 2020-2022 dollars. See Appendix H Feasible Alternatives Report for detailed cost breakdown.

4.5. FEASIBLE ALTERNATIVES SCREENING (LEVEL 2)

After developing and analyzing the feasible alternatives as described above, they underwent an additional screening (Level 2) before starting the NFP analysis:

Project Objectives: Does the feasible alternative still satisfy the Project objectives?

Technical Feasibility: Is the feasible alternative functional, constructable, and maintainable?

Based on the above criteria, the following alternatives did not pass the Level 2 screening:

- Alternative D.2 – Although this alternative passed the initial Level 1 screening to be included in the Feasible Alternatives analysis, further development made it clear that this alternative is not technically feasible due to slope constraints in the Guadalupe Gardens Park.

4.6. ALTERNATIVE RANKING METHODOLOGY

The feasible alternative ranking methodology was developed from the Valley Water Board of Directors' Ends Policy on Natural Flood Protection (E-3). This policy states, "Natural flood protection is provided to reduce risk and improve health and safety for residents, businesses, and visitors, now and into the future[60]." The CEO's policy interpretation together with the Board's Ends Policy goals were used to develop specific objectives which are the basis for Valley Water's Natural Flood Protection (NFP) alternative evaluation framework[61].

The NFP objectives and criteria are listed in Table 4-18. Objectives were given a weight of High, Medium, or Low, based on the Project's needs. Criteria were given a numerical weighting, which is predetermined by the NFP process.

[60] Santa Clara Valley Water District. (2021). Governance Policies of the Board, Ends. Last Revised July 22, 2013.
[61] Santa Clara Valley Water District. (2014). QEMS work instruction WW75125 – Guidance on Alternative Evaluation and Selection for Natural Flood Protection Projects.

Table 4-18: NFP Objectives and Criteria

NFP Objectives	Objective Weight	Justification for Objective Weight	NFP Criteria	Default Criteria Weight
Objective 1. Homes, schools, businesses, and transportation networks are protected from flooding and erosion	High	The Project's main objective is to restore the level of service established by the Lower Guadalupe River Project (LGRP). Maintaining 1% flood risk reduction to the area is imperative.	1.1 Safety	0.30
			1.2 Economic Protection	0.30
			1.3 Durability	0.10
			1.4 Resiliency	0.10
			1.5 Local Drainage	0.10
			1.6 Time to Implementation	0.10
Objective 2. Integrate Within the Context of the Watershed	Low	This Project would re-establish the level of service created by the LGRP and should already fit well within the context of the watershed.	2.1 Meets Local Watershed Goals	1
Objective 3. Support Ecologic Functions and Processes	High	This project aims to keep much of the existing vegetation in place, preserving habitat and habitat connectivity along the riparian corridor and the associated ecologic functions and processes.	3.1 Meets Local Habitat Goals	0.25
			3.2 Quality of Habitat	0.25
			3.3 Sustainability of Habitat	0.25
			3.4 Connectivity of Habitat	0.25
Objective 4. Integrate Physical Geomorphic Stream Functions and Processes	Low	The channel has some geomorphic stream functions from previous projects. Most proposed project elements are on top of existing levees and would not encroach into the channel.	4.1 Floodplain	0.35
			4.2 Active Channel	0.30
			4.3 Stable Side Slopes	0.20
			4.4 Upstream/Downstream Transitions	0.15

NFP Objectives	Objective Weight	Justification for Objective Weight	NFP Criteria	Default Criteria Weight
Objective 5. Minimize Maintenance Requirements	High	The Watersheds O&M team has not been able to maintain the previous project to its design level. Minimizing maintenance this time around is essential.	5.1 Structural Features	0.25
			5.2 Natural Processes	0.25
			5.3 Urban Flows	0.25
			5.4 Access	0.25
Objective 6. Protect the Quality and Availability of Water	Med	Water availability and quality are important functions of the Guadalupe Watershed, not only for public use, but environmental use as well.	6.1 Water Availability	0.30
			6.2 Groundwater Quality	0.25
			6.3 Instream Water Quality	0.30
			6.4 Storm-Water Management	0.10
			6.5 Flow Regime	0.05
Objective 7. Cooperate with other Local Agencies to Achieve Mutually Beneficial Goals	Low	Local Agency Coordination has been established through existing City-owned trails and will continue through this project.	7.1 Mutual Local Goals	0.5
			7.2 Supports General Plan	0.5
Objective 8. Maximize Community Benefits Beyond Flood Protection	Med	Community support for the project will affect the outcome design and construction of the selected project. Opportunities to maintain or enhance the existing community benefits will be examined.	8.1 Community Safety	0.2
			8.2 Recreation	0.2
			8.3 Aesthetics	0.2
			8.4 Open Space	0.2
			8.5 Community Support	0.2

NFP Objectives	Objective Weight	Justification for Objective Weight	NFP Criteria	Default Criteria Weight
<u>Objective 9.</u> Minimize Life-Cycle Costs	**High**	Valley Water's General Fund has limited resources available for this project. The cost of construction, as well as full life cycle costs, will be evaluated.	9.1 Capital Cost	NA
			9.2 Maintenance Cost	NA
			9.3 Grant or Cost-Sharing opportunities	NA
<u>Objective 10.</u> Impacts are Avoided, Minimized or Mitigated	**High**	Avoidance of environmental impacts is critical for permitting the project, and for maintaining a beneficial outcome for the public and the plant and animal species that live in Santa Clara County.	10.1 Compliance with San Francisco Bay Basin Plan	0.5
			10.2 Identify the Least Environmentally Damaging Practicable Alternative (LEDPA)	0.5

4.7. NATURAL FLOOD PROTECTION EVALUATION RESULTS

NFP evaluation includes 10 objectives and 36 distinct criteria associated with those objectives. Each feasible alternative was rated against all 36 criteria with a qualitative value as listed in Table 4-19. Some of the criteria required comparative ratings between the alternatives (for example, which alternative would yield the highest and lowest cost) while others were stand-alone ratings (for example, how well does the alternative meet community goals). The ratings for the criteria under each objective were then compiled into a summary objective rating.

