Appendix A
List of Technical Terms and Acronyms

Acronym/Abbreviation	Description
AC	Acres
AC-FT	Acre Feet
AFY	Acre Feet per Year
CEQA	California Environmental Quality Act
CFS	Cubic Feet Per Second
CPE	Conceptual Project Element
DGRP	Downtown Guadalupe River Project
EIR	Environmental Impact Report
FAHCE	Fisheries and Aquatic Habitat Collaborative Effort
FCCE	Flood Central and Coastal Emergencies
FEMA	Federal Emergency Management Agency
FIRO	Forecast Informed Reservoir Operations
FT	Feet
FT/SEC	Feet per Second
FY	Fiscal Year
GSA	Groundwater Sustainability Agency
HEC-RAS	Hydrologic Engineering Center's River Analysis System
ICM	Integrated Catchment Model
IN	Inches
LCA	Local Cooperative Agreement
LEDPA	Least Environmentally Damaging Practicable Alternative
LGRP	Lower Guadalupe River Project
LOS	Level of Service
MI	Miles
NFP	Natural Flood Protection
O&M	Operations and Maintenance
PSR	Planning Study Report
QEMS	Quality and Environmental Management System
Regional Board	San Francisco Bay Regional Water Quality Control Board
RIP	Rehabilitation and Inspection Program
SDR	Sediment Deposition Reach
SFPUC	San Francisco Public Utilities Commission
SMP	Stream Management Program
SRA	Shaded Riverine Aquatic

TSP	Tentatively Selected Plan
UNAREP	Ulistac Natural Area Restoration and Education Project
UPRR	Union Pacific Railroad
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	Unites States Geological Survey
Valley Water	Santa Clara Valley Water District
WRS	Water Resources Stewardship
WS	Water Supply

Appendix B
Natural Flood Protection Rating

NFP Objectives	Objective Weight	Justification	NFP Criteria	Default Criteria Weight	Feasible Alternatives: A — No Project	B — Floodwalls on outboard side of levees, headwalls at bridge crossings	B.2 — Floodwalls on outboard side of levees, passive barriers at bridge crossings	C — Levees raised, with retaining walls at outboard property line, headwalls at bridges	C.1 — Three-foot floodwalls, additional height raised with levees, headwalls at bridge crossings	D.2 — Off-stream detention basin at Guadalupe Gardens, floodwalls at outboard side of levee, headwalls at bridge crossings	H.1a — 72" pipe installed in existing Lenihan Dam outlet tunnel, floodwalls at outboard side of levee, headwalls at bridge crossings, no changes to Upper Guadalupe system	H.1b — 72" pipe installed in existing Lenihan Dam outlet tunnel, raised levee, headwalls at bridge crossings, no changes to Upper Guadalupe system	H.1c — 72" pipe installed in existing Lenihan Dam outlet tunnel, floodwalls at outboard side of levee, headwalls at bridge crossings, 25-year improvements to Upper Guadalupe system	H.1d — 72" pipe installed in existing Lenihan Dam outlet tunnel, raised levee, headwalls at bridge crossings, 25-year improvements to Upper Guadalupe system	J.a — Use existing outlet infrastructure at Lenihan Dam to operate for flood peak reduction, floodwalls at outboard side of levees, headwalls at bridge crossings, no changes to Upper Guadalupe system	J.b — Use existing outlet infrastructure at Lenihan Dam to operate for flood peak reduction, raised levee, headwalls at bridge crossings, no changes to Upper Guadalupe system
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	●	◒	◒	◒	◒	◒	○	○	○	○	●	●
			Summary Objective 1 Rating		○	◒	◒	◒	◒	◒	◒	◒	◒	◒	◒	◒
Objective 2. Integrate Within the Context of the Watershed	Low	This is a restoration of an existing project, and should already fit well within the context of the watershed	2.1 Meets Local Watershed Goals	1	⊗	◒	◒	◒	◒	◒	○	○	◔	◔	○	○
			Summary Objective 2 Rating		⊗	◒	◒	◒	◒	◒	○	○	◔	◔	○	○
Objective 3. Support Ecologic Functions and Processes	High	Vegetation in the Guadalupe River grows easily and prolifically, which has caused multiple projects to return to this area to solve the problem. This project aims to keep much of the existing vegetation in place, preserving habitat and supporting existing 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	○	◔	◔	◒	◔	◒	◒	◕	◔	◒	◒	◕
			Summary Objective 3 Rating		○	◒	◒	◕	◒	◕	◕	◕	◒	◕	◕	◕
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	●	●	●	●	●	●	●	●	●	●	●	●
			Summary Objective 4 Rating		◒	◒	◒	◒	◒	◒	◒	◒	◒	◒	◒	◒
Objective 5. Minimize Maintenance Requirements	High	Maintenance 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	●	◕	◕	◕	◕	◕	◕	◕	◕	◕	◕	◕
			Summary Objective 5 Rating		◒	◔	◔	◔	◔	◔	◔	◒	◔	◔	◔	◒
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	◕	◕	◕	◕	◕	◕	◕	◕	◕	◕	◕	◕
			Summary Objective 6 Rating		◔	◔	◔	◔	◔	◒	◒	◒	◒	◒	◔	◔
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	●	●	●	●	●	●	●	●	●	●	●	●
			Summary Objective 7 Rating		◒	◒	◒	◒	◒	◒	◒	◒	◒	◒	◒	◒
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	⊗	○	◔	◒	◒	◔	◕	◕	○	◒	◕	◕
			Summary Objective 8 Rating		◔	◔	◔	◒	◒	◒	◒	◒	◔	◒	◒	◒
Objective 9. 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		$1,048,760	$67,516,927	$78,538,745	$101,973,677	$85,816,094	$108,299,217	$51,288,309	$51,657,547	$76,829,610	$94,257,640	$15,054,876	$21,957,547
			9.2 Maintenance Cost		$5,706,000	$14,140,000	$14,140,000	$14,140,000	$14,140,000	$15,711,000	$14,140,000	$14,140,000	$14,140,000	$14,140,000	$14,140,000	$14,140,000
			9.3 Grant or Cost-Sharing opportunities		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
			Summary Objective 9 Rating		**$6,754,760**	**$81,656,927**	**$92,678,745**	**$116,113,677**	**$99,956,094**	**$124,010,217**	**$65,428,309**	**$65,797,547**	**$90,969,610**	**$108,397,640**	**$29,194,876**	**$36,097,547**
Objective 10. 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 or Central Coast Basin Plan	0.5	⊗	◔	◔	◒	◔	◒	◕	◕	○	◒	◕	◕
			10.2 Identify the Least Environmentally Damaging Practicable Alternative (LEDPA)	0.5	⊗	◔	◔	◒	◔	◒	◕	◕	○	◒	◕	◕
			Summary Objective 10 Rating		⊗	◔	◔	◒	◔	◒	◕	◕	○	◒	◕	◕
			Total Rating		◔	◔	◔	◒	◒	◒	◒	◒	◔	◒	◒	◒
			Highest Scores for Objectives Weighted HIGH		2	1	1	2	1	2	3	4	1	2	3	4
			Highest Scores for Objectives Weighted MED		0	0	0	1	1	2	2	2	1	2	1	1
			Highest Scores for Objectives Weighted LOW		2	3	3	3	3	3	2	2	2	2	2	2
			Total Highest Scores		4	4	4	6	5	7	7	8	4	6	6	7
			Total Cost		**$6,754,760**	**$81,656,927**	**$92,678,745**	**$116,113,677**	**$99,956,094**	**$124,010,217**	**$65,428,309**	**$65,797,547**	**$90,969,610**	**$108,397,640**	**$29,194,876**	**$36,097,547**

						No Project		Floodwalls and Headwalls		Floodwalls, Passive Barriers, Closed Roadways		Levees with Retaining Walls and Headwalls		Levees Floodwalls and Headwalls
NFP Objectives	**Objective Weight**	**Justification**	**NFP Criteria**	**Default Criteria Weight**	**A**	**Comments/Justification**	**B**	**Comments/Justification**	**B.2**	**Comments/Justification**	**C**	**Comments/Justification**	**C.1**	**Comments/Justification**
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	0.3	⊗	This alternative does not improve safety	○	Alternative provides safety only up to design flow. Flood hazards still exist, the low point for the system would flood the airport.	○	Alternative provides safety only up to design flow. Flood hazards still exist, the low point for the system would flood the airport.	○	Alternative provides safety only up to design flow. Flood hazards still exist, the low point for the system would flood the airport.	○	Alternative provides safety only up to design flow. Flood hazards still exist, the low point for the system would flood the airport.
			1.2 Economic Protection	0.3	⊗	This alternative does not increase economic protection	◒	Design flow is to the outdated LGRP 1% flow in order to restore capacity. But design meets federal, FEMA and USACE standards. Instream features may be subject to minimal, easily repairable damage. Potential instream damage would not impact development or the community.	◒	Design flow is to the outdated LGRP 1% flow in order to restore capacity. But design meets federal, FEMA and USACE standards. Instream features may be subject to minimal, easily repairable damage. Potential instream damage would not impact development or the community.	◒	Design flow is to the outdated LGRP 1% flow in order to restore capacity. But design meets federal, FEMA and USACE standards. Instream features may be subject to minimal, easily repairable damage. Potential instream damage would not impact development or the community.	◒	Design flow is to the outdated LGRP 1% flow in order to restore capacity. But design meets federal, FEMA and USACE standards. Instream features may be subject to minimal, easily repairable damage. Potential instream damage would not impact development or the community.
			1.3 Durability	0.1	⊗	This alternative does not increase durability	◕	Level of protection is mostly independent of future actions: designed to minimize maintenance of the instream channel by eliminating the sediment depositional reaches (SDR) and clearance of emergent vegetation outside of the active channel. Has a viable, easily permitable, practical Operation and Maintenance Plan. Protection does not rely on real-time intervention during a flood event.	◕	Level of protection is mostly independent of future actions: designed to minimize maintenance of the instream channel by eliminating the sediment depositional reaches (SDR) and clearance of emergent vegetation outside of the active channel. Has a viable, easily permitable, practical Operation and Maintenance Plan. Protection does not rely on real-time intervention during a flood event.	◕	Level of protection is mostly independent of future actions: designed to minimize maintenance of the instream channel by eliminating the sediment depositional reaches (SDR) and clearance of emergent vegetation outside of the active channel. Has a viable, easily permitable, practical Operation and Maintenance Plan. Protection does not rely on real-time intervention during a flood event.	◕	Level of protection is mostly independent of future actions: designed to minimize maintenance of the instream channel by eliminating the sediment depositional reaches (SDR) and clearance of emergent vegetation outside of the active channel. Has a viable, easily permitable, practical Operation and Maintenance Plan. Protection does not rely on real-time intervention during a flood event.
			1.4 Resiliency	0.1	⊗	This alternative does not increase resiliency	◒	Channel design conveys runoff as generated by full build-out of existing general plans, but only to the old LGRP 1% flows.	◒	Channel design conveys runoff as generated by full build-out of existing general plans, but only to the old LGRP 1% flows.	◒	Channel design conveys runoff as generated by full build-out of existing general plans, but only to the old LGRP 1% flows.	◒	Channel design conveys runoff as generated by full build-out of existing general plans, but only to the old LGRP 1% flows.
			1.5 Local Drainage	0.1	⊗	This alternative does not improve local drainage	◒	Alternative accommodates most existing local drainage inputs without causing temporary street flooding. The system has existing pump stations that will be able to operate in most conditions. Alternative does not exacerbate any existing problems with storm-drains and localized street-flooding.	◒	Alternative accommodates most existing local drainage inputs without causing temporary street flooding. The system has existing pump stations that will be able to operate in most conditions. Alternative does not exacerbate any existing problems with storm-drains and localized street-flooding.	◒	Alternative accommodates most existing local drainage inputs without causing temporary street flooding. The system has existing pump stations that will be able to operate in most conditions. Alternative does not exacerbate any existing problems with storm-drains and localized street-flooding.	◒	Alternative accommodates most existing local drainage inputs without causing temporary street flooding. The system has existing pump stations that will be able to operate in most conditions. Alternative does not exacerbate any existing problems with storm-drains and localized street-flooding.
			1.6 Time to Implementation	0.1	●	This alternative could be implemented immediately	◒	Time to implementation is approximately equal with most other alternatives.	◒	Time to implementation is approximately equal with most other alternatives.	◒	Time to implementation is approximately equal with most other alternatives.	◒	Time to implementation is approximately equal with most other alternatives.
Summary Objective 1 Rating					○		◒		◒		◒		◒	

						Off Stream Detention with Minimal ROW Acquisition		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (No Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (No Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (25yr Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (25-yr Upper Guadalupe Improvements)
NFP Objectives	Objective Weight	Justification	NFP Criteria	Default Criteria Weight	Feasible Alternatives									
					D.2	Comments/Justification	H.1a	Comments/Justification	H.1b	Comments/Justification	H.1c	Comments/Justification	H.1d	Comments/Justification
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	0.3	◔	Flood hazards still exist, the low point for the system would flood the airport. This alternative does slightly reduce peak flows	◒	This alternative improves safety compared to existing conditions when flows exceed the design flow or if design assumptions prove inaccurate, mainly because the peak flow is reduced from the LGRP 1% design flow. Although this alternative reduces peak flows most significantly of all alternatives, flood hazards still exist: the low point for the system would flood the airport.	◒	This alternative improves safety compared to existing conditions when flows exceed the design flow or if design assumptions prove inaccurate, mainly because the peak flow is reduced from the LGRP 1% design flow. Although this alternative reduces peak flows most significantly of all alternatives, flood hazards still exist: the low point for the system would flood the airport.	◔	This alternative improves safety compared to existing conditions when flows exceed the design flow or if design assumptions prove inaccurate, mainly because the peak flow is reduced from the LGRP 1% design flow. Although this alternative reduces peak flows, flood hazards still exist: the low point for the system would flood the airport.	◔	This alternative improves safety compared to existing conditions when flows exceed the design flow or if design assumptions prove inaccurate, mainly because the peak flow is reduced from the LGRP 1% design flow. Although this alternative reduces peak flows, flood hazards still exist: the low point for the system would flood the airport.
			1.2 Economic Protection	0.3	◒	Design flow is to the outdated LGRP 1% flow in order to restore capacity. But design meets federal, FEMA and USACE standards. Instream features may be subject to minimal, easily repairable damage. Potential instream damage would not impact development or the community.	◕	Because it uses flood detention with the current 2009 hydrology, this alternative can accommodate current 1% design flow and meets federal, FEMA and USACE standards. Instream features may be subject to minimal, easily repairable damage. Potential instream damage would not impact development or the community.	◕	Because it uses flood detention with the current 2009 hydrology, this alternative can accommodate current 1% design flow and meets federal, FEMA and USACE standards. Instream features may be subject to minimal, easily repairable damage. Potential instream damage would not impact development or the community.	◕	Because it uses flood detention with the current 2009 hydrology, this alternative can accommodate current 1% design flow and meets federal, FEMA and USACE standards. Instream features may be subject to minimal, easily repairable damage. Potential instream damage would not impact development or the community.	◕	Because it uses flood detention with the current 2009 hydrology, this alternative can accommodate current 1% design flow and meets federal, FEMA and USACE standards. Instream features may be subject to minimal, easily repairable damage. Potential instream damage would not impact development or the community.
			1.3 Durability	0.1	◕	Level of protection is mostly independent of future actions: designed to minimize maintenance of the instream channel by eliminating the sediment depositional reaches (SDR) and clearance of emergent vegetation outside of the active channel. Has a viable, easily permitable, practical Operation and Maintenance Plan. Protection does not rely on real-time intervention during a flood event.	○	Level of protection is mostly independent of future actions in the project area only: designed to minimize maintenance of the instream channel by eliminating the sediment depositional reaches (SDR) and clearance of emergent vegetation outside of the active channel. Has a viable, easily permitable, practical Operation and Maintenance Plan. Protection does not rely on real-time intervention during a flood event, but this alternative does require the Upper Guadalupe River Project (UGRP) to not perform any future improvements to flood protection	○	Level of protection is mostly independent of future actions in the project area only: designed to minimize maintenance of the instream channel by eliminating the sediment depositional reaches (SDR) and clearance of emergent vegetation outside of the active channel. Has a viable, easily permitable, practical Operation and Maintenance Plan. Protection does not rely on real-time intervention during a flood event, but this alternative does require the Upper Guadalupe River Project (UGRP) to not perform any future improvements to flood protection	◔	Level of protection is mostly independent of future actions in the project area only: designed to minimize maintenance of the instream channel by eliminating the sediment depositional reaches (SDR) and clearance of emergent vegetation outside of the active channel. Has a viable, easily permitable, practical Operation and Maintenance Plan. Protection does not rely on real-time intervention during a flood event, but this alternative does require the Upper Guadalupe River Project (UGRP) to limit improvements to 25-year level.	◔	Level of protection is mostly independent of future actions in the project area only: designed to minimize maintenance of the instream channel by eliminating the sediment depositional reaches (SDR) and clearance of emergent vegetation outside of the active channel. Has a viable, easily permitable, practical Operation and Maintenance Plan. Protection does not rely on real-time intervention during a flood event, but this alternative does require the Upper Guadalupe River Project (UGRP) to limit improvements to 25-year level.
			1.4 Resiliency	0.1	◒	Channel design conveys runoff as generated by full build-out of existing general plans, but only to the old LGRP 1% flows.	○	Channel designed to convey runoff from existing development, but would limit the UGRP to a level of service that is lower than 1%.	○	Channel designed to convey runoff from existing development, but would limit the UGRP to a level of service that is lower than 1%.	◔	Channel design conveys runoff, but only to 25-year future build out of UGRP. However, unlike alternatives B-D, this alternative uses the current 2009 hydrology, which predicts a higher amount of flow for a 1% flood event.	◔	Channel design conveys runoff, but only to 25-year future build out of UGRP. However, unlike alternatives B-D, this alternative uses the current 2009 hydrology, which predicts a higher amount of flow for a 1% flood event.
			1.5 Local Drainage	0.1	◒	Alternative accommodates most existing local drainage inputs without causing temporary street flooding. The system has existing pump stations that will be able to operate in most conditions. Alternative does not exacerbate any existing problems with storm-drains and localized street-flooding, although it would require some storm drain system relocation in the detention basin area. This could be an opportunity to improve local drainage, as the airport has indicated they would like to use the space for drainage.	◒	Alternative accommodates most existing local drainage inputs without causing temporary street flooding. The system has existing pump stations that will be able to operate in most conditions. Alternative does not exacerbate any existing problems with storm-drains and localized street-flooding.	◒	Alternative accommodates most existing local drainage inputs without causing temporary street flooding. The system has existing pump stations that will be able to operate in most conditions. Alternative does not exacerbate any existing problems with storm-drains and localized street-flooding.	◒	Alternative accommodates most existing local drainage inputs without causing temporary street flooding. The system has existing pump stations that will be able to operate in most conditions. Alternative does not exacerbate any existing problems with storm-drains and localized street-flooding.	◒	Alternative accommodates most existing local drainage inputs without causing temporary street flooding. The system has existing pump stations that will be able to operate in most conditions. Alternative does not exacerbate any existing problems with storm-drains and localized street-flooding.
			1.6 Time to Implementation	0.1	◒	Time to implementation is approximately equal with most other alternatives.	○	Longest time to implementation compared to other alternatives, due to additional dam permitting.	○	Longest time to implementation compared to other alternatives, due to additional dam permitting.	○	Longest time to implementation compared to other alternatives, due to additional dam permitting.	○	Longest time to implementation compared to other alternatives, due to additional dam permitting.
				Summary Objective 1 Rating	◒		◒		◒		◒		◒	

NFP Objectives	Objective Weight	Justification	NFP Criteria	Default Criteria Weight	Re-Operate Lenihan Dam and Floodwalls (No Upper Guadalupe Improvements)		Re-Operate Lenihan Dam and Levees (No Upper Guadalupe Improvements)	
					J.a	Comments/Justification	J.b	Comments/Justification
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	0.3	◒	This alternative improves safety compared to existing conditions when flows exceed the design flow or if design assumptions prove inaccurate, mainly because the peak flow is reduced from the LGRP 1% design flow. Although this alternative reduces peak flows most significantly of all alternatives, flood hazards still exist: the low point for the system would flood the airport.	◒	This alternative improves safety compared to existing conditions when flows exceed the design flow or if design assumptions prove inaccurate, mainly because the peak flow is reduced from the LGRP 1% design flow. Although this alternative reduces peak flows most significantly of all alternatives, flood hazards still exist: the low point for the system would flood the airport.
			1.2 Economic Protection	0.3	◕	Because it uses flood detention with the current 2009 hydrology, this alternative can accommodate current 1% design flow and meets federal, FEMA and USACE standards. Instream features may be subject to minimal, easily repairable damage. Potential instream damage would not impact development or the community.	◕	Because it uses flood detention with the current 2009 hydrology, this alternative can accommodate current 1% design flow and meets federal, FEMA and USACE standards. Instream features may be subject to minimal, easily repairable damage. Potential instream damage would not impact development or the community.
			1.3 Durability	0.1	○	Level of protection is mostly independent of future actions in the project area only: designed to minimize maintenance of the instream channel by eliminating the sediment depositional reaches (SDR) and clearance of emergent vegetation outside of the active channel. Has a viable, easily permitable, practical Operation and Maintenance Plan. Protection does not rely on real-time intervention during a flood event, but this alternative does require the Upper Guadalupe River Project to limit the level of service it can provide.	○	Level of protection is mostly independent of future actions in the project area only: designed to minimize maintenance of the instream channel by eliminating the sediment depositional reaches (SDR) and clearance of emergent vegetation outside of the active channel. Has a viable, easily permitable, practical Operation and Maintenance Plan. Protection does not rely on real-time intervention during a flood event, but this alternative does require the Upper Guadalupe River Project to limit the level of service it can provide.
			1.4 Resiliency	0.1	○	Channel designed to convey runoff from existing development, but would limit the UGRP to a level of service that is lower than 1%.	○	Channel designed to convey runoff from existing development, but would limit the UGRP to a level of service that is lower than 1%.
			1.5 Local Drainage	0.1	◒	Alternative accommodates most existing local drainage inputs without causing temporary street flooding. The system has existing pump stations that will be able to operate in most conditions. Alternative does not exacerbate any existing problems with storm-drains and localized street-flooding.	◒	Alternative accommodates most existing local drainage inputs without causing temporary street flooding. The system has existing pump stations that will be able to operate in most conditions. Alternative does not exacerbate any existing problems with storm-drains and localized street-flooding.
			1.6 Time to Implementation	0.1	●	Least amount of time to implementation *compared to other alternatives*.	●	Least amount of time to implementation compared to other alternatives.
			Summary Objective 1 Rating		◒		◒	

					No Project		Floodwalls and Headwalls		Floodwalls, Passive Barriers, Closed Roadways		Levees with Retaining Walls and Headwalls		Levees Floodwalls and Headwalls
NFP Objectives	**Objective Weight**	**Justification**	**NFP Criteria**	**Default Criteria Weight**	**A**	**Comments/Justification**	**B**	**Comments/Justification**	**B.2**	**Comments/Justification**	**C**	**Comments/Justification**	**C.1**	**Comments/Justification**
Objective 2. Integrate Within the Context of the Watershed	**Low**	This is a restoration of an existing project, and should already fit well within the context of the watershed	2.1 Meets Local Watershed Goals	1	⊗	The alternative advances some watershed goals, and is not in conflict with any watershed goals	◒	The alternative advances some watershed goals, and is not in conflict with any watershed goals	◒	The alternative advances some watershed goals, and is not in conflict with any watershed goals	◒	The alternative advances some watershed goals, and is not in conflict with any watershed goals	◒	The alternative advances some watershed goals, and is not in conflict with any watershed goals
Summary Objective 2 Rating					⊗		◒		◒		◒		◒	

					Off Stream Detention with Minimal ROW Acquisition		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (No Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (No Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (25yr Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (25-yr Upper Guadalupe Improvements)
NFP Objectives	**Objective Weight**	**Justification**	**NFP Criteria**	**Default Criteria Weight**	**Feasible Alternatives**								
					D.2	**Comments/Justification**	**H.1a**	**Comments/Justification**	**H.1b**	**Comments/Justification**	**H.1c**	**Comments/Justification**	**H.1d**	**Comments/Justification**
Objective 2. Integrate Within the Context of the Watershed	**Low**	This is a restoration of an existing project, and should already fit well within the context of the watershed	2.1 Meets Local Watershed Goals	1	◒	The alternative advances some watershed goals, and is not in conflict with any watershed goals	○	The alternative advances some watershed goals, but may conflict with the goal of providing flood protection for the watershed because it limits the level of service that Upper Guadalupe River can provide (current condition Upper Guadalupe)	○	The alternative advances some watershed goals, but may conflict with the goal of providing flood protection for the watershed because it limits the level of service that Upper Guadalupe River can provide (current condition Upper Guadalupe)	◔	The alternative advances some watershed goals, but may conflict with the goal of providing flood protection for the watershed because it limits the level of service that Upper Guadalupe River can provide (25-year improvements to Upper Guadalupe)	◔	The alternative advances some watershed goals, but may conflict with the goal of providing flood protection for the watershed because it limits the level of service that Upper Guadalupe River can provide (25-year improvements to Upper Guadalupe)
Summary Objective 2 Rating					◒		○		○		◔		◔	

					Re-Operate Lenihan Dam and Floodwalls (No Upper Guadalupe Improvements)		Re-Operate Lenihan Dam and Levees (No Upper Guadalupe Improvements)	
NFP Objectives	**Objective Weight**	**Justification**	**NFP Criteria**	**Default Criteria Weight**	**J.a**	**Comments/Justification**	**J.b**	**Comments/Justification**
Objective 2. Integrate Within the Context of the Watershed	**Low**	This is a restoration of an existing project, and should already fit well within the context of the watershed	2.1 Meets Local Watershed Goals	1	○	The alternative advances some watershed goals, but may conflict with the goal of providing flood protection for the watershed because it limits the level of service that Upper Guadalupe River can provide (current condition Upper Guadalupe)	○	The alternative advances some watershed goals, but may conflict with the goal of providing flood protection for the watershed because it limits the level of service that Upper Guadalupe River can provide (current condition Upper Guadalupe)
				Summary Objective 2 Rating	○		○	

						No Project		Floodwalls and Headwalls		Floodwalls, Passive Barriers, Closed Roadways		Levees with Retaining Walls and Headwalls		Levees Floodwalls and Headwalls
NFP Objectives	**Objective Weight**	**Justification**	**NFP Criteria**	**Default Criteria Weight**	**A**	**Comments/Justification**	**B**	**Comments/Justification**	**B.2**	**Comments/Justification**	**C**	**Comments/Justification**	**C.1**	**Comments/Justification**
Objective 3. Support Ecologic Functions and Processes	**High**	Vegetation in the Guadalupe River grows easily and prolifically, which has caused multiple projects to return to this area to solve the problem. This project aims to keep much of the existing vegetation in place, preserving habitat and supporting existing ecologic functions and processes.	3.1 Meets Local Habitat Goals	0.25	⊗	This alternative would require a large amount of vegetation management in and along the river to maintain the level-of service required, which would repeatedly remove and impact habitat and conflict with One Water goals and metrics (e.g., extent, continuity, and quality) for healthy river habitat .	◕	This alternative would eliminate the need for intensive vegetation removal in and along the river channel. (Regular vegetation maintenance along levees is assumed for all alternatives.) This would allow habitat to establish and exist relatively undisturbed and contribute to One Water goals and metrics.	◕	This alternative would eliminate the need for intensive vegetation removal in and along the river channel. This would allow habitat to establish and exist relatively undisturbed and contribute to One Water goals and metrics.	◕	This alternative would eliminate the need for intensive vegetation removal in and along the river channel. This would allow habitat to establish and exist relatively undisturbed and contribute to One Water goals and metrics. Wider footprint of raised levees would be accommodated mostly through retaining walls.	◕	This alternative would eliminate the need for intensive vegetation removal in and along the river channel. This would allow habitat to establish and exist relatively undisturbed and contribute to One Water goals and metrics. Wider footprint of raised levees would be accommodated mostly through retaining walls.
			3.2 Quality of Habitat	0.25	○	Alternative focuses primarily on the special needs of threatened and endangered species as required by appropriate regulatory agencies.	◕	The alternative would adequately support the needs for a locally appropriate assemblage of fish, amphibians, reptiles, birds, mammals and invertebrates in each phase of their life-cycle. There would be minimal vegetation management along the channel and levees.	◕	The alternative would adequately support the needs for a locally appropriate assemblage of fish, amphibians, reptiles, birds, mammals and invertebrates in each phase of their life-cycle. There would be minimal vegetation management along the channel and levees.	◕	The alternative would adequately support the needs for a locally appropriate assemblage of fish, amphibians, reptiles, birds, mammals and invertebrates in each phase of their life-cycle. There would be minimal vegetation management along the channel and levees. Levees would maintain wildlife movement opportunities.	◕	The alternative would adequately support the needs for a locally appropriate assemblage of fish, amphibians, reptiles, birds, mammals and invertebrates in each phase of their life-cycle. There would be minimal vegetation management along the channel and levees.
			3.3 Sustainability of Habitat	0.25	⊗	Regular maintenance for channel capacity, requiring significant removal of revegetation, would be necessary on a nearly annual basis.	◒	Regular maintenance for channel capacity is anticipated, but most vegetation management will be minimized to develop, age and change naturally. Channel banks are expected to remain stable overall, with minor potential areas of instability that would require rehabilitation. Vegetation is self-perpetuating with some appropriate successional changes.	◒	Regular maintenance for channel capacity is anticipated, but most vegetation management will be minimized to develop, age and change naturally. Channel banks are expected to remain stable overall, with minor potential areas of instability that would require rehabilitation. Vegetation is self-perpetuating with some appropriate successional changes.	◒	Regular maintenance for channel capacity is anticipated, but most vegetation management will be minimized to develop, age and change naturally. Channel banks are expected to remain stable overall, with minor potential areas of instability that would require rehabilitation. Vegetation is self-perpetuating with some appropriate successional changes.	◒	Regular maintenance for channel capacity is anticipated, but most vegetation management will be minimized to develop, age and change naturally. Channel banks are expected to remain stable overall, with minor potential areas of instability that would require rehabilitation. Vegetation is self-perpetuating with some appropriate successional changes.
			3.4 Connectivity of Habitat	0.25	○	Alternative would not provide a contiguous riparian wildlife corridor between the levees. Due to vegetation removal needs, long stretches of unvegetated corridor that are unsuitable for local wildlife could occur. Existing levees are passable by wildlife, although surrounding habitat (outside of levees) is extremely limited due to dense development.	◔	Because this alternative eliminates the need for intensive vegetation removal in the river channel, it allows for longer and more continuous riparian corridor between the levees. Floodwalls on the outboard side of levees would impact habitat connectivity and wildlife movement, prohibiting wildlife from moving in and out of riparian habitat, limiting access to food, and inhibiting escape during flood events.	◔	Because this alternative eliminates the need for intensive vegetation removal in the river channel, it allows for longer and more continuous riparian corridor between the levees. Floodwalls on the outboard side of levees would impact habitat connectivity and wildlife movement, prohibiting wildlife from moving in and out of riparian habitat, limiting access to food, and inhibiting escape during flood events.	◒	Because this alternative eliminates the need for intensive vegetation removal in the river channel, it allows for longer and more continuous riparian corridor between the levees. Raising the levees allows for more wildlife movement than floodwalls.	◔	Because this alternative eliminates the need for intensive vegetation removal in the river channel, it allows for longer and more continuous riparian corridor between the levees. Floodwalls on the outboard side of levees would impact habitat connectivity and wildlife movement.
	Summary Objective 3 Rating				○		◒		◒		◕		◒	

						Off Stream Detention with Minimal ROW Acquisition		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (No Upper		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (No Upper		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (25yr		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (25-yr Upper
					Feasible Alternatives									
NFP Objectives	Objective Weight	Justification	NFP Criteria	Default Criteria Weight	D.2	Comments/Justification	H.1a	Comments/Justification	H.1b	Comments/Justification	H.1c	Comments/Justification	H.1d	Comments/Justification
Objective 3. Support Ecologic Functions and Processes	High	Vegetation in the Guadalupe River grows easily and prolifically, which has caused multiple projects to return to this area to solve the problem. This project aims to keep much of the existing vegetation in place, preserving habitat and supporting existing ecologic functions and processes.	3.1 Meets Local Habitat Goals	0.25	◕	This alternative would eliminate the need for intensive vegetation removal in and along the river channel. This would allow habitat to establish and exist relatively undisturbed and contribute to One Water goals and metrics. Guadalupe Gardens is open-space already, and its potential to provide habitat-friendly vegetation is still TBD.	◕	This alternative would eliminate the need for intensive vegetation removal in and along the river channel. This would allow habitat to establish and exist relatively undisturbed and contribute to One Water goals and metrics. Dam modifications are assumed to result in only temporary impacts to adjacent habitat.	◕	This alternative would eliminate the need for intensive vegetation removal in and along the river channel. This would allow habitat to establish and exist relatively undisturbed and contribute to One Water goals and metrics. Dam modifications are assumed to result in only temporary impacts to adjacent habitat.	◕	This alternative would eliminate the need for intensive vegetation removal in and along the river channel. This would allow habitat to establish and exist relatively undisturbed and contribute to One Water goals and metrics. Dam modifications are assumed to result in only temporary impacts to adjacent habitat. UGRP improvements still TBD.	◕	This alternative would eliminate the need for intensive vegetation removal in and along the river channel. This would allow habitat to establish and exist relatively undisturbed and contribute to One Water goals and metrics. Dam modifications are assumed to result in only temporary impacts to adjacent habitat. UGRP improvements still TBD.
			3.2 Quality of Habitat	0.25	◕	The alternative would adequately support the needs for a locally appropriate assemblage of fish, amphibians, reptiles, birds, mammals and invertebrates in each phase of their life-cycle. The center channel will have minimal maintenance performed to encourage native habitat growth. Western Burrowing Owl nesting habitat is mapped in Guadalupe Gardens; potential for that habitat to be enhanced is still TBD.	◕	The alternative would adequately support the needs for a locally appropriate assemblage of fish, amphibians, reptiles, birds, mammals and invertebrates in each phase of their life-cycle. The center channel will have minimal maintenance performed to encourage native habitat growth. The Guadalupe River is designated as a steelhead stream, and there are no fish passage barriers for the entire length of the project.	◕	The alternative would adequately support the needs for a locally appropriate assemblage of fish, amphibians, reptiles, birds, mammals and invertebrates in each phase of their life-cycle. The center channel will have minimal maintenance performed to encourage native habitat growth.	◕	The alternative would adequately support the needs for a locally appropriate assemblage of fish, amphibians, reptiles, birds, mammals and invertebrates in each phase of their life-cycle. The center channel will have minimal maintenance performed to encourage native habitat growth.	◕	The alternative would adequately support the needs for a locally appropriate assemblage of fish, amphibians, reptiles, birds, mammals and invertebrates in each phase of their life-cycle. The center channel will have minimal maintenance performed to encourage native habitat growth.
			3.3 Sustainability of Habitat	0.25	◒	Regular maintenance for channel capacity is anticipated, but most vegetation management will be minimized to develop, age and change naturally. Channel banks are expected to remain stable overall, with minor potential areas of instability that would require rehabilitation. Vegetation is self-perpetuating with some appropriate successional changes. Vegetation in Guadalupe Gardens would likely require regular management (although not by Valley Water) as it does under existing conditions.	◒	Regular maintenance for channel capacity is anticipated, but most vegetation management will be minimized to develop, age and change naturally. Channel banks are expected to remain stable overall, with minor potential areas of instability that would require rehabilitation. Vegetation is self-perpetuating with some appropriate successional changes.	◒	Regular maintenance for channel capacity is anticipated, but most vegetation management will be minimized to develop, age and change naturally. Channel banks are expected to remain stable overall, with minor potential areas of instability that would require rehabilitation. Vegetation is self-perpetuating with some appropriate successional changes.	◒	Regular maintenance for channel capacity is anticipated, but most vegetation management will be minimized to develop, age and change naturally. Channel banks are expected to remain stable overall, with minor potential areas of instability that would require rehabilitation. Vegetation is self-perpetuating with some appropriate successional changes.	◒	Regular maintenance for channel capacity is anticipated, but most vegetation management will be minimized to develop, age and change naturally. Channel banks are expected to remain stable overall, with minor potential areas of instability that would require rehabilitation. Vegetation is self-perpetuating with some appropriate successional changes.
			3.4 Connectivity of Habitat	0.25	◒	Because this alternative eliminates the need for intensive vegetation removal in the river channel, it allows for longer and more continuous riparian corridor between the levees. Guadalupe Gardens, if managed as habitat, would increase habitat connectivity.	◒	Because this alternative eliminates the need for intensive vegetation removal in the river channel, it allows for longer and more continuous riparian corridor between the levees. Floodwalls on the outboard side of levees would impact habitat connectivity and wildlife movement, but are lower and less extensive than in earlier alternatives.	◕	Because this alternative eliminates the need for intensive vegetation removal in the river channel, it allows for longer and more continuous riparian corridor between the levees. Raising the levees allows for more wildlife movement than floodwalls and levees would be lower and less extensive than in earlier alternatives	◔	Because this alternative eliminates the need for intensive vegetation removal in the river channel, it allows for longer and more continuous riparian corridor between the levees. Floodwalls on the outboard side of levees would impact habitat connectivity and wildlife movement, and are only slightly lower and less extensive than earlier alternatives.	◒	Because this alternative eliminates the need for intensive vegetation removal in the river channel, it allows for longer and more continuous riparian corridor between the levees. Raising the levees allows for more wildlife movement than floodwalls, but levees are only slightly lower and less extensive than earlier alternatives
	Summary Objective 3 Rating				◕		◕		◕		◒		◕	

NFP Objectives	Objective Weight	Justification	NFP Criteria	Default Criteria Weight	Re-Operate Lenihan Dam and Floodwalls (No Upper Guadalupe Improvements)		Re-Operate Lenihan Dam and Levees (No Upper Guadalupe Improvements)	
					J.a	Comments/Justification	J.b	Comments/Justification
Objective 3. Support Ecologic Functions and Processes	**High**	Vegetation in the Guadalupe River grows easily and prolifically, which has caused multiple projects to return to this area to solve the problem. This project aims to keep much of the existing vegetation in place, preserving habitat and supporting existing ecologic functions and processes.	3.1 Meets Local Habitat Goals	0.25		This alternative would eliminate the need for intensive vegetation removal in and along the river channel. This would allow habitat to establish and exist relatively undisturbed and contribute to One Water goals and metrics. Dam modifications are assumed to result in only temporary impacts to adjacent habitat.		This alternative would eliminate the need for intensive vegetation removal in and along the river channel. This would allow habitat to establish and exist relatively undisturbed and contribute to One Water goals and metrics. Dam modifications are assumed to result in only temporary impacts to adjacent habitat.
			3.2 Quality of Habitat	0.25		The alternative would adequately support the needs for a locally appropriate assemblage of fish, amphibians, reptiles, birds, mammals and invertebrates in each phase of their life-cycle. The center channel will have minimal maintenance performed to encourage native habitat growth.		The alternative would adequately support the needs for a locally appropriate assemblage of fish, amphibians, reptiles, birds, mammals and invertebrates in each phase of their life-cycle. The center channel will have minimal maintenance performed to encourage native habitat growth.
			3.3 Sustainability of Habitat	0.25		Regular maintenance for channel capacity is anticipated, but most vegetation management will be minimized to develop, age and change naturally. Channel banks are expected to remain stable overall, with minor potential areas of instability that would require rehabilitation. Vegetation is self-perpetuating with some appropriate successional changes.		Regular maintenance for channel capacity is anticipated, but most vegetation management will be minimized to develop, age and change naturally. Channel banks are expected to remain stable overall, with minor potential areas of instability that would require rehabilitation. Vegetation is self-perpetuating with some appropriate successional changes.
			3.4 Connectivity of Habitat	0.25		Because this alternative eliminates the need for intensive vegetation removal in the river channel, it allows for longer and more continuous riparian corridor between the levees. Floodwalls on the outboard side of levees would impact habitat connectivity and wildlife movement, but are lower and less extensive than in earlier alternatives.		Because this alternative eliminates the need for intensive vegetation removal in the river channel, it allows for longer and more continuous riparian corridor between the levees. Raising the levees allows for more wildlife movement than floodwalls and levees would be lower and less extensive than in earlier alternatives
		Summary Objective 3 Rating						

						No Project		Floodwalls and Headwalls		Floodwalls, Passive Barriers, Closed Roadways		Levees with Retaining Walls and Headwalls		Levees Floodwalls and Headwalls
NFP Objectives	Objective Weight	Justification	NFP Criteria	Default Criteria Weight	A	Comments/Justification	B	Comments/Justification	B.2	Comments/Justification	C	Comments/Justification	C.1	Comments/Justification
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	◒	The Lower Guadalupe River is a multi-stage channel, and does allow for expansion of flows onto a modified floodplain. The larger channel is not large enough to convey sediment and ordinary flows without sediment deposition and erosion. Mainly due to right-of-way limitations.	◒	The Lower Guadalupe River is a multi-stage channel, and does allow for expansion of flows onto a modified floodplain. The larger channel is not large enough to convey sediment and ordinary flows without sediment deposition and erosion. Mainly due to right-of-way limitations.	◒	The Lower Guadalupe River is a multi-stage channel, and does allow for expansion of flows onto a modified floodplain. The larger channel is not large enough to convey sediment and ordinary flows without sediment deposition and erosion. Mainly due to right-of-way limitations.	◒	The Lower Guadalupe River is a multi-stage channel, and does allow for expansion of flows onto a modified floodplain. The larger channel is not large enough to convey sediment and ordinary flows without sediment deposition and erosion. Mainly due to right-of-way limitations.	◒	The Lower Guadalupe River is a multi-stage channel, and does allow for expansion of flows onto a modified floodplain. The larger channel is not large enough to convey sediment and ordinary flows without sediment deposition and erosion. Mainly due to right-of-way limitations.
			4.2 Active Chan	0.30	◔	Active channel is partially sinuous and partially straight, based on right-of-way availability and previous urbanization and development. Hardscape hydraulic control structures are not needed, but it is unclear if active channel will be sufficient to carry sediment load without deposition.	◔	Active channel is partially sinuous and partially straight, based on right-of-way availability and previous urbanization and development. Hardscape hydraulic control structures are not needed, but it is unclear if active channel will be sufficient to carry sediment load without deposition	◔	Active channel is partially sinuous and partially straight, based on right-of-way availability and previous urbanization and development. Hardscape hydraulic control structures are not needed, but it is unclear if active channel will be sufficient to carry sediment load without deposition	◔	Active channel is partially sinuous and partially straight, based on right-of-way availability and previous urbanization and development. Hardscape hydraulic control structures are not needed, but it is unclear if active channel will be sufficient to carry sediment load without deposition	◔	Active channel is partially sinuous and partially straight, based on right-of-way availability and previous urbanization and development. Hardscape hydraulic control structures are not needed, but it is unclear if active channel will be sufficient to carry sediment load without deposition
			4.3 Stable Side	0.20	◕	Channel side slopes are 2V:1H at the constructed levee portions, so they should be fairly stable. The in-ground channel may have variable side slopes and be more susceptible to hydraulic forces.	◕	Channel side slopes are 2V:1H at the constructed levee portions, so they should be fairly stable. The in-ground channel may have variable side slopes and be more susceptible to hydraulic forces.	◕	Channel side slopes are 2V:1H at the constructed levee portions, so they should be fairly stable. The in-ground channel may have variable side slopes and be more susceptible to hydraulic forces.	◕	Channel side slopes are 2V:1H at the constructed levee portions, so they should be fairly stable. The in-ground channel may have variable side slopes and be more susceptible to hydraulic forces.	◕	Channel side slopes are 2V:1H at the constructed levee portions, so they should be fairly stable. The in-ground channel may have variable side slopes and be more susceptible to hydraulic forces.
			4.4 Upstream/ Downstream Transitions	0.15	•	Channel bottom transitions seamlessly with upstream and downstream reaches, and does not have any grade control structures.	•	Channel bottom transitions seamlessly with upstream and downstream reaches, and does not have any grade control structures.	•	Channel bottom transitions seamlessly with upstream and downstream reaches, and does not have any grade control structures.	•	Channel bottom transitions seamlessly with upstream and downstream reaches, and does not have any grade control structures.	•	Channel bottom transitions seamlessly with upstream and downstream reaches, and does not have any grade control structures.
Summary Objective 4 Rating					◒		◒		◒		◒		◒	

					Off Stream Detention with Minimal ROW Acquisition		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (No Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (No Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (25yr Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (25-yr Upper Guadalupe Improvements)	
NFP Objectives	Objective Weight	Justification	NFP Criteria	Default Criteria Weight	Feasible Alternatives									
					D.2	Comments/Justification	H.1a	Comments/Justification	H.1b	Comments/Justification	H.1c	Comments/Justification	H.1d	Comments/Justification
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	◒	The Lower Guadalupe River is a multi-stage channel, and does allow for expansion of flows onto a modified floodplain. The larger channel is not large enough to convey sediment and ordinary flows without sediment deposition and erosion. Mainly due to right-of-way limitations.	◒	The Lower Guadalupe River is a multi-stage channel, and does allow for expansion of flows onto a modified floodplain. The larger channel is not large enough to convey sediment and ordinary flows without sediment deposition and erosion. Mainly due to right-of-way limitations.	◒	The Lower Guadalupe River is a multi-stage channel, and does allow for expansion of flows onto a modified floodplain. The larger channel is not large enough to convey sediment and ordinary flows without sediment deposition and erosion. Mainly due to right-of-way limitations.	◒	The Lower Guadalupe River is a multi-stage channel, and does allow for expansion of flows onto a modified floodplain. The larger channel is not large enough to convey sediment and ordinary flows without sediment deposition and erosion. Mainly due to right-of-way limitations.	◒	The Lower Guadalupe River is a multi-stage channel, and does allow for expansion of flows onto a modified floodplain. The larger channel is not large enough to convey sediment and ordinary flows without sediment deposition and erosion. Mainly due to right-of-way limitations.
			4.2 Active Chann	0.30	◔	Active channel is partially sinuous and partially straight, based on right-of-way availability and previous urbanization and development. Hardscape hydraulic control structures are not needed, but it is unclear if active channel will be sufficient to carry sediment load without deposition	◔	Active channel is partially sinuous and partially straight, based on right-of-way availability and previous urbanization and development. Hardscape hydraulic control structures are not needed, but it is unclear if active channel will be sufficient to carry sediment load without deposition	◔	Active channel is partially sinuous and partially straight, based on right-of-way availability and previous urbanization and development. Hardscape hydraulic control structures are not needed, but it is unclear if active channel will be sufficient to carry sediment load without deposition	◔	Active channel is partially sinuous and partially straight, based on right-of-way availability and previous urbanization and development. Hardscape hydraulic control structures are not needed, but it is unclear if active channel will be sufficient to carry sediment load without deposition	◔	Active channel is partially sinuous and partially straight, based on right-of-way availability and previous urbanization and development. Hardscape hydraulic control structures are not needed, but it is unclear if active channel will be sufficient to carry sediment load without deposition
			4.3 Stable Side S	0.20	◕	Channel side slopes are 2V:1H at the constructed levee portions, so they should be fairly stable. The in-ground channel may have variable side slopes and be more susceptible to hydraulic forces.	◕	Channel side slopes are 2V:1H at the constructed levee portions, so they should be fairly stable. The in-ground channel may have variable side slopes and be more susceptible to hydraulic forces.	◕	Channel side slopes are 2V:1H at the constructed levee portions, so they should be fairly stable. The in-ground channel may have variable side slopes and be more susceptible to hydraulic forces.	◕	Channel side slopes are 2V:1H at the constructed levee portions, so they should be fairly stable. The in-ground channel may have variable side slopes and be more susceptible to hydraulic forces.	◕	Channel side slopes are 2V:1H at the constructed levee portions, so they should be fairly stable. The in-ground channel may have variable side slopes and be more susceptible to hydraulic forces.
			4.4 Upstream/ Downstream Transitions	0.15	•	Channel bottom transitions seamlessly with upstream and downstream reaches, and does not have any grade control structures.	•	Channel bottom transitions seamlessly with upstream and downstream reaches, and does not have any grade control structures.	•	Channel bottom transitions seamlessly with upstream and downstream reaches, and does not have any grade control structures.	•	Channel bottom transitions seamlessly with upstream and downstream reaches, and does not have any grade control structures.	•	Channel bottom transitions seamlessly with upstream and downstream reaches, and does not have any grade control structures.
Summary Objective 4 Rating					◒		◒		◒		◒		◒	

NFP Objectives	Objective Weight	Justification	NFP Criteria	Default Criteria Weight	Re-Operate Lenihan Dam and Floodwalls (No Upper Guadalupe Improvements)		Re-Operate Lenihan Dam and Levees (No Upper Guadalupe Improvements)	
					J.a	Comments/Justification	J.b	Comments/Justification
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	◒	The Lower Guadalupe River is a multi-stage channel, and does allow for expansion of flows onto a modified floodplain. The larger channel is not large enough to convey sediment and ordinary flows without sediment deposition and erosion. Mainly due to right-of-way limitations.	◒	The Lower Guadalupe River is a multi-stage channel, and does allow for expansion of flows onto a modified floodplain. The larger channel is not large enough to convey sediment and ordinary flows without sediment deposition and erosion. Mainly due to right-of-way limitations.
			4.2 Active Chan	0.30	◔	Active channel is partially sinuous and partially straight, based on right-of-way availability and previous urbanization and development. Hardscape hydraulic control structures are not needed, but it is unclear if active channel will be sufficient to carry sediment load without deposition	◔	Active channel is partially sinuous and partially straight, based on right-of-way availability and previous urbanization and development. Hardscape hydraulic control structures are not needed, but it is unclear if active channel will be sufficient to carry sediment load without deposition
			4.3 Stable Side	0.20	◕	Channel side slopes are 2V:1H at the constructed levee portions, so they should be fairly stable. The in-ground channel may have variable side slopes and be more susceptible to hydraulic forces.	◕	Channel side slopes are 2V:1H at the constructed levee portions, so they should be fairly stable. The in-ground channel may have variable side slopes and be more susceptible to hydraulic forces.
			4.4 Upstream/ Downstream Transitions	0.15	●	Channel bottom transitions seamlessly with upstream and downstream reaches, and does not have any grade control structures.	●	Channel bottom transitions seamlessly with upstream and downstream reaches, and does not have any grade control structures.
			Summary Objective 4 Rating		◒		◒	