Table 4-20 shows the summary scores for all the alternatives. Completed NFP rating sheets are included in Appendix B.

Table 4-19: NFP Criteria Rating

Rating Guidance	Qualitative Value
Outstanding	●
Very Good	◕
Adequate	◒
Fair	◔
Poor	○
Unacceptable	⊗

Table 4-20: NFP Total Scores for Feasible Alternatives

Feasible Alternatives – Total NFP Rating											
A	B	B.2	C	C.1	D.2	H.1a	H.1b	H.1c	H.1d	J.a	J.b
◔	◔	◔	◒	◒	NF*	◒	◒	◔	◒	◒	◒

*Not Feasible

The NFP evaluation process is qualitative. Because of this, many alternatives scored the same at the end of the process. The following alternatives all rated as ◒, or “adequate” projects:

- Alternati alls (No Upper Guadalupe Improvements)
- Alternative H.1b – Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (No Upper Guadalupe Improvements)
- Alternative H.1d – Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (25-yr Upper Guadalupe Improvements)
- Alternative J.a – Modify Lexington Reservoir Operation and Floodwalls (No Upper Guadalupe Improvements)
- Alternative J.b – Modify Lexington Reservoir Operation and Levees (No Upper Guadalupe Improvements)

To further differentiate between alternatives, it was helpful to break down the results by objective. Table 4-21 through Table 4-24 tabulates the number of times each alternative received the highest score for each objective.

Table 4-21: Number of Times each Alternative Scored Highest per Objective Weighted "HIGH"

Feasible Alternatives – Highest Scores for Objectives Weighted HIGH											
A	B	B.2	C	C.1	D.2	H.1a	H.1b	H.1c	H.1d	J.a	J.b
2	1	1	2	1	NF*	3	4	1	2	3	4

*Not Feasible

There were five objectives with a "high" objective weight (Objectives 1, 3, 5, 9, and 10). Alternatives H.1b and J.b both had the most high-scores per high-weighted objective with a total of 4.

Table 4-22: Number of Times each Alternative Scored Highest per Objective Weighted "MEDIUM"

Feasible Alternatives – Highest Scores for Objectives Weighted MED											
A	B	B.2	C	C.1	D.2	H.1a	H.1b	H.1c	H.1d	J.a	J.b
0	0	0	1	1	NF*	2	2	1	2	1	1

*Not Feasible

There were two objectives with a "medium" objective weight (Objectives 6 and 8). Alternatives H.1a, H.1b, and H.1d had the most high-scores per medium-weighted objective with a total of 2.

Table 4-23: Number of Times each Alternative Scored Highest per Objective Weighted "LOW"

Feasible Alternatives – Highest Scores for Objectives Weighted LOW											
A	B	B.2	C	C.1	D.2	H.1a	H.1b	H.1c	H.1d	J.a	J.b
2	3	3	3	3	NF*	2	2	2	2	2	2

*Not Feasible

There were three objectives with a "low" objective weight (Objectives 2, 4, and 7). Alternatives B, B.2, C, and C.1 had the most high-scores per low-weighted objective with a total of 3.

Table 4-24: Number of Times each Alternative Scored Highest per Objective

Feasible Alternatives – Total Highest Scores for Objectives											
A	B	B.2	C	C.1	D.2	H.1a	H.1b	H.1c	H.1d	J.a	J.b
4	4	4	6	5	NF*	7	8	4	6	6	7

*Not Feasible

Alternative H.1b emerged as the alternative that scored the highest on 8 out of 10 objectives. Alternatives H.1a and J.b were in second place with a total of 7 high scores. The highest scoring non-reservoir alternative was Alternative C, with a total of 6 high scores.

Although Alternatives H.1b and H.1a scored highest in this analysis, there were multiple complicating factors that led the Project team to not recommend these alternatives.

Factor 1: The Upper Guadalupe River Project's Outcome was Uncertain

At this stage of the project, the USACE was undergoing a general re-evaluation study of the Upper Guadalupe River and had not arrived at a tentatively selected plan (TSP). Depending on the plan selected by the USACE, the UGRP could drastically change how much flow reaches the Lower Guadalupe River during high flow events.

Alternatives H.1b and H.1a assumed no improvements to the UGRP reaches. Although this reflected the current condition of the Upper Guadalupe River, it was unlikely that this would be the future condition given the uncertainty of the UGRP. Increases in flow to the Lower Guadalupe River from improvements in the UGRP reaches could render reoperation at Lenihan Dam ineffective at limiting flow to the Lower Guadalupe River.

Factor 2: Reservoir Operation Could Trigger Landslides

Lowering the water level in Lexington Reservoir prior to a large storm would require a rapid drawdown rate higher than the normal operations rate. There are several large historical landslides adjacent to Lexington Reservoir that could be triggered by the rapid drawdown rates required for Alternatives H.1a and H.1b. If activated, these landslides are in areas that would affect existing residents, infrastructure, water quality, and biological resources.

Because of these factors, staff does not recommend selecting any H alternative that would upgrade Lenihan Dam's outlet structure only for the changes to be made ineffective by the UGRP, or to trigger landslides that would severely disrupt the Lexington Reservoir area.

At this point in the study, the Project team recommended a two-phase project:

Phase 1. Construct Alternative J.b – *Modify Lexington Reservoir Operations and Construct Levees (No Upper Guadalupe Improvements)* as an interim project until the UGRP decision making process was complete.

Phase 2: If necessary (pending UGRP TSP), construct Alternative C: *Levees with Retaining Walls and Headwalls* with levee and floodwall heights designed once the flows reaching the Lower Guadalupe River were better understood.

4.8. FEASIBLE ALTERNATIVE REFINEMENTS

There were several developments that emerged after the Feasible Alternatives analysis was completed:

1. The Guadalupe River - Upper, Interstate 280 to Blossom Hill Road Project (UGRP) in partnership with the USACE arrived at a TSP (USACE 2022). Flows coming from the UGRP are now estimated to be a 2% annual chance of exceedance flow (50-year).
2. Post-pandemic construction costs have risen, making all proposed alternatives more expensive than originally estimated.
3. Valley Water staff worked with a consultant to conduct a hydrology study for the Guadalupe watershed in 2023 which redefined the 1% flow to 14,160 cfs for the Guadalupe River at State Route 237[62]. This updated hydrology accounts for the UGRP flows mentioned above.

[62] Wood Rogers. 2023. *Guadalupe River ICM Model Development*. San Jose: Valley Water.

As mentioned in the previous section, Alternative J.b was recommended as an interim project followed by Alternative C, if required. As a result of the three new developments mentioned above:

- Alternative J.b was no longer possible to achieve with modifications to Lexington Reservoir operations alone. This was due to the UGRP's increased flow capacity. To account for this increased flow, flow modifications to the Upper Guadalupe River subwatershed were needed, which required additional analysis[63].
- Alternative C cost estimates increased to $237 million, which was no longer close to the desired Project budget of $80 million.

As a result, neither of the alternatives recommended by the Feasible Alternatives Report were clear candidates for the Staff-Recommended Alternative. Some additional alternatives analysis was performed to further refine the alternatives above.

4.8.1. Alternative C – Levees with Retaining Walls and Headwalls (18,350 cfs)

This alternative was re-estimated to reflect the post-pandemic construction inflation with various Valley Water's Watershed Projects. The updated capital cost would be $237,000,000.

4.8.2. Alternative C.a – Levees with Retaining Walls and Headwalls (14,160 cfs)

Alternative C.a was a new alternative not considered in any of the previous planning phases. This alternative raised the existing levees to provide capacity for the updated 2023 hydrology flows, which were not available during the feasible alternatives analyses. The levees would be raised on the outboard side of the existing levee slope to maximize capacity and minimize impact in the river channel. Retaining walls would be constructed as needed on the outboard side of the levees to prevent encroachment onto other properties. The top of levee is assumed to be a constant 18-ft wide with side slopes of 2:1 (horizontal: vertical). Concrete headwalls would be raised or replaced at two bridges. The improvements needed for this alternative are summarized by reach below:

Table 4-25: Design Flows for Alternative C.a

Location Along Guadalupe River	1% Design Flows (cfs)
D/S of Los Gatos Creek confluence	13,925
Interstate 880	14,100
US 101	13,986
Trimble Road	13,986
Montague Expressway	13,930
Tasman Drive	14,004
State Route 237	14,160
Gold Street	14,160

[63] Xu, Jack, and Darshan Baral. 2022. "Non-Structural Alternatives to Flow Reduction." San Jose: Valley Water.

Table 4-26: Bridge Headwall Heights for Alternative C.a

Bridge Location	Existing Headwall Height (ft)	Additional Headwall Needed (ft)	Total Headwall Height (ft)
Trimble Road	3	1.09	4.25
Montague Expressway	4	2.95	7.00

Table 4-27: Levee Length and Height by Reach for Alternative C.a

	Total Levee Length (ft)	Average Levee Height (ft)
Reach A	0	0
Reach B	5000	1.0
Reach C	12200	2.4
Reach D	11100	2.0
Reach E	4100	1.0
Reach F	0	0
Reach G	0	0

Costs:
Capital costs would be $80,250,000.

Benefits:

- *Capital cost is close to the $80 million budget.*
- *This alternative can be transitioned to Design Phase now.*
- *This alternative avoids major bridge impacts at US 101, Airport Parkway, and Trimble Road.*
- *Less visual impacts at bridge crossings.*

Disadvantages:

- *Alternative provides 1% LOS, but the flows are less than the original LGRP design flows.*
- *Requires approval of USACE to operate to lower 1% flood flows, due to previous commitments with USACE for the Downtown Guadalupe River Project.*
- *Significant bridge improvements are needed at Montague Expressway. Coordination and permitting with Santa Clara County may impact design and construction timeline.*

4.8.3. Alternative J.c – Modify Lexington Reservoir and Construct Levees (50-yr Upper Guadalupe Improvements)

Alternative J.c was a new alternative not considered in the previous planning phases. This alternative was similar to Alternative J.b, which modifies operations at Lexington Reservoir to increase the amount of storage available in the reservoir before a large storm event, but it considers a higher flow from the Upper Guadalupe River Project based on recent hydrologic updates.

Because the Lower Guadalupe River receives flow from the entire Guadalupe watershed, it is affected by any upstream flood improvement projects. The UGRP is currently undergoing a General Re-evaluation Study in partnership with the USACE. The TSP proposes constructing flood risk reduction improvements to the Guadalupe River between Interstate 280 and Blossom Hill Road. The amount of flood risk reduction provided by UGRP significantly affects the peak flow downstream, but only for the hydromodification alternatives (the LGRP design flows already account for 1% flood risk reduction from the UGRP). The hydromodification flows used in Alternative J.c assume 2% annual chance exceedance (50-year) flows from the UGRP [64].