						No Project		Floodwalls and Headwalls		Floodwalls, Passive Barriers, Closed Roadways		Levees with Retaining Walls and Headwalls		Levees Floodwalls and Headwalls
NFP Objectives	**Objective Weight**	**Justification**	**NFP Criteria**	**Default Criteria Weight**	**A**	**Comments/Justification**	**B**	**Comments/Justification**	**B.2**	**Comments/Justification**	**C**	**Comments/Justification**	**C.1**	**Comments/Justification**
Objective 5. Minimize Maintenance Requirements	**High**	Maintenance 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	●	No structural features are proposed	⊗	This alternative proposes floodwalls and headwalls, which increases the amount of structural features within the project area.	⊗	This alternative proposes floodwalls, headwalls and passive barriers, which increases the amount of structural features within the project area.	◔	Structural features have been reduced by using levees instead of floodwalls for most of the project length.	◔	This alternative proposes floodwalls and headwalls, which increases the amount of structural features within the project area.
			5.2 Natural Processes	0.25	⊗	Yearly maintenance expected	◔	Expected maintenance cycle for vegetation is three years or less, due to the constant presence of water in the channel. Expected maintenance for sediment is expected to be much longer, since this alternative is removing the SDRs from the project.	◔	Expected maintenance cycle for vegetation is three years or less, due to the constant presence of water in the channel. Expected maintenance for sediment is expected to be much longer, since this alternative is removing the SDRs from the project.	◔	Expected maintenance cycle for vegetation is three years or less, due to the constant presence of water in the channel. Expected maintenance for sediment is expected to be much longer, since this alternative is removing the SDRs from the project.	◔	Expected maintenance cycle for vegetation is three years or less, due to the constant presence of water in the channel. Expected maintenance for sediment is expected to be much longer, since this alternative is removing the SDRs from the project.
			5.3 Urban Flows	0.25	○	Maintenance requirements from urban flows would be about the same or worse	○	This alternative does not propose alterations to storm drains or drainage. Maintenance requirements from urban flows would be about the same.	○	This alternative does not propose alterations to storm drains or drainage. Maintenance requirements from urban flows would be about the same.	○	This alternative does not propose alterations to storm drains or drainage. Maintenance requirements from urban flows would be about the same.	○	This alternative does not propose alterations to storm drains or drainage. Maintenance requirements from urban flows would be about the same.
			5.4 Access	0.25	●	Existing project has maintenance roads on both levees, as well as low level maintenance roads into the channel.	◕	Existing project has maintenance roads on both levees, as well as low level maintenance roads into the channel. The floodwalls will encroach slightly into the maintenance roads on top of the levees, but this will be minimized.	◕	Existing project has maintenance roads on both levees, as well as low level maintenance roads into the channel. The floodwalls will encroach slightly into the maintenance roads on top of the levees, but this will be minimized.	◕	Existing project has maintenance roads on both levees, as well as low level maintenance roads into the channel. The proposed levees will be designed to have the same width on top (18'), but floodwalls will still be needed upstream and downstream of bridges.	◕	Existing project has maintenance roads on both levees, as well as low level maintenance roads into the channel. The floodwalls will encroach slightly into the maintenance roads on top of the levees, but this will be minimized.
Summary Objective 5 Rating					◒		◔		◔		◔		◔	

						Off Stream Detention with Minimal ROW Acquisition		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (No Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (No Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (25yr Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (25-yr Upper Guadalupe Improvements)
NFP Objectives	**Objective Weight**	**Justification**	**NFP Criteria**	**Default Criteria Weight**	**Feasible Alternatives**									
					D.2	**Comments/Justification**	**H.1a**	**Comments/Justification**	**H.1b**	**Comments/Justification**	**H.1c**	**Comments/Justification**	**H.1d**	**Comments/Justification**
Objective 5. Minimize Maintenance Requirements	**High**	Maintenance 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	○	This alternative proposes a detention basin, which slightly reduces the height of floodwalls or levees, but still may require significant structural additions.	◔	This alternative significantly reduces the height of floodwalls and headwalls needed for design compared to other alternatives.	◒	This alternative significantly reduces the height of levees and headwalls needed for design compared to other alternatives.	○	This alternative slightly reduces the height of floodwalls and headwalls needed for design compared to other alternatives.	◔	This alternative slightly reduces the height of levees and headwalls needed for design compared to other alternatives.
			5.2 Natural Processes	0.25	◔	Expected maintenance cycle for vegetation is three years or less, due to the constant presence of water in the channel. Expected maintenance for sediment is expected to be much longer, since this alternative is removing the SDRs from the project.	◔	Expected maintenance cycle for vegetation is three years or less, due to the constant presence of water in the channel. Expected maintenance for sediment is expected to be much longer, since this alternative is removing the SDRs from the project.	◔	Expected maintenance cycle for vegetation is three years or less, due to the constant presence of water in the channel. Expected maintenance for sediment is expected to be much longer, since this alternative is removing the SDRs from the project.	◔	Expected maintenance cycle for vegetation is three years or less, due to the constant presence of water in the channel. Expected maintenance for sediment is expected to be much longer, since this alternative is removing the SDRs from the project.	◔	Expected maintenance cycle for vegetation is three years or less, due to the constant presence of water in the channel. Expected maintenance for sediment is expected to be much longer, since this alternative is removing the SDRs from the project.
			5.3 Urban Flows	0.25	○	This alternative does not propose alterations to storm drains or drainage. Maintenance requirements from urban flows would be about the same.	○	This alternative does not propose alterations to storm drains or drainage. Maintenance requirements from urban flows would be about the same.	○	This alternative does not propose alterations to storm drains or drainage. Maintenance requirements from urban flows would be about the same.	○	This alternative does not propose alterations to storm drains or drainage. Maintenance requirements from urban flows would be about the same.	○	This alternative does not propose alterations to storm drains or drainage. Maintenance requirements from urban flows would be about the same.
			5.4 Access	0.25	◕	Existing project has maintenance roads on both levees, as well as low level maintenance roads into the channel. The floodwalls will encroach slightly into the maintenance roads on top of the levees, but this will be minimized.	◕	Existing project has maintenance roads on both levees, as well as low level maintenance roads into the channel. The floodwalls will encroach slightly into the maintenance roads on top of the levees, but this will be minimized.	◕	Existing project has maintenance roads on both levees, as well as low level maintenance roads into the channel. The proposed levees will be designed to have the same width on top (18'), but floodwalls will still be needed upstream and downstream of bridges	◕	Existing project has maintenance roads on both levees, as well as low level maintenance roads into the channel. The floodwalls will encroach slightly into the maintenance roads on top of the levees, but this will be minimized.	◕	Existing project has maintenance roads on both levees, as well as low level maintenance roads into the channel. The proposed levees will be designed to have the same width on top (18'), but floodwalls will still be needed upstream and downstream of bridges
Summary Objective 5 Rating					◔		◔		◒		◔		◔	

					Re-Operate Lenihan Dam and Floodwalls (No Upper Guadalupe Improvements)		Re-Operate Lenihan Dam and Levees (No Upper Guadalupe Improvements)	
NFP Objectives	**Objective Weight**	**Justification**	**NFP Criteria**	**Default Criteria Weight**	**J.a**	**Comments/Justification**	**J.b**	**Comments/Justification**
Objective 5. Minimize Maintenance Requirements	**High**	Maintenance 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	◔	This alternative significantly reduces the height of floodwalls or levees and headwalls needed for design compared to other alternatives.	◒	Structural features have been reduced by using levees instead of floodwalls for most of the project length.
			5.2 Natural Processes	0.25	◔	Expected maintenance cycle for vegetation is three years or less, due to the constant presence of water in the channel. Expected maintenance for sediment is expected to be much longer, since this alternative is removing the SDRs from the project.	◔	Expected maintenance cycle for vegetation is three years or less, due to the constant presence of water in the channel. Expected maintenance for sediment is expected to be much longer, since this alternative is removing the SDRs from the project.
			5.3 Urban Flows	0.25	○	This alternative does not propose alterations to storm drains or drainage. Maintenance requirements from urban flows would be about the same.	○	This alternative does not propose alterations to storm drains or drainage. Maintenance requirements from urban flows would be about the same.
			5.4 Access	0.25	◕	Existing project has maintenance roads on both levees, as well as low level maintenance roads into the channel. The floodwalls will encroach slightly into the maintenance roads on top of the levees, but this will be minimized.	◕	Existing project has maintenance roads on both levees, as well as low level maintenance roads into the channel. The proposed levees will be designed to have the same width on top (18'), but floodwalls will still be needed upstream and downstream of bridges
				Summary Objective 5 Rating	◔		◒	

						No Project		Floodwalls and Headwalls		Floodwalls, Passive Barriers, Closed Roadways		Levees with Retaining Walls and Headwalls		Levees Floodwalls and Headwalls
NFP Objectives	**Objective Weight**	**Justification**	**NFP Criteria**	**Default Criteria Weight**	**A**	**Comments/Justification**	**B**	**Comments/Justification**	**B.2**	**Comments/Justification**	**C**	**Comments/Justification**	**C.1**	**Comments/Justification**
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	0.3	◒	This alternative would have no net change in potential recharge for the project area. Existing diversions and water rights are not negatively impacted.	◒	This alternative would have no net change in potential recharge for the project area. Existing diversions and water rights are not negatively impacted.	◒	This alternative would have no net change in potential recharge for the project area. Existing diversions and water rights are not negatively impacted.	◒	This alternative would have no net change in potential recharge for the project area. Existing diversions and water rights are not negatively impacted.	◒	This alternative would have no net change in potential recharge for the project area. Existing diversions and water rights are not negatively impacted.
			6.2 Groundwater Quality	0.25	⊗	Alternative does not propose improvements to contaminant entry into groundwater or best management practices for contaminant entry. This is mainly because the project only intercepts storm water from pump stations and storm drains and does not intend to make changes to the drainage system.	⊗	Alternative does not propose improvements to contaminant entry into groundwater or best management practices for contaminant entry. This is mainly because the project only intercepts storm water from pump stations and storm drains and does not intend to make changes to the drainage system.	⊗	Alternative does not propose improvements to contaminant entry into groundwater or best management practices for contaminant entry. This is mainly because the project only intercepts storm water from pump stations and storm drains and does not intend to make changes to the drainage system.	⊗	Alternative does not propose improvements to contaminant entry into groundwater or best management practices for contaminant entry. This is mainly because the project only intercepts storm water from pump stations and storm drains and does not intend to make changes to the drainage system.	⊗	Alternative does not propose improvements to contaminant entry into groundwater or best management practices for contaminant entry. This is mainly because the project only intercepts storm water from pump stations and storm drains and does not intend to make changes to the drainage system.
			6.3 Instream Water Quality	0.3	◕	Alternative would maintain current water quality conditions through the use of already established vegetation and instream elements.	◕	Alternative would maintain current water quality conditions through the use of already established vegetation and instream elements.	◕	Alternative would maintain current water quality conditions through the use of already established vegetation and instream elements.	◕	Alternative would maintain current water quality conditions through the use of already established vegetation and instream elements.	◕	Alternative would maintain current water quality conditions through the use of already established vegetation and instream elements.
			6.4 Storm-Water Management	0.1	○	Alternative does not contain any elements to reduce peak flows to creeks, decrease pollution potential, or increase retention and reuse of rainwater.	○	Alternative does not contain any elements to reduce peak flows to creeks, decrease pollution potential, or increase retention and reuse of rainwater.	○	Alternative does not contain any elements to reduce peak flows to creeks, decrease pollution potential, or increase retention and reuse of rainwater.	○	Alternative does not contain any elements to reduce peak flows to creeks, decrease pollution potential, or increase retention and reuse of rainwater.	○	Alternative does not contain any elements to reduce peak flows to creeks, decrease pollution potential, or increase retention and reuse of rainwater.
			6.5 Flow Regime	0.05	◕	Alternative maintains locally appropriate seasonal variation in flows (quantity and timing) that will support an appropriate physical channel configuration and locally-appropriate species. The Guadalupe River support Steelhead, and is part of the FAHCE agreement, ensuring adequate flows must be provided.	◕	Alternative maintains locally appropriate seasonal variation in flows (quantity and timing) that will support an appropriate physical channel configuration and locally-appropriate species. The Guadalupe River support Steelhead, and is part of the FAHCE agreement, ensuring adequate flows must be provided.	◕	Alternative maintains locally appropriate seasonal variation in flows (quantity and timing) that will support an appropriate physical channel configuration and locally-appropriate species. The Guadalupe River support Steelhead, and is part of the FAHCE agreement, ensuring adequate flows must be provided.	◕	Alternative maintains locally appropriate seasonal variation in flows (quantity and timing) that will support an appropriate physical channel configuration and locally-appropriate species. The Guadalupe River support Steelhead, and is part of the FAHCE agreement, ensuring adequate flows must be provided.	◕	Alternative maintains locally appropriate seasonal variation in flows (quantity and timing) that will support an appropriate physical channel configuration and locally-appropriate species. The Guadalupe River support Steelhead, and is part of the FAHCE agreement, ensuring adequate flows must be provided.
Summary Objective 6 Rating					◔		◔		◔		◔		◔	

					Off Stream Detention with Minimal ROW Acquisition		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (No Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (No Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (25yr Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (25-yr Upper Guadalupe Improvements)	
					Feasible Alternatives									
NFP Objectives	**Objective Weight**	**Justification**	**NFP Criteria**	**Default Criteria Weight**	**D.2**	**Comments/Justification**	**H.1a**	**Comments/Justification**	**H.1b**	**Comments/Justification**	**H.1c**	**Comments/Justification**	**H.1d**	**Comments/Justification**
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	0.3	◒	This alternative would have no net change in potential recharge for the project area. Although this alternative proposes a detention basin that could provide additional recharge, groundwater is already high in this area, and water would only fill the basin during large storms, during which the ground is assumed already be well-saturated. Existing diversions and water rights are not negatively impacted.	◒	This alternative would have no net change in potential recharge for the project area. This alternative would need to use FIRO to create the needed amount of reservoir storage in 3 days. This has the potential to improve water supply and therefore water rights diversions. This also runs the risk of reducing water supply compared to standard rule-curve operation.	◒	This alternative would have no net change in potential recharge for the project area. This alternative would need to use FIRO to create the needed amount of reservoir storage in 3 days. This has the potential to improve water supply and therefore water rights diversions. This also runs the risk of reducing water supply compared to standard rule-curve operation.	◒	This alternative would have no net change in potential recharge for the project area. This alternative would need to use FIRO to create the needed amount of reservoir storage in 3 days. This has the potential to improve water supply and therefore water rights diversions. This also runs the risk of reducing water supply compared to standard rule-curve operation.	◒	This alternative would have no net change in potential recharge for the project area. This alternative would need to use FIRO to create the needed amount of reservoir storage in 3 days. This has the potential to improve water supply and therefore water rights diversions. This also runs the risk of reducing water supply compared to standard rule-curve operation.
			6.2 Groundwater Quality	0.25	◒	Alternative would include a detention basin near high groundwater, so would likely not maintain the minimum required separation for natural protection of groundwater. There is an opportunity to provide space for a C3 basin for the airport, so the alternative could provide best management practices for contaminant entry from stormwater.	⊗	Alternative does not propose improvements to contaminant entry into groundwater or best management practices for contaminant entry. This is mainly because the project only intercepts storm water from pump stations and storm drains and does not intend to make changes to the drainage system.	⊗	Alternative does not propose improvements to contaminant entry into groundwater or best management practices for contaminant entry. This is mainly because the project only intercepts storm water from pump stations and storm drains and does not intend to make changes to the drainage system.	⊗	Alternative does not propose improvements to contaminant entry into groundwater or best management practices for contaminant entry. This is mainly because the project only intercepts storm water from pump stations and storm drains and does not intend to make changes to the drainage system.	⊗	Alternative does not propose improvements to contaminant entry into groundwater or best management practices for contaminant entry. This is mainly because the project only intercepts storm water from pump stations and storm drains and does not intend to make changes to the drainage system.
			6.3 Instream Water Quality	0.3	◕	Alternative would maintain current water quality conditions through the use of already established vegetation and instream elements.	◕	Alternative would maintain current water quality conditions through the use of already established vegetation and instream elements.	◕	Alternative would maintain current water quality conditions through the use of already established vegetation and instream elements.	◕	Alternative would maintain current water quality conditions through the use of already established vegetation and instream elements.	◕	Alternative would maintain current water quality conditions through the use of already established vegetation and instream elements.
			6.4 Storm-Water Management	0.1	◒	This alternative moderately increases retention and use of rainwater where it falls, through the addition of a detention basin. The detention basin also moderately reduces peak flows to Guadalupe River.	◕	This alternative significantly increases retention and use of rainwater where it falls, and significantly reduces peak flows to the creeks. This is achieved by the use of operating the reservoir for flood protection, and providing more storage in the reservoir for peak flow storage.	◕	This alternative significantly increases retention and use of rainwater where it falls, and significantly reduces peak flows to the creeks. This is achieved by the use of operating the reservoir for flood protection, and providing more storage in the reservoir for peak flow storage.	◒	This alternative slightly increases retention and use of rainwater where it falls, and significantly reduces peak flows to the creeks. This is achieved by the use of operating the reservoir for flood protection, and providing more storage in the reservoir for peak flow storage.	◒	This alternative slightly increases retention and use of rainwater where it falls, and significantly reduces peak flows to the creeks. This is achieved by the use of operating the reservoir for flood protection, and providing more storage in the reservoir for peak flow storage.
			6.5 Flow Regime	0.05	◕	Alternative maintains locally appropriate seasonal variation in flows (quantity and timing) that will support an appropriate physical channel configuration and locally-appropriate species. The Guadalupe River support Steelhead, and is part of the FAHCE agreement, ensuring adequate flows must be provided.	◕	Alternative maintains locally appropriate seasonal variation in flows (quantity and timing) that will support an appropriate physical channel configuration and locally-appropriate species. The Guadalupe River support Steelhead, and is part of the FAHCE agreement, ensuring adequate flows must be provided.	◕	Alternative maintains locally appropriate seasonal variation in flows (quantity and timing) that will support an appropriate physical channel configuration and locally-appropriate species. The Guadalupe River support Steelhead, and is part of the FAHCE agreement, ensuring adequate flows must be provided.	◕	Alternative maintains locally appropriate seasonal variation in flows (quantity and timing) that will support an appropriate physical channel configuration and locally-appropriate species. The Guadalupe River support Steelhead, and is part of the FAHCE agreement, ensuring adequate flows must be provided.	◕	Alternative maintains locally appropriate seasonal variation in flows (quantity and timing) that will support an appropriate physical channel configuration and locally-appropriate species. The Guadalupe River support Steelhead, and is part of the FAHCE agreement, ensuring adequate flows must be provided.
Summary Objective 6 Rating					◒		◒		◒		◒		◒	

					Re-Operate Lenihan Dam and Floodwalls (No Upper Guadalupe Improvements)		Re-Operate Lenihan Dam and Levees (No Upper Guadalupe Improvements)	
NFP Objectives	**Objective Weight**	**Justification**	**NFP Criteria**	**Default Criteria Weight**	**J.a**	**Comments/Justification**	**J.b**	**Comments/Justification**
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	0.3	◔	This alternative would have no net change in potential recharge for the project area. Because the time to drain the needed amount of reservoir storage is 7 days, water rights may be negatively impacted. This is because such a long lead time may reduce water supply compared to standard rule-curve operation.	◔	This alternative would have no net change in potential recharge for the project area. Because the time to drain the needed amount of reservoir storage is 7 days, water rights may be negatively impacted. This is because such a long lead time may reduce water supply compared to standard rule-curve operation.
			6.2 Groundwater Quality	0.25	⊗	Alternative does not propose improvements to contaminant entry into groundwater or best management practices for contaminant entry. This is mainly because the project only intercepts storm water from pump stations and storm drains and does not intend to make changes to the drainage system.	⊗	Alternative does not propose improvements to contaminant entry into groundwater or best management practices for contaminant entry. This is mainly because the project only intercepts storm water from pump stations and storm drains and does not intend to make changes to the drainage system.
			6.3 Instream Water Quality	0.3	◕	Alternative would maintain current water quality conditions through the use of already established vegetation and instream elements.	◕	Alternative would maintain current water quality conditions through the use of already established vegetation and instream elements.
			6.4 Storm-Water Management	0.1	◕	This alternative significantly increases retention and use of rainwater where it falls, and significantly reduces peak flows to the creeks. This is achieved by the use of operating the reservoir for flood protection, and providing more storage in the reservoir for peak flow storage.	◕	This alternative significantly increases retention and use of rainwater where it falls, and significantly reduces peak flows to the creeks. This is achieved by the use of operating the reservoir for flood protection, and providing more storage in the reservoir for peak flow storage.
			6.5 Flow Regime	0.05	◕	Alternative maintains locally appropriate seasonal variation in flows (quantity and timing) that will support an appropriate physical channel configuration and locally-appropriate species. The Guadalupe River support Steelhead, and is part of the FAHCE agreement, ensuring adequate flows must be provided.	◕	Alternative maintains locally appropriate seasonal variation in flows (quantity and timing) that will support an appropriate physical channel configuration and locally-appropriate species. The Guadalupe River support Steelhead, and is part of the FAHCE agreement, ensuring adequate flows must be provided.
			Summary Objective 6 Rating		◔		◔	

					No Project		Floodwalls and Headwalls		Floodwalls, Passive Barriers, Closed Roadways		Levees with Retaining Walls and Headwalls		Levees Floodwalls and Headwalls	
NFP Objectives	**Objective Weight**	**Justification**	**NFP Criteria**	**Default Criteria Weight**	**A**	**Comments/Justification**	**B**	**Comments/Justification**	**B.2**	**Comments/Justification**	**C**	**Comments/Justification**	**C.1**	**Comments/Justification**
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	⊗	No memorandum of consensus was developed for the project	⊗	No memorandum of consensus was developed for the project	⊗	No memorandum of consensus was developed for the project	⊗	No memorandum of consensus was developed for the project	⊗	No memorandum of consensus was developed for the project
			7.2 Supports General Plan	0.5	●	Supports all pertinent general plan elements for the cities of San Jose and Santa Clara.	●	Supports all pertinent general plan elements for the cities of San Jose and Santa Clara.	●	Supports all pertinent general plan elements for the cities of San Jose and Santa Clara.	●	Supports all pertinent general plan elements for the cities of San Jose and Santa Clara.	●	Supports all pertinent general plan elements for the cities of San Jose and Santa Clara.
Summary Objective 7 Rating					◒		◒		◒		◒		◒	

NFP Objectives	Objective Weight	Justification	NFP Criteria	Default Criteria Weight	Off Stream Detention with Minimal ROW Acquisition		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (No Upper		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (No Upper		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (25yr		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (25-yr Upper	
					Feasible Alternatives									
					D.2	Comments/Justification	H.1a	Comments/Justification	H.1b	Comments/Justification	H.1c	Comments/Justification	H.1d	Comments/Justification
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	⊗	No memorandum of consensus was developed for the project	⊗	No memorandum of consensus was developed for the project	⊗	No memorandum of consensus was developed for the project	⊗	No memorandum of consensus was developed for the project	⊗	No memorandum of consensus was developed for the project
			7.2 Supports General Plan	0.5	●	Supports all pertinent general plan elements for the cities of San Jose and Santa Clara.	●	Supports all pertinent general plan elements for the cities of San Jose and Santa Clara.	●	Supports all pertinent general plan elements for the cities of San Jose and Santa Clara.	●	Supports all pertinent general plan elements for the cities of San Jose and Santa Clara.	●	Supports all pertinent general plan elements for the cities of San Jose and Santa Clara.
Summary Objective 7 Rating					◒		◒		◒		◒		◒	

					Re-Operate Lenihan Dam and Floodwalls (No Upper Guadalupe Improvements)		Re-Operate Lenihan Dam and Levees (No Upper Guadalupe Improvements)	
NFP Objectives	**Objective Weight**	**Justification**	**NFP Criteria**	**Default Criteria Weight**	**J.a**	**Comments/Justification**	**J.b**	**Comments/Justification**
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	⊗	No memorandum of consensus was developed for the project	⊗	No memorandum of consensus was developed for the project
			7.2 Supports General Plan	0.5	●	Supports all pertinent general plan elements for the cities of San Jose and Santa Clara.	●	Supports all pertinent general plan elements for the cities of San Jose and Santa Clara.
				Summary Objective 7 Rating	◒		◒	

						No Project		Floodwalls and Headwalls		Floodwalls, Passive Barriers, Closed Roadways		Levees with Retaining Walls and Headwalls		Levees Floodwalls and Headwalls
NFP Objectives	**Objective Weight**	**Justification**	**NFP Criteria**	**Default Criteria Weight**	**A**	**Comments/Justification**	**B**	**Comments/Justification**	**B.2**	**Comments/Justification**	**C**	**Comments/Justification**	**C.1**	**Comments/Justification**
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	⊗	The alternative was not reviewed by public safety officials to evaluate safety concerns	⊗	The alternative was not reviewed by public safety officials to evaluate safety concerns	⊗	The alternative was not reviewed by public safety officials to evaluate safety concerns	⊗	The alternative was not reviewed by public safety officials to evaluate safety concerns	⊗	The alternative was not reviewed by public safety officials to evaluate safety concerns
			8.2 Recreation	0.2	◕	This alternative makes no changes to the recreational opportunities provided in the area. The Guadalupe River Trail is highly accessible to the public and is frequently used by commuters and recreationalists.	◕	This alternative makes no changes to the recreational opportunities provided in the area. The Guadalupe River Trail is highly accessible to the public and is frequently used by commuters and recreationalists.	◕	This alternative makes no changes to the recreational opportunities provided in the area. The Guadalupe River Trail is highly accessible to the public and is frequently used by commuters and recreationalists.	◕	This alternative makes no changes to the recreational opportunities provided in the area. The Guadalupe River Trail is highly accessible to the public and is frequently used by commuters and recreationalists.	◕	This alternative makes no changes to the recreational opportunities provided in the area. The Guadalupe River Trail is highly accessible to the public and is frequently used by commuters and recreationalists.
			8.3 Aesthetics	0.2	◒	This alternative makes no changes to the aesthetics of the project area	○	This alternative proposes tall flood walls, which would significantly impact the aesthetics of the area. Although existing flood walls in the project limits are colored and textured, it is still not an aesthetically pleasing choice.	◔	This alternative proposes tall flood walls, which would significantly impact the aesthetics of the area. Although existing flood walls in the project limits are colored and textured, it is still not an aesthetically pleasing choice. However, this alternative would eliminate high headwalls at two road crossings, which make it more aesthetically desirable than Alt B	◒	This alternative raises levees where practicable instead of using high floodwalls. This would improve the aesthetics of the project compared to Alts B & B.2. However, High headwalls and floodwalls would still be needed as transitions around bridges.	◒	This alternative limits floodwalls to three feet specifically to reduce the aesthetic and visual concerns with the high floodwalls in Alts B & B.2. It would still need headwalls and floodwalls transitioning to and from bridges.
			8.4 Open Space	0.2	◒	This alternative makes no changes to existing open space within the area	◒	This alternative makes no changes to existing open space within the area	◒	This alternative makes no changes to existing open space within the area	◒	This alternative makes no changes to existing open space within the area	◒	This alternative makes no changes to existing open space within the area
			8.5 Community Support	0.2	⊗	Although the community would prefer no change to the landscape, the risk of flooding makes this unacceptable	○	The community has many concerns with this alternative, including the lack of visibility from high floodwalls, and safety concerns with homeless encampments that may arise from no visual access from bridges.	◔	The community has many concerns with this alternative, including the lack of visibility from high floodwalls. Safety concerns that may arise from no visual access from bridges is reduced by using passive barriers instead of headwalls.	◒	The community has some concerns with this alternative, including safety concerns with homeless encampments that may arise from no visual access from bridges.	◒	The community has some concerns with this alternative, including safety concerns with homeless encampments that may arise from no visual access from bridges.
Summary Objective 8 Rating					◔		◔		◔		◒		◒	

					Off Stream Detention with Minimal ROW Acquisition		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (No Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (No Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (25yr Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (25-yr Upper Guadalupe Improvements)	
NFP Objectives	**Objective Weight**	**Justification**	**NFP Criteria**	**Default Criteria Weight**	**Feasible Alternatives**									
					D.2	**Comments/Justification**	**H.1a**	**Comments/Justification**	**H.1b**	**Comments/Justification**	**H.1c**	**Comments/Justification**	**H.1d**	**Comments/Justification**
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	⊗	The alternative was not reviewed by public safety officials to evaluate safety concerns	⊗	The alternative was not reviewed by public safety officials to evaluate safety concerns	⊗	The alternative was not reviewed by public safety officials to evaluate safety concerns	⊗	The alternative was not reviewed by public safety officials to evaluate safety concerns	⊗	The alternative was not reviewed by public safety officials to evaluate safety concerns
			8.2 Recreation	0.2	●	This alternative improves the recreational opportunities provided in the area. The existing Guadalupe River Trail is highly accessible to the public and is frequently used by commuters and recreationalists. In addition, this alternative would create a detention basin that could be used for public access and recreation in conjunction with the City of San Jose and the Guadalupe River Park Conservancy.	◕	This alternative makes no changes to the recreational opportunities provided in the area. The Guadalupe River Trail is highly accessible to the public and is frequently used by commuters and recreationalists.	◕	This alternative makes no changes to the recreational opportunities provided in the area. The Guadalupe River Trail is highly accessible to the public and is frequently used by commuters and recreationalists.	◕	This alternative makes no changes to the recreational opportunities provided in the area. The Guadalupe River Trail is highly accessible to the public and is frequently used by commuters and recreationalists.	◕	This alternative makes no changes to the recreational opportunities provided in the area. The Guadalupe River Trail is highly accessible to the public and is frequently used by commuters and recreationalists.
			8.3 Aesthetics	0.2	◔	This alternative would slightly reduce the heights of floodwalls needed, but they would still be very high. It would also create a detention basin that harmonizes with the landscape, and would be a significant improvement to the park area that exists now.	◒	This alternative significantly reduces the water surface elevation of the peak flow, and therefore floodwall heights are lower and headwalls are needed on less bridges.	◕	This alternative significantly reduces the water surface elevation of the peak flow, and uses levees instead of floodwalls. Heights are lower and headwalls are needed on less bridges. This will significantly improve the aesthetics of the project compared to other alternatives.	○	This alternative slightly reduces the water surface elevation of the peak flow, and therefore floodwall heights are slightly lower.	◒	This alternative slightly reduces the water surface elevation of the peak flow, and uses levees instead of floodwalls. Heights are slightly lower
			8.4 Open Space	0.2	◕	This alternative's detention basin would improve existing open space by creating a multi-use recreation area that would benefit the public and the environment.	◒	This alternative makes no changes to existing open space within the area	◒	This alternative makes no changes to existing open space within the area	◒	This alternative makes no changes to existing open space within the area	◒	This alternative makes no changes to existing open space within the area
			8.5 Community Support	0.2	◔	The community has many concerns with this alternative, including the lack of visibility from high floodwalls. Safety concerns that may arise from no visual access from bridges is reduced by using passive barriers instead of headwalls. The community has also been apprehensive about a detention basin in Guadalupe Gardens.	◕	Based on reactions from public meetings, this alternative seems to be the most acceptable alternative with the community	◕	Based on reactions from public meetings, this alternative seems to be the most acceptable alternative with the community	○	The community has many concerns with this alternative, including the lack of visibility from high floodwalls, and safety concerns with homeless encampments that may arise from no visual access from bridges.	◒	The community has some concerns with this alternative, including safety concerns with homeless encampments that may arise from no visual access from bridges.
Summary Objective 8 Rating					◒		◒		◒		◔		◒	

NFP Objectives	Objective Weight	Justification	NFP Criteria	Default Criteria Weight	Re-Operate Lenihan Dam and Floodwalls (No Upper Guadalupe Improvements)		Re-Operate Lenihan Dam and Levees (No Upper Guadalupe Improvements)	
					J.a	Comments/Justification	J.b	Comments/Justification
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	⊗	The alternative was not reviewed by public safety officials to evaluate safety concerns	⊗	The alternative was not reviewed by public safety officials to evaluate safety concerns
			8.2 Recreation	0.2	◕	This alternative makes no changes to the recreational opportunities provided in the area. The Guadalupe River Trail is highly accessible to the public and is frequently used by commuters and recreationalists.	◕	This alternative makes no changes to the recreational opportunities provided in the area. The Guadalupe River Trail is highly accessible to the public and is frequently used by commuters and recreationalists.
			8.3 Aesthetics	0.2	◒	This alternative significantly reduces the water surface elevation of the peak flow, and therefore floodwall heights are lower and headwalls are needed on less bridges.	◒	This alternative significantly reduces the water surface elevation of the peak flow, and therefore levee heights are lower and headwalls are needed on less bridges.
			8.4 Open Space	0.2	◒	This alternative makes no changes to existing open space within the area	◒	This alternative makes no changes to existing open space within the area
			8.5 Community Support	0.2	◕	Based on reactions from public meetings, this alternative seems to be the most acceptable alternative with the community	◕	Based on reactions from public meetings, this alternative seems to be the most acceptable alternative with the community
			Summary Objective 8 Rating		◒		◒	

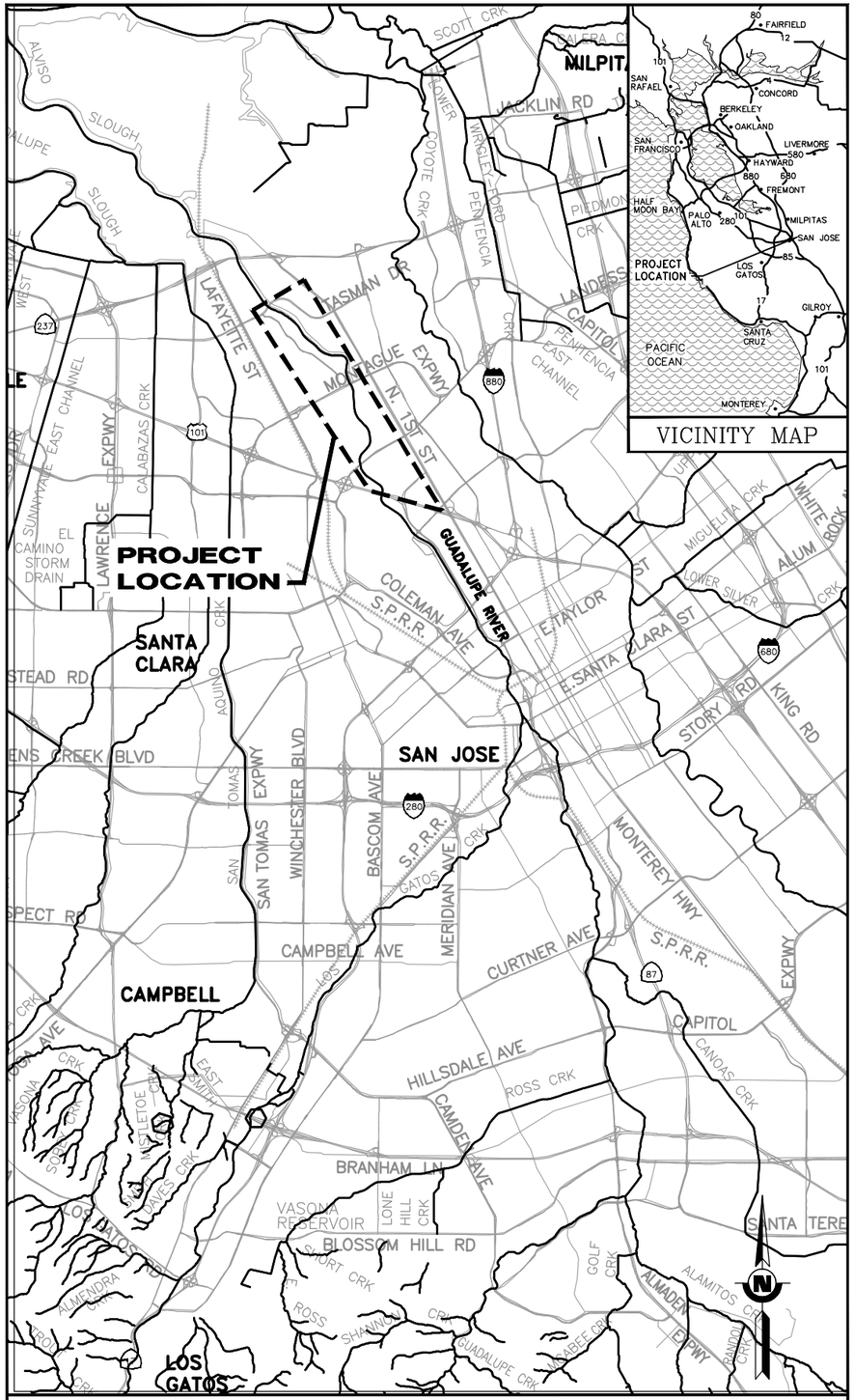
NFP Objectives	Objective Weight	Justification	NFP Criteria	Default Criteria Weight	A: No Project	B: Floodwalls and Headwalls	B.2: Floodwalls, Passive Barriers, Closed Roadways	C: Levees with Retaining Walls and Headwalls	C.1: Levees Floodwalls and Headwalls	D.2: Off Stream Detention with Minimal ROW Acquisition	H.1a: Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (No Upper Guadalupe Improvements)	H.1b: Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (No Upper Guadalupe Improvements)	H.1c: Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (25yr Upper Guadalupe Improvements)	H.1d: Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (25-yr Upper Guadalupe Improvements)	J.a: Re-Operate Lenihan Dam and Floodwalls (No Upper Guadalupe Improvements)	J.b: Re-Operate Lenihan Dam and Levees (No Upper Guadalupe Improvements)
					Comments/ Justification	Comments/ Justification	Comments/ Justification	Comments/ Justification	Comments/ Justification	Comments/ Justification	Comments/ Justification	Comments/ Justification	Comments/ Justification	Comments/ Justification	Comments/ Justification	Comments/ Justification
Objective 9. Minimize Life-Cycle Cost	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		$1,048,760	$67,516,927	$78,538,745	$101,973,677	$85,816,094	$108,299,217	$51,288,309	$51,657,547	$76,829,610	$94,257,640	$15,054,876	$21,957,547
			9.2 Maintenance Cost (NPV)		$5,706,000	$14,140,000	$14,140,000	$14,140,000	$14,140,000	$15,711,000	$14,140,000	$14,140,000	$14,140,000	$14,140,000	$14,140,000	$14,140,000
			9.3 Grant or Cost-Sharing Opportunities													
			Summary Objective 9 Rating		$6,754,760	$81,656,927	$92,678,745	$116,113,677	$99,956,094	$124,010,217	$65,428,309	$65,797,547	$90,969,610	$108,397,640	$29,194,876	$36,097,547

					No Project		Floodwalls and Headwalls		Floodwalls, Passive Barriers, Closed Roadways		Levees with Retaining Walls and Headwalls		Levees Floodwalls and Headwalls	
NFP Objectives	**Objective Weight**	**Justification**	**NFP Criteria**	**Default Criteria Weight**	**A**	**Comments/Justification**	**B**	**Comments/Justification**	**B.2**	**Comments/Justification**	**C**	**Comments/Justification**	**C.1**	**Comments/Justification**
Objective 10. 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 or Central Coast Basin Plan	0.5	⊗	Vegetation management necessary to maintain flood capacity would result in significant erosion and sedimentation of Guadalupe River. Project alternative will have potentially adverse effects on existing or potential beneficial uses for the water body.	◔	This alternative is designed to minimize impacts to waterbody. Floodwalls would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance. Construction would be conducted on outboard side of levees and remain outside the ordinary highwater mark. Some of the headwalls on bridges would trigger instream work due to pier modifications.	◔	This alternative is designed to minimize impacts to waterbody. Floodwalls would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance. Construction would be conducted on outboard side of levees and remain outside the ordinary highwater mark. Passive barriers on bridges would avoid the need to elevate or replace bridges and avoid instream work.	◒	This alternative is designed to minimize impacts to waterbody. Higher levees would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance in the channel. Vegetation on levees would be cleared for maintenance and visual inspections. Construction on levees may increase the levee footprint and may impact ordinary highwater mark. Some of the headwalls on bridges would trigger instream work due to pier modifications.	◔	This alternative is designed to minimize impacts to waterbody. Higher levees would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance in the channel. Vegetation on levees would be cleared for maintenance and visual inspections. Construction on levees may increase the levee footprint and may impact ordinary highwater mark. Flood walls would reduce the height requirement for the Levee. Some of the headwalls on bridges would trigger instream work due to pier modifications.
			10.2 Identify the Least Environmentally Damaging Practicable Alternative (LEDPA)	0.5	⊗	Vegetation management necessary to maintain flood capacity would result in significant erosion and sedimentation and impacts to habitat within the Guadalupe River channel. . Project alternative will have potentially adverse effects on existing or potential beneficial uses for the water body.	◔	This alternative is designed to minimize impacts to waterbody. Floodwalls would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance. Construction would be conducted on outboard side of levees and remain outside the ordinary highwater mark. Some of the headwalls on bridges would trigger instream work due to pier modifications.	◔	This alternative is designed to minimize impacts to waterbody. Floodwalls would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance. Construction would be conducted on outboard side of levees and remain outside the ordinary highwater mark. Passive barriers on bridges would avoid the need to elevate or replace bridges and avoid instream work.	◒	This alternative is designed to minimize impacts to waterbody. Higher levees would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance in the channel. Vegetation on levees would be cleared for maintenance and visual inspections. Construction on levees may increase the levee footprint and may impact ordinary highwater mark. Some of the headwalls on bridges would trigger instream work due to pier modifications.	◔	This alternative is designed to minimize impacts to waterbody. Higher levees would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance in the channel. Vegetation on levees would be cleared for maintenance and visual inspections. Construction on levees may increase the levee footprint and may impact ordinary highwater mark. Flood walls would reduce the height requirement for the Levee. Some of the headwalls on bridges would trigger instream work due to pier modifications.
Summary Objective 10 Rating					⊗		◔		◔		◒		◔	

					Off Stream Detention with Minimal ROW Acquisition		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (No Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (No Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (25yr Upper Guadalupe Improvements)		Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (25-yr Upper Guadalupe Improvements)	
NFP Objectives	**Objective Weight**	**Justification**	**NFP Criteria**	**Default Criteria Weight**	**Feasible Alternatives**									
					D.2	**Comments/Justification**	**H.1a**	**Comments/Justification**	**H.1b**	**Comments/Justification**	**H.1c**	**Comments/Justification**	**H.1d**	**Comments/Justification**
Objective 10. 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 or Central Coast Basin Plan	0.5	◒	A detention basin at Guadalupe Gardens would reduce the height needed for flood walls. This alternative would allow vegetation to grow naturally in the stream channel and minimize need for vegetation maintenance in the channel. Construction would be conducted on outboard side of levees and remain outside the ordinary highwater mark. Some of the headwalls on bridges would trigger instream work due to pier modifications.	◕	Replacing the Dam outlet may have some impacts to stream flow within the stream channel during construction. This alternative would allow larger flows to be released before storms to increase capacity in Lexington Reservoir. This alternative with floodwalls would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance. Construction would be conducted on outboard side of levees and remain outside the ordinary highwater mark. Headwalls on bridges would avoid the need to elevate or replace bridges and avoid instream work.	◕	Replacing the Dam outlet may have some impacts to stream flow within the stream channel during construction. This alternative would allow larger flows to be released before storms to increase capacity in Lexington Reservoir. This alternative with levees would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance. Construction would be conducted on top of and to the outboard side of levees and remain outside the ordinary highwater mark. Headwalls on bridges would avoid the need to elevate or replace bridges and avoid instream work.	○	Replacing the Dam outlet may have some impacts to stream flow within the stream channel during construction. This alternative would allow larger flows to be released before storms to increase capacity in Lexington Reservoir. This alternative with floodwalls would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance. Construction would be conducted on outboard side of levees and remain outside the ordinary highwater mark. Some of the headwalls on bridges would trigger instream work due to pier modifications.	◒	Replacing the Dam outlet may have some impacts to stream flow within the stream channel during construction. This alternative would allow larger flows to be released before storms to increase capacity in Lexington Reservoir. This alternative with levees would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance. Construction would be conducted on top of and to the outboard side of levees and remain outside the ordinary highwater mark. Some of the headwalls on bridges would trigger instream work due to pier modifications.
			10.2 Identify the Least Environmentally Damaging Practicable Alternative (LEDPA)	0.5	◒	This alternative is designed to minimize impacts to waterbody. A detention basin at Guadalupe Gardens would reduce the height needed for flood walls. This alternative would allow vegetation to grow naturally in the stream channel and minimize need for vegetation maintenance in the channel. Construction would be conducted on outboard side of levees and remain outside the ordinary highwater mark. Some of the headwalls on bridges would trigger instream work due to pier modifications.	◕	Replacing the Dam outlet may have some impacts to stream flow within the stream channel during construction. This alternative would allow larger flows to be released before storms to increase capacity in Lexington Reservoir. This alternative with floodwalls would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance. Construction would be conducted on outboard side of levees and remain outside the ordinary highwater mark. Headwalls on bridges would avoid the need to elevate or replace bridges and avoid instream work.	◕	Replacing the Dam outlet may have some impacts to stream flow within the stream channel during construction. This alternative would allow larger flows to be released before storms to increase capacity in Lexington Reservoir. This alternative with levees would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance. Construction would be conducted on top of and to the outboard side of levees and remain outside the ordinary highwater mark. Headwalls on bridges would avoid the need to elevate or replace bridges and avoid instream work.	○	Replacing the Dam outlet may have some impacts to stream flow within the stream channel during construction. This alternative would allow larger flows to be released before storms to increase capacity in Lexington Reservoir. This alternative with floodwalls would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance. Construction would be conducted on outboard side of levees and remain outside the ordinary highwater mark. Some of the headwalls on bridges would trigger instream work due to pier modifications.	◒	Replacing the Dam outlet may have some impacts to stream flow within the stream channel during construction. This alternative would allow larger flows to be released before storms to increase capacity in Lexington Reservoir. This alternative with levees would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance. Construction would be conducted on top of and to the outboard side of levees and remain outside the ordinary highwater mark. Some of the headwalls on bridges would trigger instream work due to pier modifications.
Summary Objective 10 Rating					◒		◕		◕		○		◒	

					Re-Operate Lenihan Dam and Floodwalls (No Upper Guadalupe Improvements)		Re-Operate Lenihan Dam and Levees (No Upper Guadalupe Improvements)	
NFP Objectives	**Objective Weight**	**Justification**	**NFP Criteria**	**Default Criteria Weight**	**J.a**	**Comments/Justification**	**J.b**	**Comments/Justification**
Objective 10. 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 or Central Coast Basin Plan	0.5		This alternative would avoid construction of new outlet at Lenihan Dam. Reoperation of Lenihan Dam would allow larger flows to be released before storms to increase capacity in Lexington Reservoir. This alternative with floodwalls would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance. Construction would be conducted on outboard side of levees and remain outside the ordinary highwater mark. Headwalls on bridges would avoid the need to elevate or replace bridges and avoid instream work.		This alternative would avoid construction of new outlet at Lenihan Dam. Reoperation of Lenihan Dam would allow larger flows to be released before storms to increase capacity in Lexington Reservoir. This alternative with floodwalls would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance. Construction would be conducted on outboard side of levees and remain outside the ordinary highwater mark. Headwalls on bridges would avoid the need to elevate or replace bridges and avoid instream work.
			10.2 Identify the Least Environmentally Damaging Practicable Alternative (LEDPA)	0.5		This alternative would avoid construction of new outlet at Lenihan Dam. Reoperation of Lenihan Dam would allow larger flows to be released before storms to increase capacity in Lexington Reservoir. This alternative with floodwalls would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance. Construction would be conducted on outboard side of levees and remain outside the ordinary highwater mark. Headwalls on bridges would avoid the need to elevate or replace bridges and avoid instream work.		This alternative would avoid construction of new outlet at Lenihan Dam. Reoperation of Lenihan Dam would allow larger flows to be released before storms to increase capacity in Lexington Reservoir. This alternative with floodwalls would allow vegetation to grow naturally in the flood channel and minimize need for vegetation maintenance. Construction would be conducted on outboard side of levees and remain outside the ordinary highwater mark. Headwalls on bridges would avoid the need to elevate or replace bridges and avoid instream work.
Summary Objective 10 Rating								