Once the 2% flows from Upper Guadalupe are considered, Lexington Reservoir becomes less effective at modifying the flows for the Lower Guadalupe River. Additional flow reduction strategies need to be considered in the Upper Guadalupe sub-watershed to achieve the LOS needed for the Lower Guadalupe River. These strategies include reservoir storage/FIRO at Almaden Reservoir and flow detention at the Guadalupe Percolation Pond system. A hydraulic analysis performed by Valley Water's Hydrology, Hydraulics, and Geomorphology Unit concluded that these additional elements are conceptually feasible, but additional analysis is needed to refine these elements. This analysis is still in progress and is not expected to be complete until 2024. Using the preliminary flows from UGRP in combination with FIRO, the following 1% flow distribution is assumed for this alternative:

Table 4-28: Design Flows for Alternative J.c

Location Along Guadalupe River	1% Design Flows (cfs)
D/S of Los Gatos Creek confluence	12,700
Interstate 880	12,700
US 101	13,000
Trimble Road	13,000
Montague Expressway	13,200
Tasman Drive	13,200
State Route 237	13,400
Gold Street	13,400

The reduced 1% flood flow is still higher than the channel's capacity, so levees would still be needed. The levees would be raised on the outboard side of the existing levee slope to maximize capacity and minimize impact in the river channel. Retaining walls would be

[64] Xu, Jack, and Darshan Baral. 2022. "Non-Structural Alternatives to Flow Reduction." San Jose: Valley Water.

constructed on the outboard side of the levees to prevent encroachment onto other properties, where needed. The top of levee is assumed to be a constant 18-ft wide with side slopes of 2:1 (horizontal: vertical). Headwalls would need to be constructed or re-constructed at one bridge. The improvements needed for this alternative are summarized by reach below:

Table 4-29: Bridge Headwall Heights for Alternative J.c

Bridge Location	Existing Headwall Height (ft)	Additional Headwall Needed (ft)	Total Headwall Height (ft)
Montague Expressway	4	2	6

Table 4-30: Levee Length and Height by Reach for Alternative J.c

	Total Levee Length (ft)	Average Levee Height (ft)
Reach A	900	0.7
Reach B	3800	0.5
Reach C	12200	1.8
Reach D	11100	1.6
Reach E	3900	0.9
Reach F	400	0.5
Reach G	700	2.5

In addition to the technical analysis needed to determine the feasibility of Almaden Reservoir, Guadalupe Ponds, and Guadalupe Watershed FIRO, there are several policy concerns that need to be considered for this alternative.

1. *This alternative shifts Valley Water's risk from "structural risk" to "operational risk".*
2. *This alternative has the potential to affect Water Rights.*
3. *This alternative has the potential to affect the Fish and Aquatic Habitat Collaborative Effort (FAHCE) Settlement Agreement.*
4. *This alternative could affect groundwater and retailer charges, future cost-sharing of operations and maintenance costs, and costs associated with water losses.*

All of these policy issues would take time to study and would delay the timeline of the Project by 18 months or more.

Costs:

Capital costs would be $50,000,000*.

*This does not include improvements to Almaden Reservoir or Guadalupe Ponds.

Benefits:

- *Capital cost is under the $80 million budget.*
- *This alternative avoids major bridge impacts at US 101, Airport Parkway, and Trimble Road.*
- *Less visual impacts at bridge crossings.*

Disadvantages:

- *Technical and policy concerns would add at least 18 months to the Project's planning phase.*
- *Alternative provides 1% LOS, but the flows are less than the original LGRP design flows.*
- *The final flow values used for the UGRP are still preliminary and may change during the design process.*
- *Requires approval of USACE to operate to lower 1% flood flows, due to previous commitments with USACE for the Downtown Guadalupe River Project.*

4.8.4. Alternative L – Vegetation Removal

Due to the high cost and complex nature of the other alternatives considered, the Planning Team was often asked why Valley Water cannot simply remove vegetation to restore channel capacity. This alternative was eliminated early in the Conceptual Alternatives phase but was brought back to re-evaluate due to high interest in this alternative as a possible solution.

It is estimated that the Project would need to remove 2,300 trees to return the channel to the design condition, focused between Montague Expressway and Trimble Road[65]. This scenario, however, would not completely return the channel to the existing condition, due to cross-sectional area changes not accounted for in the design. Removing vegetation to this degree is anticipated to be a temporary measure. Vegetation removals would need to be repeated in the future as site conditions, including relatively high groundwater and year-round flows, are highly conducive to riparian vegetation growth. Estimated cost for vegetation removal, mitigation, and monitoring is $62 million. To offset impacts associated with significant vegetation removal, mitigation would be required. Real estate acquisition of land required for mitigation could add another $750 million. It is possible the real estate cost could be lowered if another option for mitigation becomes available, but this would require significant analysis and conversations with permitting agencies.

Costs:

Capital costs would be $62,000,000 up to $812,000,000.

Benefits:

- *This alternative avoids major bridge impacts.*
- *Less visual impacts at bridge crossings.*

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[65] Valley Water. 2018. *Business Case Report for Guadalupe River Freeboard Restoration, Montague Expressway to Airport Parkway*. San Jose. Valley Water.

Disadvantages:

- *Cost of property acquisition is significantly higher than the $80 million budget.*
- *Would require frequent maintenance to maintain, some of which may be outside what Valley Water's Stream Maintenance Program (SMP) can accommodate.*

4.8.5. Conclusion

Based on the comparison of the alternatives above, Project Staff recommended a two-part Project:

1. Transition Alternative C.a (lower 1% flow – 14,160 cfs) to Design Phase
2. Continue to study FIRO for flood risk reduction in Lexington and Almaden Reservoirs, as well as Guadalupe Ponds.

With this recommendation, Valley Water staff can more quickly begin the work of designing an alternative that provides 1% flood flow LOS to the Lower Guadalupe River without the uncertainty of flow detention/FIRO elements. At the same time, staff can continue to study reservoir modifications and FIRO to determine if this element can bring adaptability to the Guadalupe watershed, and perhaps other Valley Water reservoirs as well.

SECTION 5. RECOMMENDED PROJECT

This chapter outlines the design criteria, recommended Project elements, and right of way requirements of the recommended Project. Initial engineering drawings are included in Appendix C of this report.

5.1. RECOMMENDED PROJECT

The recommended Project (Alternative C.a) involves raising existing levees to accommodate the updated 2023 hydrology flows. The levee elevation would occur on the outboard side of the existing slope to maximize capacity and minimize impact on the river channel. Retaining walls would be constructed where required on the outboard side of the levees to prevent encroachment onto other properties. Concrete headwalls at two bridges would need to be raised or replaced as described in detail in **Section 4.8.2.**

5.2. DESIGN CRITERIA

The overall design criteria for the Project are as follows:

5.2.1. Hydraulic and Geotechnical Criteria

1. Provide 1% flood protection to the reach between Gold Street and Interstate 880, as specified in the updated 2023 hydrology flow study[66].