Appendix C
Initial Engineering Drawings



PRELIMINARY MAP AND CONSTRUCTION PLAN

FOR

LOWER GUADALUPE RIVER CAPACITY RESTORATION PROJECT

SAN JOSE, CALIFORNIA

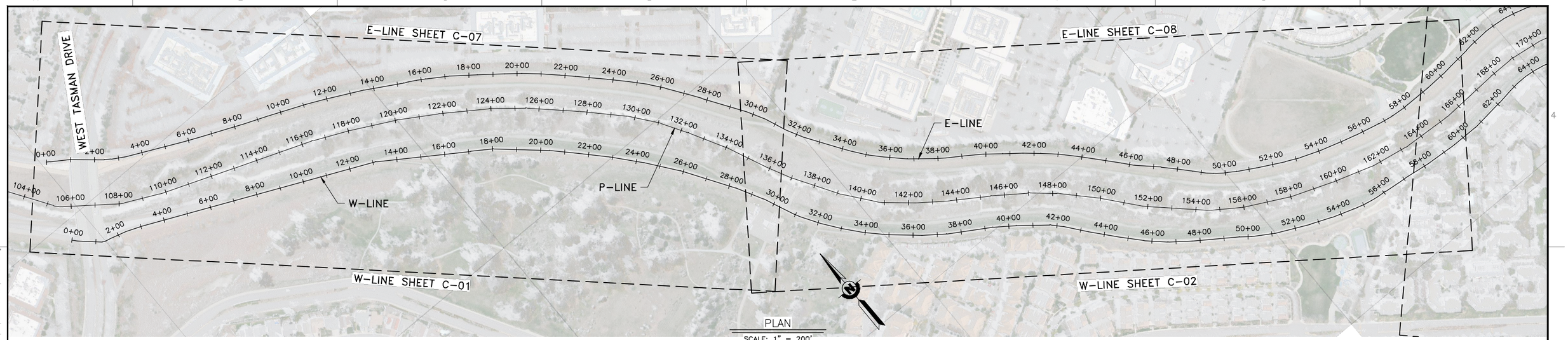
SANTA CLARA VALLEY WATER DISTRICT

Valley Water

10% PRELIMINARY DESIGN

03-28-2024

CONTRACT NUMBER	C-XXXXX
PROJECT NUMBER	30154019
SHEET CODE:	G-01
SHEET NUMBER: 01	TOTAL SHEETS: 16



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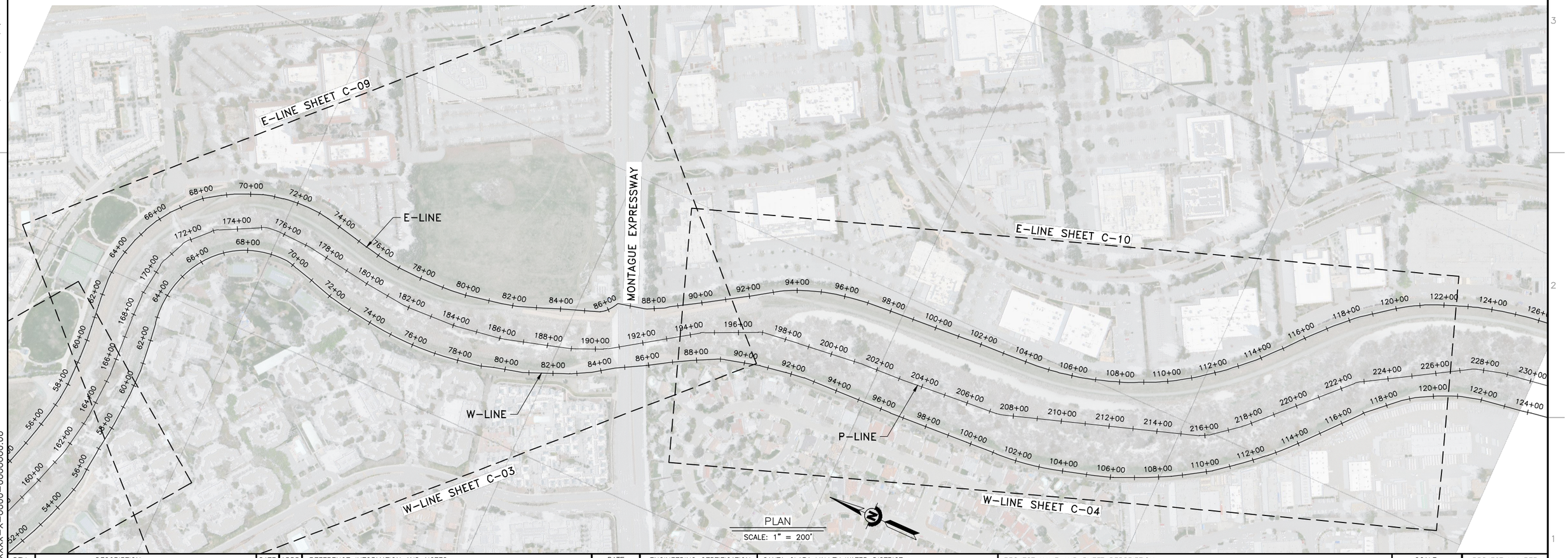

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DOCUMENT NUMBER: XXXX-X-0000-0000000.00

REV	DESCRIPTION	DATE	APPR
	10% PRELIMINARY **MARCH 2024**		

REFERENCE INFORMATION AND NOTES

DATE: 3/28/2024
DESIGN: K. MULLER
DRAWN: J. PINKERTON
CHECKED:

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

PROJECT NAME AND SHEET DESCRIPTION:

LOWER GUADALUPE RIVER CAPACITY RESTORATION PROJECT

INDEX MAP
P-LINE STA 104+00 - 230+00

SCALE: AS SHOWN

VERIFY SCALES
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BAR IS ONE INCH ON ORIGINAL DRAWING
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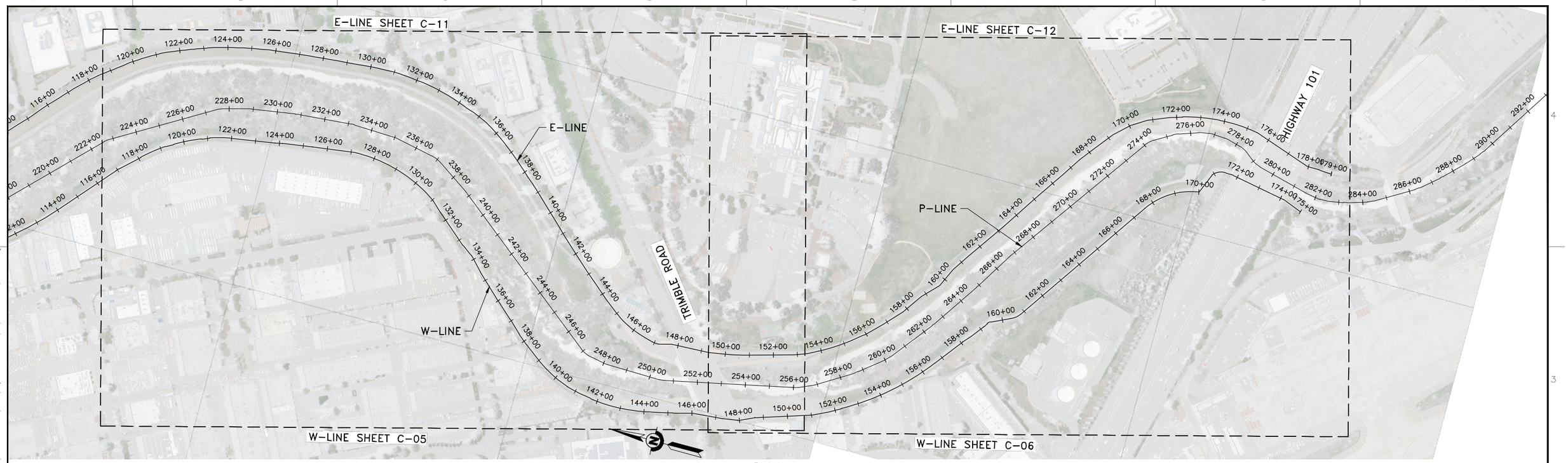
PROJECT NUMBER: 30154019

SHEET CODE: G-02

SHEET NUMBER: 2 OF 16



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REV	DESCRIPTION	DATE	APPR	REFERENCE INFORMATION AND NOTES
	10% PRELIMINARY MARCH 2024			

DATE 3/28/2024
DESIGN K. MULLER
DRAWN J. PINKERTON
CHECKED

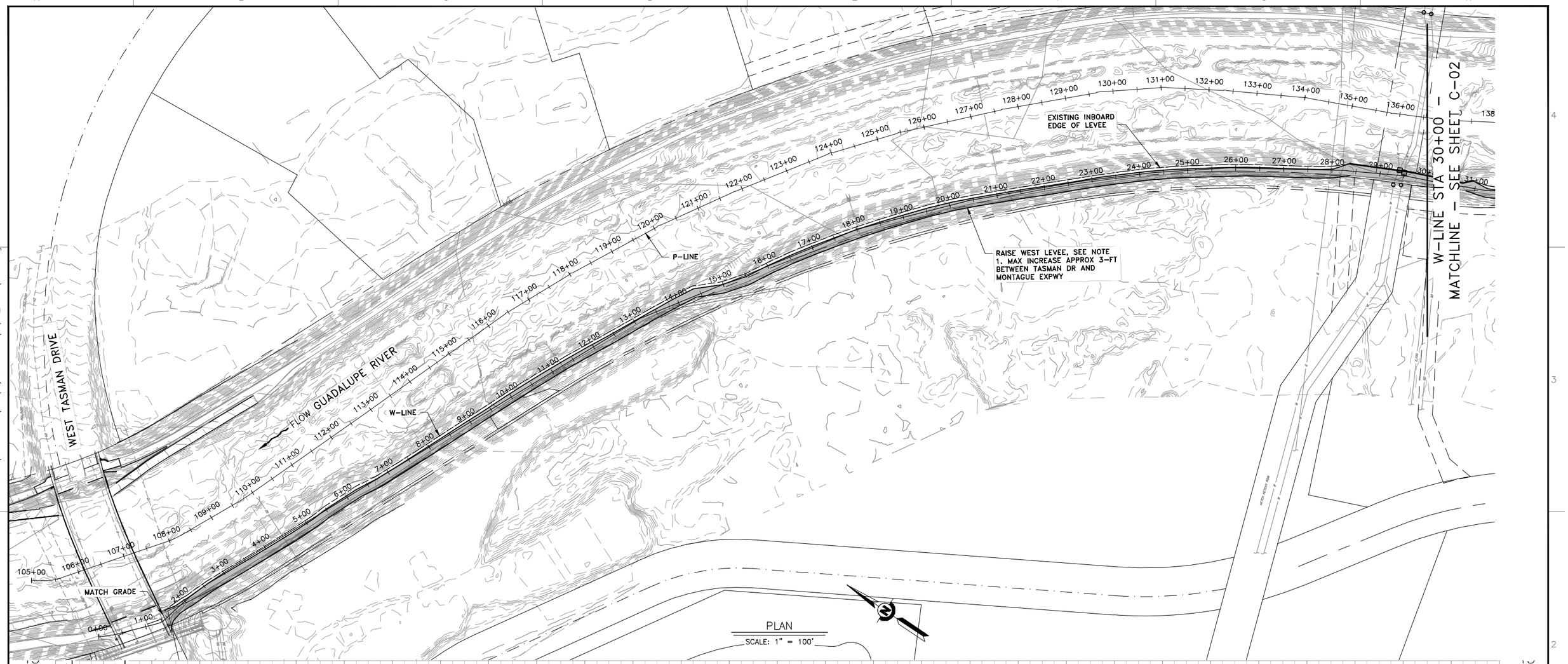
ENGINEERING CERTIFICATION
PROJECT ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT
Valley Water

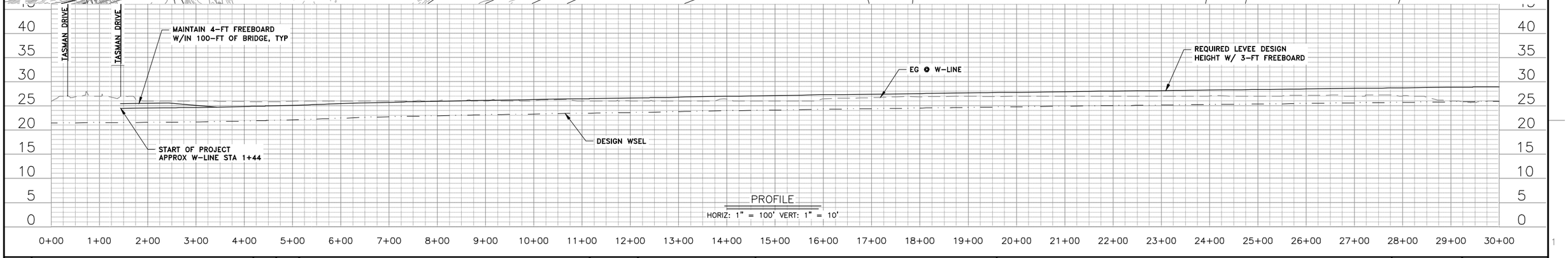
PROJECT NAME AND SHEET DESCRIPTION:
LOWER GUADALUPE RIVER CAPACITY RESTORATION PROJECT
INDEX MAP
P-LINE STA 220+00 - 292+00

SCALE AS SHOWN
VERIFY SCALES 0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER 30154019
SHEET CODE: G-03
SHEET NUMBER: 3 OF 16



PLAN
SCALE: 1" = 100'



PROFILE
HORIZ: 1" = 100' VERT: 1" = 10'

REV	DESCRIPTION	DATE	APPR
	10% PRELIMINARY **MARCH 2024**		

REFERENCE INFORMATION AND NOTES

1. FREEBOARD REQUIREMENTS:
   - 1.1. MINIMUM 4-FT OF FREEBOARD IS REQUIRED WITHIN 100-FT OF BRIDGES.
   - 1.2. MINIMUM 3-FT OF FREEBOARD IS REQUIRED ELSEWHERE.
   - 1.3. HEADWALLS SHALL PROVIDE MINIMUM 4-FT OF FREEBOARD.

DATE: 3/28/2024
DESIGN: K. MULLER
DRAWN: J. PINKERTON
CHECKED:

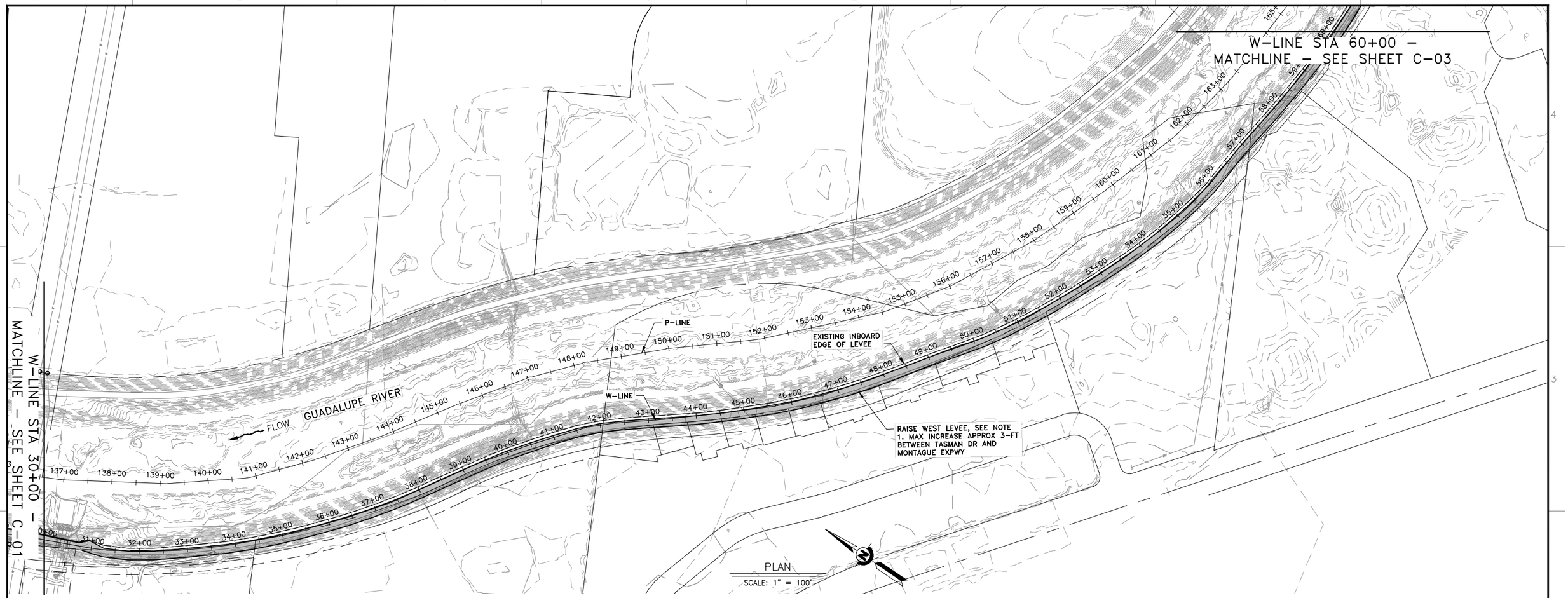
ENGINEERING CERTIFICATION
PROJECT ENGINEER DATE

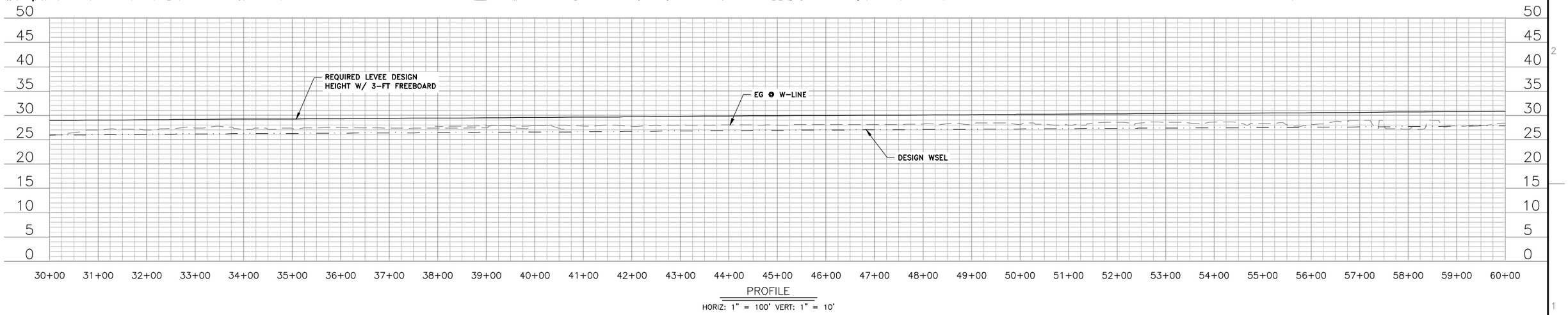
SANTA CLARA VALLEY WATER DISTRICT
Valley Water

PROJECT NAME AND SHEET DESCRIPTION:
LOWER GUADALUPE RIVER CAPACITY RESTORATION PROJECT
PLAN AND PROFILE W-LINE STA 0+00 - 30+00

SCALE: AS SHOWN
PROJECT NUMBER: 30154019
VERIFY SCALES: 0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY
SHEET CODE: C-01
SHEET NUMBER: 4 OF 16

DOCUMENT NUMBER: XXXX-X-0000-0000000.00





REV	DESCRIPTION	DATE	APPR
	10% PRELIMINARY **MARCH 2024**		

REFERENCE INFORMATION AND NOTES

1. FREEBOARD REQUIREMENTS:
   - 1.1. MINIMUM 4-FT OF FREEBOARD IS REQUIRED WITHIN 100-FT OF BRIDGES.
   - 1.2. MINIMUM 3-FT OF FREEBOARD IS REQUIRED ELSEWHERE.
   - 1.3. HEADWALLS SHALL PROVIDE MINIMUM 4-FT OF FREEBOARD.

DATE 3/28/2024
DESIGN K. MULLER
DRAWN J. PINKERTON
CHECKED

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

PROJECT NAME AND SHEET DESCRIPTION:

LOWER GUADALUPE RIVER CAPACITY RESTORATION PROJECT

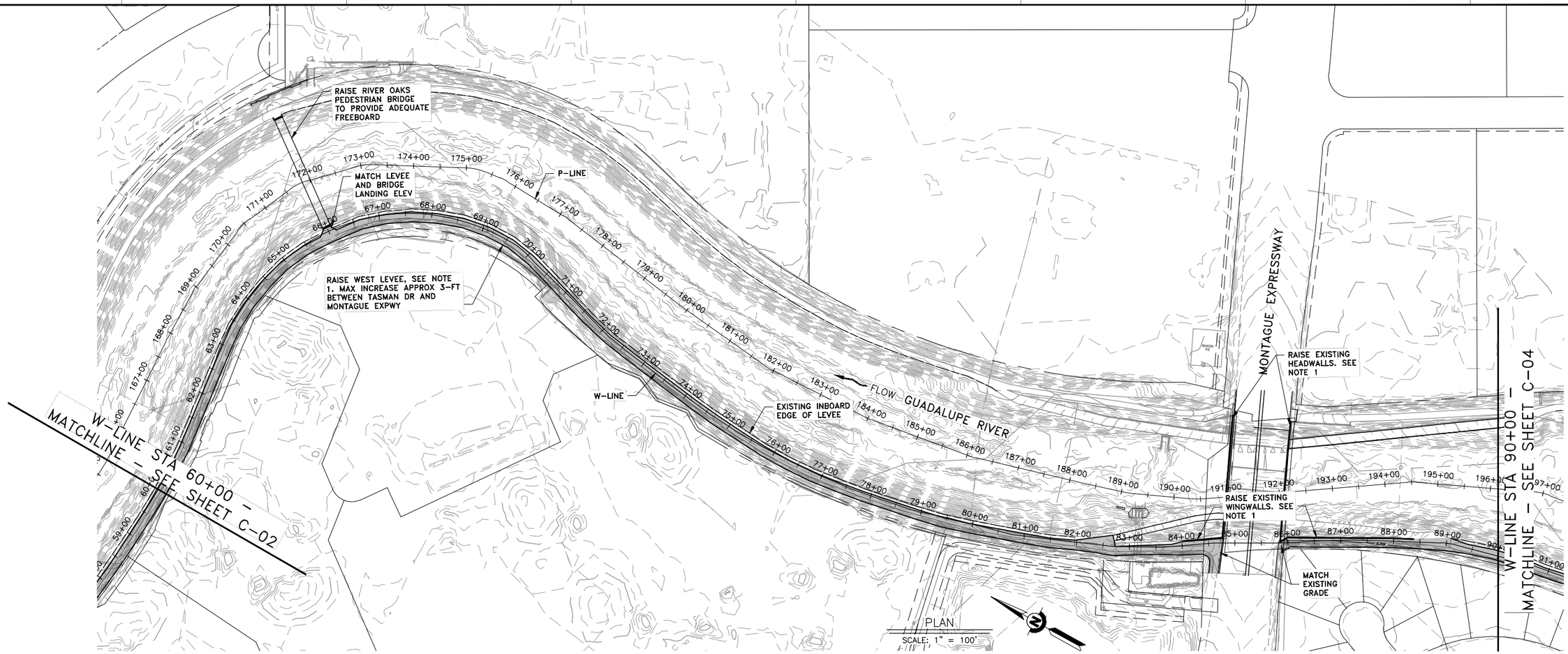
PLAN AND PROFILE
W-LINE STA 30+00 – 60+00

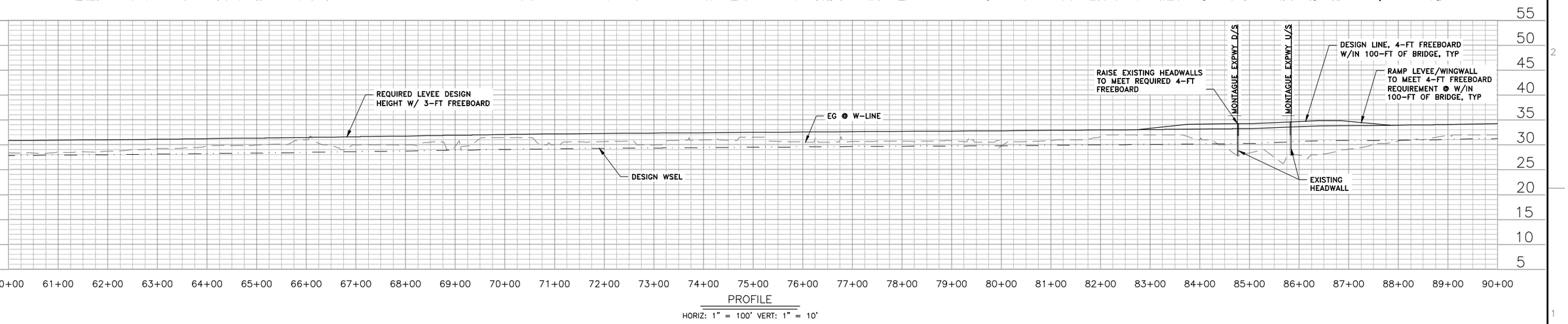
SCALE	PROJECT NUMBER
AS SHOWN	30154019

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

SHEET CODE: C-02
SHEET NUMBER: 5 OF 16

DOCUMENT NUMBER: XXXX-X-0000-0000000.00





REV	DESCRIPTION	DATE	APPR
	10% PRELIMINARY **MARCH 2024**		

REFERENCE INFORMATION AND NOTES

1. FREEBOARD REQUIREMENTS:
   - 1.1. MINIMUM 4-FT OF FREEBOARD IS REQUIRED WITHIN 100-FT OF BRIDGES.
   - 1.2. MINIMUM 3-FT OF FREEBOARD IS REQUIRED ELSEWHERE.
   - 1.3. HEADWALLS SHALL PROVIDE MINIMUM 4-FT OF FREEBOARD.

DATE: 3/28/2024
DESIGN: K. MULLER
DRAWN: J. PINKERTON
CHECKED:

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

PROJECT NAME AND SHEET DESCRIPTION:

LOWER GUADALUPE RIVER CAPACITY RESTORATION PROJECT

PLAN AND PROFILE W-LINE STA 60+00 - 90+00

SCALE: AS SHOWN

VERIFY SCALES: 0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

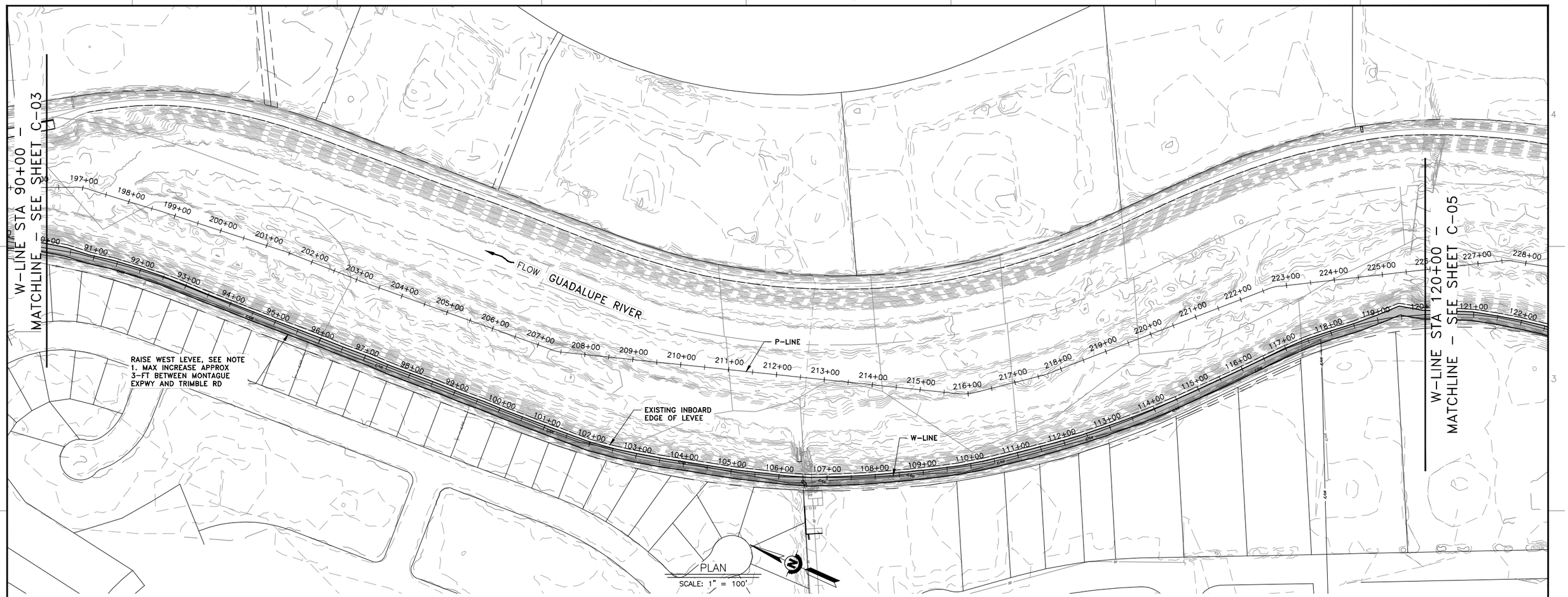
PROJECT NUMBER: 30154019

SHEET CODE: C-03

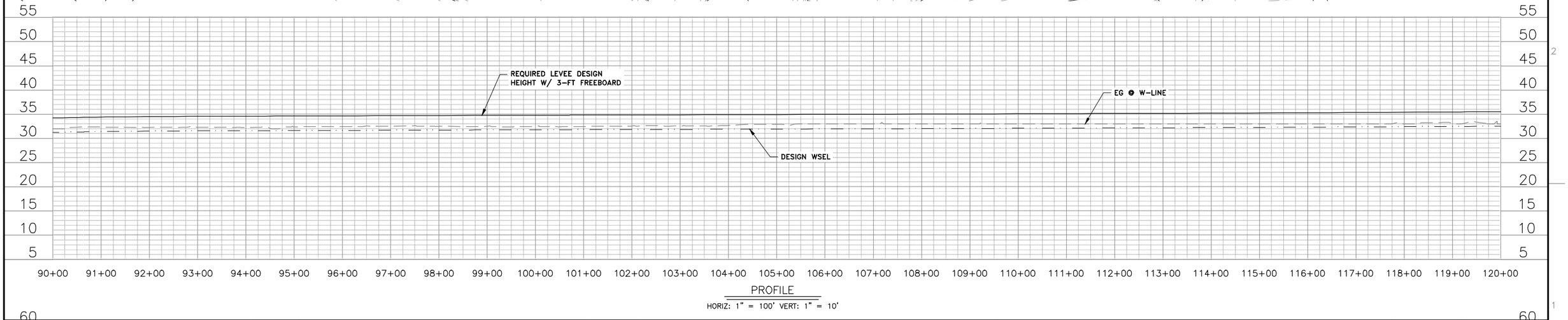
SHEET NUMBER: 6 OF 16

W-LINE STA 90+00 - MATCHLINE - SEE SHEET C-03

W-LINE STA 120+00 - MATCHLINE - SEE SHEET C-05



PLAN
SCALE: 1" = 100'



PROFILE
HORIZ: 1" = 100' VERT: 1" = 10'

REV	DESCRIPTION	DATE	APPR
	10% PRELIMINARY **MARCH 2024**		

REFERENCE INFORMATION AND NOTES

1. FREEBOARD REQUIREMENTS:
   - 1.1. MINIMUM 4-FT OF FREEBOARD IS REQUIRED WITHIN 100-FT OF BRIDGES.
   - 1.2. MINIMUM 3-FT OF FREEBOARD IS REQUIRED ELSEWHERE.
   - 1.3. HEADWALLS SHALL PROVIDE MINIMUM 4-FT OF FREEBOARD.

DATE	3/28/2024
DESIGN	K. MULLER
DRAWN	J. PINKERTON
CHECKED	

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

PROJECT NAME AND SHEET DESCRIPTION:

LOWER GUADALUPE RIVER CAPACITY RESTORATION PROJECT

PLAN AND PROFILE W-LINE STA 90+00 - 120+00

SCALE	PROJECT NUMBER
AS SHOWN	30154019

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

SHEET CODE: C-04

SHEET NUMBER: 7 OF 16

W-LINE STA 120+00 - SEE SHEET C-04
MATCHLINE

FLOW GUADALUPE RIVER

EXISTING INBOARD EDGE OF LEVEE

RAISE WEST LEVEE, SEE NOTE 1. MAX INCREASE APPROX 3-FT BETWEEN MONTAGUE EXPWY AND TRIMBLE RD

P-LINE

W-LINE

TRIMBLE ROAD

RAISE EXISTING HEADWALLS. SEE NOTE 1

RAISE EXISTING WINGWALLS. SEE NOTE 1

MATCH EXISTING GRADE

W-LINE STA 150+00 - SEE SHEET C-06
MATCHLINE

PLAN
SCALE: 1" = 100'

REQUIRED LEVEE DESIGN HEIGHT W/ 3-FT FREEBOARD

DESIGN WSEL

EG @ W-LINE

DESIGN LINE, 4-FT FREEBOARD W/IN 100-FT OF BRIDGE, TYP

RAMP LEVEE/WINGWALL TO MEET 4-FT FREEBOARD REQUIREMENT @ W/IN 100-FT OF BRIDGE, TYP

TRIMBLE RD D/S

TRIMBLE RD U/S

RAISE EXISTING HEADWALLS TO MEET REQUIRED 4-FT FREEBOARD

EXISTING HEADWALL

PROFILE
HORIZ: 1" = 100' VERT: 1" = 10'

REV	DESCRIPTION	DATE	APPR
	10% PRELIMINARY **MARCH 2024**		

REFERENCE INFORMATION AND NOTES

1. FREEBOARD REQUIREMENTS:
   1.1. MINIMUM 4-FT OF FREEBOARD IS REQUIRED WITHIN 100-FT OF BRIDGES.
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   1.3. HEADWALLS SHALL PROVIDE MINIMUM 4-FT OF FREEBOARD.

DATE: 3/28/2024
DESIGN: K. MULLER
DRAWN: J. PINKERTON
CHECKED:

ENGINEERING CERTIFICATION
PROJECT ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

PROJECT NAME AND SHEET DESCRIPTION:
LOWER GUADALUPE RIVER CAPACITY RESTORATION PROJECT
PLAN AND PROFILE W-LINE STA 120+00 - 150+00

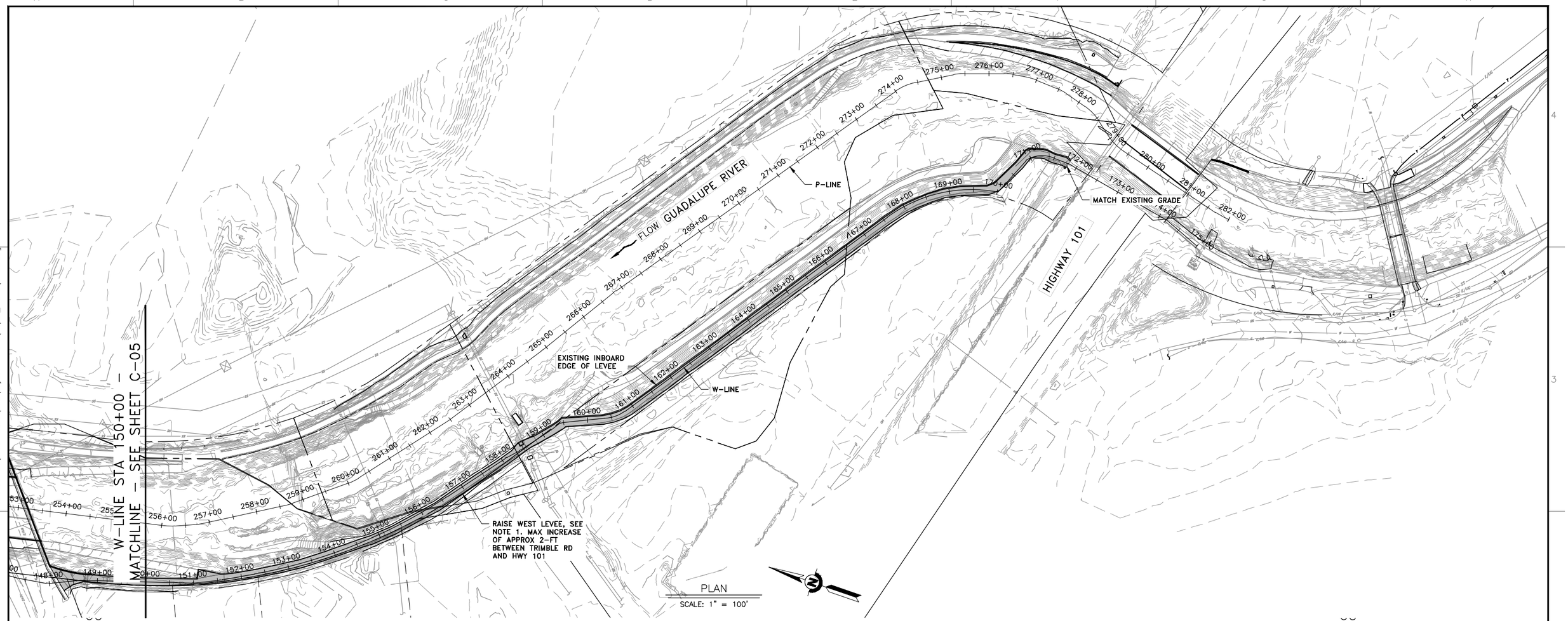
SCALE: AS SHOWN

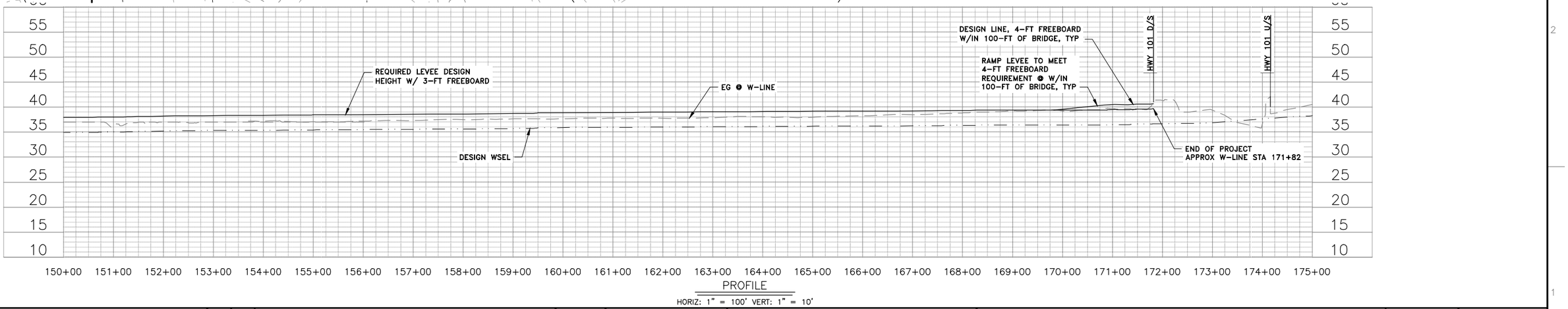
VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 30154019

SHEET CODE: C-05

SHEET NUMBER: 8 OF 16





REV	DESCRIPTION	DATE	APPR
	10% PRELIMINARY **MARCH 2024**		

REFERENCE INFORMATION AND NOTES

1. FREEBOARD REQUIREMENTS:
   1.1. MINIMUM 4-FT OF FREEBOARD IS REQUIRED WITHIN 100-FT OF BRIDGES.
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   1.3. HEADWALLS SHALL PROVIDE MINIMUM 4-FT OF FREEBOARD.

DATE	3/28/2024
DESIGN	K. MULLER
DRAWN	J. PINKERTON
CHECKED	

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

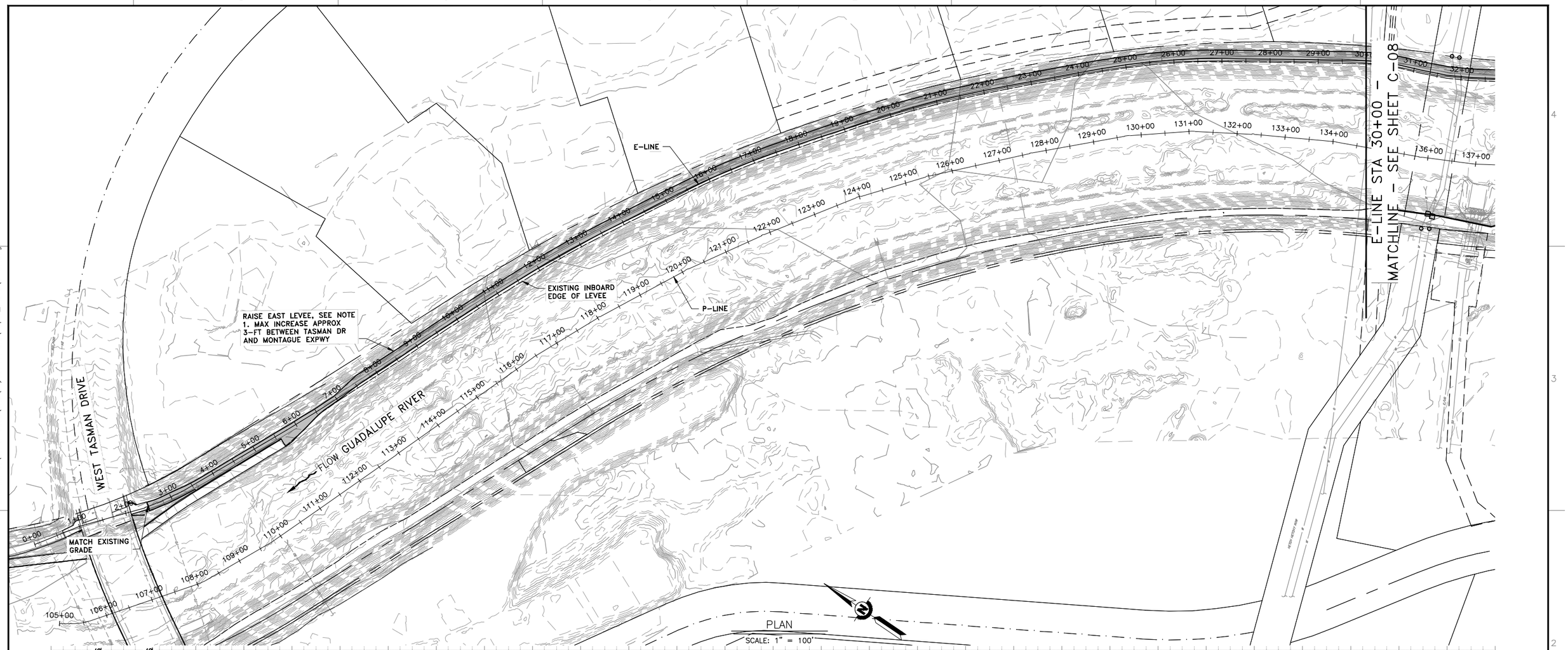
PROJECT NAME AND SHEET DESCRIPTION:

LOWER GUADALUPE RIVER CAPACITY RESTORATION PROJECT

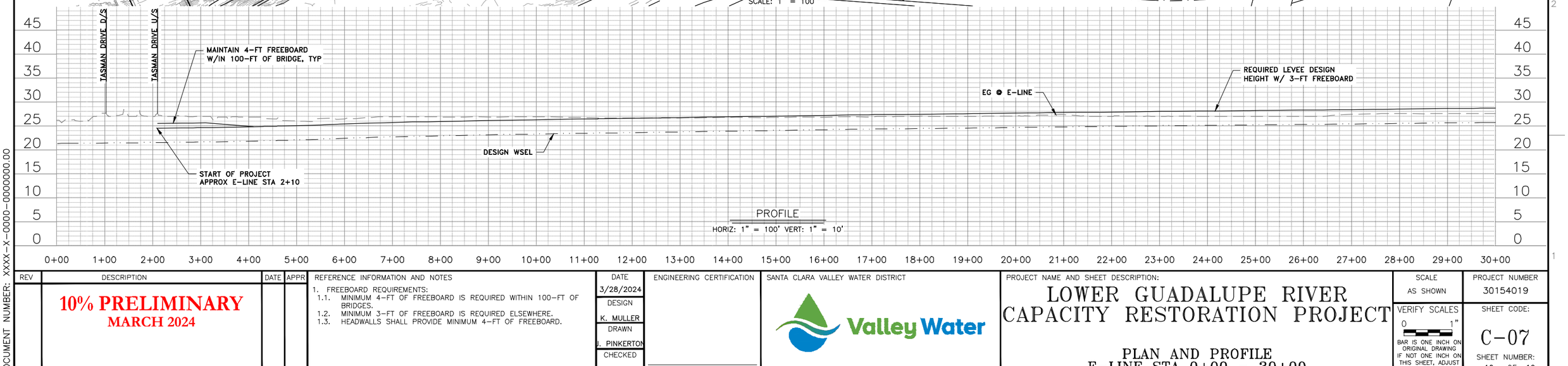
PLAN AND PROFILE W-LINE STA 150+00 - 175+00

SCALE	AS SHOWN
PROJECT NUMBER	30154019
VERIFY SCALES	0 1"
	BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY
SHEET CODE:	C-06
SHEET NUMBER:	9 OF 16

DOCUMENT NUMBER: XXXX-X-0000-0000000.00



PLAN
SCALE: 1" = 100'



PROFILE
HORIZ: 1" = 100' VERT: 1" = 10'

REV	DESCRIPTION	DATE	APPR
	10% PRELIMINARY **MARCH 2024**		

REFERENCE INFORMATION AND NOTES

1. FREEBOARD REQUIREMENTS:
   - 1.1. MINIMUM 4-FT OF FREEBOARD IS REQUIRED WITHIN 100-FT OF BRIDGES.
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DATE	3/28/2024
DESIGN	K. MULLER
DRAWN	J. PINKERTON
CHECKED	

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

PROJECT NAME AND SHEET DESCRIPTION:

LOWER GUADALUPE RIVER CAPACITY RESTORATION PROJECT

PLAN AND PROFILE
E-LINE STA 0+00 - 30+00

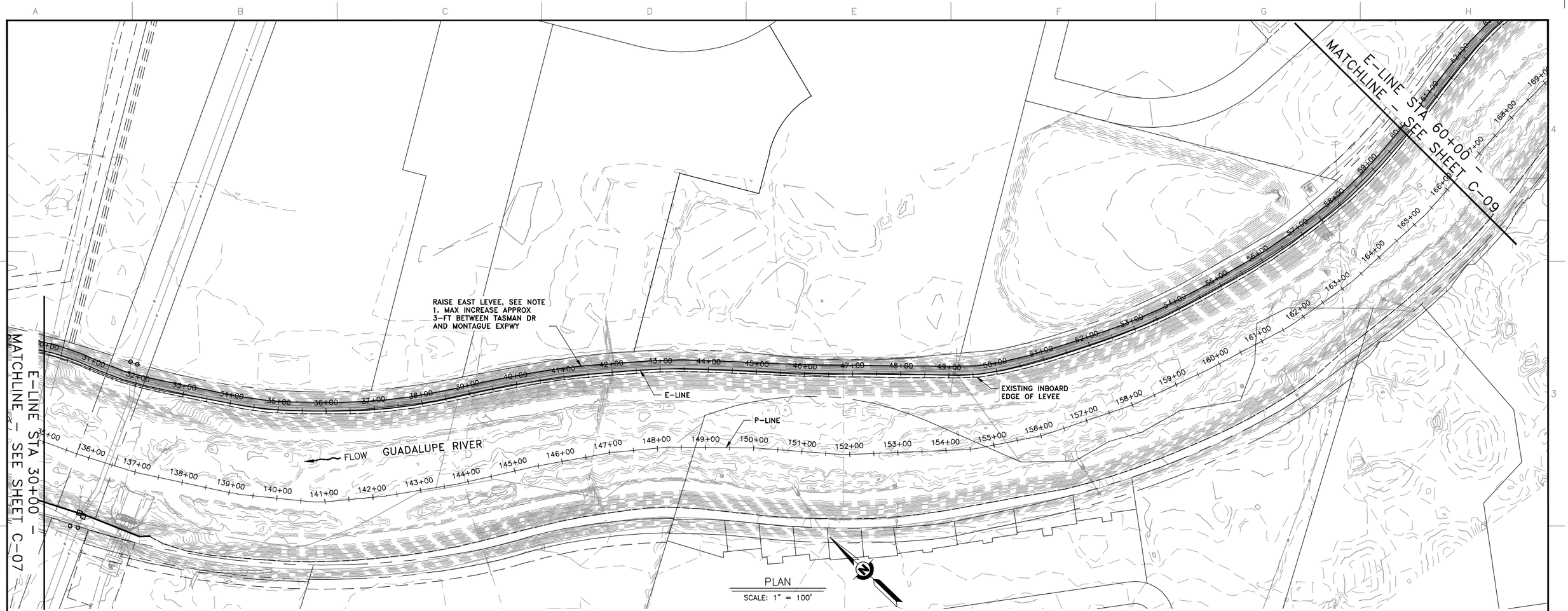
SCALE	PROJECT NUMBER
AS SHOWN	30154019

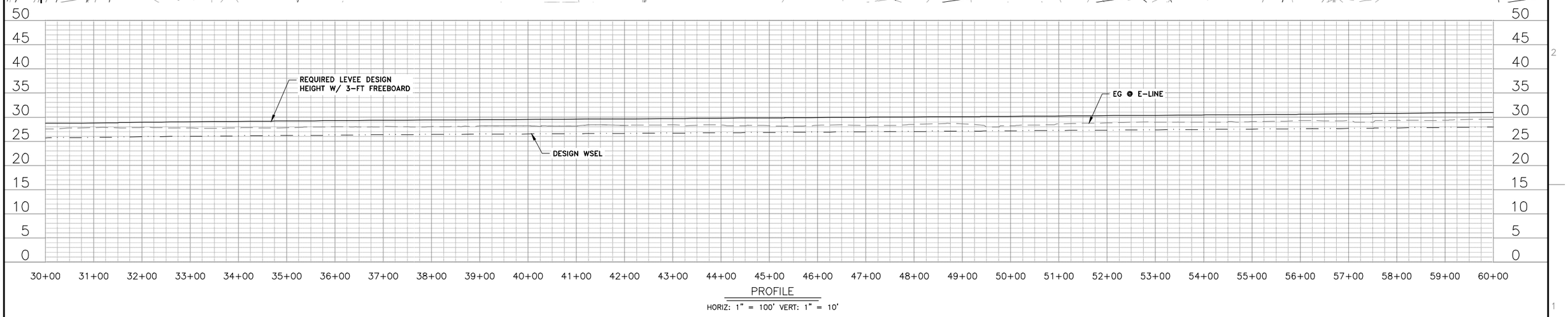
VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

SHEET CODE: C-07

SHEET NUMBER: 10 OF 16

DOCUMENT NUMBER: XXXX-X-0000-0000000.00





REV	DESCRIPTION	DATE	APPR
	10% PRELIMINARY **MARCH 2024**		

REFERENCE INFORMATION AND NOTES

1. FREEBOARD REQUIREMENTS:
   - 1.1. MINIMUM 4-FT OF FREEBOARD IS REQUIRED WITHIN 100-FT OF BRIDGES.
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DATE: 3/28/2024
DESIGN: K. MULLER
DRAWN: J. PINKERTON
CHECKED:

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

PROJECT NAME AND SHEET DESCRIPTION:

LOWER GUADALUPE RIVER CAPACITY RESTORATION PROJECT

PLAN AND PROFILE E-LINE STA 30+00 - 60+00

SCALE: AS SHOWN

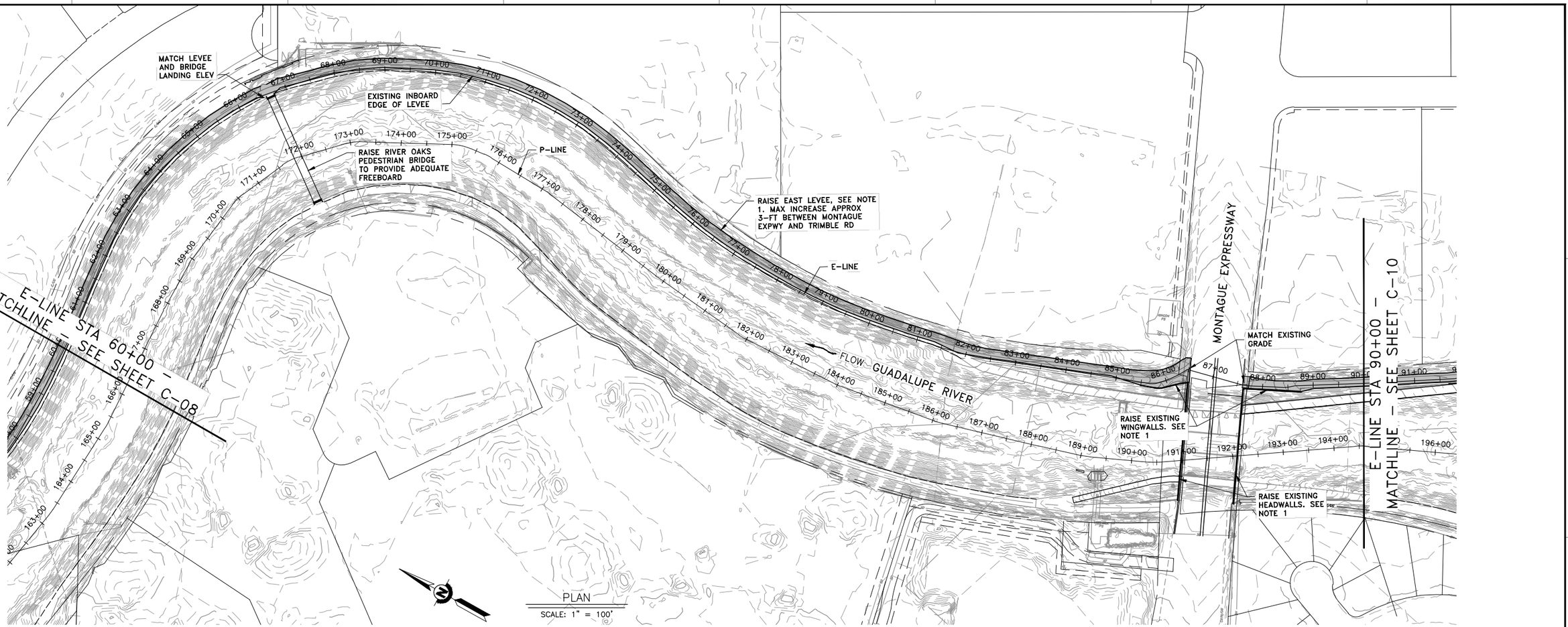
VERIFY SCALES: 0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 30154019

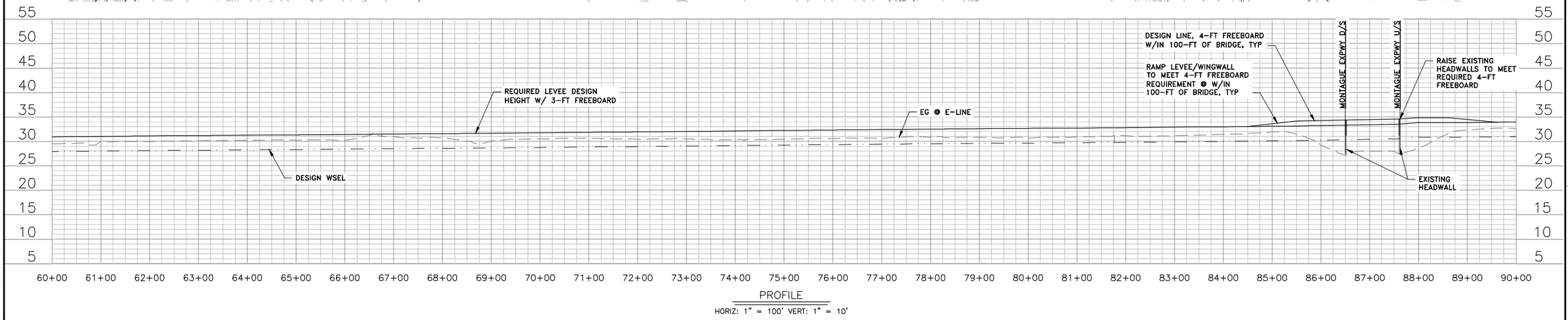
SHEET CODE: C-08

SHEET NUMBER: 11 OF 16

DOCUMENT NUMBER: XXXX-X-0000-0000000.00



PLAN
SCALE: 1" = 100'



PROFILE
HORIZ: 1" = 100' VERT: 1" = 10'

REV	DESCRIPTION	DATE	APPR
	10% PRELIMINARY **MARCH 2024**		

REFERENCE INFORMATION AND NOTES

1. FREEBOARD REQUIREMENTS:
   - 1.1. MINIMUM 4-FT OF FREEBOARD IS REQUIRED WITHIN 100-FT OF BRIDGES.
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DATE	3/28/2024
DESIGN	K. MULLER
DRAWN	J. PINKERTON
CHECKED	

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

PROJECT NAME AND SHEET DESCRIPTION:

LOWER GUADALUPE RIVER CAPACITY RESTORATION PROJECT

PLAN AND PROFILE
E-LINE STA 60+00 - 90+00

SCALE	PROJECT NUMBER
AS SHOWN	30154019

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

SHEET CODE: C-09

SHEET NUMBER: 12 OF 16

DOCUMENT NUMBER: XXXX-X-0000-0000000.00

E-LINE STA 90+00 –
MATCHLINE – SEE SHEET C-09

E-LINE STA 120+00 –
MATCHLINE – SEE SHEET C-11

RAISE EAST LEVEE, SEE NOTE 1. MAX INCREASE APPROX 3-FT BETWEEN MONTAGUE EXPWY AND TRIMBLE RD

FLOW GUADALUPE RIVER

E-LINE

EXISTING INBOARD EDGE OF LEVEE

P-LINE

PLAN
SCALE: 1" = 100'

REQUIRED LEVEE DESIGN HEIGHT W/ 3-FT FREEBOARD

EG @ E-LINE

DESIGN WSEL

PROFILE
HORIZ: 1" = 100' VERT: 1" = 10'

REV	DESCRIPTION	DATE	APPR
	10% PRELIMINARY **MARCH 2024**		

REFERENCE INFORMATION AND NOTES

1. FREEBOARD REQUIREMENTS:
   1.1. MINIMUM 4-FT OF FREEBOARD IS REQUIRED WITHIN 100-FT OF BRIDGES.
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   1.3. HEADWALLS SHALL PROVIDE MINIMUM 4-FT OF FREEBOARD.

DATE 3/28/2024
DESIGN K. MULLER
DRAWN J. PINKERTON
CHECKED

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

PROJECT NAME AND SHEET DESCRIPTION:

LOWER GUADALUPE RIVER CAPACITY RESTORATION PROJECT

PLAN AND PROFILE
E-LINE STA 90+00 – 120+00

SCALE: AS SHOWN

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER: 30154019

SHEET CODE: C-10

SHEET NUMBER: 13 OF 16

DOCUMENT NUMBER: XXXX-X-0000-0000000.00

PLAN
SCALE: 1" = 100'

PROFILE
HORIZ: 1" = 100' VERT: 1" = 10'

REV	DESCRIPTION	DATE	APPR
	10% PRELIMINARY **MARCH 2024**		

REFERENCE INFORMATION AND NOTES

1. FREEBOARD REQUIREMENTS:
   - 1.1. MINIMUM 4-FT OF FREEBOARD IS REQUIRED WITHIN 100-FT OF BRIDGES.
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   - 1.3. HEADWALLS SHALL PROVIDE MINIMUM 4-FT OF FREEBOARD.

DATE	3/28/2024
DESIGN	K. MULLER
DRAWN	J. PINKERTON
CHECKED	

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

PROJECT NAME AND SHEET DESCRIPTION:

LOWER GUADALUPE RIVER CAPACITY RESTORATION PROJECT

PLAN AND PROFILE E-LINE STA 120+00 - 150+00

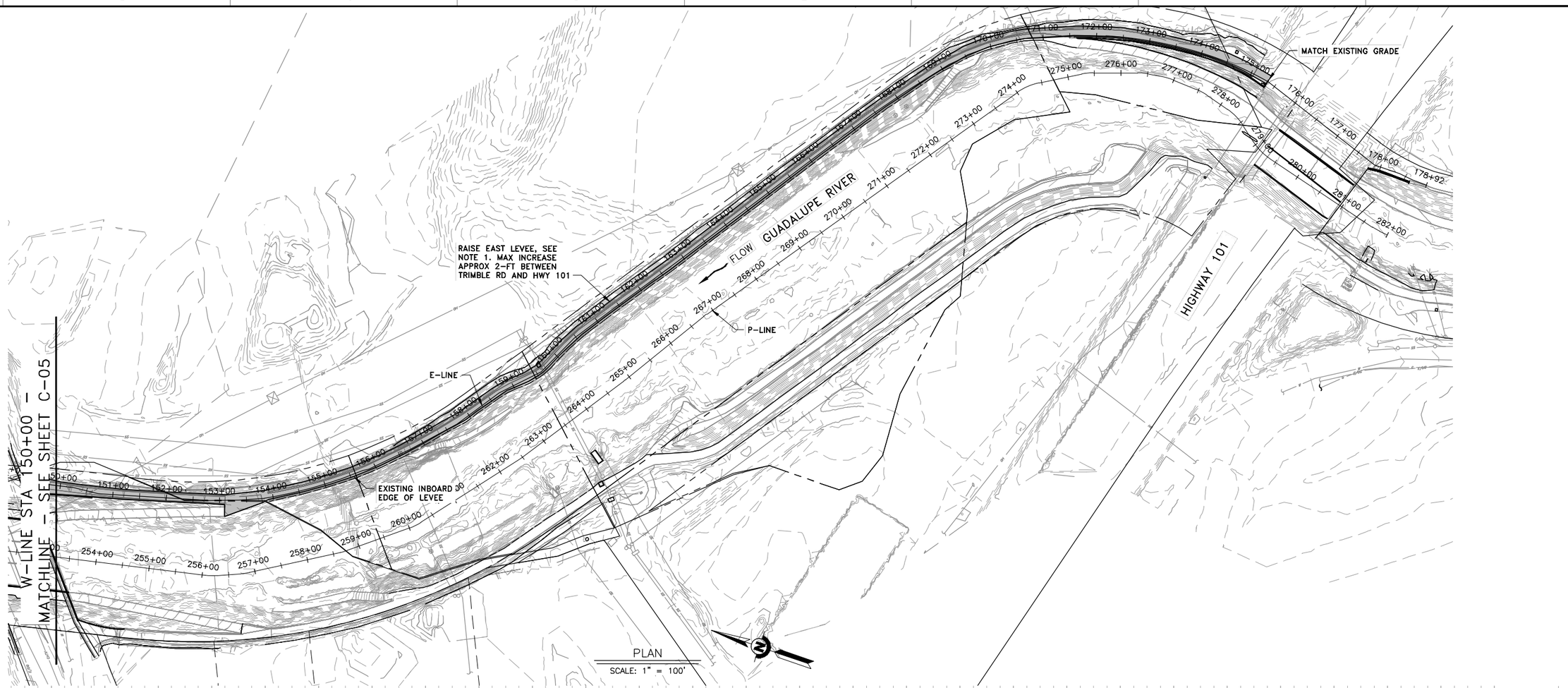
SCALE	PROJECT NUMBER
AS SHOWN	30154019

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

SHEET CODE: C-11

SHEET NUMBER: 14 OF 16

DOCUMENT NUMBER: XXXX-X-0000-0000000.00



REV	DESCRIPTION	DATE	APPR
	10% PRELIMINARY **MARCH 2024**		

REFERENCE INFORMATION AND NOTES

1. FREEBOARD REQUIREMENTS:
   - 1.1. MINIMUM 4-FT OF FREEBOARD IS REQUIRED WITHIN 100-FT OF BRIDGES.
   - 1.2. MINIMUM 3-FT OF FREEBOARD IS REQUIRED ELSEWHERE.
   - 1.3. HEADWALLS SHALL PROVIDE MINIMUM 4-FT OF FREEBOARD.

DATE: 3/28/2024
DESIGN: K. MULLER
DRAWN: J. PINKERTON
CHECKED:

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

PROJECT NAME AND SHEET DESCRIPTION:

LOWER GUADALUPE RIVER CAPACITY RESTORATION PROJECT

PLAN AND PROFILE
E-LINE STA 150+00 - 179+00

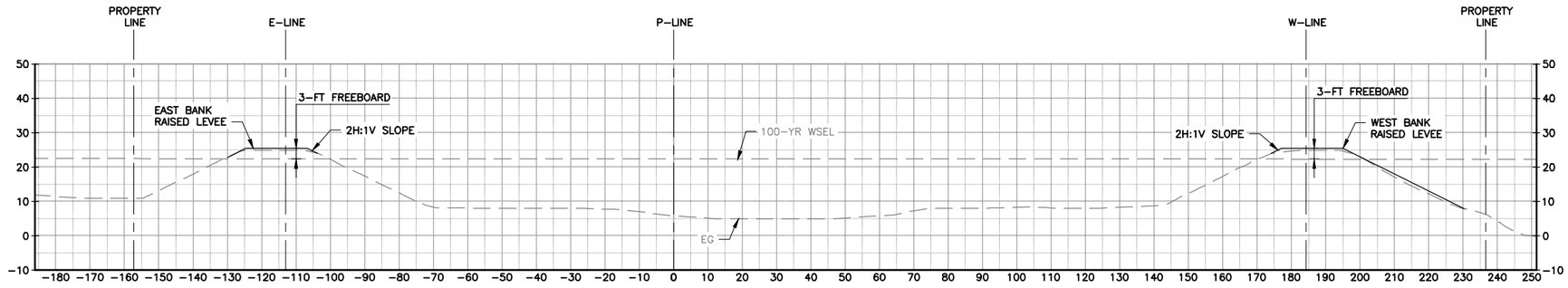
SCALE: AS SHOWN

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

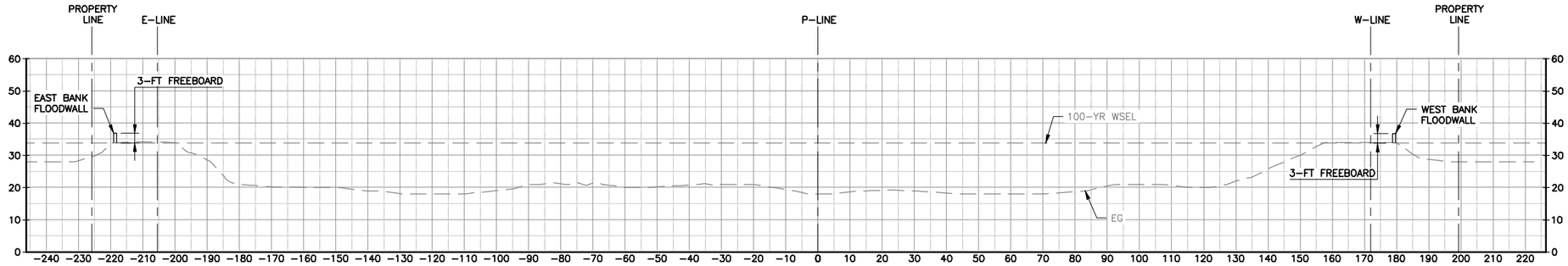
PROJECT NUMBER: 30154019

SHEET CODE: C-12

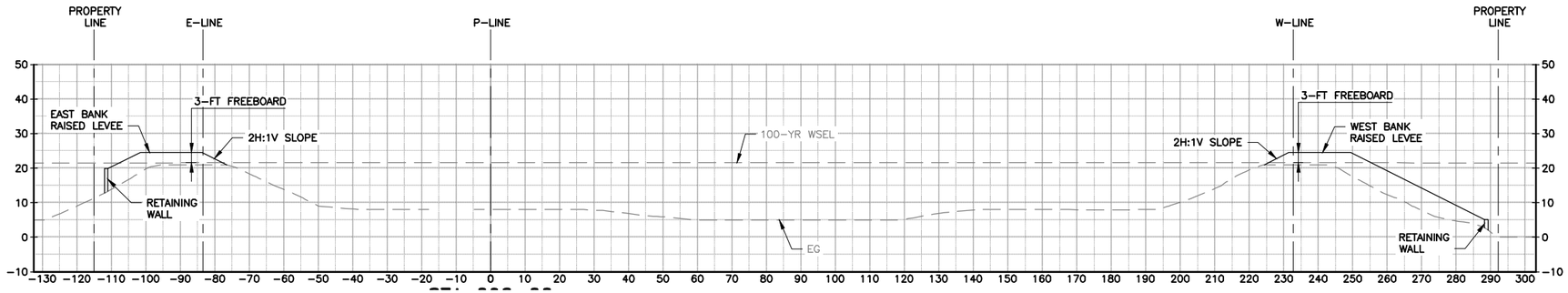
SHEET NUMBER: 15 OF 16



TYPICAL SECTION 1 – RAISED LEVEE



TYPICAL SECTION 2 – FLOODWALL



TYPICAL SECTION 3 – RAISED LEVEE W/ RETAINING WALL

REV	DESCRIPTION	DATE	APPR
	10% PRELIMINARY MARCH 2024		

REFERENCE INFORMATION AND NOTES

1. CROSS SECTIONS ARE VIEWED LOOKING UPSTREAM.

DATE 3/28/2024
DESIGN K. MULLER
DRAWN J. PINKERTON
CHECKED

ENGINEERING CERTIFICATION

PROJECT ENGINEER DATE

SANTA CLARA VALLEY WATER DISTRICT

Valley Water

PROJECT NAME AND SHEET DESCRIPTION:

LOWER GUADALUPE RIVER CAPACITY RESTORATION PROJECT

TYPICAL CROSS SECTIONS

SCALE AS SHOWN

VERIFY SCALES
0 1"
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER 30154019

SHEET CODE: X-01

SHEET NUMBER: 16 OF 16

DOCUMENT NUMBER: XXXX-X-0000-0000000.00

USERNAME: JillPink 3/28/2024 6:02 PM
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Appendix D
Detailed Cost Estimate

Guadalupe River Project - Tasman Drive to Interstate 880
Alternative C.a with ICM Flow
Levee with Retaining Walls and Headwalls
Cost Estimate Summary

Item	Unit Cost	Unit	Quantity	Amount
Site Preparation				
Remove existing concrete Barriers (Headwalls)	$ 100	LF	$ 492	$ 49,200
Remove existing median	$ 50	SQFT	1608	$ 80,400
Remove existing floodwalls	$ 120	CY	6271	$ 752,524
Grubbing and clearing	$ 7,041	AC	56	$ 391,651
Temporary fencing	$ 10	LF	33653	$ 336,528
Installation				
Wingwall Retrofit	$ 20,000	EA	$ 4	$ 80,000
Headwall	$ 50	SQFT	$ 1,386	$ 69,300
Concrete Barrier	$ 500	LF	954	$ 477,000
Joint Seal	$ 30	LF	220	$ 6,600
Bridge deck drainage system	$ 100,000	LS	2	$ 200,000
24" Cast-in-Drilled-Hole Concrete Piling	$ 400	LF	2800	$ 1,120,000
Pile cap	$ 30,000	EA	8	$ 240,000
Bent cap extension	$ 25,000	EA	8	$ 200,000
Pier wall extension	$ 40,000	EA	8	$ 320,000
abutment extension	$ 50,000	EA	4	$ 200,000
Deck Retrofit	$ 200	SQYD	2457	$ 491,400
Bent Cap vertical Restrainers	$ 5,000	EA	52	$ 260,000
66" Reinforce concrete pipe extension	$ 1,000	LF	22	$ 22,000
Levee construction	$ 130	CY	142403	$ 18,512,383
Levee Excavation (Key - In)	$ 40	CY	35601	$ 1,424,029
Hydroseeding	$ 3,000	AC	14	$ 43,326
Retaining Walls	$ 175	SF	121828	$ 21,319,913
Raised Pedestrian Bridge	$ 752,000	LS	1	$ 752,000
Contractor Security	$ 500,000	LS	1	$ 500,000
Establishment Maintenance (Vegetation)		LS	1	
Relocation				
Lighting Conduits	$ 5,000	LS	6	$ 30,000
Flow gauge	$ 1,000	EA	1	$ 1,000
Utility Protection/Relocation/Potholing		LS		$ 200,000
Noise/Vibration monitoring		LS		$ 100,000
Mitigation		LS		
Traffic Control				
Traffic Control		LS		$ 800,000
SUBTOTAL				$ 48,979,254
Compliance w/ General Permit (+SWPPP)		LS		$2,000,000
Mobilization and Demobilization (10%)		LS		$ 4,897,925
TOTAL CONSTRUCTION COSTS				**$ 55,877,179**
Construction Management		LS		$ 2,000,000
Design (15%)		LS		$ 8,381,577
RIGHT-OF-WAY COSTS		LS		$ -
Contingency (25%)				$ 13,969,295
TOTAL COSTS				**$ 80,228,051**

Appendix E
Public Comments and Responses

September 23, 2019 Public Comments

Legend: **P** - Personal comment provided during public meeting
C - Comment card provided at public meeting
E - Email sent to project team

Number	Comment	Code
1	How does vegetation influence flow? Don't flows just go over the vegetation?	P
2	Are you considering removing all vegetation in the channel?	P
3	Why did the vegetation grow more than expected?	P
4	(Online) Does development downstream affect plans?	P
5	How would dam operations help?	P
6	Even under best plan, how do we avoid having to do this again?	P
7	Are you accounting for even stricter regulatory restrictions in the future?	P
8	Are you planning to incorporate Sea Level Rise?	P
9	Have you modeled flood extent? And potential damage?	P
10	Is levee failure a concern?	P
11	What are you doing about rodents and burrows in the levees?	P
12	How do passive floodwalls work?	P
13	100-Year protection: make it happen!	P
14	Want to be less dependent on upstream dam operations	P
15	Channel is too crowded with vegetation. Now that the vegetation removal has been done, you can see more wildlife. Maybe the channel being too crowded was a hindrance for wildlife?	P
16	Raise more public awareness of flood risk. People don't realize that floods don’t always happen like we think they	P
17	Have you looked at just digging the channel deeper?	P
18	Floodwalls always get graffiti on them.	P
19	Look at other rivers and countries for ideas/alternatives	P
20	Do more to publicize current efforts and environmental enhancements. It looks good! Next Door posting, Tell Kathy (Wantanabe?) because she's good at reaching out to people, library community board, Post a sign and host Q&A session at pedestrian bridge (River Oaks) & parks. There is so much traffic, people will stop and ask.	P
21	Recreation access is very important, bicycle commuting is increasing.	P
22	Have you looked at putting concrete over entire channel, or parts of it?	P
23	Vegetation cover provides shelter for homeless encampments	P
24	Do storm drain pumps help?	P
25	Are there other creeks and rivers experienceing similar lack of capacity?	P
26	How do trails impact capacity?	P
27	Narrowing the trails/top of levee would be unsafe. Bicycles go by so fast!	P
28	What about cost as an objective?	P
29	Length of floodwall would be long	P
30	You should minimize need for maintenance	P
31	What happens if trees fall in the river and cause blockages?	P
32	Communicate risks while 100-year protection is not provided (in coordination with cities, County, & Valley Water)	P

October 01, 2020 6:00 pm Public Meeting - Webinar

Number	Comment	Answer	Answer Type	Commenter Name	Commenter Email
1	Have you projected how sea level rise will affect the river?	Hi Yes, sea level rise is taken into account in our hydraulic model. Tidal events effect the channel up to about Tasman Drive.	live answered	tom mcCarter	tgmcc04@gmail.com
2	You say your best efforts have not kept the river clear of vegetation so how do plan to ramp up your efforts. I live right next to the river, so I am concerned	We have ramped up our efforts and controlled over 56 acres of vegetation last year on Guadalupe River from 101 to Alviso Bay. We are currently managing these acreages again this year and will continue to do so annually.		tom mcCarter	tgmcc04@gmail.com
3	Very glad to see VW addressing this before it becomes a serious problem, as seasonal weather patterns have been becoming more unpredicatable in recent years! Flood corridor improvements on San Tomas Aquino creek (under San Tomas Expwy) a few years back saved our goat when there were heavy rains the following winter (whew!)	We do not remove the roots of the vegetation, thus erosion is not an issue. Herbaceous natives have been passively regenerating in the place of vegetation removed. These herbaceous plants are not an issue for flow conveyance and help to stabilize the riparian soils.		Frank L	flemmon@comcast.net
4	Cutting the vegetation will also cause erosion at the river bed, which causes more damage. We have seen this in Guadelupe river	answered*	live answered	Pekon Gupta	pekon.gupta@gmail.com
5	After this project is completed what type of protections and safeguards will be taken to ensure there is a robust maintenance program that will keep the river clear of vegetation? I'd like the opinion of the Valley Waterteam and Board Member Santos on this	In the past, components of our stream maintenance program permits did not allow for certain types of vegetation removal. We have addressed these issues in our current program and permits.		Kevin	kmanley99@yahoo.com
6	If you ramp up the flow of the water, wouldn't that increase erosion of the levees?		live answered	tom mcCarter	tgmcc04@gmail.com
7	Over the length of this project, might different alternatives be used, pending on local conditins?		live answered	Eileen McLaughlin	mclaughlin.eileen@gmail.com
8	Have you considered the impact of climate change on your hydraulic analysis?		live answered	Javad Shiva	Javad.shiva@mottmac.com
9	At my manufactured home park, Oakcrest Estates, we have a catch basin that goes dry in the summer. Would it help to keep it full all year?		live answered	tom mcCarter	tgmcc04@gmail.com
10	What are other methods of flood prevention instead of removing the vegetation? Like splitting the streaming into channels. Removing vegetation also allows debris to flow downstream, which causes more problems. This year we have lost lot of green cover, so removing any more vegetation should be carefully evaluated. May be we wont have flood at all. Please advise.		live answered	Pekon Gupta	pekon.gupta@gmail.com
11	With Covid, is there any money available for ANY of these plans?		live answered	tom mcCarter	tgmcc04@gmail.com
12	I like Alternative B		live answered	tom mcCarter	tgmcc04@gmail.com
13	Are you aware that Realtor.com is now listing flood risk on their listings. This affects our ability to sell		live answered	tom mcCarter	tgmcc04@gmail.com
14	What are some operating examples of deployable floodwalls? Have such been used successfully to hold-off floodwaters in at-risk cities, such as New Orleans?		live answered	Frank L	flemmon@comcast.net
15	Are there rough timelines for each of the different options? Are some options markedly faster to implement than others?		live answered	Kevin	kmanley99@yahoo.com
16	What protections would be required to obviate flood insurance in Alviso?		live answered	Barb	f863@gmail.com
17	Can a hybrid solution be utilized across the distance to be protected? Like one or two bypass culverts, along with paving and/or floodwalls along other portions?		live answered	Frank L	flemmon@comcast.net
18	I am worried about heat sink for pedestrians		live answered	clysta	clysta@earthlink.net
19	Alternative J seems like the "value" option at $11M. What would be the negatives with this approach. It seems like the least impactful for the river and trail downtstream.		live answered	Yves Zsutty	yves.zsutty@sanjoseca.gov
20	Can you clarify the vegetation management with these options?		live answered	Dave Poeschel	dave.poeschel@gmail.com
21	I prefer Alternative D.2. Detention basin. This alternative not only adds to our green space, but also helps recharging the aquifers. Between the pissible alternatives, what are the impact of each plan on wildlife?		live answered	Mojgan	mojgan00@hotmail.com
22	I would like to stay anonymous. I attend as a concerned san jose resident. I think that this is a perfect example of why Measure S is needed. Can someone explain why if Measure S passes it may benefit the residents of Santa Clara County from running into these kind of occurrences in the future? What other benefits does Measure S provide for these kind of efforts?			Enrico (Rick) Callender	rcallender@valleywater.org
23	I don't recall mention of impact on the Guadalupe River trail underpasses at HWY 101, Trimble, Montague -- in the winter of 2017 - 2018 - this section was closed from late December to March due to outflow from Lexington Dam etc - Can planned changes lessen lengthy trail closure that requires detouring to North First Street - not as safe alternative	in urban setting our waterways are intended to carry storm flows as quickly away as possible and the whole channel except the upper 3 feet is area required to carry away the flows. this does mean in the winter trails which go below bridges are impacted.		Richard McCaw	Richard.mccaw@sbcglobal.net
24	Does a detention basin have a concrete bottom or is it all natural?	a detention basin can have either a natural or concrete bottom. for this project, we are considering a natural bottom		clysta	clysta@earthlink.net
25	1. Flood walls curtail line of sight and in this area, likely to facilitate homelessness and associated hazards.		live answered	shani	Advocate@scvas.org
26	Alternate H1 saves millions of dollars, and adds delay of only 4 days. Does the cost include all engineering construction costs associated with this option?		live answered	Pekon Gupta	pekon.gupta@gmail.com
27	What is the funding source for this project and for future ongoing maintenance/vegetation management?		live answered	Jason Su	jason@grpg.org
28	2. This project should provide capacity to allow vegetation to grow and reduce need for excessive removal of vegetation which is harmful to the riparian corridor and the species that use it.		live answered	shani	Advocate@scvas.org

Number	Comment	Answer	Answer Type	Commenter Name	Commenter Email
29	Climate Change is not limited to sea-level rise only. It can also change the pattern of discharge for 100-Yr return events. Did you consider this in your analysis?		live answered	Javad Shiva	Javad.shiva@mottmac.com
30	Is weather prediction a significant risk with H.1 and J? They seem like the least expensive and least impactful to the stream.		live answered	Dave Poeschel	dave.poeschel@gmail.com
31	Have alternatives been evaluated to determine which alternative might best avoid or minimize access and use of the channel by homeless people and related monitoring for public safety. As homeless are a major water quality program this would be an opportunity to design to manage this issue. For instance steep slopes make access harder and flood wals can make it harder to monitor encampments.		live answered	Eileen McLaughlin	mclaughlin.eileen@gmail.com
32	3. I may have misunderstood, but Rick Callender mentioned in a “meet the CEO” event that this project may need to be extended all the way to Gold street?		live answered	shani	Advocate@scvas.org
33	Also - is part of the feasibility that it be under the project budget of $80 million? Many of the alternatives seem to be over budget		live answered	Jason Su	jason@grpg.org
34	Does the use of deep soil mixing techniques for several story construction projects change the hyrdrology assumptions around annual water absorption in our soils?	it's surface development and hardscaping that affect the rate of ground absorption. develpments are now required to incorporate green infrastructure to capture flow and return them to areas to be better directed to flow and runoff into the ground and make there way to the creeks.		clysta	clysta@earthlink.net
35	Is there potential for improvements in this project to increase speed or volume of flows downstream, possibly increasing flood risks below Tasman or in Alviso.	flows in Guadalupe Riverr generally slow as you approach the bay becasue the channel becomes wide and flatter as well as encounters tidal events which doesn't allow flow to just run out to the bay.		Eileen McLaughlin	mclaughlin.eileen@gmail.com
36	I apologize if was already discussed but I missed the first 20 minutes: How does the design flow for the 100-yr flow for this project compare to the design flow for the project constructed in 2004? For the previous project modeling, did you account for the roughness that would result from the vegetation fully grown in ? And for this proposed project are you accounting for vegetation being fully grown in? Are the issues of hydraulic capacity that are ascribed to vegetation due to only non-native species?		live answered	Susan Glendening	susan.glendening@waterboards.ca.gov
37	Will we be able to download this recording from Valley Water website in a few days? Sorry if I missed this if it was asked earlier, I arrived late.	we will post the recording on the project webpage by Monday or sooner. Here is the link: https://www.valleywater.org/guadalupe-river-tasman-i880		Cecile Glassy	daystechsupportservices@gmail.com
38	Could you tell us the location of the Guadalupe Gardens basin - what are the side streets?	Guadalupe Garden is between Hedding and Taylor street off of St. Route 87		SJohnson@shfb.org	sjohnson@shfb.org
39	How do we handle problem of elevated homelessness which pushes debris downstream ? There have been many homeless encampments coming up in recent times very close to river bed. And they come back within weeks after clearing, is there a plan to work with city councils to fix the issue at larger level ?		live answered	Pekon Gupta	pekon.gupta@gmail.com
40	As sea level rise will bring groundwater closer to the surface or even emerge on the surface, have potential detention sites been evaluated for possibility of groundwater reducing above surface capacity? Recent USGS studies point to groundwater as an issue of significant concern associated with SLR in California and the Bay.		live answered	Eileen McLaughlin	mclaughlin.eileen@gmail.com
41	I like options B and C because they ensure there is a local, targeted solution by higher risk areas that is more reliable in case the river is not maintained		live answered	Kevin	kmanley99@yahoo.com
42	If Alternative J has shortcomings as describrd (7 days, reduced water availability), why is it feasible?		live answered	shani	Advocate@scvas.org
43	Off topic: who is in charge of removing homeless people from the banks of Guadeloupe river?		live answered	Mojgan	mojgan00@hotmail.com
44	shouldn't water supply projects be paid for by water charges?		live answered	K N	katja.irvin@sbcglobal.net
45	When does the existing tax run out that funds these water projects?		live answered	SJohnson@shfb.org	sjohnson@shfb.org
46	how will you decide which alternative to select as the prefered alternative for CEQA? once that is decided it will be vitually impossible to move to another alternative		live answered	K N	katja.irvin@sbcglobal.net
47	Is the construction of the luxury hotel In Alviso going forward? If not, how about an affordable housing village?		live answered	tom mcCarter	tgmcc04@gmail.com
48	How much has subsidence and subsequest sedimentation in the river channel influenced the design of all of these alternatives being discussed tonight?		live answered	Patrick Ferraro	ptferraro5@vgmail.com
49	Which alternative is the staff leaning towards at this time, and why?		live answered	SJohnson@shfb.org	sjohnson@shfb.org
50	How much groundwater enters the river during the dry periods?		live answered	Patrick Ferraro	ptferraro5@vgmail.com
51	Hi, large parts of lower guadelupe trail are within city of santa clara, so the homelessness program should also be on priority list of all the cities including city of santa clara. Thank You		live answered	Pekon Gupta	pekon.gupta@gmail.com
52	Thank you. Very informative. I hope you preserve habitat for wildlife and line of sight for pedestrians who use the walking trails. Cooperative detention opportunities exist and should be transparently discussed with citizens in other jurisdictions.		live answered	clysta	clysta@earthlink.net

October 26, 2023 5:30 pm Public Meeting

Location: Northside Branch Library (695 Moreland Way, Santa Clara, CA 95054)

Link to Outlook Item: click here

Invitation Message

Valley Water is holding a public meeting to update the community on the Guadalupe River – Tasman to I880 Project. A question-and-answer session will take place during the public meeting, which is in-person and available via Zoom in the library's community room.

Chiefs and external stakeholders will also receive a separate calendar hold. Director Santos has been notified of this event.

Legend: **C** - Comment provided at public meeting
N - Note from public meeting
E - Email sent to project team

Number	Comment	Answer	Code
1	City of San Jose pays a lot money for the trail pavement.		C
2	Traffic impact at the bridges during construction period. How VW is going to manage/mitigate the impact?		C
3	Does raising the levee allow people to safely see the water flowing during high flow event? Is there safety feature associate with raising levee?		C
4	Linh addresses Flooding safety issue with the flood alert program including partnership with local cities		N
5	What will happen to the pedestrian bridge?	It will be relocated	C
6	What is the rough cost estimate of construction and where is the fund coming from?	$90M and General Fund 12	C
7	Considering the right of way/access area (top of levee road) as transportation system for the public (i.e., trail/bike road)		C
8	Does Tasman bridge need any headwall?	No, the bridge is o.k.	C
9	There is pony wall (floodwall) at between Tasman and SR 237.		C
10	It's very inconvenient to cross the river		C
11	How close was the water to overtopping during last winter storm events?		C
12	Can you elaborate more about what will happen in the during the design phase?		C
13	When will be the next design public meeting?		C
14	Where will be location of flooding and where will they go (at current condition of river)?		C
15	What would the veg maintenance work look like (after the project)?		C
16	Karl Neuman - Introduces himself as design team of this project and explains design phase process. Acknowledge there is no schedule public meeting at this point but will coordinate one.		N
17	At what point does VW Engineers engage with other agencies?		C

Appendix F
Problem Definition and Refined Objectives Report

Valley Water

Clean Water • Healthy Environment • Flood Protection

Guadalupe River Project – Tasman Drive to Interstate 880

Project No. 30154019

Problem Definition and Refined Objectives Report

December 2019

Prepared by
Katie Muller

With contributions from
Clelia Busadas
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Under the Direction of
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Table of Contents

Figures

Tables

1 Introduction

This Problem Definition and Refined Objectives Report is the first step in the planning process for the Guadalupe River Project – Tasman Drive to Interstate 880 (Project).

The report includes the following:

- Project background
- Existing condition
- Problem definition
- Community outreach
- Opportunities and constraints
- Potential changes to project objectives and scope
- Next steps

The Lower Guadalupe River is the portion of the Guadalupe River between Interstate 880 and the San Francisco Bay (Figure 1). It has been the subject of several Santa Clara Valley Water District (Valley Water) flood protection projects over the years, the latest of which was the Lower Guadalupe River Project (LGRP) completed in 2004. The project provided protection from a 1 percent chance exceedance flood (100-year flood) from Interstate 880 to the UPRR bridge in Alviso, near the San Francisco Bay. 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 between Interstate 880 and Interstate 280. Valley Water committed to USACE that the LGRP would convey the 1 percent design flows from the DGRP, 17,000 cubic feet per second (cfs), as well as an additional 1,350 cfs from interior drainage inflow[1]. The largest recorded river flow since completion of both projects was in February 2017, with a recorded peak of 6,340 cfs[2] 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. Recent high water marks in the Lower Guadalupe River were measured in 2014, 2017, and 2019. Based on these measurements, it was determined that the Guadalupe River does not convey the 1 percent flood for which it was designed. Staff estimates that the river channel has 4 percent flood (25-year) capacity with freeboard, or 2 percent flood (50-year) capacity without freeboard. The capacity is reduced between Tasman Drive and Interstate 880, about five miles in total. This problem definition report is intended to identify the flood risks that now exist in the river, and refine the objectives needed to restore the 1 percent design capacity of the LGRP.

[1] USACE. 2005. U.S. Army Corps of Engineers to Santa Clara Valley Water District. December 15.
[2] 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.

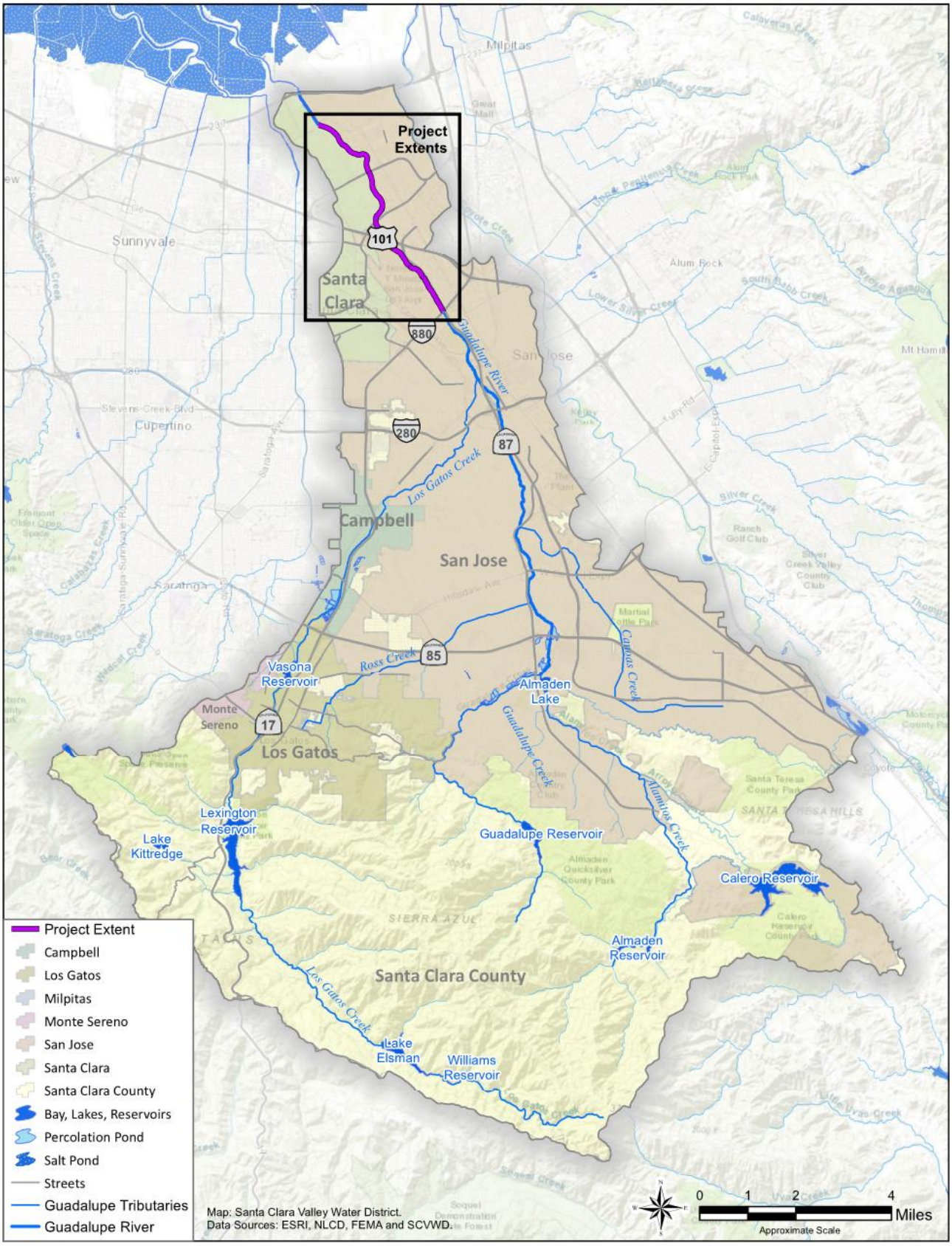

Figure 1: Guadalupe Watershed

2 Background

2.1 Project History

The Guadalupe River has a long history of flooding, with the earliest recorded event occurring in the winter of 1852-1853. Table 1 and Figure 2 summarize the river's known flood events throughout history.

Table 1: Historical Flood Events in Guadalupe River

Flood Event Date	Summary of Event	Peak Discharge at USGS San Jose Gage[3] (cfs)
Winter 1852 - 1853[4]	Downstream from Montague Expressway, Guadalupe River merges with Coyote Creek	Unknown
Winter 1861 - 1862[4]	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[4]	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[5]	Minor local flooding	7,910
March 31, 1982[6]	Guadalupe overbanks, causing evacuations, and 1-10 ft of flooding. 20 homes and 5 businesses report damage	7,340
January 24, 1983[7]	River overbanks in two locations, causing up to 10 ft of flooding.	7,130 (8,400[7])
February 18, 1986[8]	River overbanks at four locations, primarily street flooding	9,140
January 9, 1995[9]	River overbanks at three locations, flooding portions of Highway 87 with up to six feet of water.	9,290
March 10, 1995[9]	Highest flow on record, flooding Highway 87 and portions of downtown. Many residences and businesses are evacuated	11,000
February 1998[10]	River overbanks in two locations, flooding Highway 87	7,541

[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/nwis/peak?site_no=11169000&agency_cd=USGS&format=html.

[4] 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.

[5] Valley Water. 1980. "Flood Emergency Report: Feb. 13 through Feb. 22, 1980." Flood Report. San Jose.

[6] Valley Water. 1982. "Report on Flooding and Flood Related Damages: January 1 to April 30, 1982." Flood Report. San Jose.

[7] Valley Water. 1983. "Report on Flooding and Flood Related Damages: January 1 to April 30, 1983." Flood Report. San Jose.

[8] Valley Water. 1986. "Report on Flooding and Flood Related Damages: February 12th thru 20th, 1986." Flood Report. San Jose.

[9] Valley Water. 1995. "Report on Flooding and Flood Related Damages: Santa Clara County, January 3 to March 11,1995." Flood Report. San Jose.

[10] Valley Water. 1998. "Report on Flooding and Flood Related Damages in Santa Clara County February 2-9, 1998." Flood Report. San Jose.

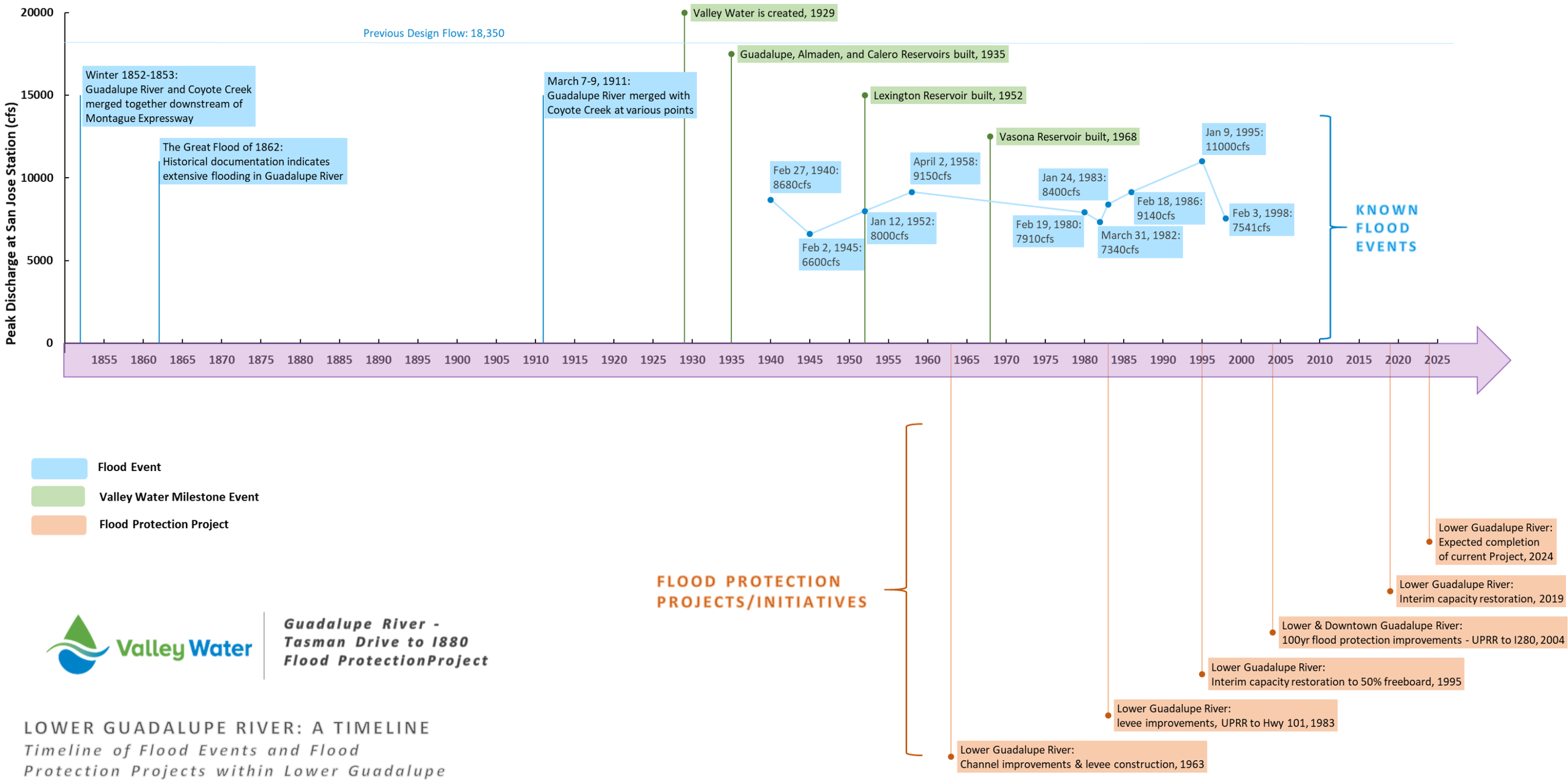

Figure 2: Timeline of Events in the Lower Guadalupe River

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[11].

1945 USACE completes the Preliminary Examination Report, and authorizes flood control investigations for all streams in the south San Francisco Bay[11].

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[11].