    - Updated 2023 Hydrology Flows: 14,100 cfs U/S of Hwy 880

Location Along Guadalupe River	100-Year Current Flows (cfs)
D/S of Los Gatos Confluence	13,925
Highway 880	14,100
US 101	13,986
Trimble Rd	13,986
Montague Expressway	13,930
Tasman Drive	14,004
State Route 237	14,160
Gold Street	14,160

[66] Wood Rogers 2023. Guadalupe River ICM Model Development.

2. Comply with Valley Water freeboard requirements (which exceed FEMA criteria)[67]

   Levees or Floodwalls:

   - 3.5-ft freeboard at flood wall or levee sections
   - 4-ft freeboard within 100' of bridges
   - Tapered freeboards between the 4-ft and 3.5-ft sections identified above
   - Maintained freeboard when flows are super-elevated at channel bends

   Excavated or lined channels:

   - 1-ft freeboard at all sections
   - Maintained freeboard when flows are super-elevated at channel bends

3. Comply with FEMA Levee certification requirements
   - Design local drainage outfalls to prevent seepage at any time and back flow during flood flows
   - Demonstrate that erosion resulting from design flow currents will not result in failure of levees and floodwalls
   - Engineering analyses demonstrating that seepage resulting from the design flow will not jeopardize embankment or foundation stability
   - Engineering analyses that assess the potential and magnitude of levee settlement resulting from consolidation of the levee embankment or foundation materials.
   - Engineering analyses that assess the potential and magnitude of future losses of freeboard resulting from sediment aggradation in the river channel.

5.2.2. Technical Criteria

1. Design Life:

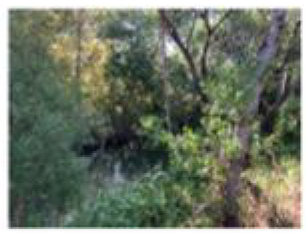
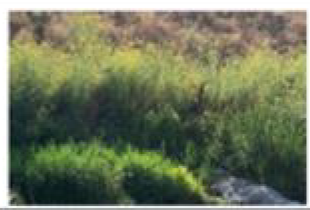
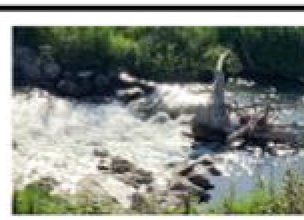
The LGRP was designed to last 100 years, and construction was completed in 2004. The existing 100-year design life will still apply (year 2104).

2. Channel Roughness

One parameter used in the design of flood protection channels is the channel roughness factor (Manning's n). A composite roughness factor in many instances is used for non-uniform channel sections. The cross-section of a channel may be composed of several distinct subsections with each subsection different in roughness from the others. The composite roughness value is based on a combination of the roughness factors for multiple sections across the channel. Typical roughness values for potential subsections of a channel cross-section are shown in the Table below.

[67] Valley Water. 2009. Design Manual Open Channel Hydraulics and Sediment Transport. Page 5-51.

Table 5-1: Roughness Values for Project

Type ID	Description	Vegetation Description	Sample Image	Manning's "n"
1	Extremely Dense Vegetation	Willow and cottonwood trees with overhanging limbs; intertwined, low-lying roots and limbs. Green vegetation greater than 3-ft tall.		0.10
2	Dense Vegetation	Large diameter (willow and cottonwood) or dense trees with low vegetation over 3 feet and debris on channel floor.		0.08
3	Moderate Vegetation	Some small trees with minimal low vegetation; mostly green low vegetation.		0.06
4	Grassed Floodway	Taller native grasses and green vegetation; generally clear of limbs and debris; no trees.		0.04
5	Grassy Bank	Short grasses clear of trees.		0.03
5	Channel Bed	Sands, gravels, some cobbles, intermittent boulder clusters.		0.025

For all project elements and alternatives, based on lessons learned from the maintenance of the LGRP, it is assumed that the central low-flow channel and its adjacent riparian borders would not require vegetation maintenance, other than work to remove any large logjams or other debris barriers and habitat enhancement work to remove invasive and non-native plants and restoration of native vegetation. For all alternatives, the assumed future vegetation maintenance is limited to the levee slopes and 15-ft from the toe of the levee, to be mowed every year.

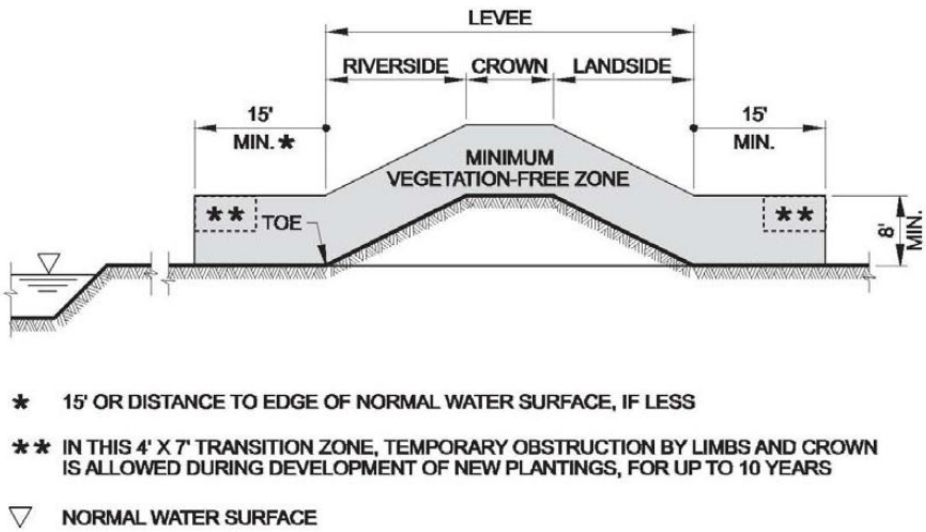


Figure 5-1: Levee Section - Basic, from USACE EP 1110-2-18[68]

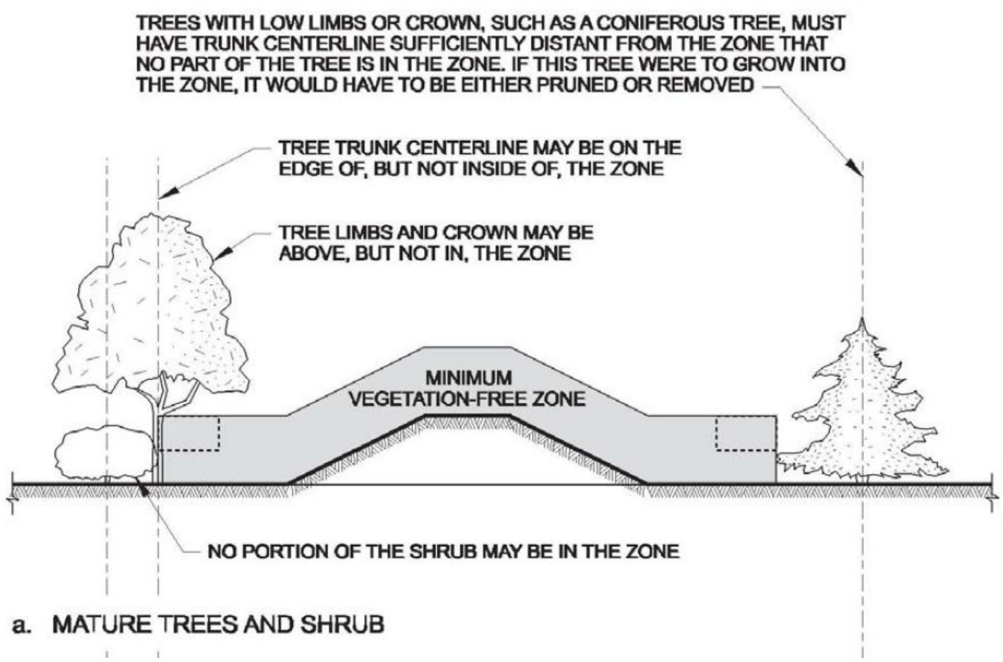


Figure 5-2: Proper Application of the Vegetation-Free Zone, from USACE EP 1110-2-18

[68] USACE. 2019. Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures.

3. Channel Velocity

Channel erosion and deposition are natural processes needed to maintain a healthy riverine environment. However, erosion may undermine infrastructure, reduce bank stability, and erode or cover spawning gravels. This in turn can affect shaded riverine aquatic (SRA) cover vegetation, in-stream cover, substrate composition, and other components of habitat for aquatic species. Project design features for erosion protection were developed where appropriate, per USACE guidance documents entitled, "Hydraulic Design of Flood Control Channels (EM 1110-2-1601)" and "Stability Assessment for Flood Control Channels (EM 1110-2-1418)". Where flow velocities exceed the maximum allowable, armor protection is recommended. Maximum allowable velocities are determined by soil type and channel geometry. A typical range of high velocities is 11.5 to 16.4 feet per second (ft/s). In the case of Lower Guadalupe River, high velocities were predominantly observed in upper section of Reach A, with an average velocity of 7 ft/s. Consequently, armor protection would not be deemed necessary in this area.

4. Boundary Conditions

The model sets the downstream boundary condition for the 100-year flow event as a known water surface elevation of 12.4-ft (NAVD88). The upstream end of the weir into Pond A8 is also set at a known elevation of 12.4 feet. This is equivalent to a 10-year coastal flood event/tidal elevation (9.8-ft NAVD88) with 2.6-ft of sea level rise for today’s conditions.

5. Sea Level Rise

The end of design life for this project is estimated to be 2104, and the project uses 2.59-ft for sea level rise, which represents the USACE high emissions scenario for 2067. There is wide uncertainty in sea level rise estimates for the 2000 to 2100 period, ranging from 1.6-ft to 6.9-ft per current studies, and the 2.59-ft assumption falls within this range. If actual sea level rise is less than 2.59-ft in 2104, the project may provide greater flood protection than originally designed; however, if it is greater than 2.59-ft, the project would still provide the level of protection depending on the level of extreme tide events (Table 3-1). Also note there is freeboard built into the project which provides an extra safety factor. Valley Water will continue to monitor actual sea level rise over time to ensure constructed projects continue to provide adequate protection.

6. Maintenance Roads

Existing maintenance roads allow access for heavy equipment and vehicles along the channel, with widths as follows:

- 18-ft clear width at grade and where depressed below top of levees or banks
- 18-ft clear width, where elevated (top of levees)
- 22-ft equipment swing width
- 25-ft clear width passing areas every 500 to 800-ft
- 1,000-ft separates access points
- 30-ft by 30-ft turnarounds, where maintenance road dead-ends

Maintenance access roads are provided on both sides of the river channel at top of levee bank with access from existing public ROW. The maintenance roads are surfaced with a 6-in thick layer of aggregate and are paved with Portland cement concrete beneath bridges and where steeper than 15%.

Watersheds O&M staff have indicated that maintenance roads should not be impacted as a result of design.