1977 USACE completes the Hydrologic Engineering Office Report for Guadalupe River and Coyote Creek[12].

1982 Valley Water completes the Guadalupe River Planning Study, Union Pacific Railroad (UPRR) in Alviso to Highway 101, which was intended to provide 1% flood protection[13].

1983 Construction is completed on the improvements listed above[11].

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[11].

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[14].

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 completes flood protection improvements from Interstate 880 to Interstate 280 (DGRP)[15].
November 5: USACE sends a letter verifying that both LGRP and DGRP meet USACE criteria for passing the 1 percent flood[16].

2005 November 15: USACE sends a letter certifying construction of the LGRP[17].
December 15: USACE sends a letter verifying that the LGRP satisfies USACE criteria for Federal Emergency Management Agency (FEMA) certification[18].

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[11] USACE. 2007. Draft Lower Guadalupe and Downtown Guadalupe River Flood Protection Project San Jose, Santa Clara County, California: Operation, Maintenance, Repair, Replacement, & Rehabilitation Manual.
[12] USACE. 1977. Hydrologic Engineering Office Report Guadalupe River and Coyote Creek Santa Clara County, California.
[13] 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.
[14] CH2MHill. 2002. Lower Guadalupe River Planning Study.
[15] Valley Water. 2019. Lower Guadalupe River Project from the Alviso Marina County Park to Interstate 880. Board Agenda Memo.
[16] USACE. 2004. Department of the Army to Santa Clara Valley Water District. November 5.
[17] USACE. 2005. Lower Guadalupe River Flood Control Construction Certification. November 15.
[18] USACE. 2005. Department of the Army to Santa Clara Valley Water District. December 15.

2007 USACE issues Valley Water a draft "Operations, Maintenance, Repair, Replacement, & Rehabilitation Manual for the Guadalupe River Project" (O&M manual)[19].

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)[20].

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. Staff commits to returning to the Board in 12 months with a recommendation for how to restore design flow conveyance[19].

2.2 Project Objectives

The project must:

1. Provide 1 percent flood protection to the reach between Tasman Drive and Interstate 880, as specified in the 1992 LCA. (Subsequent agreements with USACE specify flows such as 17,000 cfs from the DGRP, and 18,325 cfs for LGRP. Providing the level of protection for these specific flows should be evaluated in the alternatives analysis.)
2. Minimize the need for future operations and maintenance activities
3. Maintain and/or enhance public recreation and access
4. Obtain community support and participation for the Project

Valley Water's objectives for Natural Flood Protection are incorporated in Board Ends Policy No. E-3, as follows[21]:

1. Provide natural flood protection for residents, businesses, and visitors.
   1.1. Protect parcels from flooding by applying an integrated watershed management approach that balances environmental quality and protection from flooding.
   1.2. Preserve flood conveyance capacity and structural integrity of stream banks, while minimizing impacts on the environment and protecting habitat values.
2. Reduce potential for flood damages.
   2.1. Promote the preservation of flood plain functions.
   2.2. Reduce flood risks through public engagement.
   2.3. Prepare and respond effectively to flood emergencies countywide to protect life and property.

[19] Valley Water. 2019. Lower Guadalupe River Project from the Alviso Marina County Park to Interstate 880. Board Agenda Memo.
[20] USACE. 2013. Department of the Army to Santa Clara Valley Water District. August 05.
[21] Valley Water. 2013. *Governance Policies of the Board; III. Ends.* San Jose.

2.3 Past and Present Studies

Most of the studies conducted in the project area were completed prior to 2002 as part of the Lower Guadalupe 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 recent or ongoing studies that include the Lower Guadalupe River project area:

2.3.1 FAHCE

The Fisheries and Aquatic Habitat Collaborative Effort (FAHCE) is an ongoing program that will improve fish passage and aquatic spawning and rearing habitat in the Guadalupe River, Coyote Creek, and Stevens Creek. Currently, the program is conducting extensive modeling to support the Fish Habitat Restoration Plan and Environmental Impact Report (EIR)[22].

2.3.2 South Bay Salt Ponds Restoration Partnership

The South Bay Salt Ponds Restoration Partnership aims to restore the salt ponds adjacent to Alviso Slough by depositing sediment from surrounding streams[23]. Through this partnership with the U.S. Fish and Wildlife Service (FWS), Valley Water is conducting the San Tomas Aquino and Calabazas Creek Realignment Study. 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 from Pond A8, so any modifications may affect the water surface elevation during floods.

2.3.3 San Francisco Bay Shoreline Protection Project

The San Francisco Bay Shoreline Protection Project will 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. Construction of the coastal levees and ecotones east of the Guadalupe River will occur in the future[24].

2.3.4 Ross Creek Engineering Study

This planning study is part of the Safe, Clean Water and Natural Flood Protection Program[25]. The intention is to identify flood risk and develop solutions for mitigating floods. The study is evaluating 1 percent and 4 percent floods (100 and 25 year, respectively) and is in the feasible alternatives phase.

2.3.5 Alamitos Creek Engineering Study

This planning study is part of the Safe, Clean Water and Natural Flood Protection Program[25]. The study aims to identify flood risk, and update flood risk maps. It was completed in 2018[26].

[22] Valley Water. 2019. FAHCE: Fisheries and Aquatic Habitat Collaborative Effort.
[23] Valley Water. 2019. D8: South Bay Salt Ponds Restoration Partnership.
[24] Valley Water. 2019. E7: San Francisco Bay Shoreline Protection.
[25] Valley Water. 2019. E3: Flood Risk Reduction Studies.
[26] Valley Water. 2019. Alamitos Creek Flood Study.

3 Existing Condition

3.1 Watershed Description

The Guadalupe River collects water from the 170-square-mile Guadalupe Watershed, originating in the Santa Cruz Mountains and draining north to the San Francisco Bay (Figure 1). The river begins at the confluence of Alamitos Creek and Guadalupe Creek, and collects flows from Ross Creek, Canoas Creek, and Los Gatos Creek. The upper watershed contains five reservoirs owned by Valley Water. These reservoirs are operated for water supply purposes, but they provide incidental flood protection from the capture and temporary storage of peak storm flows. Valley Water operates groundwater recharge ponds along Los Gatos Creek downstream of Highway 85 and along Guadalupe River near Highway 85.

3.2 Project Area

The project area covers the Guadalupe River between Tasman Drive and Interstate 880 near Airport Parkway (Figure 3). Land use is very urbanized, with a mix of high density residential and commercial buildings. The Norman Y. Mineta San Jose International Airport is directly adjacent to the west bank of the river. Since the LGRP's completion in 2004, additional development has occurred in the area, partially due to the 1 percent flood protection the project provided. 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 habitat of native California plants. The Guadalupe River Trail runs along the west levee from Interstate 880 to Highway 101, and on the east levee from Airport Parkway to Tasman Drive. The trail is paved, and heavily used by the community for commuting and recreational purposes, up to 2,470 users a day[27].

The land use surrounding the project area is heavily urbanized, with very little undeveloped land. 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 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.

[27] City of San Jose. 2019. Trail Count.

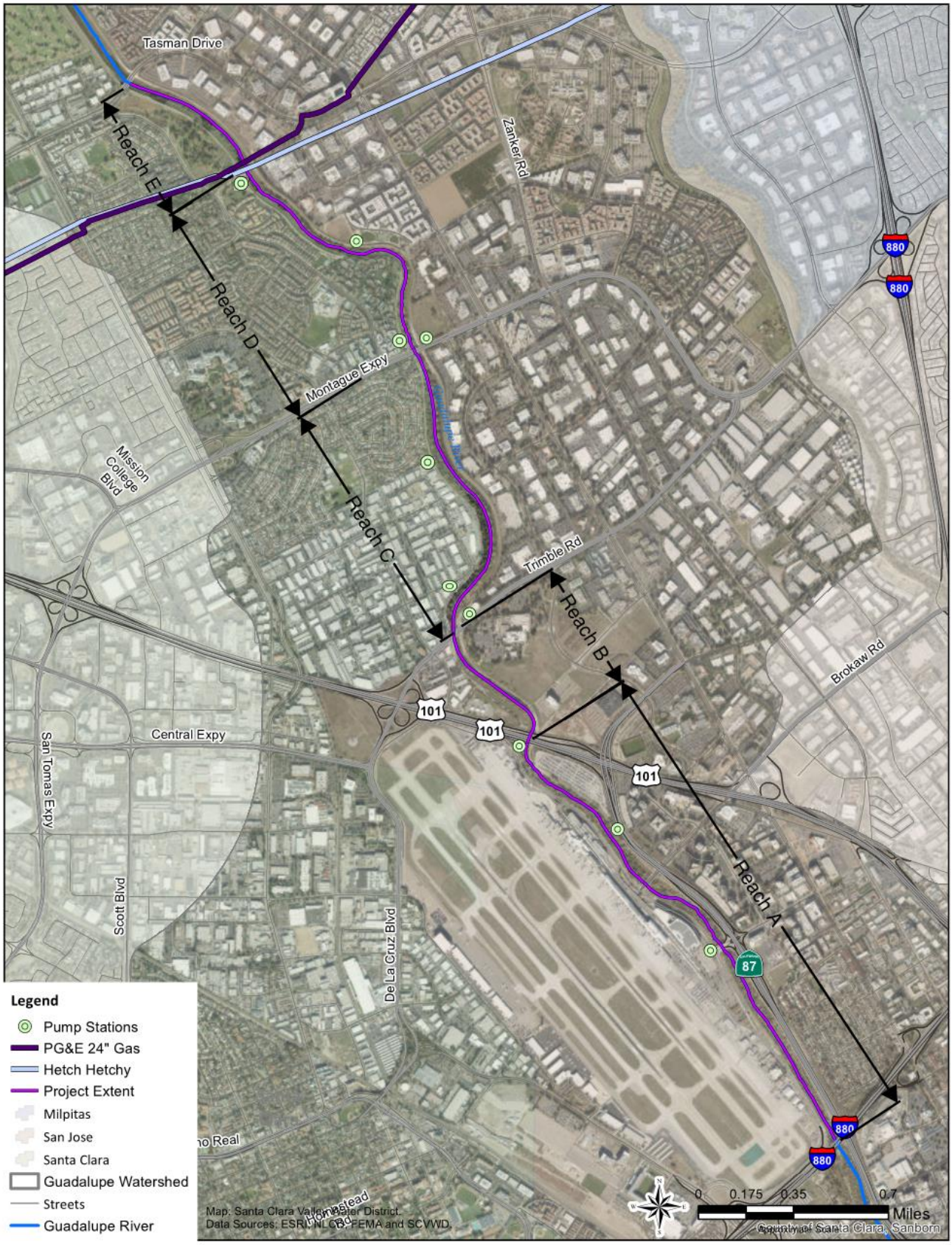

Figure 3: Project Reaches, with Pipelines and Pump Stations Shown

There are 10 bridges within the project area, summarized below (Table 2).

Table 2: Bridges in the Project Area

Bridge	Length (ft)[28]	Year Built[28]	Owner
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
Highway 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

There are several known large utilities that cross under the river, both of which cross 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[29].

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 3 and mapped in Figure 3.

[28] GIS. 2019. National Bridge Inventory (NBI) Bridges.
[29] CH2MHill. 2002. Lower Guadalupe River Planning Study Engineer's Report.

Table 3: Pump Stations in the Project Area

No	Stormwater Pump Station	Capacity (cfs)[30,31]	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

The LGRP established Sediment Deposition Reaches (SDR) that were specifically designed to catch sediment. The SDRs range from 30 to 90 ft in width and 50 ft to 250 ft in length (Figure 4). The SDRs were designed to be cleared out when they reached 2 feet of deposited sediment. This has proven to be difficult to carry out in practice, because Valley Water's Stream Maintenance Program has strict limits on length and volume of sediment can be removed per year from a river channel.

The LGRP planted native riparian forest and shady riverine aquatic habitat as part of compensatory mitigation for project impacts (Figure 5). The mitigation areas were monitored annually to ensure that the 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[32]. There is currently only one actively monitored mitigation site in the project area, downstream of Highway 101.

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

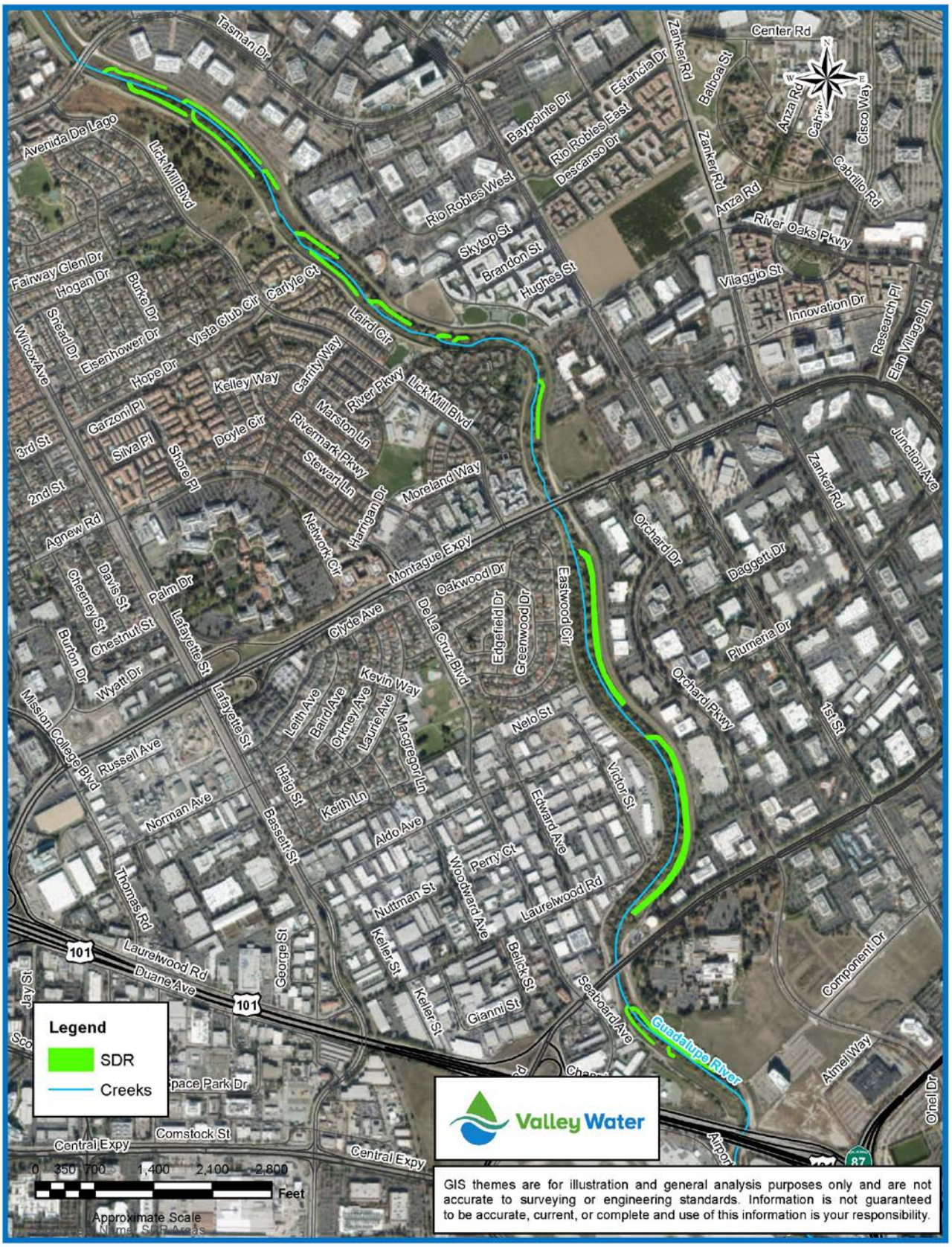

Figure 4: SDR Locations in Project Area

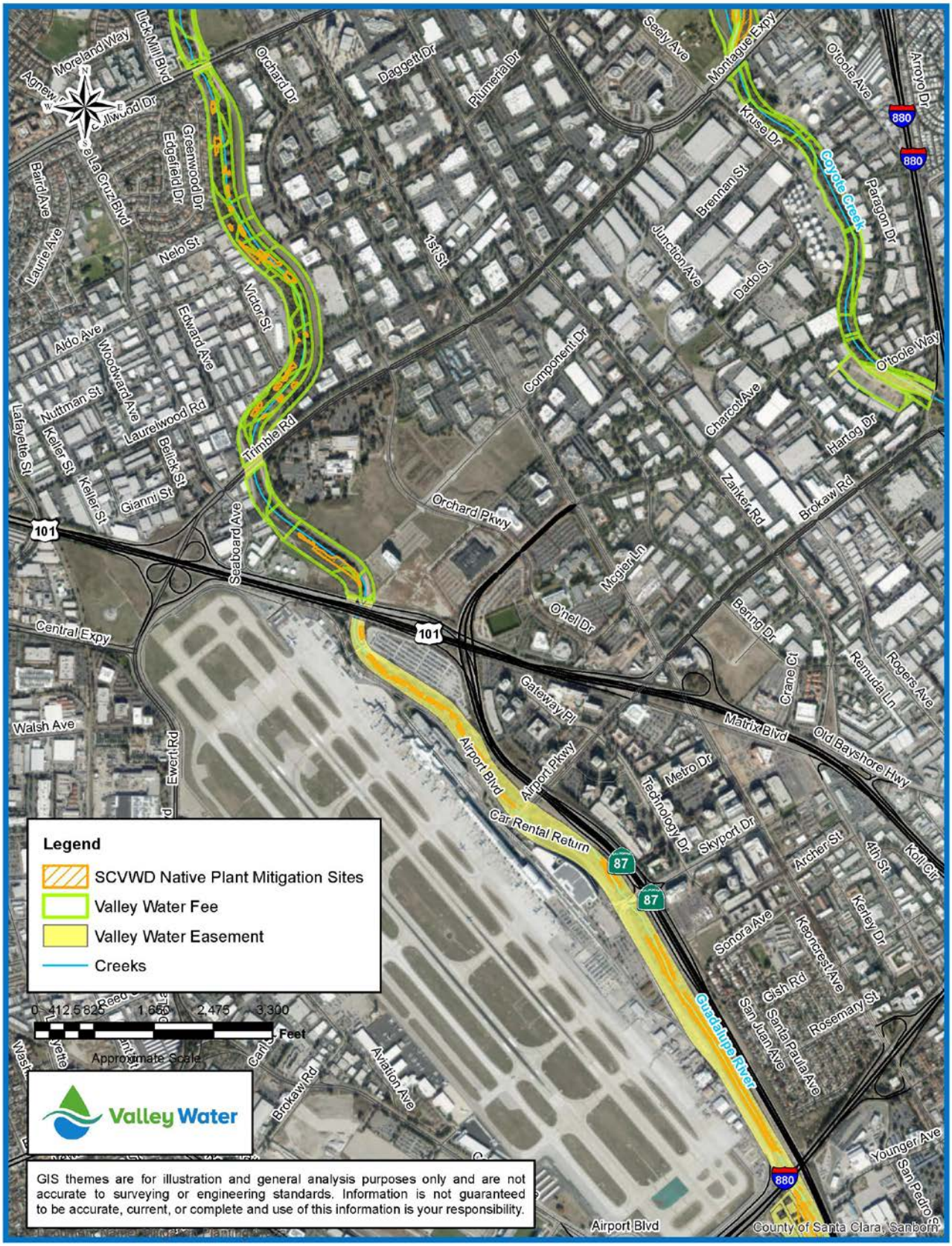

Figure 5: Mitigation Planting in the Project Area

The project is divided into five reaches, which were the same as those used by the previous LGRP study (Figure 3).

3.2.1 Reach A: Interstate 880 to Highway 101

Reach A (Figure 6) is a 1.9-mile section of the river, bounded at the south end by Interstate 880, and at the north end by Highway 101. The channel ranges from 200 ft to 300 ft wide and is 20 ft deep. It is mainly excavated channel, with a small portion of levees upstream of Highway 101. Reach A is full of large woody vegetation and trees, partially a result of mitigation plantings that were planted starting in 1999 as part of the DGRP. The paved Guadalupe River Trail runs along the west bank and for a portion of the east bank from Airport Parkway to Highway 101. To the east of the river is Highway 87, which parallels the channel alignment. East of Highway 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 Highway 101.

3.2.2 Reach B: Highway 101 to Trimble Road

Reach B (Figure 7) is a 0.5-mile section of the river, bounded to the south by Highway 101, and to the north by Trimble Road. The channel is 300 ft in width, 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 woody vegetation and trees in the center of the channel, and the floodplains are sparsely vegetated with grass. 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 Highway 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: Highway 101 to the south, and Trimble Road to the north.

3.2.3 Reach C: Trimble Road to Montague Expressway

Reach C (Figure 7) is a 1.2-mile section of the river, bounded to the south by Trimble Road, and to the north by Montague Expressway. The channel is 350 ft in width, 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 large woody shrubs and trees, except for the lower gravel maintenance road on the east bench. 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 6: Reach A – Interstate 880 to Highway 101

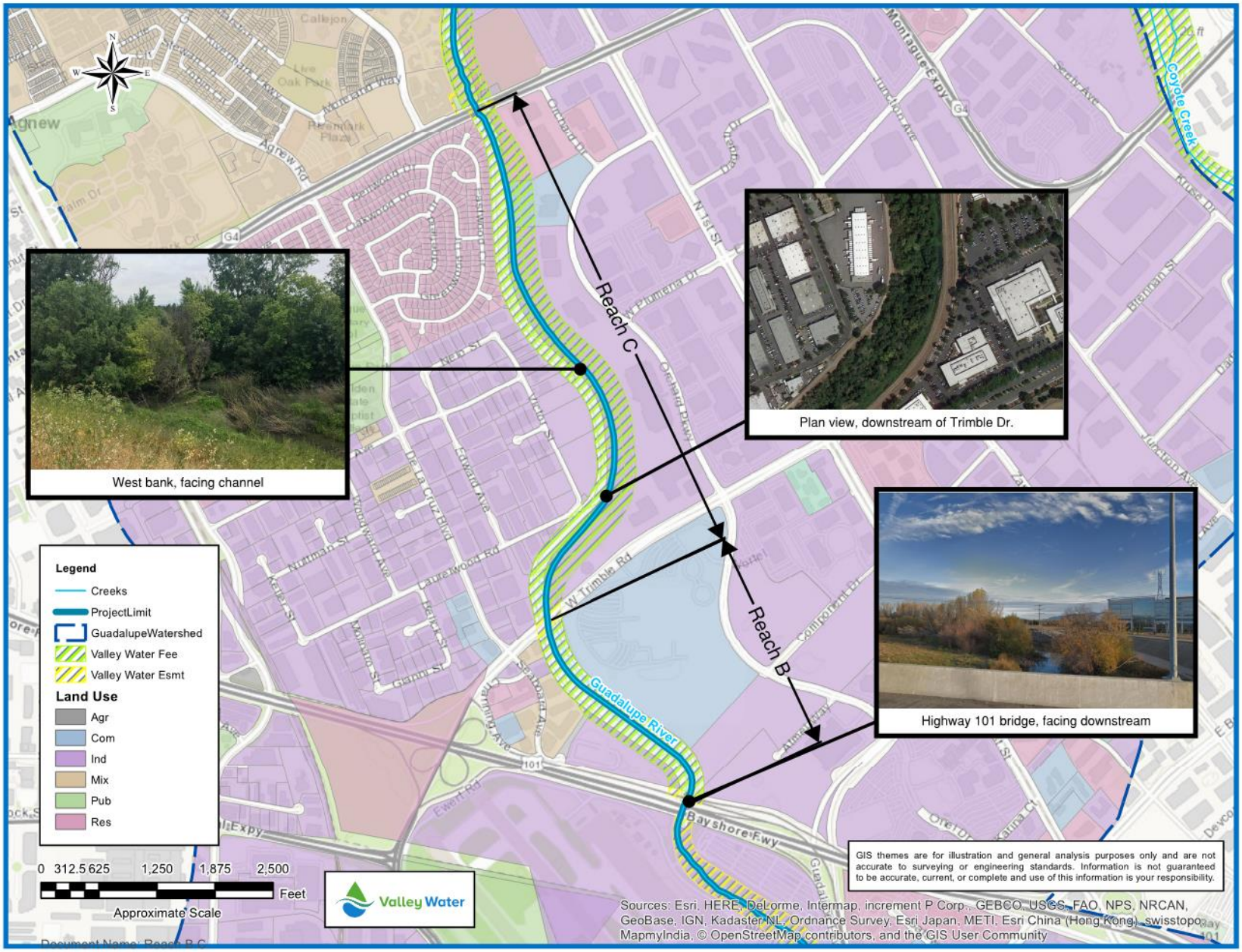

Figure 7: Reaches B & C - Highway 101 to Montague Expressway

3.2.4 Reach D: Montague Expressway to Hetch Hetchy Pipelines

Reach D (Figure 8) is a 1.1-mile 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" 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.

3.2.5 Reach E: Hetch Hetchy Pipelines to Tasman Drive

Reach E (Figure 8) is a 0.6-mile 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.

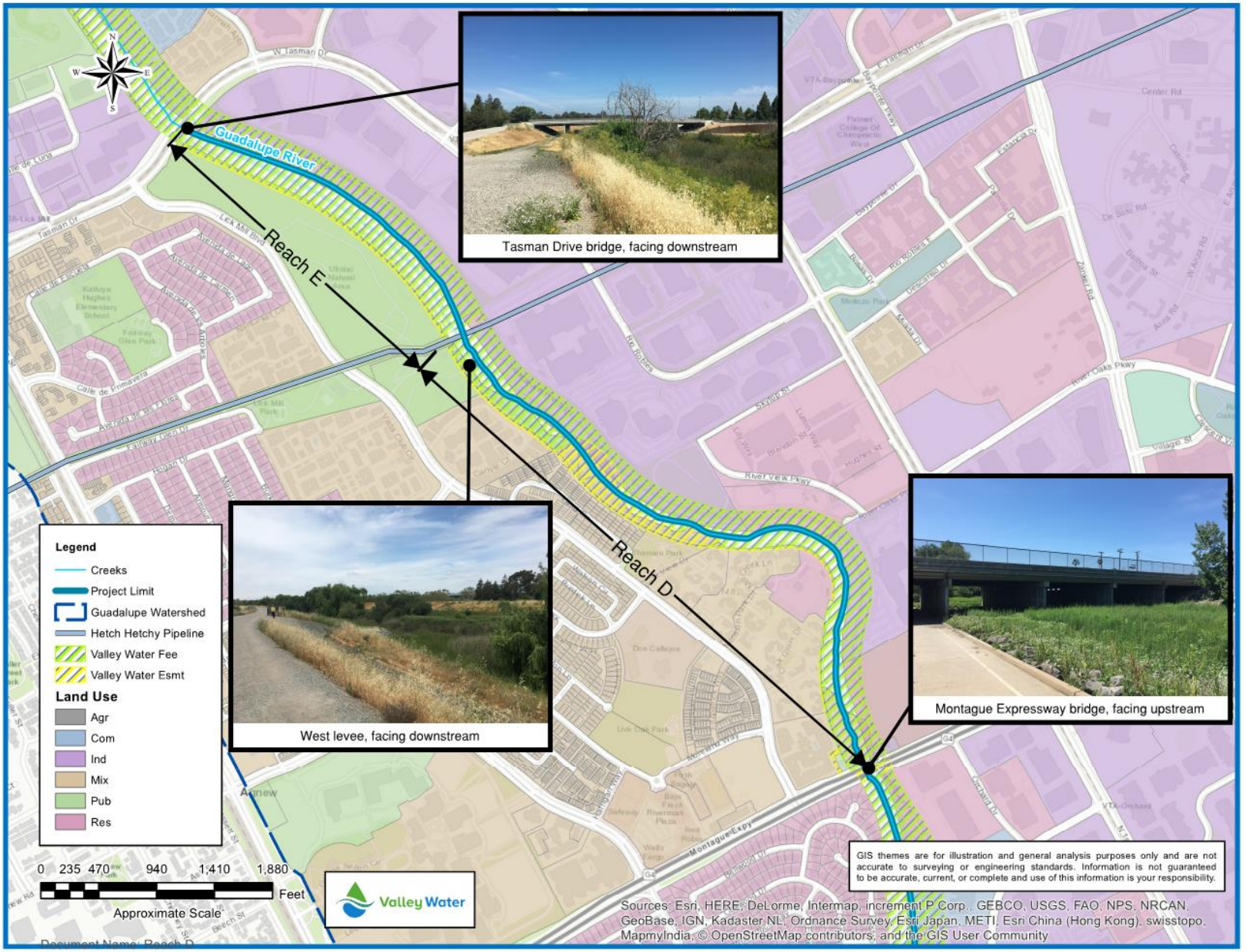

Figure 8: Reaches D & E - Montague Expressway to Tasman Drive

3.3 Right-of-Way

Because of the LGRP, Valley Water owns 60% the project area in fee title. The other 40% is located in Reach A, adjacent to Mineta San Jose International Airport, and is owned in easement. There is at least one encroachment onto Valley Water property from an adjacent property owner on Laurelwood Road, extending about 10 ft past the property line. The previous flood protection project chose not to enforce the property boundary, and the levee was modified from the original plans to accommodate the loss in space[33].

3.4 Geology

The soil in the project area is alluvial sediment, deposited from the mountains upstream from the Coast Mountain Range[34]. The levees were constructed with imported engineered levee fill, designed to be resilient to hydraulic influence. A Geotechnical Study was conducted for the LGRP.

3.5 Hydrology

The upper and lower extents of the Guadalupe River watershed are very distinct hydrologically. The average annual rainfall ranges from 13 in. at the downtown San José rain gage to 42 in. at the Lexington gage. 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.

3.5.1 Reservoirs

Much of the runoff from the upland areas 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 4.

Table 4: Reservoirs in Guadalupe Watershed

Reservoir	Year Built[35]	Capacity (ac-ft)[36]	Outlet Capacity (cfs)[36]	Owner
Almaden	1935	1,600	190	Valley Water
Calero	1935	9,900	185	Valley Water
Lexington	1952	19,000	410	Valley Water
Guadalupe	1935	3,400	235	Valley Water
Vasona	1968	500	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

[33] Personal Communication. Kris Puthoff. 2019. Email.
[34] CH2MHill. 2002. Lower Guadalupe River Planning Study.
[35] Valleywater.org. Local Dams and Reservoirs. 2019
[36] USACE. 2009. Guadalupe Watershed Hydrologic Assessment.

reservoirs are not associated with flood management project design considerations further downstream in the Lower Guadalupe River[37].

3.5.2 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 floodflows;" The design flows used for both the Downtown and Lower Guadalupe Projects are 1 percent flood flows, which include inflow from the adjacent pump stations. The hydrology for the LGRP and DGRP was determined by USACE. During a 1 percent flood event, the upstream end of the LGRP will receive 17,000 cfs from the DGRP, and end with 18,325 cfs (Table 5[38]).

Table 5: 1 Percent Flood Design Flows for Previous Lower Guadalupe River Project

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

In 2009, USACE updated the hydrology for the Guadalupe Watershed (Table 6). The 1 percent storm, per the updated model, is now slightly higher than what was used for the LGRP.

Table 6: Guadalupe River Peak Flow (cfs) - 2009 Update

Location	10% (10 year)	4% (25 year)	2% (50 year)	1% (100 year)	0.2% (500 year)
D/S of Los Gatos Creek confluence (USGS Gage 11169000)	7,720	10,470	14,260	17,970	27,950
Highway 101 (USGS Gage 11169205)	8,200	10,790	14,770	18,600	28,770
Highway 237	8,280	11,360	15,230	19,020	29,170

Both sets of 1 percent design flows (Table 5 & Table 6) assume an "ultimate" condition in the watershed, in which all tributaries and creeks have been modified to contain the full 1 percent flood

[37] USACE. 2009. Guadalupe Watershed Hydrologic Assessment.
[38] NHC. 2000. Lower Guadalupe River Flood Protection Study – Draft Existing Conditions Report

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 percent 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 that currently comes from the Upper Guadalupe River is about 8,000 cfs. With the current condition of the Guadalupe River and its tributaries, the Lexington-centered storm creates the highest peak flow[39]. A comparison of flows at different storm return periods is summarized in Table 7.

Table 7: Current Condition Storm Flows by Return Period and Storm Location

Location Along Guadalupe River	Storm Flows (cfs) by Return Period and Storm Center					
	4% (25yr)		2% (50yr)		1% (100yr)	
	Lexington	Guadalupe	Lexington	Guadalupe	Lexington	Guadalupe
Highway 101	10,425	9,157	13,546	12,580	16,000	15,316
Montague Expy	10,635	9,449	13,692	12,704	16,102	15,366

The maximum flow that is currently able to reach the Project area is 16,000 cfs, slightly less than the 17,000 cfs used by the LRGP and the 18,600 cfs calculated by the 2009 USACE hydrology update. Because it is unlikely that the "ultimate" condition in the watershed will ever be achieved within the useful life of this project, it is worth considering the current condition 1 percent flood flows as the design flows. This should be examined in the alternative analysis.

3.6 Wildlife, Fisheries, and Vegetation

Habitat types in the project area include open water, riparian forest and scrub, marsh and wetlands, and ruderal uplands (see Figure 9 and Figure 10). The Guadalupe River channel supports perennial, or year-round, surface water and has coarse-textured rock and gravel substrate. The lower portion of the river in the project area, up to approximately Montague Expressway, is tidally influenced. The sediment depositional reaches (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. The margins of the river channel and SDRs are densely vegetated with riparian or marsh vegetation. From Interstate 880 to approximately Montague Expressway, the margins of the river channel and SDRs support dense, mature riparian trees and shrubs. Some of this vegetation was planted as mitigation for the DGRP. In the tidally influenced portion of the project area, from approximately Tasman Drive to Montague Expressway, riparian forest and scrub is replaced by perennial marsh and occasional weeping willow trees. Floodplain uplands and levee slopes are dominated by ruderal/weedy upland herbs and grasses.

[39] Jack Xu. 2019. Lower Guadalupe River Capacity. Tech Memo.

Figure 9: Examples of open water, dense riparian forest, wetland, and ruderal upland (on levee slopes and bases) habitats along SDRs.

Figure 10: Examples of marsh habitat downstream of Montague Expressway

Based on the stream flow and habitat conditions in the project area and historical wildlife survey records, the following special-status species have potential to occur in the project area at least seasonally[40].

- Central California Coast (CCC) Steelhead (*Oncorhynchus mykiss*)
- Central Valley Fall Run Chinook Salmon (*Oncorhynchus tshawytscha*)
- Pacific Lamprey (*Entosphenus tridentatus*)
- Riffle sculpin (*Cottus gulosus*)
- Southwestern Pond Turtle (*Actinemys pallida*)
- Pallid bat (*Antrozous pallidus*)
- Townsend's big-eared bat (*Corynorhinus townsendii*)
- Alameda Song Sparrow (*Melospiza melodia pusillula*)
- American Peregrine Falcon (*Falco peregrinus anatum*)
- Bald Eagle (*Haliaeetus leucocephalus*)

[40] Valley Water. 2019. Biological Site Assessment for the Lower Guadalupe River Invasive Tree Removal Project.

- Burrowing Owl (*Athene cunicularia*)
- Swainson's Hawk (*Buteo swainsoni*)
- White-tailed Kite (*Elanus leucurus*)
- San Francisco Dusky-Footed Woodrat (*Neotoma fuscipes annectens*)

In addition, numerous other migratory birds and common or nonnative fish and wildlife species occur in the project area.

3.7 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[41]. 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. 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 further discussed in Section 4.3.

3.8 Community Interests

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[42]. The trail will need to be accounted for during planning and design.

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 is home to many native flora and fauna, and is open to the public for recreational use[43].

[41] Devin Mody, personal communication
[42] 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)
[43] Ulistac Natural Area. 2019. http://www.ulistac.org/about

4 Problem Definition

4.1 Reduced Capacity

The LGRP was completed in 2004 with the objective to provide 1 percent flood flow capacity (17,000-18,325 cfs). High water marks collected during recent storms indicate that the channel is not carrying the flows as designed, prompting Valley Water to update the HEC-RAS hydraulic model Lower Guadalupe River.

4.2 Model Calibration

Because the 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. Incorporating these changes allowed the model to more accurately match the water surface elevations observed during high flows. 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 Field Observation: 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.

During the update of the hydraulic model, Manning's n-values were updated based on field observations and aerial photos. The n-values were also peer-reviewed by an outside consultant[44]. The channel n-values increased by about 50% whereas the floodplain n-values more than doubled in certain areas. Figure 11 shows a sample cross-section where the channel design n-value is increased from 0.03 to 0.045 and a portion of the floodplain n-value being increased from 0.08 to 0.2. The widths of the roughness zones were also updated based on aerial photos and field observations[45].

[44] Schaaf & Wheeler. 2019. Peer Review of Roughness Estimates for Lower Guadalupe River in San Jose between Interstate 880 and San Francisco Bay.
[45] John Yang. 2018. Draft Lower Guadalupe Model Update. Tech Memo.

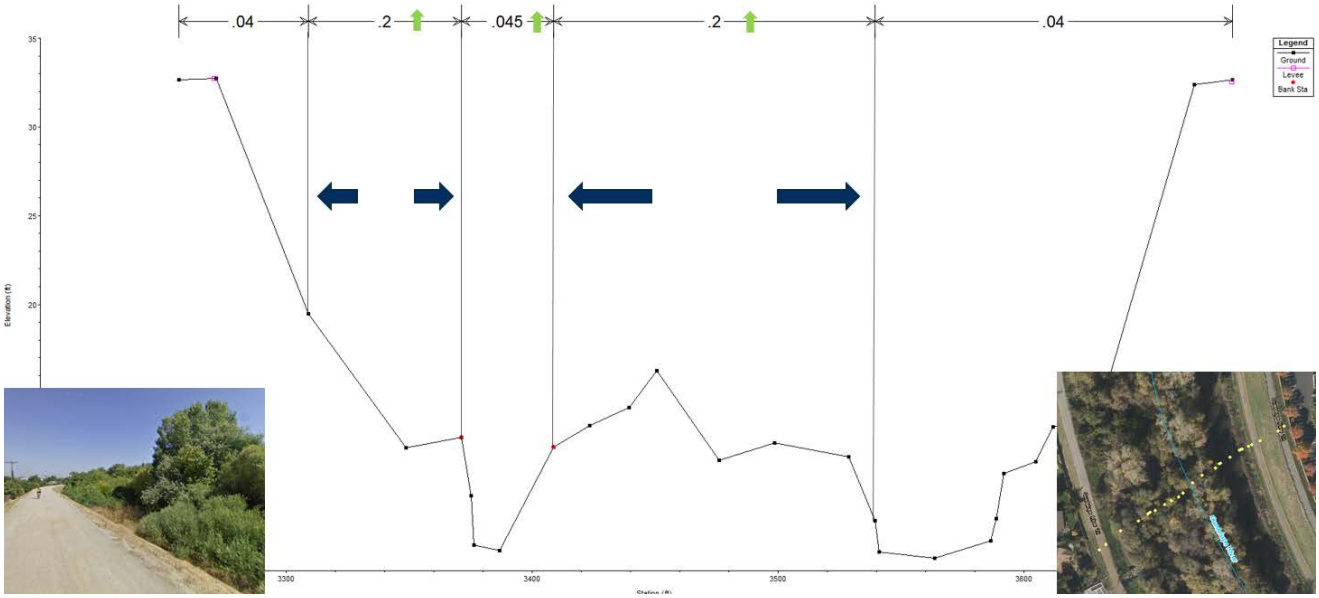

Figure 11: Typical Cross Section with increased Manning's n values

With updated roughness values in the HEC-RAS model, the results show that the Lower Guadalupe River is unable to convey the design 1 percent flood. Capacity exceedance is predicted from Montague Expressway to upstream of Highway 101. The maximum exceedance occurs downstream of Trimble Road with a water surface elevation almost two feet above top of bank. This suggests that the water surface profile here needs to be lowered by about 5 ft to meet the 3 ft freeboard required by FEMA[46]. The current estimated capacity of Lower Guadalupe River is summarized in Table 8.

Table 8: Current Capacity Estimates

Flow (cfs)	Approx. Exceedance Probability[47]	Notes
18,325*	1%** (100yr)	Design flow for LGRP
14,800	2% (50yr)	Current estimated capacity without any freeboard
10,800	4% (25yr)	Current estimated capacity with 3 ft of freeboard

*17,000 cfs from Downtown Guadalupe, with additional inflow from pump stations.

**Current condition 1 percent flood is 16,000 cfs downstream of Los Gatos Creek confluence plus pump station flows.

Figure 12 depicts the HEC-RAS cross sections with varying levels of capacity for the 1 percent flood event. The green sections have full capacity and design freeboard, the yellow sections have reduced freeboard, and the red sections do not have adequate capacity.

[46] FEMA. 2019. CFR44 § 65.10.

[47] SCVWD. Design Flood Flow Manual for All District Watersheds. January 2018.

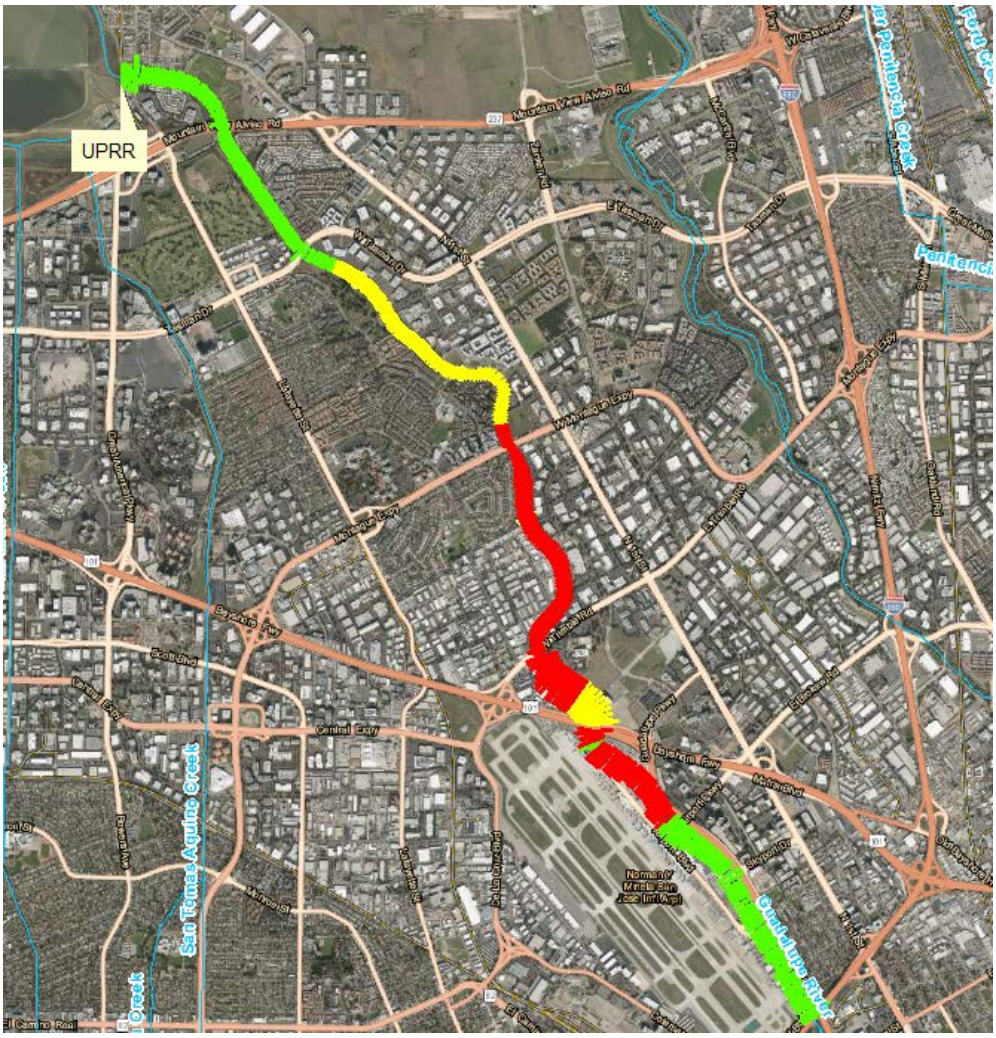

Figure 12: HEC-RAS Cross Sections with Capacity Level Shown

4.3 Vegetation Growth

Valley Water's capacity investigation determined that more vegetation exists in the channel than was assumed in the LGRP design (see Figure 13 to Figure 15). Maintenance has been regularly conducted, but it has not been enough to keep the channel in its design condition. There are several reasons for this, one being that the LGRP project was designed when there was much less vegetation in the channel. 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.

Another possible factor is the change in permitting requirements since LGRP was designed and constructed. Standards for vegetation removal activities are stricter now, and many forms require mitigation plantings in other areas that have increased the scale and cost of vegetation maintenance. 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.