5.2.3. Environmental Criteria

1. Does not result in unacceptable environmental effects
2. Does not result in impediment to fish migration
3. Minimizes adverse effects to wetland resources and SRA cover habitat
4. Maintains or improves water temperature
5. Compatible with measures to resolve known hazardous materials issues
6. Avoids adverse effects to threatened and endangered species
7. Minimizes effects on significant archaeological/historical resources

5.2.4. Public Acceptance Criteria

1. Maintains and/or enhances public recreation and access
2. Maintains and enhances aesthetic values of the river corridor
3. Minimizes traffic disruption on roadways and trails

5.3. RIGHT OF WAY REQUIREMENTS

Valley Water owns 60% of the project area in fee title. The remaining 40% is situated in Reach A adjacent to Mineta San Jose International Airport, and Valley Water has easement rights. There is a reported encroachment onto Valley Water property on Laurelwood Road, extending approximately 10-ft past the property line, with historical non-enforcement of the property boundary during the previous flood protection project. The levee was consequently modified to accommodate the loss of space.

Flood protection elements and maintenance access will be on Valley Water ROW, determined by either fee title or easement obtained from ROW drawings and parcel maps. The data available for this Planning Study Report is considered preliminary and approximate. ROW encroachments are planned to be resolved before the construction phase commences.

SECTION 6. OPERATIONS AND MAINTENANCE PROGRAM

6.1. PROJECT MAINTENANCE

In 2007, USACE issued to Valley Water a draft operations and maintenance manual for both the LGRP and DGRP. When the operations and maintenance manual was finalized in 2011, USACE modified its approach to only include the DGRP in the manual, with the Lower Guadalupe portions of the manual removed from the final document[69]. In practice, Valley Water staff continues to use the draft 2007 manual to inform inspections and maintenance on the LGRP. Maintenance includes sediment removal and vegetation management when the channel exceeds certain thresholds specified in the maintenance manual. Sediment removal activities involve the dredging and disposal of sediment and vegetation in the SDRs, the overbank portions of the river channel specifically designed to capture sediment. Typical vegetation management activities include trimming vegetation higher than one foot in height and clearing vegetation and tree branches that could cause flow impediments as shown in Figure 6-1. Mitigation areas are maintained to protect the vegetation growth in those areas and to remove nonnative invasive plant species. Since the completion of the LGRP in 2004, it has been difficult to conduct sediment removal and vegetation management regularly and to the full extent specified in the maintenance guidelines due to permitting restrictions.

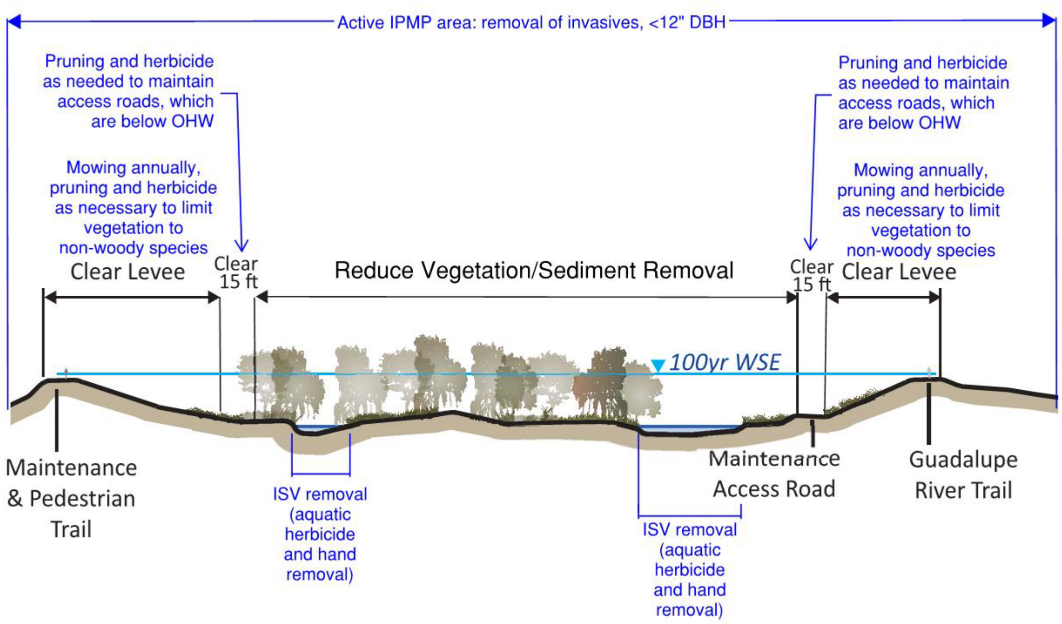


Figure 6-1: Typical Vegetation Management Activities

69 Devin Mody, personal communication

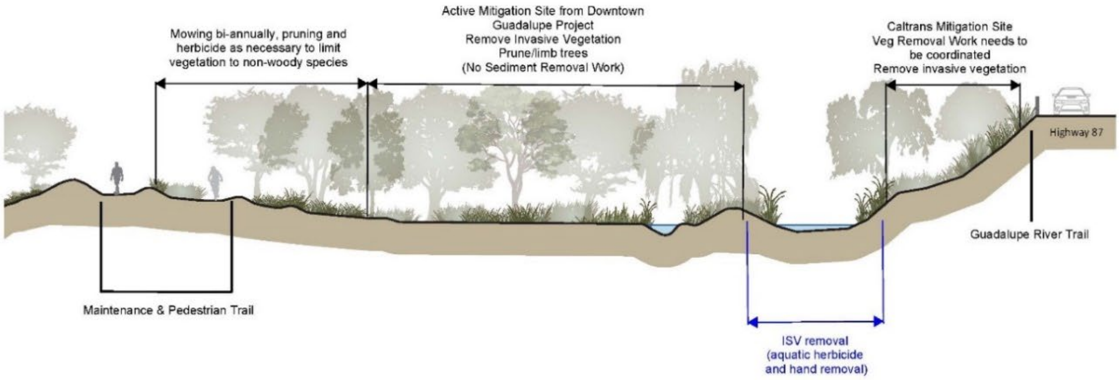


Figure 6-2: Vegetation management activities in mitigation areas

SECTION 7. CAPITAL AND MAINTENANCE COST, FUNDING AND SCHEDULE

This chapter describes in detail the estimated planning level capital cost, operations and maintenance cost, and life cycle cost for the Project. It also presents the Project's funding sources and the tentative schedules.