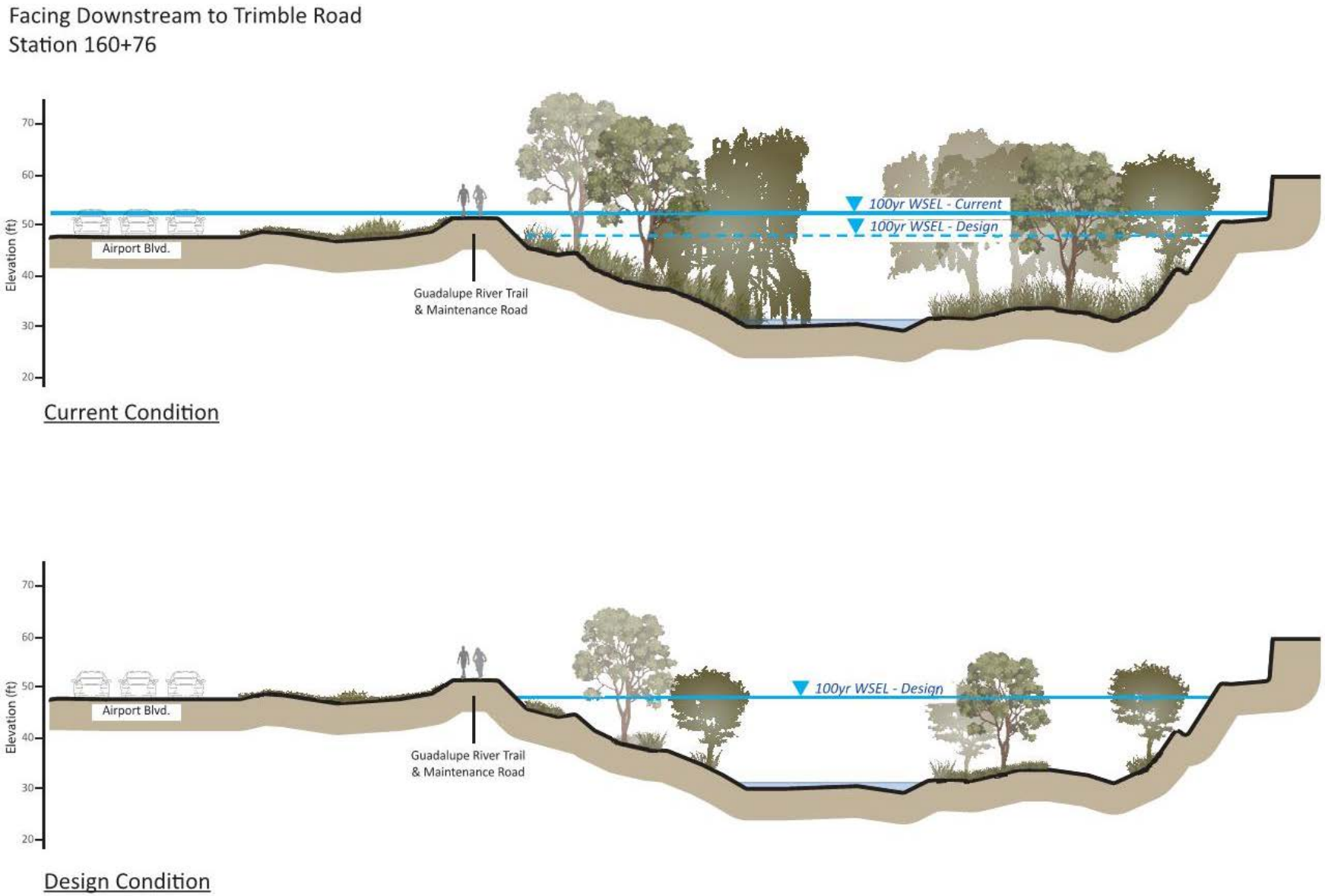

Figure 13: Typical Section – Interstate 880to Trimble Road

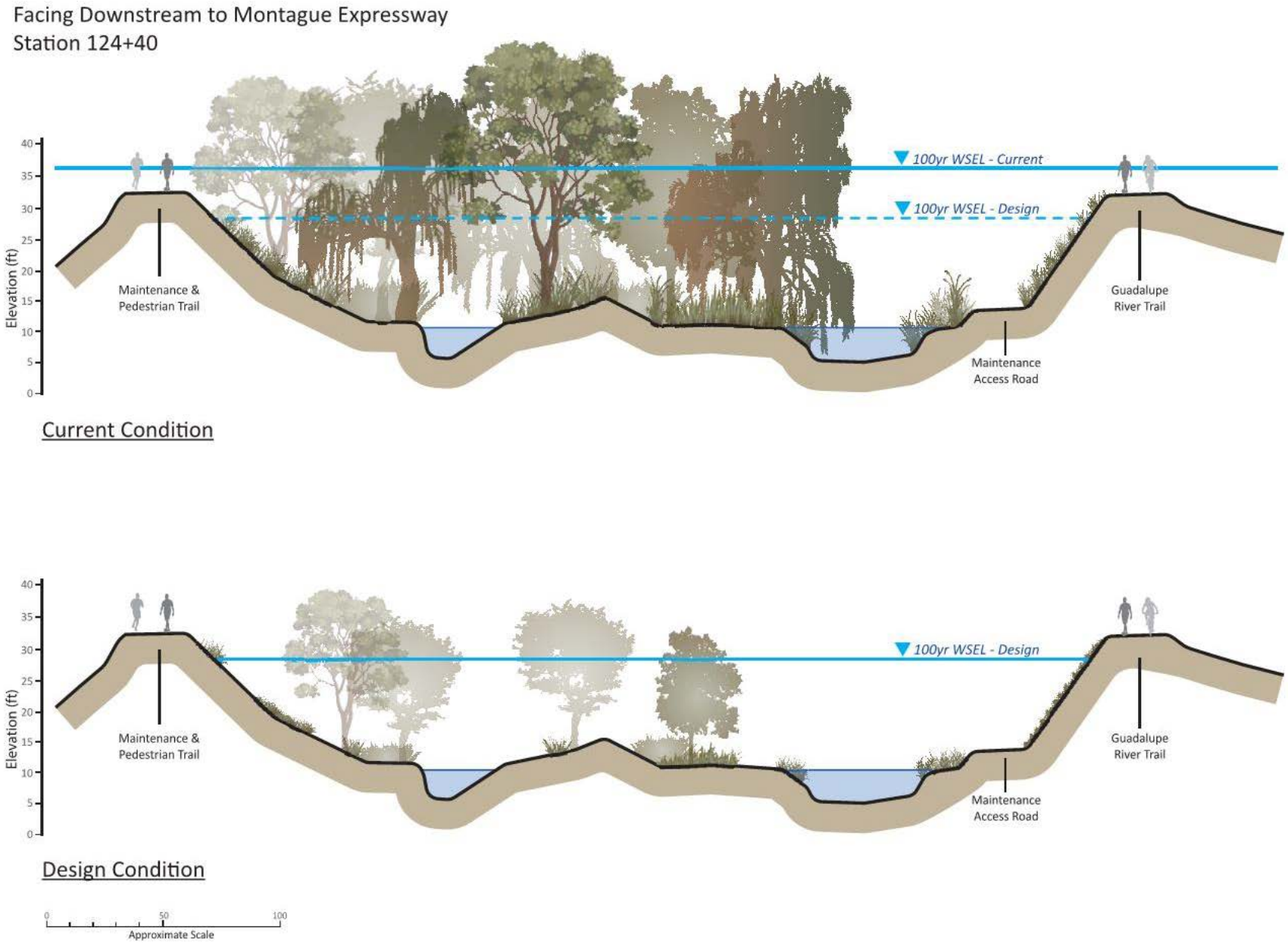

Figure 14: Typical Section -Trimble Road to Montague Expressway

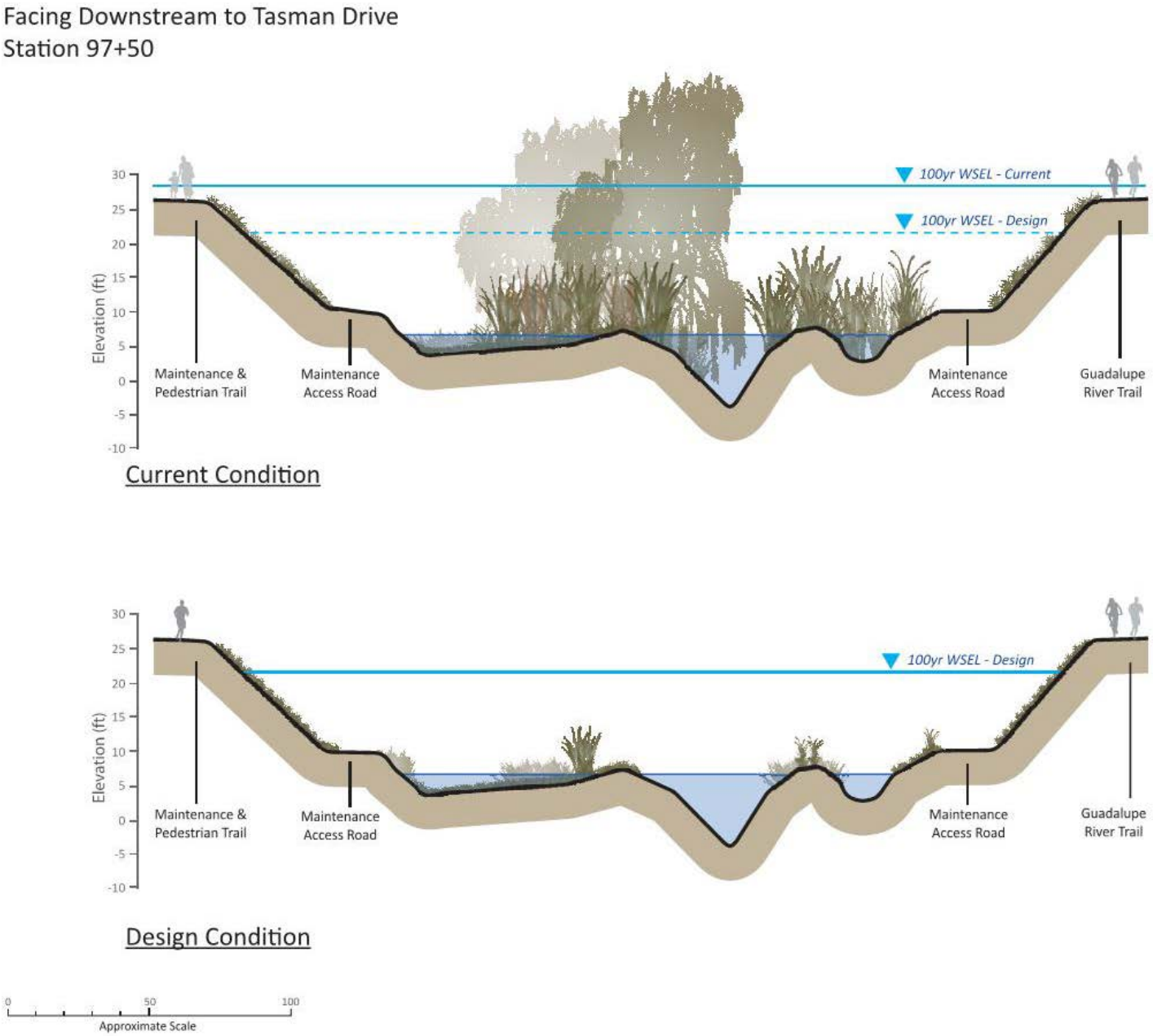

Figure 15: Typical Section - Montague Expressway to Tasman Drive

Routine vegetation removal alone will not be enough to achieve 1 percent flood flow capacity for the channel. Although some vegetation management activities are covered under the Stream Maintenance Program and Safe, Clean Water Project D2, the amount of vegetation removal necessary to influence channel capacity would require California Environmental Quality Act (CEQA) documentation, regulatory permits, extensive mitigation, and significant environmental planning effort and vegetation clearing work. Even if the channel is cleared, the river would not convey 1 percent flood flows and would require channel improvements beyond vegetation maintenance[48]. 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.

4.4 Channel Geometry

The existing conditions investigation show a reduction in channel area that was not accounted for in the LGRP design. In order to raise the levees, the 2004 LGRP improvements included the placement of fill on the inboard side of the existing levees. This encroachment was unaccounted for in the project design and as-builts, and effectively, has reduced the flow conveyance area of the river.

The existing HEC-RAS model was created from a HEC2 model that used surveyed cross sections and photogrammetry from 1996[49]. 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[50]. 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 14, with original HEC-RAS model, 2008 as-builts, 2017 data, and 2018 data included.

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

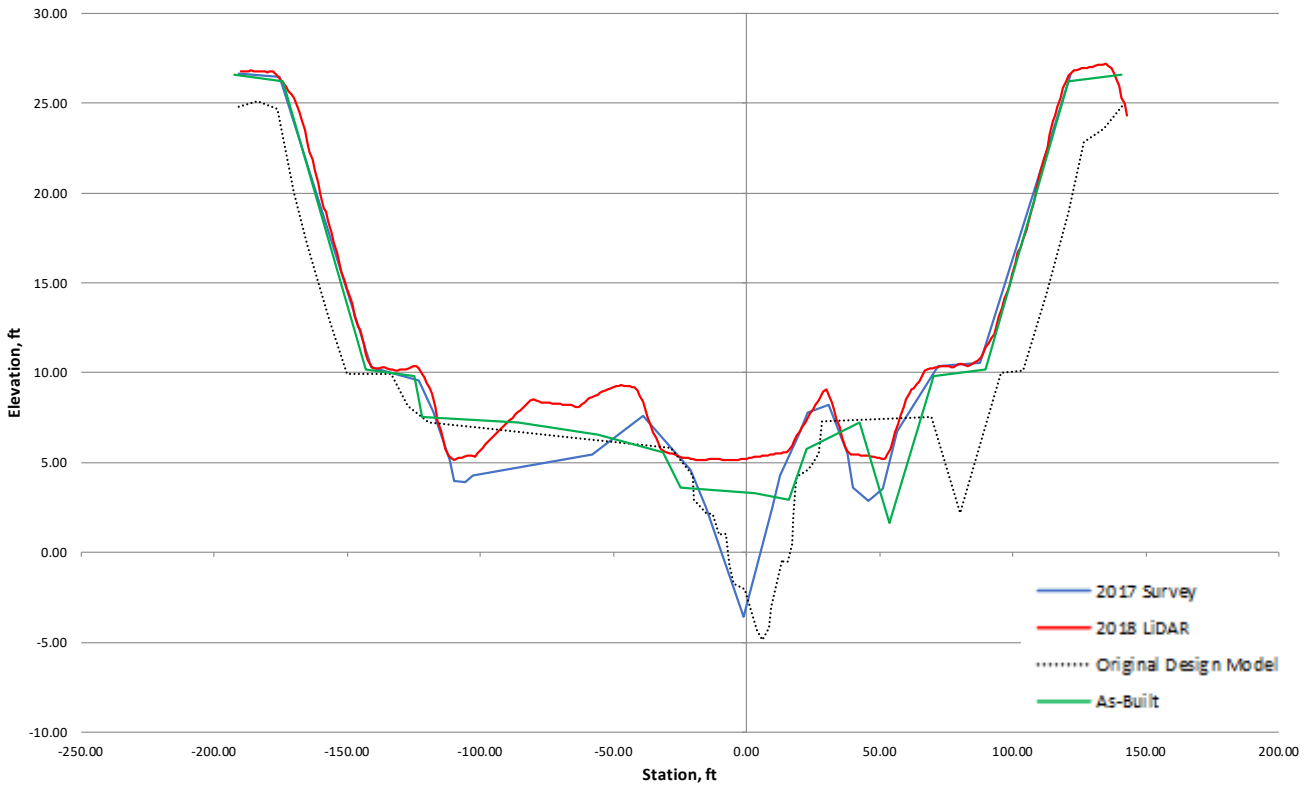

Figure 16: Comparison of Cross Section Data at Station 97+50, Upstream of Tasman Drive

4.5 Near-Term Work

Once the channel capacity issues were identified, staff sought options to restore design flow capacity. To be compliant with USACE operation and maintenance guidelines, levee side slopes are supposed to be clear of woody vegetation or trees, and grass should be maintained below 12 in. In the near-term, staff identified various vegetation management and sediment removal activities that could be conducted to make progress in restoring the channel's design flow capacity and be more consistent with USACE standards.

4.5.1 Stream Maintenance Program

Some of the vegetation management and sediment removal work proposed to help restore design flow conveyance capacity in the project area falls under the Stream Management Program (SMP). Vegetation management activities include instream vegetation removal, invasive plant management, routine pruning, tree and limb removal, and removal of trees between 9 in. and 12 in. Diameter at Breast Height (DBH). As of August 2019, vegetation management activities were being conducted under the SMP, and are summarized by reach in Table 9.

Additionally, several of the project's SDRs were cleared as part of the SMP, which included the removal of sediment and management of large vegetation and trees. This work has been completed as of December 2019.

Table 9: Vegetation Maintenance Activities Proposed Under SMP in FY20

		Proposed Vegetation Management Activities under the Stream Maintenance Program (SMP)					
Reach	**Location**	**Instream Vegetation Removal (ISV)**	**Invasive Plant Management Program (IPMP)**	**Routine Pruning**	**Limb Removal > 4 in. DBH**	**Tree Removal 9-12 in. DBH**	**Vegetation Removal <6 in. DBH**
E, D	Tasman to Montague	Less than 6 in. Diameter at Breast Height (DBH) below Ordinary High Water Mark (OHWM)	Removal of all less than 12 in. DBH	1. Lower Maintenance Road (LMR), for access 2. Instream, for flow conveyance	1. LMR, for access 2. Instream, for flow conveyance	Instream, for flow conveyance	-
C	Montague to Trimble	Less than 6 in. DBH below OHWM	-	-	-	within 15 ft from levee toe	-
B	Trimble to 101	Less than 6 in. DBH below OHWM	-	-	-	-	Woodies growing in rip-rap
A	101-880	Less than 6 in. DBH below OHWM	Removal of all less than 12 in. DBH	-	-	-	-

It should be noted that the vegetation management and sediment removal work being conducted under the SMP in FY20, as described above, will not provide for complete restoration of the project area's design flow conveyance capacity.

4.5.2 Safe, Clean Water Program, Project D2

Project D2 is part of the Safe, Clean Water and Natural Flood Protection Program. D2 allows Valley Water to remove non-native, invasive plants from Valley Water creeks and rivers. In the project area, approximately 150 non-native, invasive trees exceeding SMP tree size thresholds have been identified as candidates for removal. Because these trees cannot be removed under the SMP, this effort is currently in a separate CEQA and regulatory permit acquisition process. The estimated timeframe for removal of said trees is FY21.

It should be noted that the vegetation management work to be conducted under D2 in FY21, as described above, will not provide for complete restoration of the project area's design flow conveyance capacity.

4.6 Risks and Impacts

Since the LGRP was constructed in 2004, the number of residential units has grown, adding increased economic risk of flooding. Upon completion of the LGRP, most of the homes and businesses in the pre-project, 1 percent floodplain were no longer required to purchase flood insurance. If the channel is unable to carry a 1 percent flow, some of these residences and businesses may be required to pay new FEMA flood insurance fees or be subject to unexpected flooding with no insurance to aid in recovery. Limited river channel capacity would also affect several bridges in the project area. 1% return period storm levels could limit the freeboard available on Highway 101 and Trimble Road, and could overtop the existing headwalls on Montague Expressway. These bridges may need to be modified to increase the headwall heights or increase capacity under the bridges.

A higher water surface elevation could also impact the pump stations in the project area. A higher water surface could translate to a higher pumping head that the pumps will need to accommodate during a large storm.

Sea-level rise could exacerbate flooding to higher levels than originally designed. This project planning study should account for the sea level height projected in 50 years[51]. Sea level rise was not considered as part of the LGRP.

4.7 Limitations

The LGRP previously committed to carrying 17,000 cfs from the DGRP. The current planning project will consider design alternatives that contain this flow entirely within the channel, as well as upstream detention or flow reduction methods that would reduce the 1 percent flow to a value lower than 17,000 cfs. The Project team will also consider the pump station inflows in the project area, which LGRP calculated to be 1,325 cfs.

Dense growth of woody vegetation is a large contributor to the capacity issues in the project reaches. However, it may be difficult to obtain permits for vegetation management activities proposed as part of this project, and/or the amount of mitigation required may be prohibitive. An active mitigation planting site exists in Reach B, between Trimble Road and Highway 101. These sites would need additional mitigation if vegetation removal or management was proposed.

5 Community Outreach

In a February 2019 letter sent to the surrounding communities, Valley Water informed residents of the increased risk of flooding due to the reduction of capacity in the river. The letter included a map of the affected neighborhoods in Santa Clara and San Jose. A public meeting was held on May 23, 2019 for the Rivermark Homeowners Association to address residents' questions and concerns. An additional meeting was held September 23, 2019 for the community to learn about the project and provide input on the current project alternatives. Comments received during the public meeting are listed in Appendix A.

Valley Water staff will continue to conduct outreach to the community, to ensure they are informed about the upcoming project, and to gather feedback on aspects of the project that affect community members. Valley Water staff has created a website for the project, and will keep the project website current, with up-to-date information, brochures and maps. The website can be accessed at https://www.valleywater.org/guadalupe-river-tasman-i880. Valley Water staff plans to conduct public meetings at the following stages:

- Problem definition, early alternatives
- Late alternatives, early feasible
- Staff recommended project

[51] Valley Water. 2016. Working Guidance for Incorporating Sea Level Rise in Planning and Design of Flood Protection Projects by Santa Clara Valley Water District. Draft.

6 Opportunities and Constraints

The Project has identified the following opportunities:

- Operational: Minimize the amount of routine stream maintenance required by accounting for high amounts of vegetation and sediment in the channel as part of the design.
- Stakeholders: Create collaborative opportunities with stakeholders, such as those who are involved with UNAREP, to ensure that wildlife corridors are protected and preserved.
- Design:
    - Provide flood protection to the channel for the 1% return period storm event assumed in the LGRP design.
    - Identify opportunities to use available open space as flood detention or to increase channel capacity.

The Project has identified the following constraints:

- Schedule: Staff committed to have a recommendation for the Board 12 months from the March 12, 2019 Board meeting. They also committed to starting construction by June 2021, which results in a very tight planning-design-construction schedule. Because of the complexity of this project and the constraints of current environmental permitting conditions, it is more realistic to expect construction to start in 2022 at the earliest.
- Permitting: It is very difficult to permit the removal of vegetation that does not fall into already established Valley Water programs (e.g., SMP, Instream Vegetation Management, Invasive Plant Management Program). Any removal will require extensive and costly mitigation. Most project alternatives will require preparation of appropriate CEQA documentation and acquisition of regulatory permits. The Staff-Recommended Alternative will require additional regulatory permits for construction.
- Budget: The planning phase has been allotted $1 million to produce a staff-recommended alternative. It is unclear what funds will be available from Fund 12 to finance the design and construction phases of this project. Additional budget may be needed for operations and maintenance costs if they exceed the costs budgeted for maintaining the LGRP.
- Operational: Regular maintenance of the project levees and 15 ft from the levee toe will be required. This is a USACE requirement for levees.
- Technical:
    - Sea level is expected to rise within the next 50 years. Higher water levels at the downstream boundary should be considered to make sure they do not cause future flooding issues.
    - There are many bridges within this project area that are affected by overtopping. Modifying these bridges will require coordination with the agencies that own them, and impacts should be minimized if possible.
    - SFPUC's Hetch Hetchy pipelines cross under the river in the project area. Project plans should seek to avoid impacts to these pipelines.
    - There are many pump stations on both sides of the project that cross through the levees and discharge into the river. Impacts to the pump stations should be minimized if possible.
- Design:
    - In the 1992 Local Cooperation Agreement between USACE and Valley Water for the Downtown Guadalupe River Project, Valley Water commits to operating and managing the LGRP to "convey design flood flows" and to operating or managing Guadalupe River basin

reservoirs "for water conservation purposes consistent with past practices". Page 1-2 of the 2002 LGRP Engineer's Report states the project will "contain one percent design flood with peak flow of 17,000 cfs".
    - The Guadalupe River trails are heavily used by the public. Any changes perceived as negative may be ill-received.
    - Limited real estate property is available for channel widening.

7 Potential Changes to Project

The Project has made the following assumptions:

- The CEQA process will need to be followed, and a consultant will be retained to prepare the necessary Environmental Impact Report (EIR).
- A consultant will be retained from the on-call planning services contract to assist with alternatives analysis.

Potential changes to project objectives and scope are identified as follows:

- Project limits: The limits of the project may need to be refined if design alternatives raise the water surface elevation upstream or downstream of the original project extents.
- Project scope: Currently, the planning phase is considering upstream flow detention or attenuation. In the future, the scope may be reduced to only consider conveying 17,000-18,325 cfs flow if USACE does not find flow reduction alternatives acceptable based on previous LCA commitments.

8 Next Steps

Once the problem definition and refined objectives phase has been completed, the planning team will begin formulating conceptual design alternatives. The conceptual alternatives will be evaluated, and the options that best meet the project objectives will be included in the feasible alternatives analysis. The design alternative that best meets the project objectives will be selected as the Staff Recommended Alternative, and will be presented to the Board of Directors. There will also be several public meetings during this process to gather input from the community. The alternative selected by staff and approved by the Board will move to the design phase.

Because the project's schedule is expedited, several tasks typically initiated in the design phase will be initiated in the planning phase. These tasks may include a detailed design survey of the channel, plan and profile drafting in AutoCAD, and utility investigation. Other investigations and studies, such as a geotechnical investigation, may need to be initiated now so they can be completed by the time the design phase starts.

The project team will also need to start the CEQA process as soon as possible, and plans to start this process at the end of the feasible alternatives phase. Any other permits that may take a long time to obtain may also need to be started in the planning phase.

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Appendix G
Conceptual Alternatives Analysis Report

Valley Water

Clean Water • Healthy Environment • Flood Protection

Guadalupe River Project – Tasman Drive to Interstate 880

Project No. 30154019

Conceptual Alternatives Report

November 2020

Prepared by

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Contents

Formulation of Alternatives

This report describes the range of alternatives considered for the Guadalupe River – Tasman Drive to Interstate 880 Project (Project) and the methodology followed to determine the recommended project. The information presented here will become the Formulation of Alternatives chapter of the Planning Study Report (PSR).

Summary of Problem Definition

The Lower Guadalupe River Project (LGRP) was completed in 2004 with the objective to provide 1% flood flow capacity (17,000-18,325 cubic feet per second (cfs)). High water marks collected during recent storms (2014, 2017, and 2019) indicate that the channel is not carrying the flows as designed (current capacity estimates are 10,200 cfs between Montague and Trimble). With updated roughness values in the HEC-RAS model, the results show that the Lower Guadalupe River is unable to convey the design 1% flood. The purpose of the Project is to restore the LGRP design level of service to the Lower Guadalupe River.

Objectives

The primary objective of the project is to restore flood protection to the reach between Tasman Drive and Interstate 880, specified in the 1992 Local Cooperation Agreement between the United States Army Corps of Engineers (USACE) and Santa Clara Valley Water District (Valley Water) as the 1% flood event. (Subsequent agreements with USACE specify flows of 17,000 cfs from the Downtown Guadalupe River Project (DGRP), and 18,325 cfs for the LGRP. Providing the level of protection for these specific flows will be evaluated in the alternatives analysis.) It should be noted that the hydrology has been updated by USACE in a 2009 study that found higher flows reaching the Guadalupe River (17,967 cfs- to 19,292 cfs). The Project is considering this objective as a Level of service restoration to the LGRP design condition, and not to incorporate the 1% flow increase as well.

Other project objectives are:

1. Maintain and/or enhance ecological conditions
2. Minimize the need for future operations and maintenance activities
3. Maintain and/or enhance public recreation and access
4. Obtain community support and participation for the Project

Changes to Project Extents

The Project's capacity problem area has been extended to cover the reach of Guadalupe River between Gold Street and Interstate 880. The early calibration of 1D steady state HEC-RAS models showed that reduced channel capacity stopped at Tasman Drive. However, later peer-reviewed calibrations of Manning's n values identified freeboard insufficiencies stretched past Tasman Drive to Gold Street, including the Alviso neighborhood to the east of the river.

Between State Route 237 and Tasman Drive, land east of the river is heavily developed with residential properties. On the west side of the river, land is less developed and used as a golf course and BMX track. The land from Gold Street to State Route 237 is urbanized with over half of the surrounding land used for residential and industrial use. A large open space exists to the east of this section of river, which is used as a golf practice facility.

Alternatives Approach

The alternatives development approach for the Project is 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) objectives.
- Select a recommended alternative based on the outcome of the NFP objectives rating.

Design Criteria

The Project team selected preliminary design criteria to guide the course of the alternatives evaluation. A complete documentation of the design criteria is listed in Appendix A: Draft Design Criteria. The summarized criteria are as follows:

Based on discussions with subject matter experts and lessons learned from the on-going maintenance of the 2004 LGRP, it is unlikely that the channel's riparian vegetation can be reliably maintained to the LGRP design level. Therefore, 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. This is based off USACE requirements for levee clearance, shown in Figure 2 and Figure 3 below. Levee slopes and the adjacent areas have been maintained somewhat regularly in the past and provide beneficial grassland habitat. The most valuable riparian vegetation is in the zone adjacent to the bankfull channel, which is more highly regulated as Shaded Riverine Aquatic (SRA) habitat. Vegetation maintenance proposed in this area would be limited to work needed to remove large logjams or debris barriers and remove invasive and non-native plants to restore native vegetation. The full proposed maintenance cross section is illustrated in Figure 1.

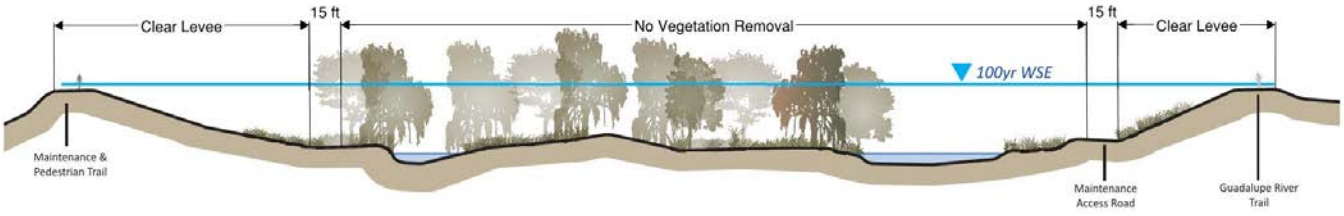

Figure 1: Proposed Maintenance Condition for the Project

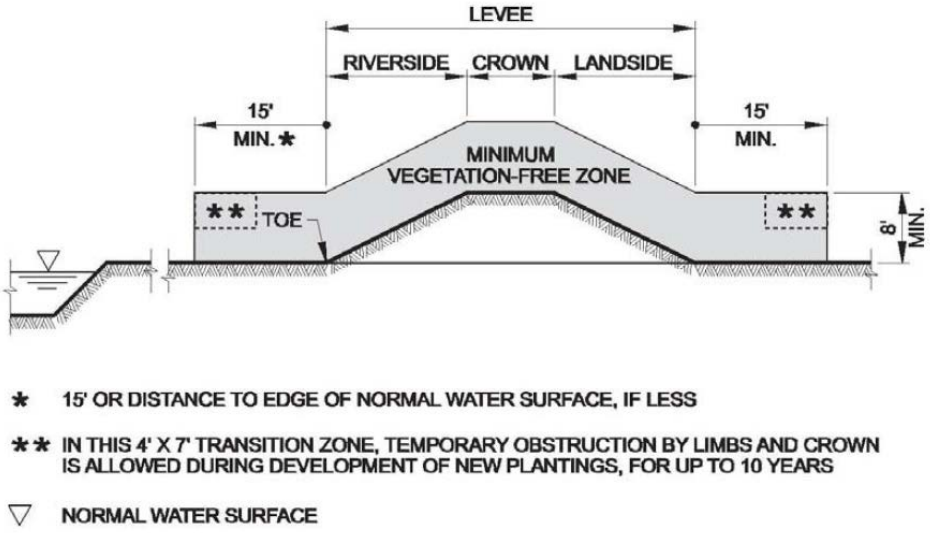

Figure 2: Levee Section - Basic, from USACE EP 1110-2-18[1]

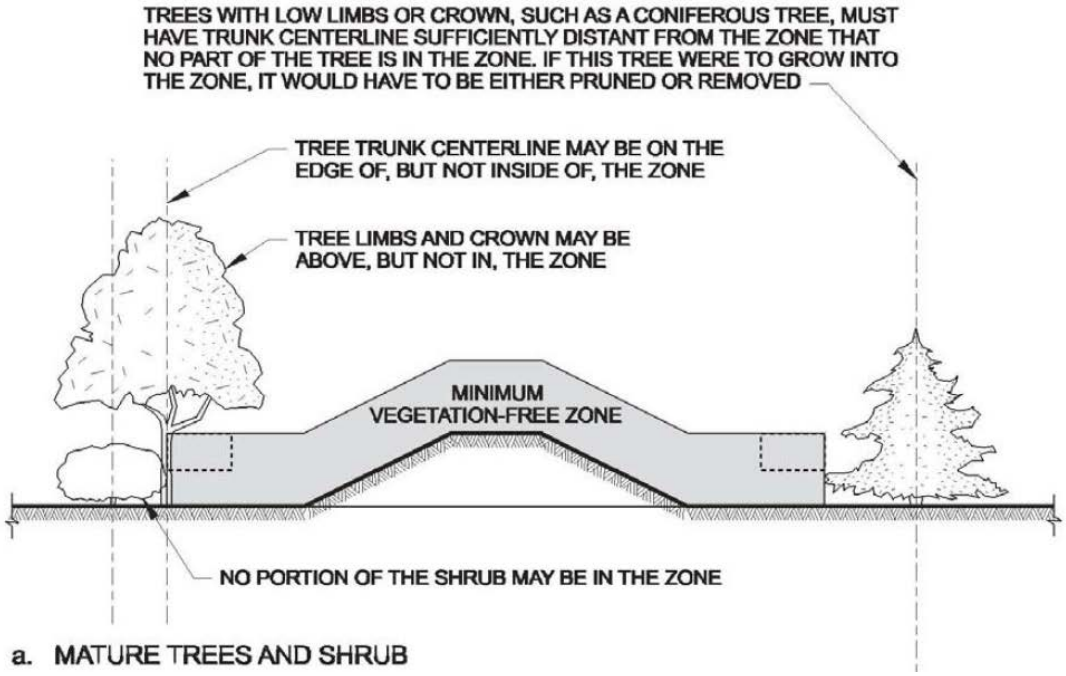

Figure 3: Proper Application of the Vegetation-Free Zone, from USACE EP 1110-2-18

All Project elements and alternatives use levee freeboard heights listed in the Valley Water Hydraulic Design Manual: 3.5 feet generally, and 4 feet within 100 feet from bridges. Standard FEMA levee freeboard height is 3 feet generally and 4 feet withing 100' of bridges, which is what the previous LGRP design used as freeboard. The 2004 LGRP was designed to last 100 years; therefore, design for seepage, slope stability, levee erosion, sediment

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

aggradation, and levee settlement must be considered to ensure levee integrity, and freeboard requirements are maintained for the life of the Project.

The Project will provide the LGRP's 1% or 100-year level of service flood protection for the reach between Gold Street and Interstate 880. Design flows for structural alternatives range from 17,000 cfs at Interstate 880 to approximately 18,325 cfs at Highway 237. Current hydrology estimates a higher flow for 1% flood events, but the Project has chosen to use the LGRP flows, because it is what the DGRP and LGRP both used for design.

Table 1: LGRP Design Flows for Structural Alternatives

Location Along Guadalupe River	100-Year Design Flows (cfs)
D/S of Los Gatos Creek confluence	16,000
Interstate 880	17,000
Highway 101	17,300
Trimble Road	17,500
Montague Expressway	17,900
Tasman Drive	18,100
Highway 237	18,300

Conceptual Project Elements

The Project team identified a variety of approaches to meet the Project's flood protection 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 others 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 would leave the river channel in its current condition (max capacity of 10,200 cfs between Montague and Trimble) and continue the maintenance activities that have been conducted since the construction of the original project.

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

This project element would increase the capacity of Guadalupe, Almaden, and/or Calero Dams to store more of the peak flow and reduce flows that ultimately reach the Lower Guadalupe River. The initial target peak flow is 10,200 cfs at Interstate 880, which is the flow that the existing channel can carry with appropriate freeboard under future maintenance conditions. Greater or less flow reduction was investigated as well to optimize. Calero and Guadalupe Dam are both currently under capacity restrictions due to seismic concerns, which are not projected to be completed until at least 2023, and likely will be delayed due to Anderson Dam complications.

3. Raise Lenihan Dam (Lexington Reservoir)

This CPE would increase the capacity in Lexington Reservoir, 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 is 10,200 cfs at Interstate 880, which is the flow that the existing channel can carry with appropriate freeboard under future maintenance conditions. Greater or less flow reduction was investigated as well to optimize.

4. Re-operate Lexington Reservoir

This CPE would re-operate 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 is 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 investigated as well to optimize upstream storage and minimize downstream peak flow.

5. Add Outlet Capacity to Lexington Reservoir

This CPE would add outlet capacity to Lenihan Dam at Lexington Reservoir in order to reduce the time needed to release more water prior to a large storm. This would increase the volume available in the reservoir to store the peak flow during a large storm. As with CPEs 3 and 4, the initial target peak flow is 10,200 cfs at Interstate 880. Greater or less flow reduction was investigated as well to optimize upstream storage and minimize downstream peak flow.

6. Modify Vasona Reservoir

This CPE would use Vasona Reservoir as a detention basin to capture some of the peak flow from Lexington Reservoir. The initial target peak flow is 10,200 cfs at Interstate 880, which is the flow that the existing channel can carry with appropriate freeboard under future maintenance conditions. Vasona Reservoir's current maximum capacity is 495 acre-feet (ac-ft).

7. Fluvial Geomorphological Alignment

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

8. Channel Widening

This project element would involve widening the river channel by 150 feet from Tasman Drive to Highway 101, approximately three miles. This scenario assumes widening of the existing east bank levee only to avoid altering the remainder of the river channel.

9. Off-stream Storage at Coleman Loop

This project element would divert peak storm flows into a temporary storage basin, thereby reducing the peak flow in the channel. Project staff identified vacant 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.

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

This project element would use the Los Gatos Creek Recharge Ponds 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 is 10,200 cfs at Interstate 880, which is the flow that the channel can carry with appropriate freeboard under future maintenance conditions.

11. Levee/Channel Paving

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

12. Raise Levees

This project element would raise the existing levees. Raising the levees would ensure all flow is contained for the one-percent storm and would maintain the original freeboard. Raising the levees would increase the total 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 are constructed to contain the additional levee slope.

13. Floodwalls

This project element would install 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 would install 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 when water levels are low.

15. Setback Levee at Ulistac

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

16. Lengthen Bridges

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

17. Bridge Headwalls

This project element installs or raises headwalls on existing bridges. The 1% flood overtops three bridges along Guadalupe River under existing conditions, including Highway 101, Trimble Road, and Montague Expressway. Airport Parkway has inadequate freeboard. Containing all flows within the channel (e.g., floodwalls) also results in the need to raise the existing bridge headwalls. Adding headwalls increases the pressurized flow under the bridges and results in an uplift force. A review of the bridge structures at Montague Expressway, Tasman Drive, and Highway 101 found that the bridge superstructures would not be able to resist uplift loading, and the structures would need to be evaluated for the application of additional restraints which may include foundation piles designed for capacity in tension (i.e. 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 would raise up to five bridges crossing Guadalupe River to allow the one-percent flow to pass underneath the bridge decks unimpeded. Potential bridge raising could occur at Tasman Drive, Montague Expressway, Trimble Road, Highway 101, and Airport Parkway. 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 would remove 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 would remove vegetation to achieve various channel roughness values, as specified by the project design. One such scenario would be removing vegetation to the LGRP design condition. This would involve removing many large trees, would have extensive impacts, and may require significant mitigation.

21. Channel Bypass

This project element would add a box culvert inside or under one or both existing levees to redirect some of the design flow from the channel through the bypass. In order 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 would temporarily close 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 the water flowed over the bridge deck. This would eliminate the need to raise bridges or headwalls to protect the roadway from floods. The roads would be closed for the few hours that the peak passes over the bridge, plus any additional time needed to clear debris before opening the bridge to traffic.

Evaluation of Conceptual Project Elements

All the CPEs listed above were individually evaluated. The elements proposing structural changes were analyzed using HEC-RAS and elements proposing flow modifications were analyzed using HEC-HMS, or a combination of HEC-HMS and HEC-RAS. A preliminary cost estimate was also created for each individual CPE.

The following CPEs were rejected from further analysis and not included in the creation of conceptual alternatives for the reasons listed below:

CPE 2: Modify Guadalupe, Almaden, and/or Calero Dams

The analysis of CPE 2 examined if it is possible to use these three dams in the upper Guadalupe River watershed to reduce the 1% peak flow. The initial target peak flow is 10,200 cfs at Interstate 880, which is the flow that the Project channel reach can carry with appropriate freeboard under future maintenance conditions. The tributaries in the upper watershed currently do not provide 1% flood protection, and spill in

the upper watershed before reaching the Lower Guadalupe River. Due to the water spilling over the creek banks during flooding, the highest peak flow that currently comes from the Upper Guadalupe River (upstream of the Los Gatos Creek confluence) is about 8,000 cfs[2].

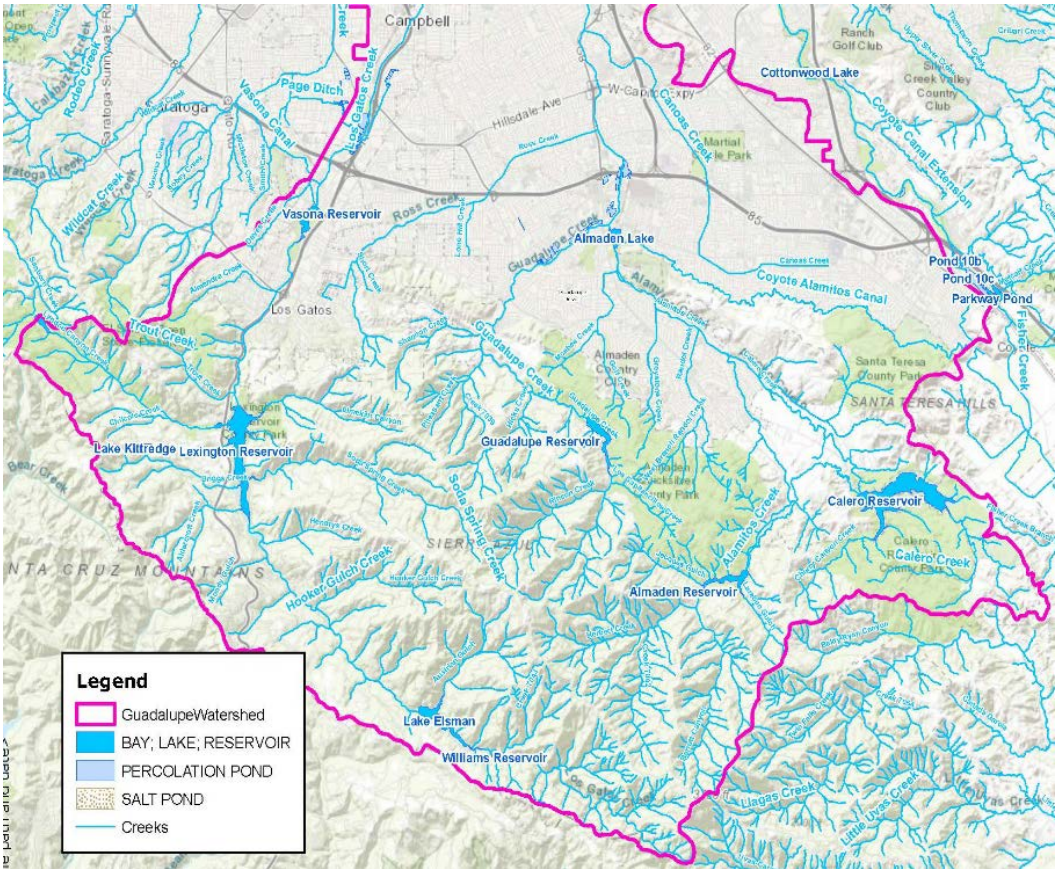

Figure 4: Guadalupe Watershed Reservoirs

The full 1% flow at this location is approximately 14,600 cfs. Downstream of all three dams, the local inflow from interior drainage and tributaries is 10,500 cfs, so dam re-operation or modification alone would not be able to reduce the peak flow to a level suitable for this project. Adding off-stream storage by using existing percolation ponds or new detention basins could further reduce the peak flow. The hydrology of the upper watershed is complex and determining a flow reduction alternative that incorporates all three dams and off-stream detention will require extensive analysis. Due to the expedited nature of this Project to restore capacity to the LGRP, this analysis cannot be completed to the full extent needed within the Project's timeframe. The Upper Guadalupe sub-watershed is considered as part of the Upper Guadalupe River Project (UGRP) project being managed by the U.S. Army Corps of Engineers with Valley Water as the local sponsor. There are existing plans for the UGRP to provide 1% flood protection, although it is unclear if the project will be able to be completed in the foreseeable future. The Project will use current conditions of 8,000 cfs from the Upper Guadalupe River for planning but will consider and document the effects to the UGRP should the U.S. Army Corps of Engineers move forward with designing and constructing 100-year flood protection improvements in the future.

[2] Valley Water. 2019. Lower Guadalupe River Capacity Existing Flow Frequencies. Technical Memorandum.

CPE 6: Modify Vasona Reservoir

This project element would operate and/or modify Vasona Reservoir to store peak flows during a storm. The target flow reduction is 10,200 cfs at Interstate 880. Since the storage needed to achieve this at Lexington Reservoir is 7,000 ac-ft, it can be assumed that the storage amount needed downstream at Vasona Reservoir would be similar. The reservoir's maximum capacity is 495 ac-ft. At 600 ac-ft, Vasona Park begins to flood, as shown in the table below.

Table 2: Vasona Reservoir Elevations and Storage

	Elevation (ft)	Storage (ac-ft)
Dam Crest	308	1320
Park Flooded	303	820
Park Bottom	300	609
Spillway*	298	495
Radial Gate*	278	0

*Converted +2.47 from NGVD29 to NAVD88

There are two 13x10 ft radial gates at the dam with a maximum outflow of 750 to 800 cfs. During the winter, the water surface in the reservoir is kept 2 ft below the spillway, and water is released ahead of storms. The reservoir is never completely drained. There is a mound of sediment that deposited in the upper portion of the reservoir and there are concerns that completely draining the pond would bring that sediment further into the reservoir. There are also fish in the lake, which would be affected by a rapid draining of the reservoir.

Modifying the dam to increase storage capacity could trigger the state's Division of Safety of Dams (DSOD) safety upgrades, including spillway modifications to pass the Probable Maximum Flood (PMF). This analysis has not been completed for Vasona Reservoir, but it is estimated that most of the flows from Lexington Reservoir's PMF would likely arrive at Vasona Reservoir based on the surrounding terrain. The PMF for Lexington Reservoir is around 43,500 cfs[3]. To accommodate this amount of water through Vasona's spillway, the dam crest would need to be raised by 2 ft, not including DSOD freeboard. This is assuming a 220 ft spillway would require a 15 ft crest height to pass 43,500 cfs.

Because the reservoir's available storage is small in comparison to the capacity needed and further modifications would require major upgrades without providing much benefit, this project element will not be included in the conceptual alternatives.

CPE 7: Fluvial Geomorphological Alignment

This project element would create a stable, multi-staged river channel based on the historical floodplain, and meander belt. This element was considered by the LGRP and determined to be around 1,600 ft in width based on historical data of the Lower Guadalupe River. The existing channel width is less than 500 ft, so this CPE would require purchasing a large amount of property. Cost of property acquisition alone was estimated to be in the billions of dollars. Because the Project area is highly developed and the cost of acquiring property is so high, this element will not be considered as part of the conceptual alternatives.

[3] Jack Xu. 2019. Personal Communication RE: Vasona PMF/Spillway.

CPE 15: Setback Levee at Ulistac Natural Area

This project element uses the Ulistac Natural Area to create a setback levee. The existing levee bordering Ulistac would be setback to Lick Mill Blvd to include the natural area in the floodplain for additional conveyance. This element would significantly reduce the water surface elevation in the channel near this location and be a potential opportunity to restore the channel to a more natural floodplain. The Project team communicated with Board Members of the Ulistac Natural Area on March 2, 2020[4] with the proposal to create a setback levee and was met with strong resistance. The concerns expressed were:

- Members and volunteers are highly invested in the area, and spend countless hours restoring and maintaining the site. Any proposed changes that would eliminate vegetation would be seen as destruction of that investment.
- Security: the setback levee would decrease visibility of encampments along the creek, which are becoming increasingly violent.
- Increased soil contamination from arsenic and mercury
- Potential to disturb cultural resources
- Conversion of the area to riparian habitat would destroy the existing upland habitat, which is much less common in the area.

Because of the valid objections raised and because public acceptance of projects is critical to their success, this element will not be evaluated with the conceptual alternatives.

CPE 16: Lengthen Bridges

This project element would lengthen existing bridges that cross the Guadalupe River, including Montague Expressway, Trimble Road, and Highway 101, which all currently bottleneck and restrict flow. When these bridges were modeled with widened corridors to match the upstream and downstream widths, the water surface elevations only slightly decreased. Because significant modification and utility relocations would be required for this element, while only providing minimal benefit, this element will not be considered with the conceptual alternatives.

CPE 19: Sediment Removal

This element would remove sediment 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. Sediment removal of some SDRs in the Project limits was conducted during the planning phase in the summer of 2019. It is estimated that the cost of this work was $480,000, not including design and coordination costs. Sediment removal does not restore full capacity to the channel. Because this element only produces minimal and temporary benefits to capacity, this element will not be included in the conceptual alternatives.

[4] Jen Michelson. 2020. Meeting with Ulistac: Conceptual Flood Risk Mitigation Alternatives at Ulistac. Meeting Minutes.

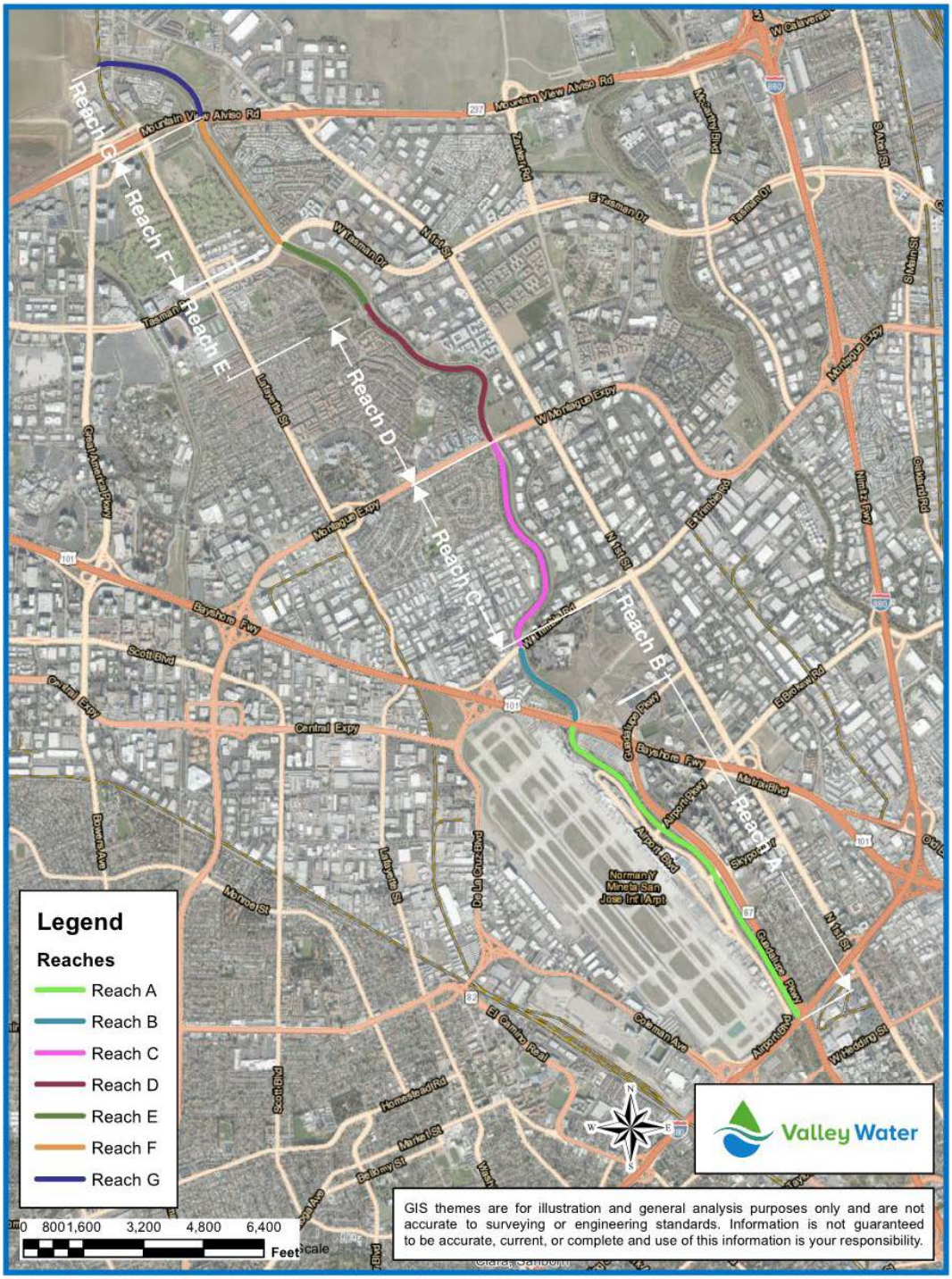

Figure 5: Lower Guadalupe Reaches

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. The following is a description of the conceptual alternatives analyzed:

A. No Project Alternative

Alternative Description

This alternative would make no changes to the current condition. It contains the following CPEs

- CPE 1 – No Action
  This project element would leave the river channel in its current condition and make no changes to existing maintenance activities based on the original LGRP.

Technical Feasibility

This alternative is technically feasible.

Costs

Capital costs would be $0
Maintenance costs would be $180,000 per year based off average amount spent over the years since project completion
Maintenance costs were $550,000 in 2019 to reduce the roughness in the channel
Flood damage losses could be $1.7 billion[5] in the event of a catastrophic levee failure in Santa Clara
Flood damage losses could be $1 billion[6] in the event of a catastrophic levee failure in San Jose

Strengths

- No capital cost

Weaknesses

- Does not meet project objectives
- River is still at risk for levee overtopping and flooding
- Intensive vegetation management requirements, and costs will be very high
- Potential environmental damage from vegetation removal

B. Floodwalls and Headwalls

Alternative Description

This alternative constructs floodwalls and headwalls to restore the capacity of the river channel. It is composed of the following CPEs:

- CPE 13 – Floodwalls:
  This alternative would install new floodwalls or raise existing floodwalls to provide 3.5 ft of freeboard in channel and 4 ft of freeboard 100 ft upstream and downstream of bridges. Floodwalls were assumed to be concrete with spread footings, placed on the outboard side of the top of existing levees. Floodwalls would extend for 4.8 miles on both banks from UPRR bridge to Skyport Drive. The floodwalls would be raised to a maximum height of 10.5 ft to meet the highest headwall needed at Montague Expressway.