7.1. ESTIMATED CAPITAL COST

Planning-level capital cost estimates were developed for the various feasible alternatives of the project. The recommended alternative recently underwent a revision, resulting in an updated estimated total cost of $95.5 million. This revision was attributed to inflation in construction costs, leading to an adjustment in the overall cost projection.

Table 7-1: Estimated Planning-Level Capital Cost for the Project

Phase	Estimated Amount[a]
Planning	$4,040,000
Environmental	$1,270,000
Design	$9,630,000
Right of Way	$585,000
Construction	$79,920,000
Close Out	$50,000
Total	$95,495,000

Notes: a. Estimated amount is in 2023 dollars

7.2. ESTIMATED OPERATIONS AND MAINTENANCE COST

The recommended Project will not result in additional operations and maintenance. Rather, the Project is anticipated to require an equivalent level of effort as has been carried out previously for the remainder of LGRP's project lifespan, to the year 2104. In August 2018, the Watersheds Operations and Maintenance Division organized a multi-disciplinary team meeting to address the long-term forecasting of operations and maintenance costs for capital improvement projects being planned or in design. The objective was to enhance the prediction of future resource needs and identify potential resource gaps. A key outcome from this meeting was the establishment of an annual process where project managers, every July, would provide the Operations and Maintenance (O&M) staff with estimates of the long-term operating cost impacts of capital projects after their construction and delivery to O&M. Since 2018, this annual operations and maintenance cost estimation has been conducted using a spreadsheet template prepared by the O&M team and completed by each project manager. Using the maintenance work described in *Chapter 6 Operations and Maintenance Program* for this report, the O&M spreadsheet template was completed and is presented in Table 7-2.

Table 7-2: Estimated Operations and Maintenance Costs

Estimated Annual O&M Cost	$855,000[a]
Useful Life (years)	74[b]
O&M over useful life (2020 dollars)	$63,270,000

Notes: a. Based on FY 24 three-year average O&M cost
b. Assuming Project would be completed in the year 2030

SECTION 8. CONCLUSIONS AND RECOMMENDATIONS

Valley Water Staff recommends a two-part project for the Lower Guadalupe River Capacity Restoration:

1. **Transition Alternative C.a (lower 1% flow – 14,160 cfs) to Design Phase**
   - Proceed with the design phase for Alternative C.a, which provides a 1% flood flow Level of Service (LOS) to the Lower Guadalupe River. This alternative avoids uncertainties associated with flow detention/Flood Risk Reduction elements.
2. **Continue studying reservoir operations for flood risk reduction in Lexington and Almaden Reservoirs, as well as Guadalupe Ponds:**
   - Reservoir modifications and FIRO have the potential to enhance adaptability to future climate conditions (e.g., larger or more frequent storms) in the Guadalupe watershed and potentially across all of the watersheds managed by Valley Water. In addition, if reservoir operations for flood risk reduction is proven fully feasible, there is potential to downsize the planned infrastructure (headwalls and levees) prior to construction.

Further recommendations will be summarized in the Planning to Design Transition Report.

While the Lower Guadalupe River Capacity Restoration Project primarily addresses immediate flood risk, it is not a comprehensive solution to all issues along the entire Guadalupe River. The Project should be seen as part of a holistic approach to manage the Guadalupe watershed, with a focus on preserving, enhancing, and conserving the river's habitat in its natural setting amid a heavily urbanized environment.

8.1. INTERIM CAPACITY REDUCTION ACTIVITIES

To address capacity issues in the interim, staff has sought options to partially restore design flow capacity until the Project is completed. Staff made the recommendation to lower the water level in Lexington Reservoir on an emergency basis to an equivalent storage of 13,500 acre-feet from November 1 to March 31 of each water year, increasing the space available to store peak flows during a large storm and lowering the water surface elevation downstream[70]. Lexington Reservoir has been limited tsso this level since 2019. However, a memorandum issued on February 7,2023, allows for flexibility in maximum storage limitations based on weather forecasts.

Staff has also performed vegetation and sediment removal activities under the SMP from US 101 to Alviso Slough. Vegetation maintenance activities in FY20 and FY21 included removing over 107.3 acres of in-channel vegetation including 167 large trees and 22.9 acres of invasive plants. The large native tree removal efforts required mitigation by planting around 360 native trees and revegetating 2.8 acres with native riparian vegetation within Guadalupe watershed. These plantings are required to be monitored for 5 years[71]. Vegetation management activities completed in the last several years are summarized by reach in Table 8-1.

[70] Valley Water. 2019. “Recommended Lexington Reservoir Interim Operations for Flood Risk Reduction.” Memorandum.
[71] Valley Water. 2021. “Summary of Lower Guadalupe River Work.”

Table 8-1: Vegetation Maintenance Activities Completed in FY20 and FY21[71]

Reach	Location	Invasive Plant Removal (acres)	Native Plant Removal (acres)	Native Trees Removed	Aquatic Herbicide (acres)
A	I-880 to US 101	9.35	-	-	-
B	US 101 to Trimble Rd.	1.11	-	-	-
C	Trimble Rd. to Montague Expy.	8.17	1.39	112	-
D & E	Montague Expy. to Tasman Dr.	4.26	7.00	55	-
F	Tasman Dr. to State Route 237	-	-	-	25.5
G	State Route 237 to UPRR Bridge	-	50.5	-	-

Vegetation maintenance activities should continue as needed to limit further capacity reduction in the channel. It should be noted that the vegetation management and sediment removal work described above does not provide for complete restoration of the project area's design flow conveyance capacity.

In addition to conducting the aforementioned vegetation maintenance activities as part of the SMP, Valley Water may be able to leverage Project D2, which is part of Valley Water's Safe, Clean Water and Natural Flood Protection Program. Project D2 provides non-native, invasive vegetation management for the purpose of habitat improvement, and when permit coverage is available, can perform work in areas that are not covered by the SMP.

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