[5] Hazus. 2020. Flood Global Risk Report.
[6] Hazus. 2020. Flood Global Risk Report.

Table 3: Alternative B Floodwall Summary

Reach	Average Floodwall Height (ft)	Floodwall Length per levee (mi)
Reach A	2.0	0.7
Reach B	4.2	0.5
Reach C	5.4	1.2
Reach D	4.7	1.1
Reach E	3.2	0.5
Reach F	1.0	0.7
Reach G	0.5	0.2

- CPE 17 – Bridge Headwalls:
  Headwalls must be constructed or re-constructed at the following bridges to provide 4 ft of freeboard:
  - At Airport Parkway new headwall H = 2.75 ft (no existing headwall)
  - At Highway 101, raised headwall H = 6.25 ft (has existing 2 ft headwall)
  - At Trimble Road, raised headwall H = 9.25 ft (has existing 3 ft headwall)
  - At Montague Expressway, raised headwall H = 10.5 ft (has existing 3-4 ft headwall)

  A review of the bridge structures after modification found that the bridge superstructures at Montague Expressway, Tasman Drive, and Highway 101 would not be able to resist uplift loading, and the structures would need to be evaluated for the application of additional restraints.

Alternative B: Floodwalls

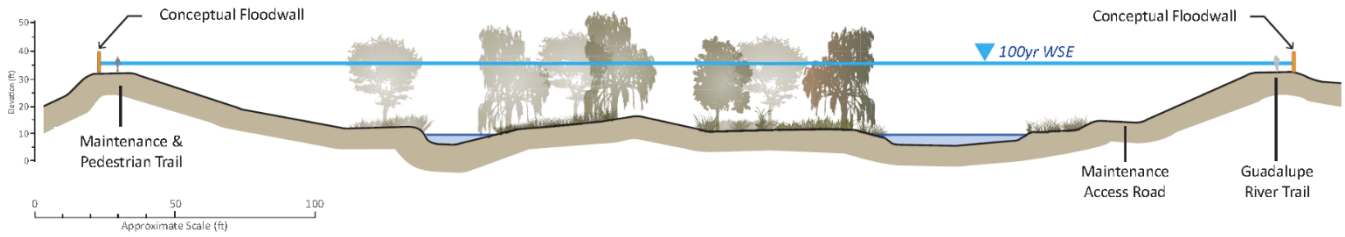

Figure 6: Typical Section – Alternative B Floodwalls

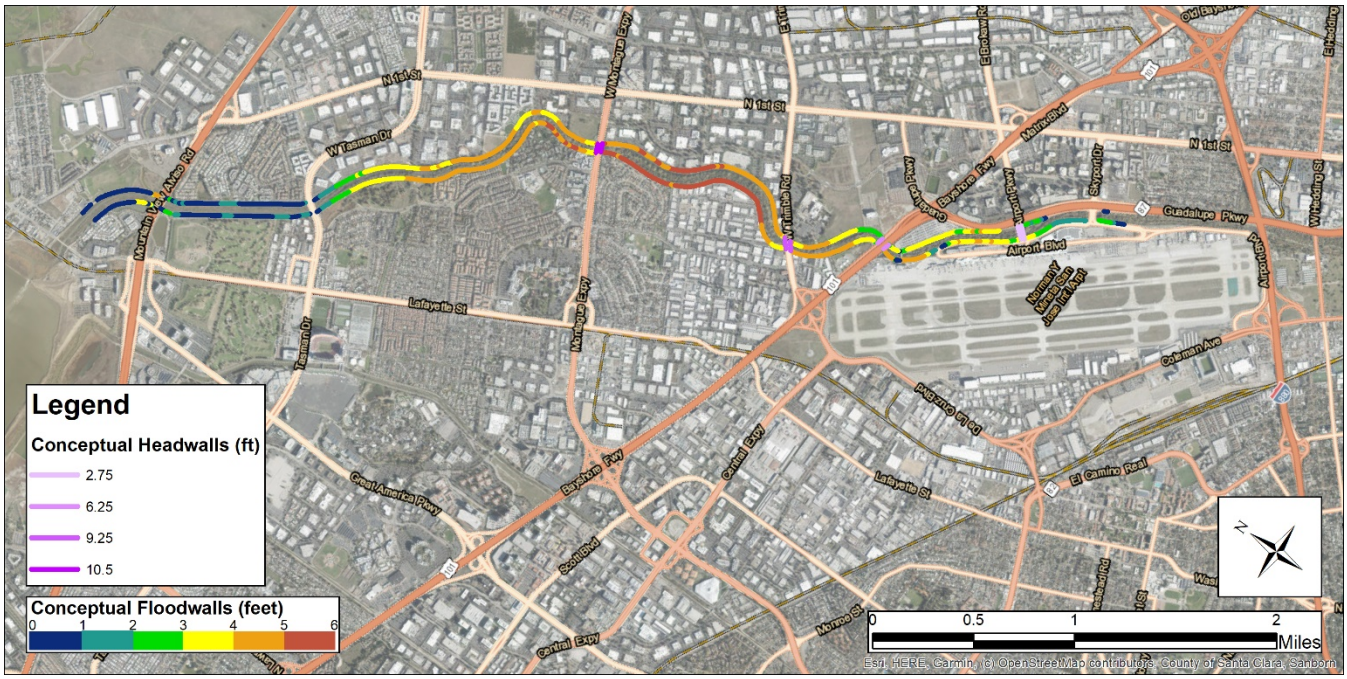

Figure 7: Alternative B Conceptual Layout

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $47,000,000
Maintenance costs would be $450,000 annually

Strengths

- The existing public trails are preserved
- Minimal maintenance is required
- Comparatively lower capital cost
- Less environmental impacts in the river and riparian corridor

Weaknesses

- Floodwalls present a visual barrier, create safety issues on trails, and affect maintenance access/space for vehicles
- High headwalls limit sight distance of drivers and visually disconnect residents from natural area
- Floodwalls will attract graffiti
- Coordination and permitting will be needed with Caltrans, City of San Jose, Santa Clara County to construct headwalls

B.1. Passive Barriers, Floodwalls, and Headwalls

Alternative Description

This alternative constructs floodwalls and passive barriers combined with headwalls to restore the capacity of the river channel. It is composed of the following CPEs:

- CPE 13 – Floodwalls
  Floodwalls would extend for 3.6 miles on both banks from UPRR bridge to Skyport Drive. Floodwalls are assumed to be concrete with spread footings, placed on the outboard side of the top of levee. The floodwalls would be raised to a maximum height of 10.5 ft to meet the highest headwall.

Table 4: Alternative B.1 Floodwall Summary

Reach	Average Floodwall Height (ft)	Floodwall Length per levee (mi)
Reach A	2.0	0.7
Reach B	4.2	0.5
Reach C	4.5	0.2
Reach D	4.6	0.9
Reach E	3.2	0.5
Reach F	1.0	0.7
Reach G	0.5	0.2

- CPE 14 – Passive Barriers
  Passive barriers would be used where floodwalls over 5 ft is needed in order to preserve visual access to the river and trail. Five feet is used as the threshold to balance the high cost of barriers with visibility to trail users. This would result in a total length of 2.7 miles of barrier primarily between Montague Expressway and Trimble Road. The barriers vary in height from 5 ft to 8 ft. Barriers would be placed so that they hinge on the outboard side of the top of levee, to provide the most conveyance area within the channel.

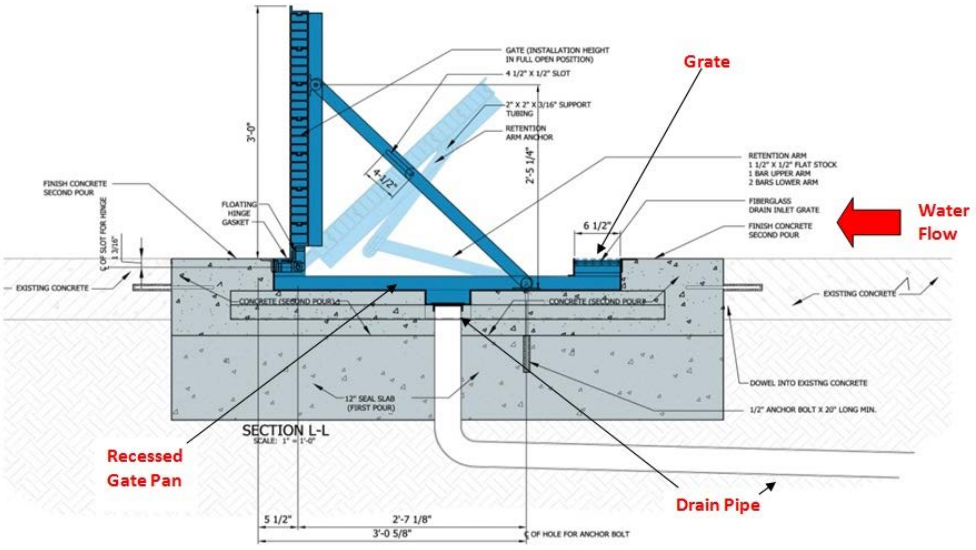

Figure 8: FloodBreak Passive Flood Barrier Engineering Drawing

- CPE 17 – Bridge Headwalls
  Headwalls would need to be constructed or re-constructed at the following bridges:
  - Airport Parkway to 2.75 ft (no existing headwall)

- Highway 101 to 6.25 ft (has existing 2 ft headwall)
- Trimble Road to 9.25 ft (has existing 3 ft headwall)
- Montague Expressway to 10.5 ft (has existing 3-4 ft headwall)

A review of the bridge structures after modification found that the bridge superstructures at Montague Expressway, Tasman Drive, and Highway 101 would not be able to resist uplift loading, and the structures would need to be evaluated for the application of additional restraints.

Alternative B.1: Passive Barrier

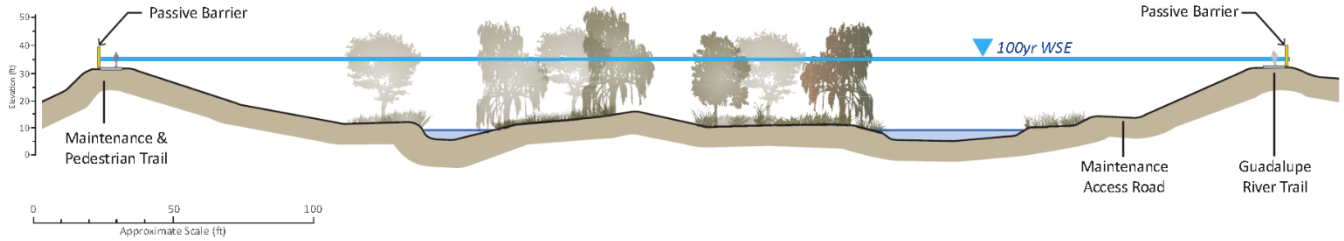

Figure 9: Typical Section – Passive Barriers

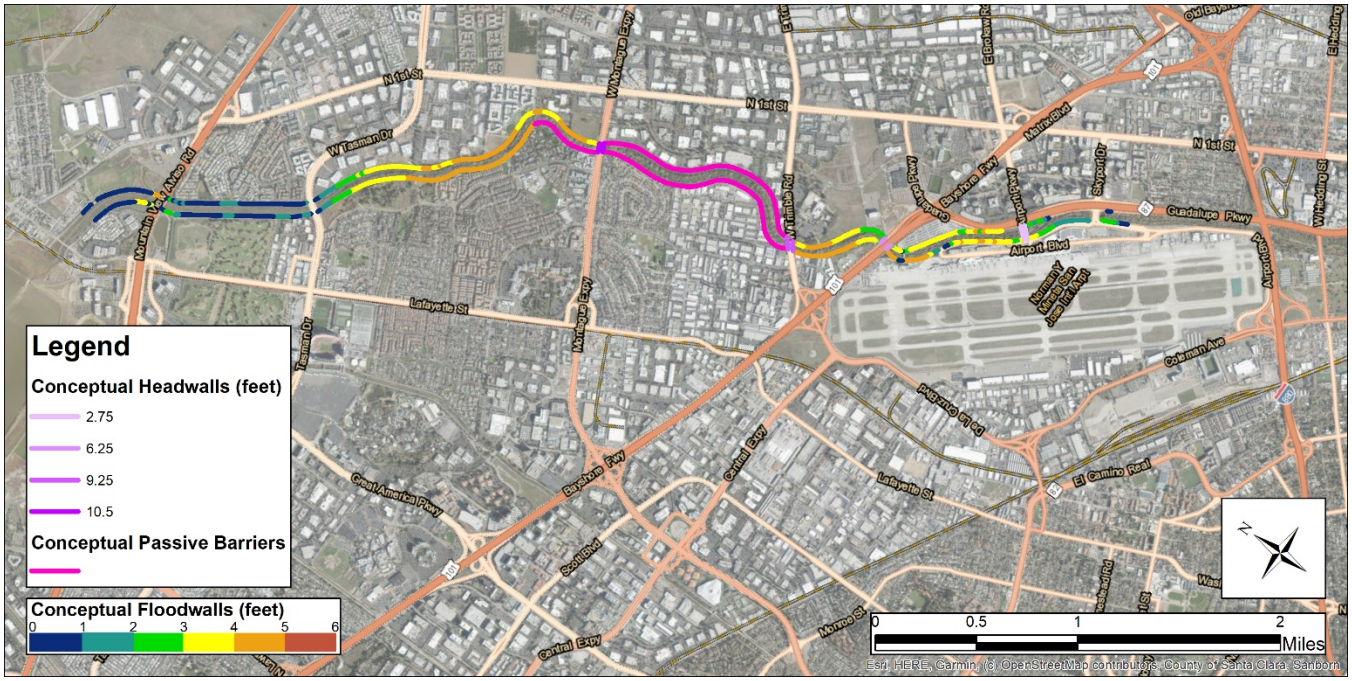

Figure 10: Alternative B.1 Conceptual Layout

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $180,000,000

Maintenance costs would be $450,000 annually

Strengths

- The existing public trails are preserved
- Passive barriers can match existing ground surface composition
- There are no visual impacts from passive barriers between Montague Expressway to Trimble Road
- Less environmental impacts in the river and riparian corridor

Weaknesses

- The remaining floodwalls present a visual barrier
- High capital costs
- Coordination and permitting will be needed with Caltrans, City of San Jose, Santa Clara County to construct headwalls
- Passive barriers require different maintenance than floodwalls and introduce an element of potential mechanical failure as a risk factor
- Passive barriers reduce the width of the maintenance road and trail when deployed
- Trails must be cleared before large storm events when there is a potential for deploying the passive barriers

B.2. Floodwalls and Headwalls with Closed Roadways

Alternative Description

This alternative constructs floodwalls and passive barriers combined with headwalls to restore the capacity of the river channel. It is composed of the following CPEs:

- CPE 13 – Floodwalls
  Same as Alternative B
- CPE 17 – Bridge Headwalls
  Headwalls would need to be constructed or re-constructed at the following bridges to provide 4 ft of freeboard:
  - Airport Parkway to 2.75 ft (no existing headwall)
  - Highway 101 to 6.25 ft (has existing 2 ft headwall)

  A review of the bridge structures after modification found that the bridge superstructure at Highway 101 would not be able to resist uplift loading, and the structures would need to be evaluated for the application of additional restraints.
- CPE 22: Close Road Crossing with Passive Barriers
  Instead of building headwalls at the following bridge crossings, the roadways would have a passive barrier installed that would deploy during a flood to allow flows to pass over the bridge deck. The passive barrier heights would be as follows:
  - Trimble Road to 9.25 ft
  - Montague Expressway to 10.5 ft

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $60,000,000
Maintenance costs would be $450,000 annually

Strengths

- The existing public trails are preserved
- Minimal maintenance is required
- Comparatively lower capital cost
- Less environmental impacts in the river and riparian corridor

Weaknesses

- The remaining floodwalls present a visual barrier
- Coordination and permitting will be needed with Caltrans, City of San Jose, Santa Clara County to construct headwalls and passive barriers
- 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

C. Levees with Retaining wall and Headwalls

Alternative Description

This alternative would raise the existing levees to provide additional capacity in the river channel. It consists of the following CPEs:

- CPE 12 – Raise Levees:
  The raised levees would extend for 5.4 miles on both banks from UPRR bridge to Skyport Drive. The average elevation increase ranges by reach from 3.6 ft to 6.1 ft. 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 on the outboard side of the levees to prevent encroachment onto other properties, where needed, and have a maximum height of 12.2 feet. The top of levee is assumed to be a constant 18 feet wide with side slopes of 2:1 (horizontal:vertical). The levees would be raised a maximum height of 10.5 ft to meet the highest headwall or would transition to floodwall upstream and downstream of the bridge.
- CPE 17 – Bridge Headwalls:
  Headwalls must be constructed or re-constructed at the following bridges:
  - Airport Parkway to 2.75 ft (no existing headwall)
  - Highway 101 to 6.25 ft (has existing 2 ft headwall)
  - Trimble Road to 9.25 ft (has existing 3 ft headwall)
  - Montague Expressway to 10.5 ft (has existing 3-4 ft headwall)

  A review of the bridge structures after modification found that the bridge superstructures at Montague Expressway, Tasman Drive, and Highway 101 would not be able to resist uplift loading, and the structures would need to be evaluated for the application of additional restraints.

Alternative C: Levee and Retaining Wall

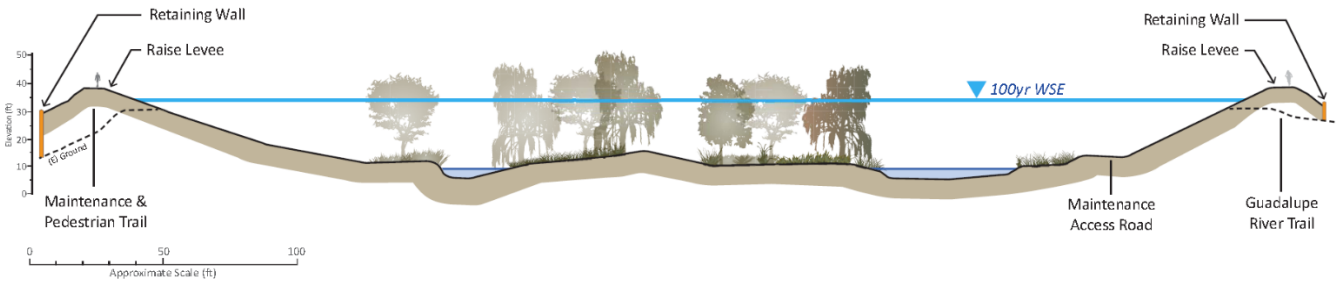

Figure 11: Typical Section – Raised Levees with Retaining Wall

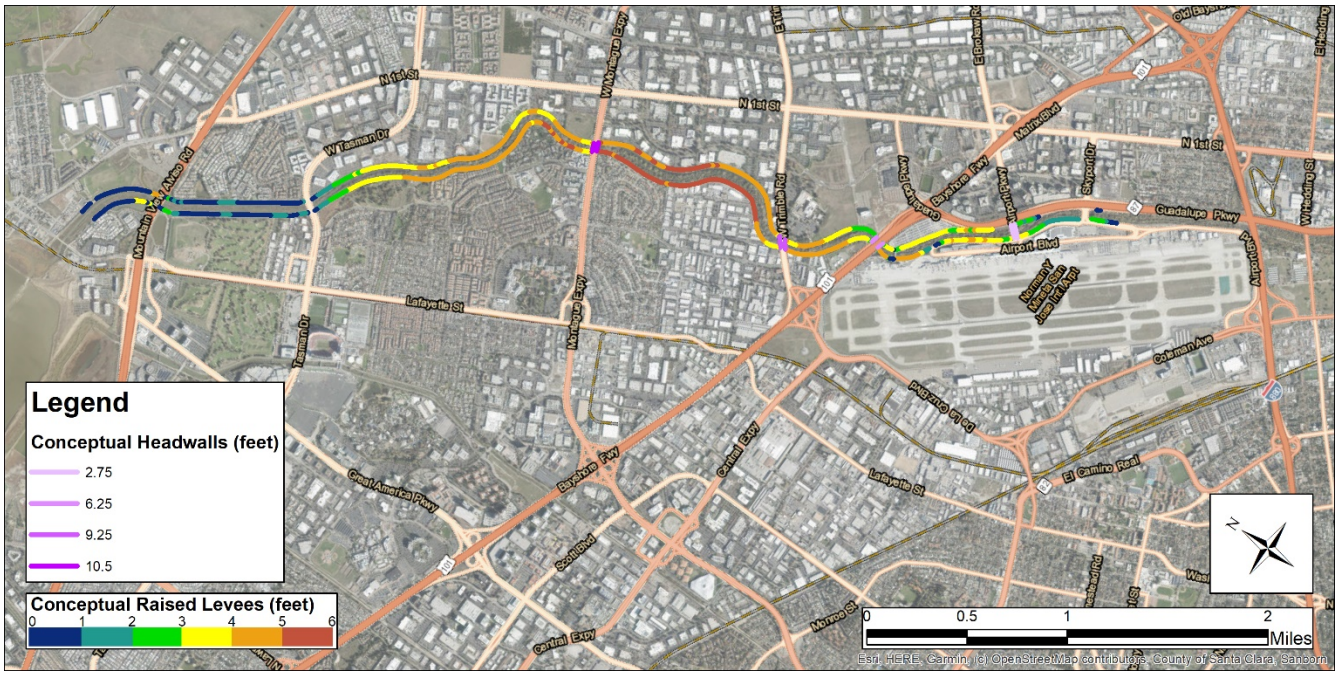

Figure 12: Alternative C Conceptual Layout

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $80,000,000
Maintenance costs would be $450,000 annually

Strengths

- The existing public trails are preserved
- Levees minimize visual barriers
- Minimal additional maintenance is required
- Comparatively lower capital cost
- Retaining walls may reduce pioneer trails from neighborhoods
- Less environmental impacts in the river and riparian corridor

Weaknesses

- Retaining walls and grading may create access issues
- Coordination and permitting with Caltrans, City of San Jose, Santa Clara County to construct headwalls
- 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 fences will be needed
- Retaining walls and floodwalls provide more area for graffiti

C.1. Levees, Floodwalls, and Headwalls

Alternative Description

This alternative would limit floodwall height to 3 ft and raise levees for the additional height needed. It consists of the following CPEs:

- CPE 12 – Raise Levees:
  The raised levees would extend for 3.7 miles on both banks from Airport Parkway to Tasman Drive. The average elevation difference per reach would be 1.8 ft with a maximum difference of 3.1 ft. 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 on the outboard side of the levees to prevent encroachment on other properties and would have a maximum height of 7.5 feet.

Reach	Average Levee Height (ft)	Raised Length per levee (mi)
Reach A	0.8	0.1
Reach B	1.3	0.5
Reach C	2.4	1.2
Reach D	1.8	1.1
Reach E	0.9	0.4
Reach F	0.1	0.0
Reach G	1.3	0.1

- CPE 13 – Floodwalls:
  Floodwalls would be raised or installed anywhere requiring additional flood protection but would be held to a maximum height of 3 ft. The floodwalls would be installed on both banks for 5.1 miles from UPRR bridge to Skyport Drive. Floodwalls are assumed to be concrete with spread footings and are placed on the outboard side of the top of levee.

Table 5: Alternative C.1 Floodwall Summary

Reach	Average Floodwall Height (ft)	Floodwall Length per levee (mi)
Reach A	1.8	0.7
Reach B	3.0	0.5
Reach C	3.0	1.2
Reach D	3.0	1.1
Reach E	2.7	0.5
Reach F	1.3	0.7
Reach G	0.9	0.5

- CPE 17 – Bridge Headwalls:
  Headwalls would need to be constructed or re-constructed at the following bridges:
  - Airport Parkway to 2.75 ft (no existing headwall)
  - Highway 101 to 6.25 ft (has existing 2 ft headwall)
  - Trimble Road to 9.25 ft (has existing 3 ft headwall)
  - Montague Expressway to 10.5 ft (has existing 3-4 ft headwall)

  A review of the bridge structures after modification found that the bridge superstructures at Montague Expressway, Tasman Drive, and Highway 101 would not be able to resist uplift loading, and the structures would need to be evaluated for the application of additional restraints .

Alternative C.1: Levee and Floodwall

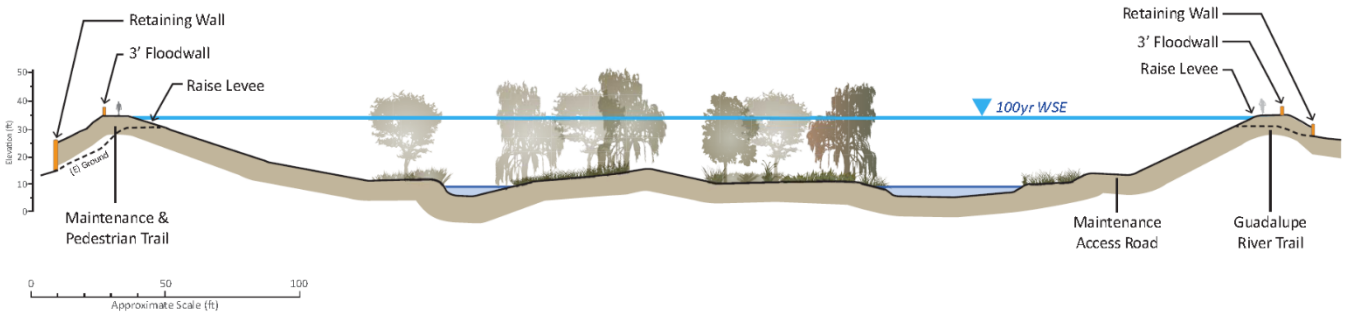

Figure 13: Typical Section – Levees and Floodwall

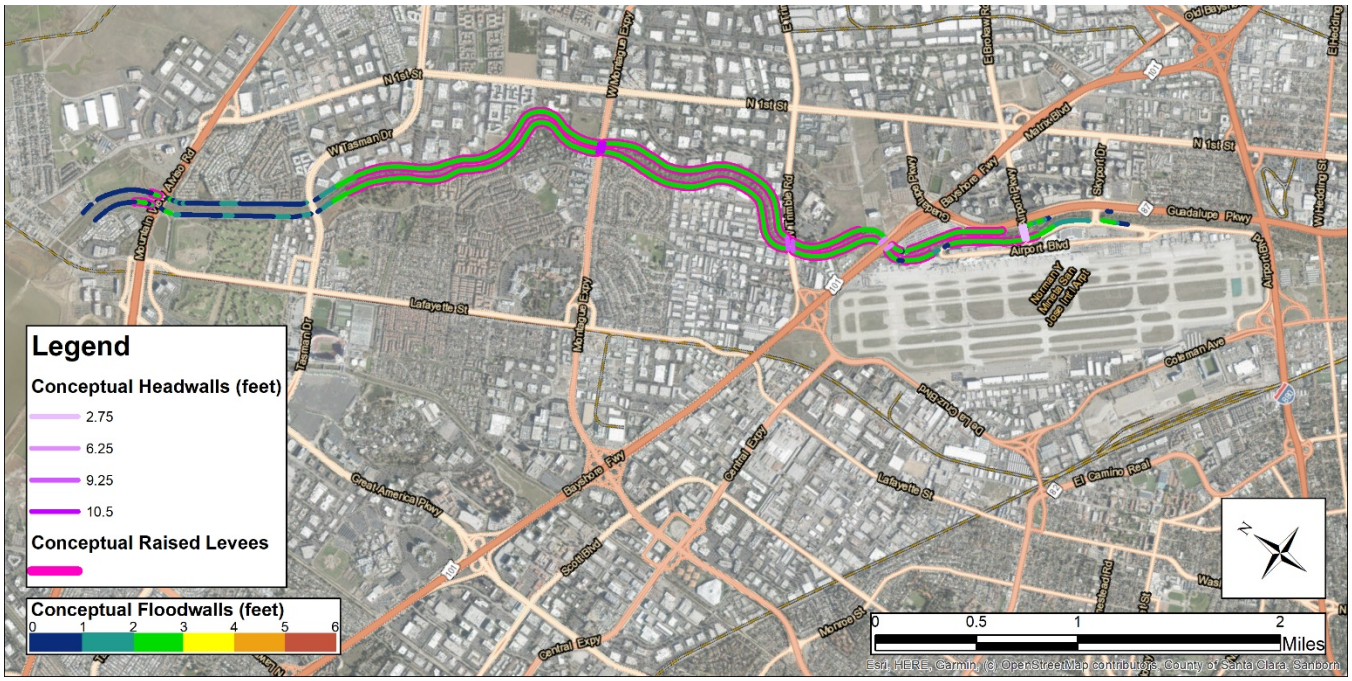

Figure 14: Alternative C.1 Conceptual Layout

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $70,000,000
Maintenance costs would be $450,000 annually

Strengths

- The existing public trails are preserved
- Lower floodwalls minimize visual impacts
- Minimal additional maintenance is required
- Comparatively lower capital cost
- Less environmental impacts in the river and riparian corridor

Weaknesses

- Retaining walls may create access issues
- Increased levee footprint may create maintenance access issues
- Coordination and permitting will be needed with Caltrans, City of San Jose, Santa Clara County to construct headwalls
- Vegetation maintenance and trash removal access is limited between the floodwall and retaining wall
- Retaining walls and floodwalls provide more area for graffiti

D. Off-stream Detention, Floodwalls, and Headwalls

Alternative Description

This alternative would use off-stream detention upstream of the Project limits to store floodwaters and reduce the peak flows. It consists of the following CPEs:

- CPE 9 – Off-Stream Storage at Guadalupe Gardens:
  This alternative would utilize 86 acres of land upstream of Interstate 880 in the Guadalupe Gardens area to create a 5 ft deep detention basin, providing 430 ac-ft of storage and lowering the peak discharge by approximately 1,400 cfs. Groundwater is high in this area and could result in ponding with a deeper detention basin. To maximize storage area, this element assumes some right-of-way acquisition for privately owned properties is needed. Securing use of this area would require coordination and permits with agencies, including the Federal Aviation Administration (FAA), National Marine Fisheries Service (NMFS), San Francisco Bay Regional Water Quality Control Board (RWQCB), and City of San Jose (CSJ).
- CPE 13 – Floodwalls:
  The alternative would install or raise existing floodwalls to provide 3.5 ft of freeboard in channel and 4 ft of freeboard 100 ft from bridges. Floodwalls would extend for 4.8 miles on both banks from UPRR bridge to Skyport Drive. The floodwalls would be raised to a maximum height of 7.5 ft to meet the highest headwall. Floodwalls are assumed to be concrete with spread footings, placed on the outboard side of the top of levee.

Table 6: Alternative D Floodwall Summary

Reach	Average Floodwall Height (ft)	Floodwall Length per levee (mi)
Reach A	1.3	0.6
Reach B	2.9	0.5
Reach C	4.3	1.2
Reach D	4.0	1.1
Reach E	2.7	0.5
Reach F	0.8	0.7
Reach G	0.9	0.4

- CPE 17 – Bridge Headwalls:
  Headwalls must be constructed or re-constructed at the following bridges:
  - Airport Parkway to 2.25 ft (no existing headwall)
  - Highway 101 to 5 ft (has existing 2 ft headwall)
  - Trimble Road to 8 ft (has existing 3 ft headwall)
  - Montague Expressway to 9.5 ft (has existing 3-4 ft headwall)

  A review of the bridge structures after modification found that the bridge superstructures at Montague Expressway, Tasman Drive, and Highway 101 would not be able to resist uplift loading, and the structures would need to be evaluated for the application of additional restraints.

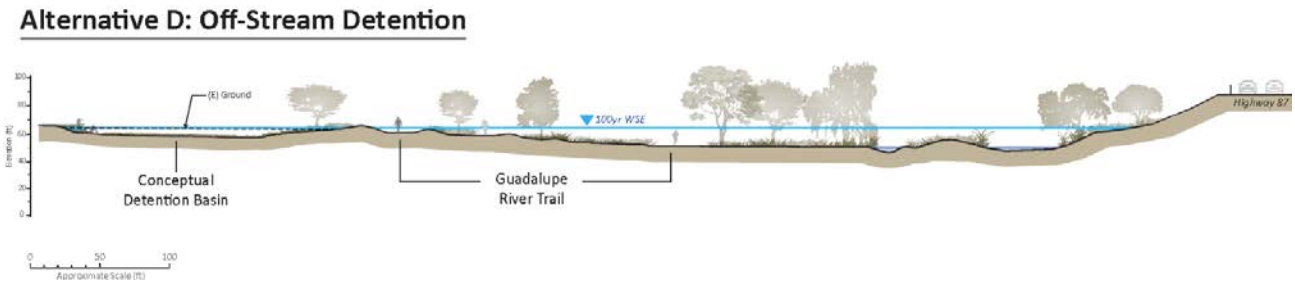

Figure 15: Typical Section – Off-stream Detention

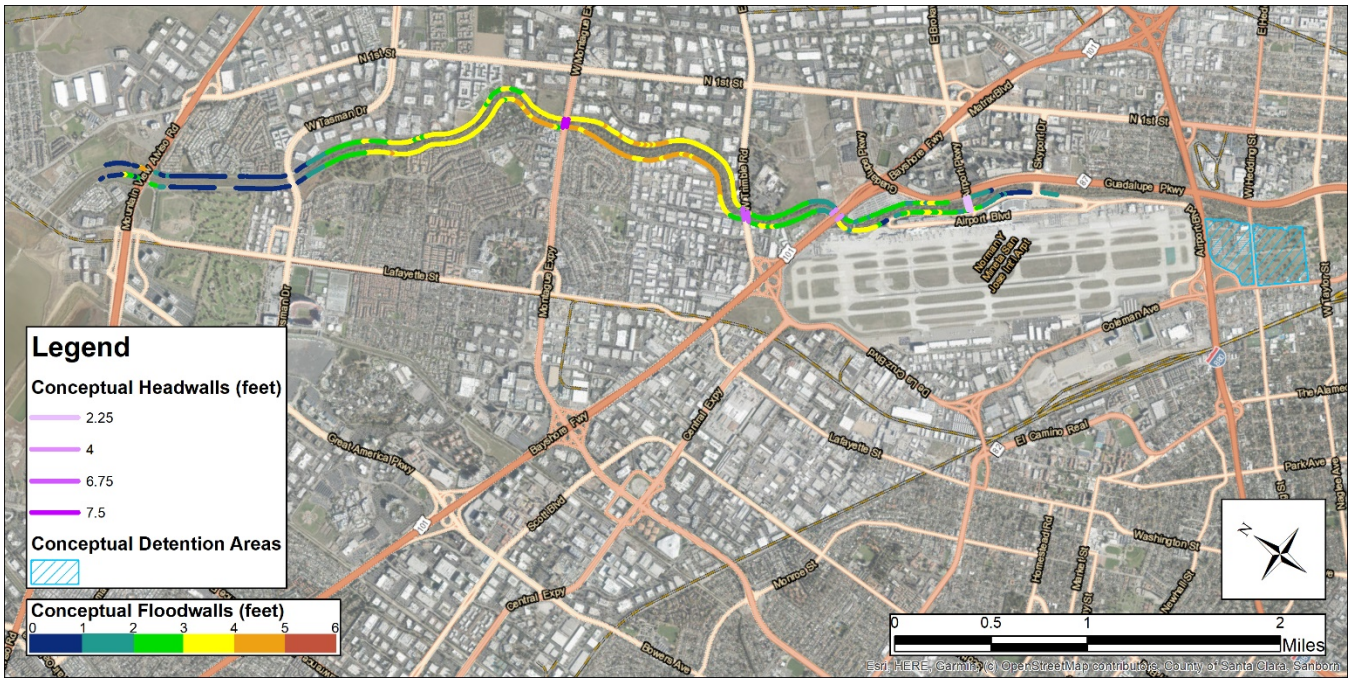

Figure 16: Alternative D Conceptual Layout

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $160,000,000
Maintenance costs would be $500,000 annually

Strengths

- The existing public trails are preserved
- Headwall heights are reduced
- Minimal maintenance is required
- Provides water quality benefits
- Potential collaboration with the City (on green stormwater infrastructure/storm drain master plan)
- Opportunity to create jurisdictional wetlands

Weaknesses

- Coordination and permitting with Caltrans, City of San Jose, Santa Clara County to construct headwalls

- Right-of-way acquisition is required
- High capital cost
- High groundwater
- Requires rights to flood the area, which comes with maintenance responsibilities
- May result in nuisance groundwater if the water is detained for a long time
- Potential fish entrapment in detention basin
- Vector control and temperature issues, if the water is stored for long periods of time

D.1. Off-stream Detention to Avoid Work on 101, Floodwalls, and Headwalls

Alternative Description

This alternative would use off-stream detention upstream of the Project limits to store floodwaters and reduce the peak flows enough to avoid headwall modifications to Highway 101. It consists of the following CPEs:

- CPE 9 – Off-stream Storage at Guadalupe Gardens
  This alternative would utilize 86 acres of land upstream of Interstate 880 in the Guadalupe Gardens area to create a 25 ft deep detention basin, storing 2,000 ac-ft and lowering the peak discharge by approximately 4,000 cfs. Groundwater is high in this area and would result in ponding, so an underground drainage system would be required. To maximize storage area, this element assumes some right-of-way acquisition for privately owned properties. Securing use of this area would require coordination with agencies including the FAA, NMFS, RWQCB, and City of San Jose (CSJ).
- CPE 13 – Floodwalls
  The alternative would install or raise existing floodwalls to provide 3.5 ft of freeboard in channel and 4 ft of freeboard 100 ft from bridges. Floodwalls would extend for 2.1 miles on both banks from Tasman Drive to Trimble Road. The floodwalls would be raised to a maximum height of 5.25 ft to meet the highest headwall. Floodwalls are assumed to be concrete with spread footings, placed on the outboard side of the top of levee.

Table 7: Alternative D.1 Floodwall Summary

Reach	Average Floodwall Height (ft)	Floodwall Length per levee (mi)
Reach A	0.0	0.0
Reach B	0.0	0.0
Reach C	0.3	0.9
Reach D	0.5	0.9
Reach E	0.2	0.2
Reach F	0.3	0.0
Reach G	2.0	0.1

- CPE 17 – Bridge Headwalls
  Headwalls must be constructed or re-constructed at the following bridges:
  - Trimble Road to 3.5 ft (has existing 3 ft headwall)
  - Montague Expressway to 5.25 ft (has existing 3-4 ft headwall)

A review of the bridge structures after modification found that the bridge superstructures at Montague Expressway and Tasman Drive would not be able to resist uplift loading, and the structures would need to be evaluated for the application of additional restraints.

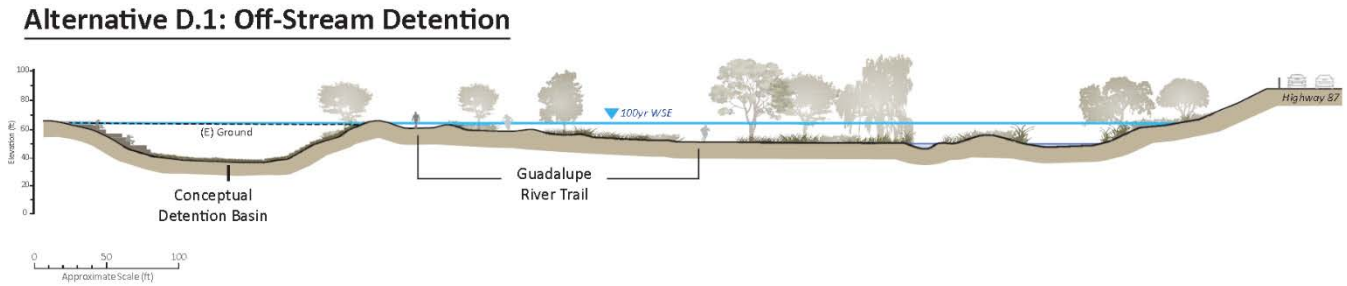

Figure 17: Typical Section – Off-stream Detention

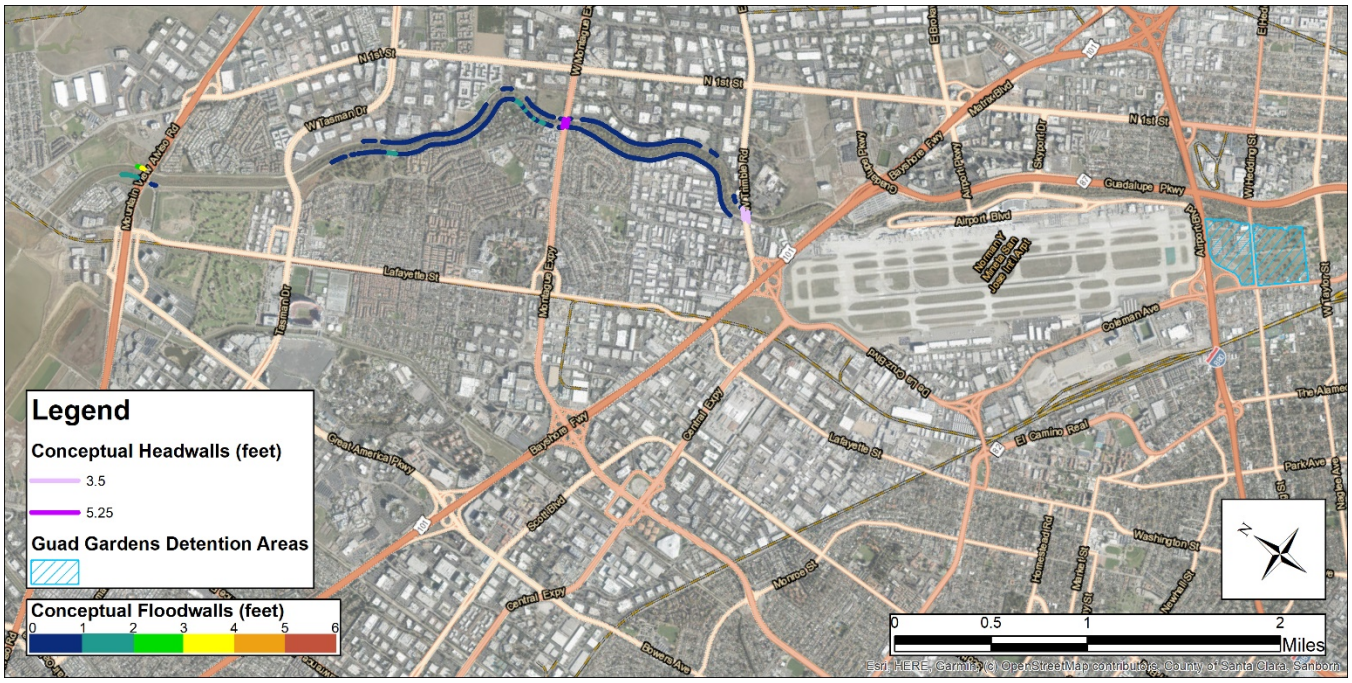

Figure 18: Alternative D.1 Conceptual Layout

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $200,000,000
Maintenance costs would be $500,000 annually

Strengths

- The existing public trails are preserved
- Visual impacts are minimized
- Headwalls at Highway 101 and Tasman Drive are not required
- Water pumped from the detention basin could potentially augment the river in low flow periods

- Benefits to water quality
- Collaboration with San Jose on their storm drain master plan
- Opportunity to create jurisdictional wetlands

Weaknesses

- Coordination and permitting with City of San Jose and Santa Clara County to construct headwalls and acquire easements may delay the Project
- Right-of-way acquisition is required
- Increased maintenance for basin and drainage system
- High capital cost
- Potential fish entrapment in detention basin
- Vector control and temperature issues, if the water is stored for long periods of time
- Central Pipeline runs through the gardens, which may require relocation

D.2 Off-Stream Detention with Minimal ROW Acquisition

Alternative Summary

This alternative would use off-stream detention upstream of the Project limits to store floodwaters and reduce the peak flows, minimizing areas that would require property acquisition. It consists of the following CPEs:

- CPE 9 – Off-stream Storage at Guadalupe Gardens
  This alternative would utilize 50 acres of land upstream of Interstate 880 in the Guadalupe Gardens area to create a 5 ft deep detention basin, storing 200 ac-ft and lowering the peak discharge by 900 cfs. Groundwater is high in this area and could result in ponding, if a deeper basin is desired. To maximize storage area, this element assumes some right-of-way acquisition for privately owned properties, but less than the previous two alternatives (H and H.1). Securing use of this area would require coordination with agencies including the FAA, NMFS, RWQCB, and City of San Jose (CSJ).
- CPE 13 – Floodwalls:
  The alternative would install or raise existing floodwalls to provide 3.5 ft of freeboard in channel and 4 ft of freeboard 100 ft from bridges. Floodwalls would extend for 5.0 miles on both banks from UPRR bridge to Skyport Drive. The floodwalls would be raised to a maximum height of 9.75 ft to meet the highest headwall. Floodwalls are assumed to be concrete with spread footings, placed on the outboard side of the top of levee.

Table 8: Alternative D.2 Floodwall Summary

Reach	Average Floodwall Height (ft)	Floodwall Length per levee (mi)
Reach A	1.7	0.6
Reach B	3.3	0.5
Reach C	4.7	1.2
Reach D	4.3	1.1
Reach E	2.9	0.5
Reach F	1.0	0.7
Reach G	0.6	0.4

- CPE 17 – Bridge Headwalls:
  Headwalls must be constructed or re-constructed at the following bridges:
    - Airport Parkway to 2.25 ft (no existing headwall)
    - Highway 101 to 5.75 ft (has existing 2 ft headwall)
    - Trimble Road to 8.25 ft (has existing 3 ft headwall)
    - Montague Expressway to 9.75 ft (has existing 3-4 ft headwall)

  A review of the bridge structures after modification found that the bridge superstructures at Montague Expressway, Tasman Drive, and Highway 101 would not be able to resist uplift loading, and the structures would need to be evaluated for the application of additional restraints.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $85,000,000
Maintenance costs would be $500,000 annually

Strengths

- The existing public trails are preserved
- Headwall heights are reduced
- Minimal maintenance is required
- Water quality benefits
- Less environmental impacts in the river and riparian corridor

Weaknesses

- Floodwalls may affect animals crossing the levees
- Coordination and permitting with Caltrans, City of San Jose, Santa Clara County to construct headwalls
- Right-of-way acquisition is required
- High capital cost
- High groundwater
- Requires rights to flood the area, which comes with maintenance responsibilities
- Potential fish entrapment in detention basin
- Vector control and temperature issues, if the water is stored for long periods of time

E. Raised Bridges and Floodwalls

Alternative Description

This alternative would raise five bridges crossing the Guadalupe River to allow the design flow to pass underneath the bridge decks unimpeded. It consists of the following CPEs:

- CPE 13 – Floodwalls:
  The alternative would install or raise existing floodwalls to provide 3.5 ft of freeboard in channel and 4 ft of freeboard 100 ft from bridges. Floodwalls would extend for 4.7 miles on both banks from UPRR bridge to Skyport Drive. The floodwalls would be raised to a maximum height of 9.5 ft to meet the highest bridge. Floodwalls are assumed to be concrete with spread footings, placed on the outboard side of the top of levee.

Table 9: Alternative E Floodwall Summary

Reach	Average Floodwall Height (ft)	Floodwall Length per levee (mi)
Reach A	1.4	0.6
Reach B	3.1	0.5
Reach C	4.8	1.2
Reach D	4.7	1.1
Reach E	3.1	0.5
Reach F	1.0	0.7
Reach G	0.5	0.2

- CPE 18 – Raise Bridges
  Bridges would be raised to 1 ft above the 100-year water surface elevation. The bridges that would be raised are listed below:
  - Tasman Drive: raise 3.6 ft
  - Montague Expressway: raise 9.5 ft
  - Trimble Road: raise 5.7 ft
  - Highway 101: raise 6.8 ft
  - Airport Parkway: raise 4.1 ft

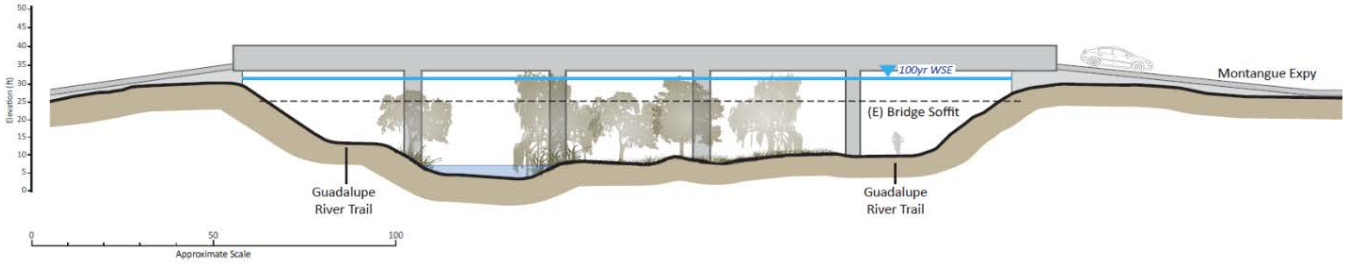

Figure 19: Typical Section – Montague Expressway Bridge Raised

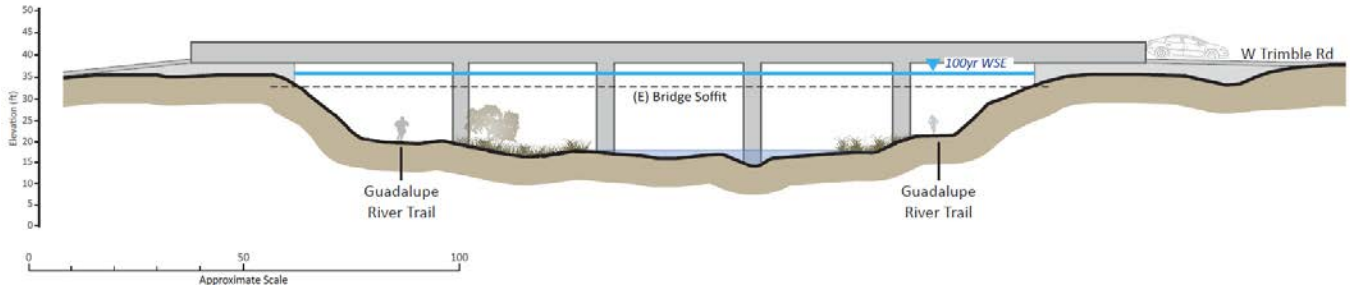

Figure 20: Typical Section – Trimble Road Bridge Raised

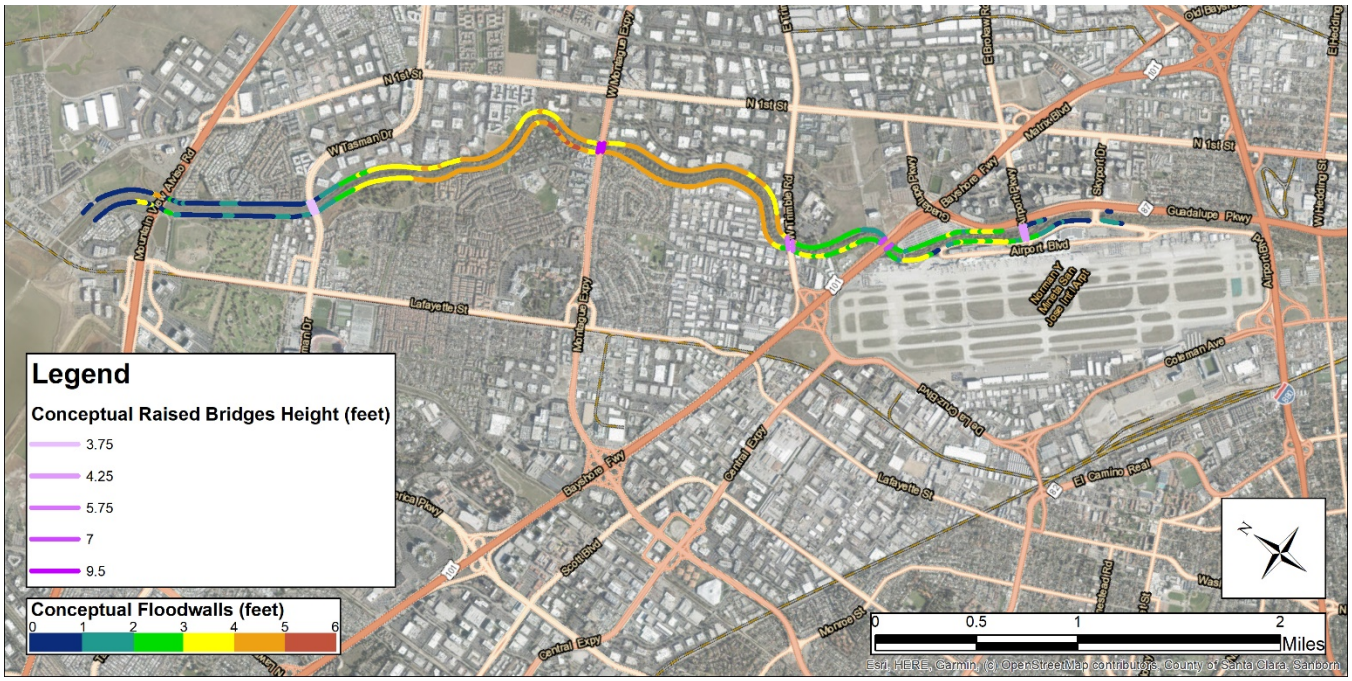

Figure 21: Alternative E Conceptual Layout

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $190,000,000
Maintenance costs would be $450,000 annually

Strengths

- The existing public trails are preserved
- Minimal maintenance is required
- Floodwall heights are reduced by allowing the flow to pass under the bridge soffit

Weaknesses

- Visual impacts from high floodwalls
- Coordination and permitting with Caltrans, City of San Jose, Santa Clara County to raise bridges
- Utility relocations near the bridges
- Traffic impacts during bridge construction
- High capital cost

F. Channel Bypass

Alternative Description

This alternative would create a bypass culvert to reduce the peak flow in the river channel. It consists of the following CPEs:

- CPE 13 – Floodwalls:
  The alternative would install or raise existing floodwalls to provide 3.5 ft of freeboard in channel and 4 ft of freeboard 100 ft from bridges. Floodwalls would extend for 0.2 miles on both banks from Highway 237 to Airport Parkway. The floodwalls would be raised to a maximum height of 3.8 ft. Floodwalls are assumed to be concrete with spread footings, placed on the outboard side of the top of levee.

Table 10: Alternative F Floodwall Summary

Reach	Average Floodwall Height (ft)	Floodwall Length per levee (mi)
Reach A	0.3	0.03
Reach B	0.0	0.00
Reach C	0.0	0.00
Reach D	0.1	0.01
Reach E	0.0	0.00
Reach F	0.6	0.02
Reach G	0.1	0.14

- CPE 21 – Channel Bypass:
  This would construct a 55x15 ft box culvert or two 28x15 ft box culverts, beginning downstream of Highway 101 and ending upstream of Gold Street for a total length of 5 mi. The length and size of the bypass were selected to lower the water surface elevation (WSEL) sufficiently to eliminate headwalls and minimize floodwalls. This lowers the peak channel discharge by 8,000 cfs. The culverts would be constructed underneath the existing levees to minimize disruptions to roadways and utilities.

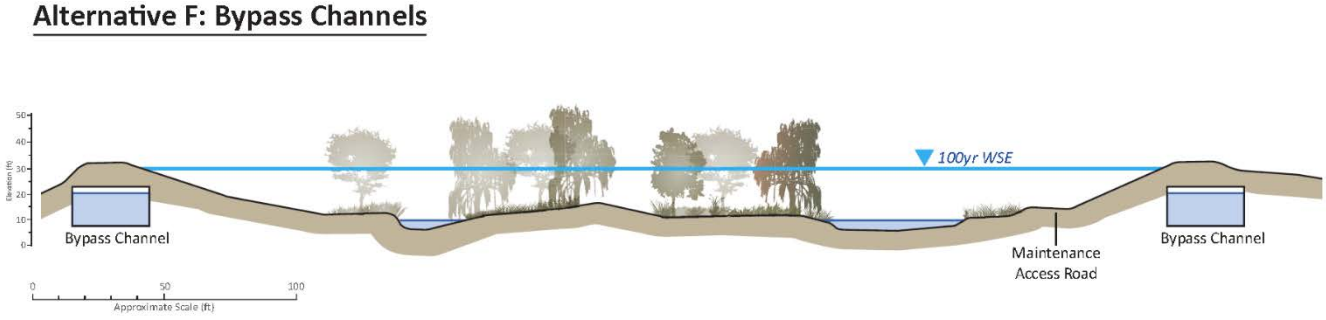

Figure 22: Typical Section – Channel Bypass

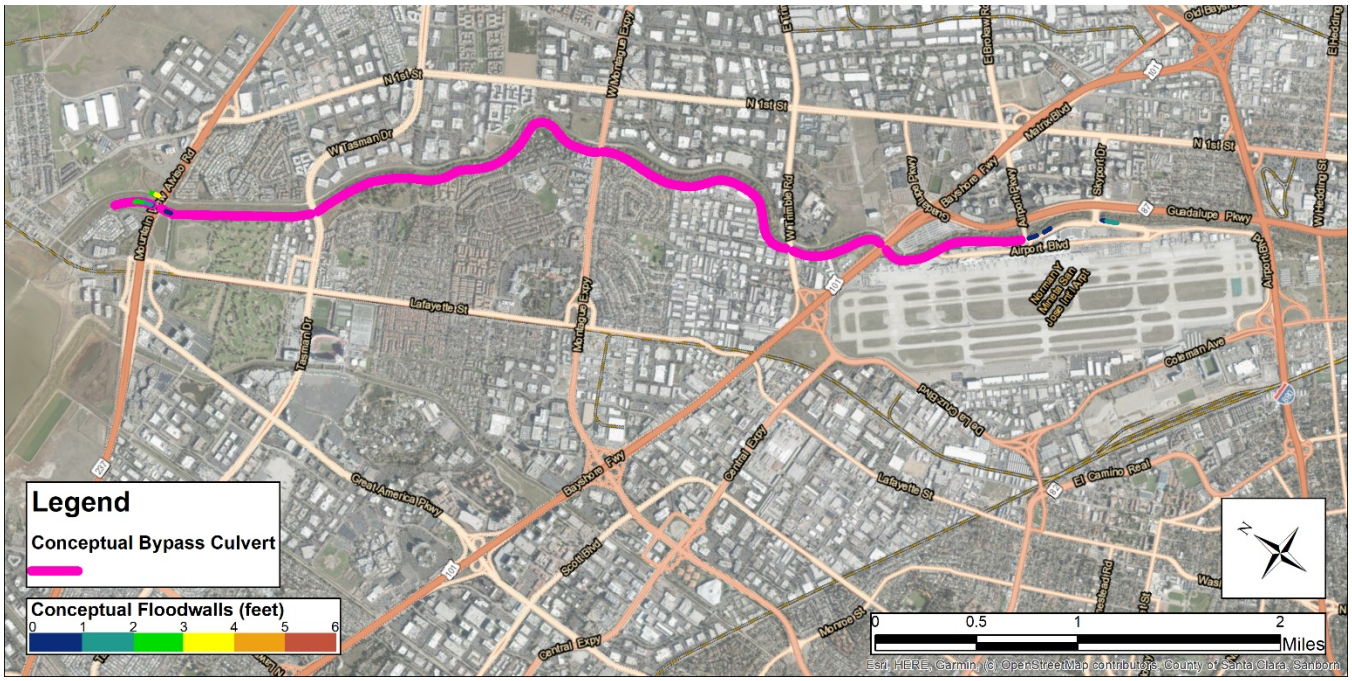

Figure 23: Alternative F Conceptual Layout

Technical Feasibility

All project elements are technically feasible

Costs

Capital costs would be $300,000,000
Maintenance costs would be $450,000 annually

Strengths

- The existing trails are preserved
- Floodwall heights and extents are reduced
- Headwalls are not needed at bridges
- Water quality benefits (sediment and trash could be trapped)
- Less environmental impacts in the river and riparian corridor

Weaknesses

- The floodwalls present a visual barrier
- Maintenance would be required inside the bypass
- Safety issues maintaining the bypass due to confined space entry and potential for human activity
- High capital cost
- Requires utility relocation
- Requires design to prevent fish entrainment, promote fish passage / migration, and permitting

G. Replace Levee with Floodwall

Alternative Description

This alternative would replace the west levee with a high floodwall at the location of the outboard toe of the existing levee. It consists of the following CPEs:

- CPE 13 – Floodwalls:
  From Highway 101 to Tasman Drive, the existing west levee would be demolished, ground paved to expand the flow area and lower the composite Manning's n value. A 20 ft high floodwall would be constructed on the west bank to replace the levee. Additional floodwalls would be required for 1.6 miles on the west levee and 4.2 miles on the east levee from Highway 237 to Skyport Drive. The floodwalls would be raised to a maximum height of 6.5 ft to meet the highest headwall. Floodwalls are assumed to be concrete with spread footings, placed on the outboard side of the top of levee.

Table 11: Alternative G Floodwall Summary

Reach	Average Floodwall Height (ft)	Floodwall Length per levee (mi)
Reach A	1.0	0.5
Reach B	0.2	0.1
Reach C	0.5	0.6
Reach D	0.8	0.5
Reach E	0.9	0.3
Reach F	1.0	0.7
Reach G	1.3	0.2

- CPE 17 – Bridge Headwalls:
  Headwalls must be constructed or re-constructed at the following bridges:
  - Airport Parkway to 2.5 ft (no existing headwall)
  - Highway 101 to 3.5 ft (has existing 2 ft headwall)
  - Trimble Road to 5 ft (has existing 3 ft headwall)
  - Montague Expressway to 6.5 ft (has existing 3-4 ft headwall)

  A review of the bridge structures after modification found that the bridge superstructures at Montague Expressway, Tasman Drive, and Highway 101 would not be able to resist uplift loading, and the structures would need to be evaluated for the application of additional restraints.

Alternative G: Replace Levee with Floodwall

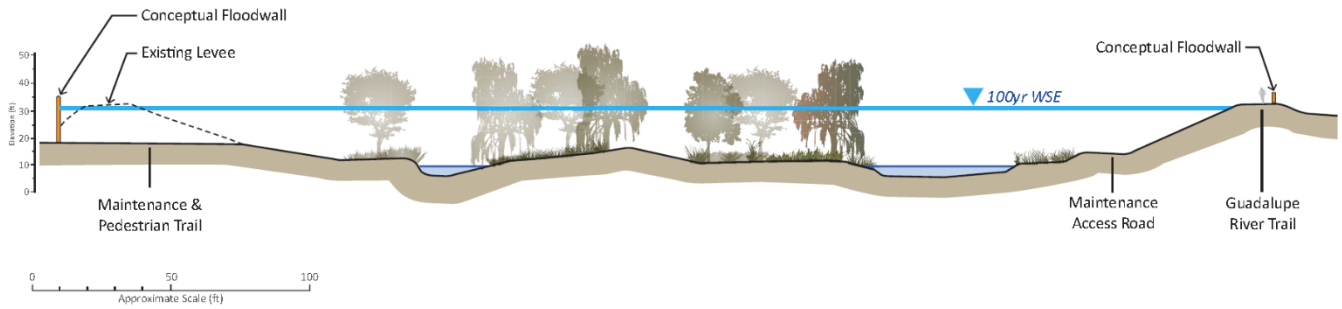

Figure 24: Typical Section – Replace Levee with Floodwall

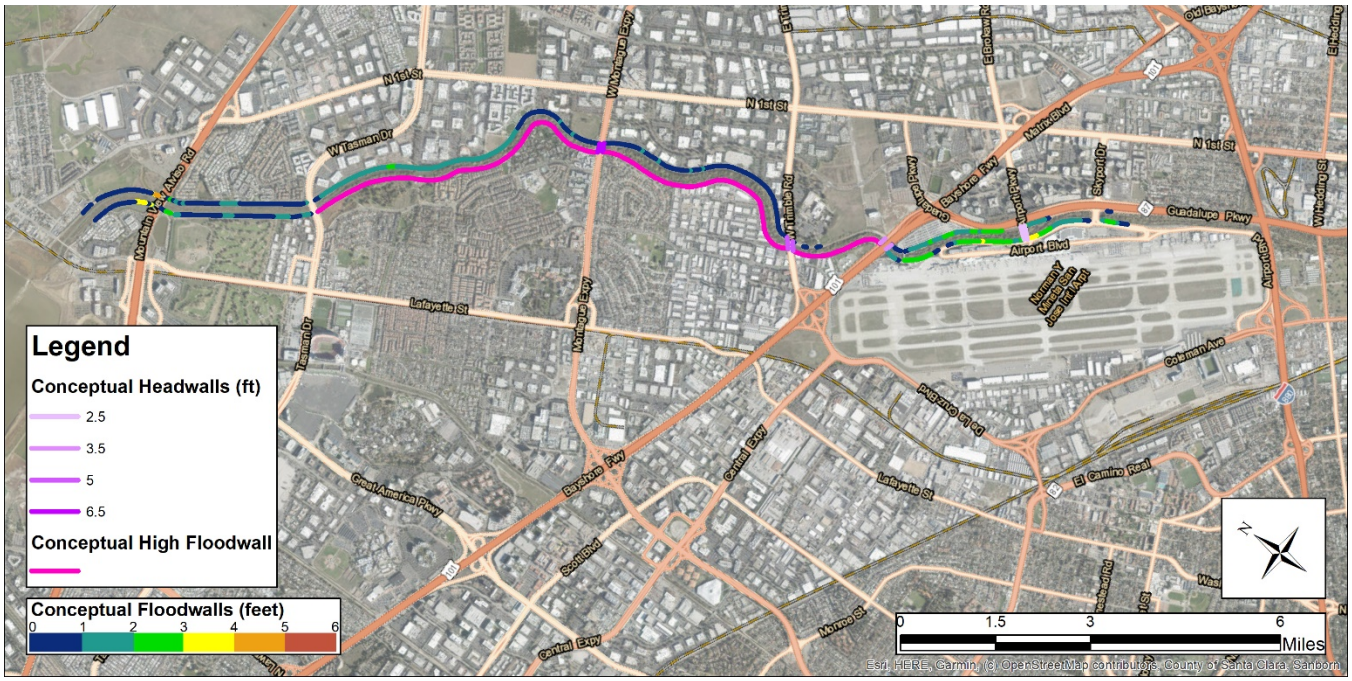

Figure 25: Alternative G Conceptual Layout

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $190,000,000
Maintenance costs would be $400,000 annually

Strengths

- Channel capacity is increased
- Levee maintenance is reduced

Weaknesses

- Visual impacts from high floodwalls
- Coordination and permitting will be needed with Caltrans, City of San Jose, Santa Clara County to raise headwalls
- Biological impacts to wildlife pathways from floodwalls
- High capital cost
- Reduced access to the channel
- Floodwalls attract graffiti
- Requires increased CEQA analysis and permitting

H. Add Outlet Capacity to Lenihan Dam in New Tunnel

Alternative Description

This alternative would create an additional outlet at Lenihan Dam to allow the reservoir to partially empty before a storm event. This alternative consists of the following CPEs.

- CPE 5 – Add Outlet Capacity to Lenihan Dam
  Adding additional outlet capacity to Lenihan Dam would increase the ability to release water and provide additional storage to reduce the peak flow of a large storm. The total capacity of Lexington Reservoir is 19,000 ac-ft. The 2009 USACE Hydrology Study for the Guadalupe Watershed assumes a starting storage for Lexington Reservoir at 16,000 ac-ft. Using this study's 100-year conditions, the initial storage needed before the storm is 7,000 ac-ft. This amounts to a starting water surface elevation of 12,000 ac-ft, which is 4,000 ac-ft of additional storage needed to contain the peak in Lexington Reservoir. The existing outlet, which has a maximum capacity of 450-500 cfs, would be used to account for inflow into the reservoir from a previous storm. In order to reduce the storage in the reservoir by 4,000 ac-ft within 72 hrs, an additional outlet capable of discharging 670 cfs is needed. This is about a 5 ft pipe. The reduced time to drain the reservoir would increase reliability and reduce the need to prematurely release flow in the event the peak storm moves away from the watershed. It would reduce the 1% flow at Interstate 880 to 10,800 cfs. Increasing the size of the pipe or the initial storage in the reservoir does not further reduce the 1% peak flow due to inflow downstream of the reservoir.

Table 12: LGRP Design Flows for Flow Modification Alternatives

Location Along Guadalupe River	100-Year Design Flows (cfs)
D/S of Los Gatos Creek confluence	9,800
Interstate 880	10,800
Highway 101	11,100
Trimble Road	11,300
Montague Expressway	11,700
Tasman Drive	11,900
Highway 237	12,100

- CPE 13 – Floodwalls:
  Because the reduced 1% flood flow is still higher than the channel's capacity, floodwalls are still needed. Floodwalls would extend for 2.1 miles on both banks from Trimble Road to Tasman Drive. The floodwalls would be raised to a maximum height of 5.25 ft to meet the highest headwall. Floodwalls are assumed to be concrete with spread footings, placed on the outboard side of the top of levee.

Table 13: Alternative H Floodwall Summary

Reach	Average Floodwall Height (ft)	Floodwall Length per levee (mi)
Reach A	0.2	0.02
Reach B	0.0	0.00
Reach C	0.4	0.95
Reach D	0.6	0.92
Reach E	0.2	0.19
Reach F	0.2	0.01
Reach G	0.0	0.00

- CPE 17 – Bridge Headwalls:
  Headwalls must be constructed or re-constructed at the following bridges:
  - Trimble Road to 3.5 ft (has existing 3 ft headwall)
  - Montague Expressway to 5.25 ft (has existing 3-4 ft headwall)

  A review of the bridge structures after modification found that the bridge superstructures at Montague Expressway and Tasman Drive would not be able to resist uplift loading, and the structures would need to be evaluated for the application of additional restraints.

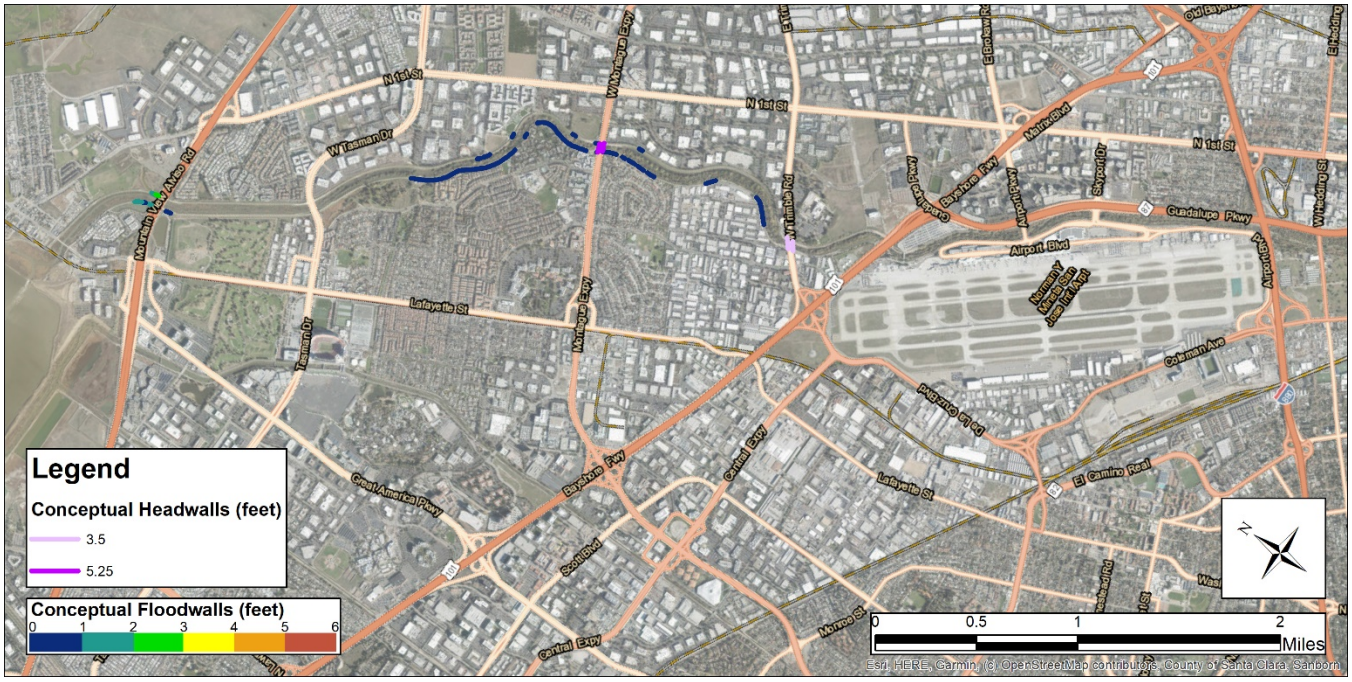

Figure 26: Alternative H Conceptual Layout

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $110,000,000
Maintenance costs would be $450,000 annually

Strengths

- The existing trails are preserved
- Floodwall heights and extents are reduced
- Avoids in-stream environmental impacts
- Opportunity to coordinate with FAHCE

Weaknesses

- Coordination and permitting are needed with City of San Jose and Santa Clara County to raise headwalls
- This alternative relies on Guadalupe River to remain in current restricted capacity. If Upper Guadalupe River capacity is raised to provide 1 % flood protection as currently planned, this alternative would not work

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

Alternative Description

This alternative would replace the existing outlet pipe at Lenihan Dam with a larger outlet to allow the reservoir to partially empty before a storm event. This alternative consists of the following CPEs.

- CPE 5 – Add Outlet Capacity to Lenihan Dam
  Adding additional outlet capacity to Lenihan Dam would increase the dam's ability to release water and provide additional storage to reduce the peak flow of a large storm. The total capacity of Lexington Reservoir is 19,000 ac-ft. The 2009 USACE Hydrology Study for the Guadalupe Watershed assumes a starting storage for Lexington Reservoir at 16,000 ac-ft. Using this study's 100-year conditions, the initial storage needed before the storm is 7,000 ac-ft. This amounts to a starting water surface elevation of 12,000 ac-ft, which is 4,000 ac-ft of additional storage needed to contain the peak in Lexington Reservoir. The existing outlet, which has a maximum capacity of 450-500 cfs, would be replaced with a 72 in pipe with a capacity of 1,000 cfs. Because the existing 54-inch sloping intake only provides about 450 to 500 cfs of capacity, a secondary 60-inch intake would also be constructed adjacent to the existing intake to supply additional flow. The reduced time to drain the reservoir would increase reliability and reduce the need to prematurely release flow in the event the peak storm moves away from the watershed. It would reduce the 1% flow at I880 to 10,800 cfs. Increasing the size of the pipe or the initial storage in the reservoir does not further reduce the 1% peak flow due to inflow downstream of the reservoir.

Table 14: LGRP Design Flows for Flow Modification Alternatives

Location Along Guadalupe River	100-Year Design Flows (cfs)
D/S of Los Gatos Creek confluence	9,800
Interstate 880	10,800
Highway 101	11,100
Trimble Road	11,300
Montague Expressway	11,700
Tasman Drive	11,900
Highway 237	12,100

- CPE 13 – Floodwalls:
  Because the reduced 1% flood flow is still higher than the channel's capacity, floodwalls would still be needed. Floodwalls would extend for 2.1 miles on both banks from Trimble Road to Tasman Drive. The floodwalls would be raised to a maximum height of 5.25 ft to meet the highest headwall. Floodwalls are assumed to be concrete with spread footings, placed on the outboard side of the top of levee.

Table 15: Alternative H.1 Floodwall Summary

Reach	Average Floodwall Height (ft)	Floodwall Length per levee (mi)
Reach A	0.2	0.02
Reach B	0.0	0.00
Reach C	0.4	0.95
Reach D	0.6	0.92
Reach E	0.2	0.19
Reach F	0.2	0.01
Reach G	1.9	0.06

- CPE 17 – Bridge Headwalls:
  Headwalls must be constructed or re-constructed at the following bridges:
  - Trimble Road to 3.5 ft (has existing 3 ft headwall)
  - Montague Expressway to 5.25 ft (has existing 3-4 ft headwall)

  A review of the bridge structures after modification found that the bridge superstructures at Montague Expressway and Tasman Drive would not be able to resist uplift loading, and the structures would need to be evaluated for the application of additional restraints.

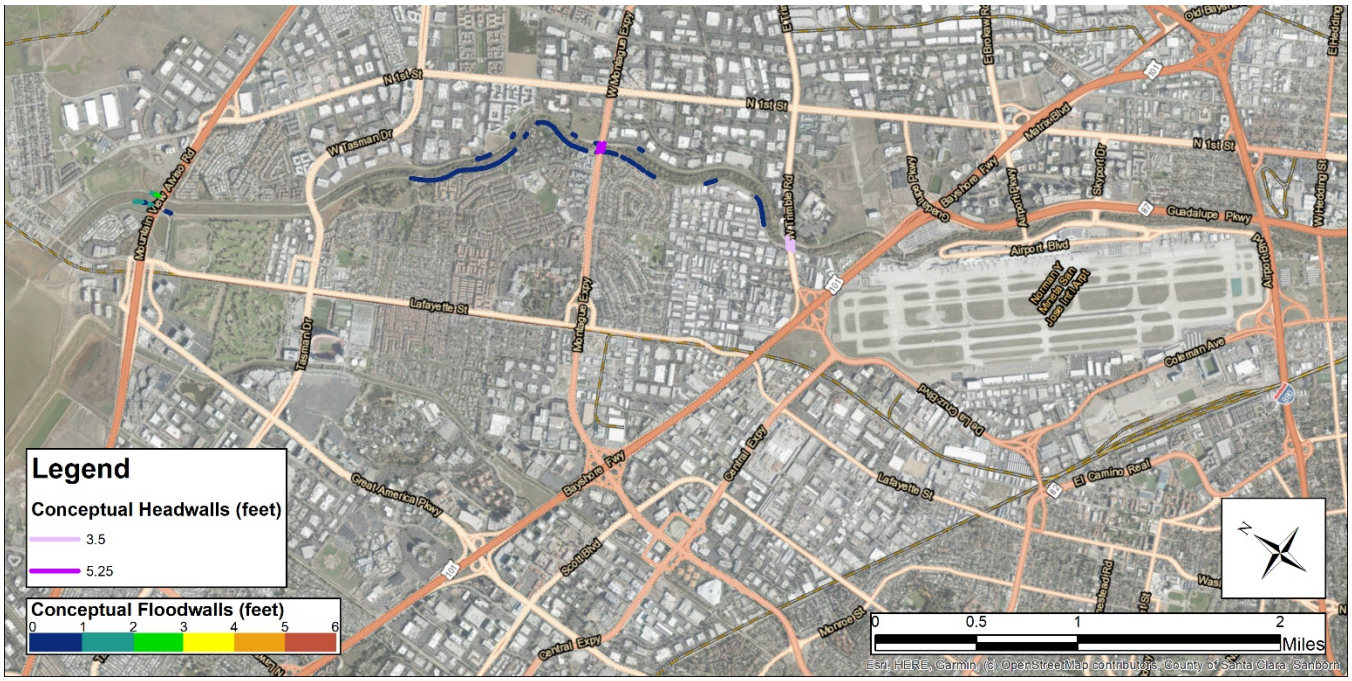

Figure 27: Alternative H Conceptual Layout

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $32,000,000
Maintenance costs would be $450,000 annually

Strengths

- The existing trails are preserved
- Floodwall heights and extents are reduced
- Avoids in-stream environmental impacts

Weaknesses

- Coordination and permitting are needed with City of San Jose and Santa Clara County to raise headwalls
- This alternative relies on Guadalupe River to remain in current restricted capacity. If Upper Guadalupe River capacity is raised as currently planned, this alternative would not work
- Coordination with FAHCE would be needed
- Less maintenance access as a result of replacing the outlet pipe with a larger diameter pipe

I. Raise Lenihan Dam

Alternative Description

This alternative would raise Lenihan Dam to provide additional peak storage during a storm. It consists of the following CPEs:

- CPE 3 – Raise Lenihan Dam:
  Raising Lenihan Dam would create additional capacity to store water during large storms, reducing the peak flow downstream. The current total capacity of Lexington Reservoir is 19,000 ac-ft. The 2009 USACE Hydrology Study for the Guadalupe Watershed assumes 16,000 ac-ft is the 1% starting volume for the reservoir, based on historical data of the median recorded storage at Lexington 5 days before the downtown San Jose stream gauge exceeded 1,000 cfs. Upon review of the watershed hydrology, the USACE methodology appears to still be appropriate, resulting in the same 16,000 ac-ft initial storage. Using the 2009 study's 100-year conditions, the initial storage needed before the storm is 7,000 ac-ft, which would be added to the 16,000 ac-ft starting storage for a final capacity of 23,000 ac-ft. Increasing the dam's capacity to 23,000 ac-ft would raise the water surface elevation from 651 ft to 661 ft. From this, it can be assumed that the dam crest should be raised 10 ft. This additional storage would reduce the 1% flow at I880 to 10,800 cfs. Increasing the size of the initial storage in the reservoir does not further reduce the 1% peak flow due to inflow downstream of the reservoir.

Table 16: LGRP Design Flows for Flow Modification Alternatives

Location Along Guadalupe River	100-Year Design Flows (cfs)
D/S of Los Gatos Creek confluence	9,800
Interstate 880	10,800
Highway 101	11,100
Trimble Road	11,300
Montague Expressway	11,700
Tasman Drive	11,900
Highway 237	12,100

- CPE 13 – Floodwalls:
  Because the reduced 1% flood flow is still higher than the channel's capacity, floodwalls are still needed. Floodwalls would extend for 2.1 miles on both banks from Trimble Road to Tasman Drive. The floodwalls would be raised to a maximum height of 5.25 ft to meet the highest headwall. Floodwalls are assumed to be concrete with spread footings, placed on the outboard side of the top of levee.

Table 17: Alternative I Floodwall Summary

Reach	Average Floodwall Height (ft)	Floodwall Length per levee (mi)
Reach A	0.2	0.02
Reach B	0.0	0.00
Reach C	0.4	0.95
Reach D	0.6	0.92
Reach E	0.2	0.19
Reach F	0.2	0.01
Reach G	1.9	0.06

- CPE 17 – Bridge Headwalls:
  Headwalls must be constructed or re-constructed at the following bridges:
    - Trimble Road to 3.5 ft (has existing 3 ft headwall)
    - Montague Expressway to 5.25 ft (has existing 3-4 ft headwall)

  A review of the bridge structures after modification found that the bridge superstructures at Montague Expressway and Tasman Drive would not be able to resist uplift loading, and the structures would need to be evaluated for the application of additional restraints.

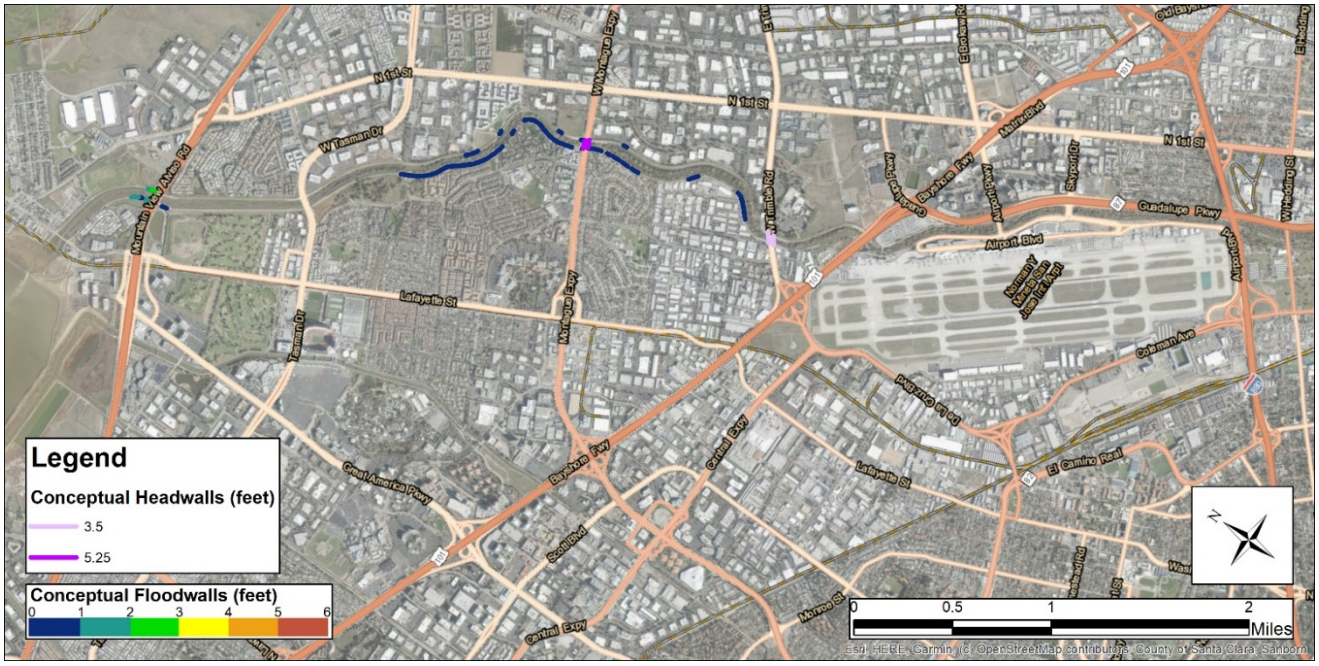

Figure 28: Alternative I Conceptual Layout

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $110,000,000
Maintenance costs would be $450,000 annually

Strengths

- The existing trails are preserved
- Floodwall heights and extents are reduced

Weaknesses

- Coordination and permitting with City of San Jose and Santa Clara County to raise headwalls
- This alternative relies on Guadalupe River to remain in current restricted capacity. If Guadalupe River capacity would be raised to provide 1% flood protection as currently planned, this alternative would not work.
- Coordination with FAHCE
- Park infrastructure may change

- Many private encroachments currently exist on Lexington Reservoir and would restrict the water surface elevation

J. Re-operate Lenihan Dam

Alternative Description

This alternative would operate Lexington Reservoir to increase the amount of storage available before a large storm using the existing outlet. It consists of the following CPEs:

- CPE 4 – Re-Operate Lexington Reservoir:
  This alternative would re-operate Lenihan Dam at Lexington Reservoir to release more water prior to a large storm, thus increasing the volume available to store the peak flow. The total capacity of Lexington Reservoir is 19,000 ac-ft. The 2009 USACE Hydrology Study for the Guadalupe Watershed assumes a starting storage for Lexington Reservoir at 16,000 ac-ft. Using this study's 100-year conditions, the initial storage needed before the storm is 7,000 ac-ft. This amounts to a starting water surface elevation of 12,000 ac-ft, which is 4,000 ac-ft of additional storage needed to contain the peak in Lexington Reservoir. 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 450-500 cfs. With baseflow considered, it would take 7 days to drain 4,000 ac-ft from the reservoir to provide 7,000 ac-ft of storage for an incoming storm. A preexisting capped 30 in pipe could also be used for additional drawdown capacity, if modifications are made to the outlet structure. The maximum outlet capacity using both 36 in pipes and the capped 30 in pipe is 650 cfs. Using both 36 in pipes and the capped 30 in pipe reduces the time to drain to 4.5 days with baseflow considered. Draining the reservoir to a 12,000 ac-ft starting elevation would reduce the 1% flow at I880 to 10,800 cfs. Increasing the size of the initial storage in the reservoir does not further reduce the 1% peak flow due to inflow downstream of the reservoir.

Table 18: LGRP Design Flows for Flow Modification Alternatives

Location Along Guadalupe River	100-Year Design Flows (cfs)
D/S of Los Gatos Creek confluence	9,800
Interstate 880	10,800
Highway 101	11,100
Trimble Road	11,300
Montague Expressway	11,700
Tasman Drive	11,900
Highway 237	12,100

The base flow between storms has been estimated to be 200 cfs, based on the heavy rainfall observed during the 2016-2017 winter season[7]. This was calculated by performing a volume balance based on Lexington Reservoir storage change and outlet release for four storms in January and February of 2017. The time ranges began when the WSEL dropped under the spillway elevation through the next large

[7] Jack Xu. 2020. Personal Communication RE: Dam Modification Alternative discussion.

storm, which caused an increase in WSEL. The calculated baseflows from the four storms were averaged to provide a conservative assumption for baseflow.

- CPE 13 – Floodwalls
  Because the reduced 1% flood flow is still higher than the channel's capacity, floodwalls are still needed. Floodwalls would extend for 2.1 miles on both banks from Trimble Road to Tasman Drive. The floodwalls would be raised to a maximum height of 5.25 ft to meet the highest headwall. Floodwalls are assumed to be concrete with spread footings, placed on the outboard side of the top of levee.
- CPE 17 – Headwalls
  Headwalls must be constructed or re-constructed at the following bridges:
    - Trimble Road to 3.5 ft (has existing 3 ft headwall)
    - Montague Expressway to 5.25 ft (has existing 3-4 ft headwall)

  A review of the bridge structures after modification found that the bridge superstructures at Montague Expressway and Tasman Drive would not be able to resist uplift loading, and the structures would need to be evaluated for the application of additional restraints.

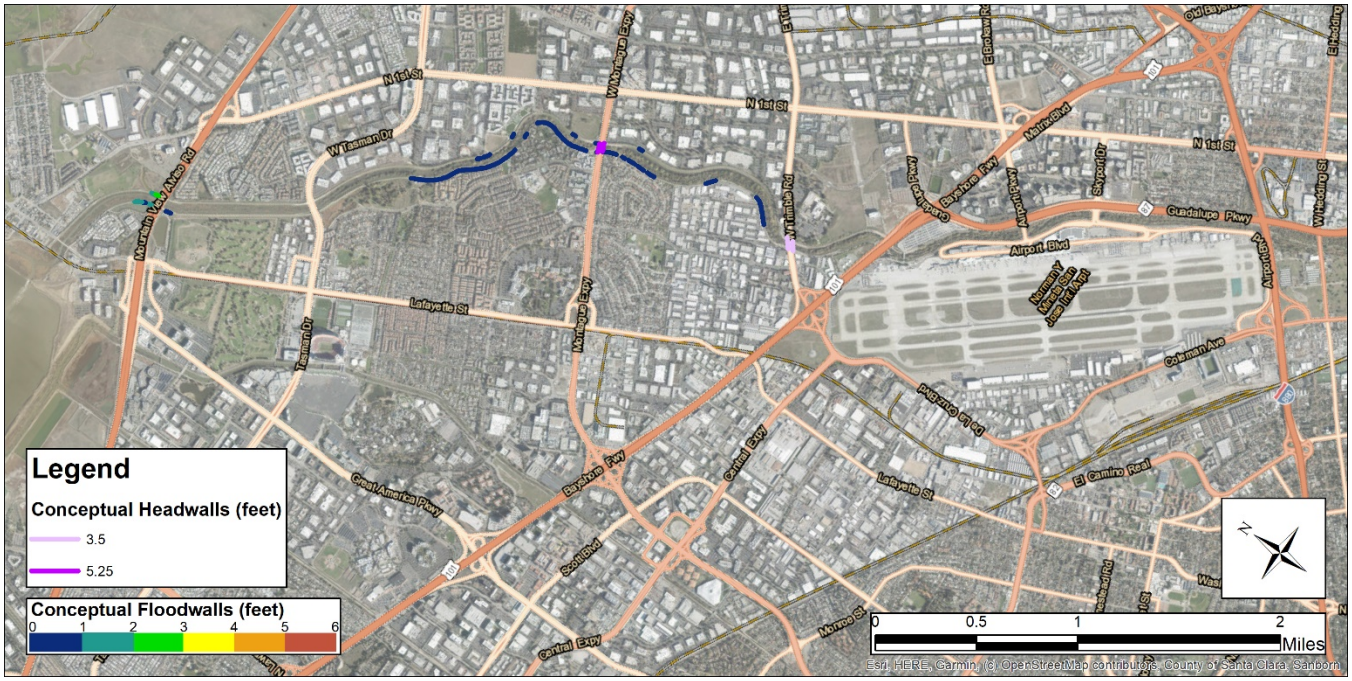

Figure 29: Alternative J Conceptual Layout

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $11,000,000
Maintenance costs would be $450,000 annually
Average water utility reimbursement costs would be $2,500,000 annually

Strengths

- The existing trails are preserved
- Floodwall heights are reduced

- Avoids in-stream environmental impacts
- Opportunities to coordinate with FAHCE

Weaknesses

- Coordination and permitting with City of San Jose and Santa Clara County to raise headwalls
- This alternative relies on Guadalupe River to remain in current restricted capacity. If Guadalupe River capacity would be raised as currently planned, this alternative would not work.
- 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)

K. Channel Widening

Alternative Description

This alternative would widen the existing channel to increase capacity. It consists of the following CPEs:

- CPE 8: Channel Widening:
  This project element would widen the channel to the east by 150 ft between Tasman Drive and Highway 101 increasing the channel's flow area by up to 45%. Channel velocities decreased as much as 40%, negating the widened channel's effect on the water surface elevation. Widening the channel lowers the 1% water surface elevation by a maximum of three feet, sufficient to prevent overtopping, but insufficient to provide the required freeboard of 3.5 feet. This scenario would require acquisition of 32 parcels totaling 310 acres.
- CPE 13 – Floodwalls
  Because the reduced 1% flood flow is still higher than the channel's capacity, floodwalls are still needed. Floodwalls would extend for 5.2 miles on both banks from Trimble Road to Tasman Drive. The average height of the floodwalls is 1.7 ft and the maximum height is 6.5 ft. Floodwalls are assumed to be concrete with spread footings, placed on the outboard side of the top of levee.
- CPE 17 – Headwalls
  Headwalls must be constructed or re-constructed at the following bridges:
  - Airport Parkway to 2.5 ft (no existing headwall)
  - Highway 101 to 3.5 ft (has existing 2 ft headwall)
  - Trimble Road to 5 ft (has existing 3 ft headwall)
  - Montague Expressway to 6.5 ft (has existing 3-4 ft headwall)

  A review of the bridge structures after modification found that the bridge superstructures at Montague Expressway, Tasman Drive, and Highway 101 would not be able to resist uplift loading, and the structures would need to be evaluated for the application of additional restraints.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $640,000,000
Maintenance costs would be $670,000 annually

Strengths

- Riparian areas are expanded

- Reduces the height of structural elements needed

Weaknesses

- High capital cost
- Right-of-way acquisition is required to widen the channel
- May trigger utility relocations
- May trigger bridge modifications

L. Vegetation Removal

Alternative Description

This alternative would remove a large amount of vegetation in the channel to reduce the roughness in the channel and lower the water surface elevation. It consists of the following CPEs:

- CPE 20: Vegetation Removal
  This element would remove large amounts of vegetation in the channel to return it to the condition specified by the LGRP. Most of the vegetation removal would be focused between Montague Expressway and Trimble Road. This scenario would not completely return the channel to the existing condition, due to cross sectional area changes not accounted for in the design. Furthermore, it is clear that vegetation grows very well in this reach of Guadalupe River. Removing vegetation to this degree is anticipated to be a temporary measure that would likely need to be repeated in the future as vegetation would continue to grow, at great cost to Valley Water. It is estimated that this element alone would cost $800 million, mainly in real estate acquisition costs to account for planting and maintaining the mitigation required to offset impacts associated with vegetation removal work.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $840,000,000
Maintenance costs would be $800,000 annually

Strengths

- Minimizes the need for structural elements

Weaknesses

- Very high impacts to natural habitat along the creek
- High capital cost
- Very high maintenance and mitigation costs
- Extensive removal may be required in the future if regular O&M is not able to maintain a lower roughness in the channel

M. Levee/Channel Paving

Alternative Description

This alternative would pave the existing river channel to reduce the roughness and increase capacity. It consists of the following CPEs:

- CPE 11: Levee Paving
  This project element proposes paving the entire channel with concrete to decrease the Manning's roughness value and increase flow velocity. Although this scenario provides 1% flood protection hydraulically, it presents significant environmental issues. This river is a steelhead (a Federally threatened species) habitat and part of the FAHCE agreement. Paving the channel to replace natural habitat would be impossible to permit with the regulatory agencies.
- CPE 20: Vegetation Removal
  This element would remove all vegetation in the channel to allow for it to be paved with concrete. It is estimated that this element alone would cost $800 million, mainly in real estate acquisition costs to account for planting and maintaining the mitigation required to offset impacts associated with vegetation removal work.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $170,000,000
Maintenance costs would be $240,000 annually

Strengths

- Minimizes the need for structural elements
- Maintenance requirements (in particular, vegetation management) significantly reduced

Weaknesses

- Unlikely to be permitted
- Very high mitigation cost
- Right-of-way acquisition required for mitigation
- Significant permanent biological impacts to habitat

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 in order 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. Costs are considered current as of 2020.

Technical Feasibility: All Project elements must be able to be built using widely available construction materials and knowledge. Alternatives that 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.

Level 1 Screening

The screening criteria were applied to the conceptual alternatives to determine which alternatives will progress to the feasible alternatives analysis. The screening results are summarized in Table 19 below:

Selection of Feasible Alternatives

The following alternatives meet the Level 1 screening criteria and will be 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

Table 19: 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	✓	✗	✓	✓	✗

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Appendix H
Feasible Alternatives Report and Staff Recommended Alternative Report

Guadalupe River Project – Tasman Drive to Interstate 880

Project No. 30154019

Feasible Alternatives and Staff-Recommended Alternative Report

December 2022

Prepared by

Water Resources Planning and Policy Unit

Katie Muller, Associate Engineer

Jaeho Hahn, Assistant Engineer I - Civil

Under the Direction of

Afshin Rouhani, Water Resources Policy and Planning Manager

Contents

Formulation of Alternatives

This report describes the range of alternatives considered for the Guadalupe River – Tasman Drive to Interstate 880 Project (Project) and the methodology used to determine the recommended project. The information presented here will become the Formulation of Alternatives chapter of the Planning Study Report (PSR).

Summary of Problem Definition

The Lower Guadalupe River Project (LGRP) was completed in 2004 with the objective to provide one percent flood flow capacity with Federal Emergency Management Agency (FEMA) freeboard. The design level of service (LOS) was a storm event that would cause 17,000-18,325 cubic feet per second (cfs) of flow in the project reach if fully contained in the channel upstream. High water marks collected during subsequent storms (2014, 2017, and 2019) indicate that the channel is not carrying the LOS flows (current capacity estimates are 10,200 cfs between Montague and Trimble). With updated roughness values in the HEC-RAS model, current condition creek models show that the Lower Guadalupe River is unable to convey the LOS flood. The purpose of the Project is to restore the LOS flood capacity to the Lower Guadalupe River. More details about the problem definition can be found in the Guadalupe River Project – Tasman Drive to Interstate 880 Problem Definition and Refined Objectives Report.

Objectives

The primary objective of the project is to restore 1% flood LOS to the Guadalupe River reach between Gold Street and Interstate 880.

There are two ways to achieve this:

1. **Maintain the LGRP LOS through channel expansion (to achieve 17,000 cfs -18,325 cfs flow capacity)**
   Valley Water entered into several agreements with the U.S. Army Corps of Engineers (USACE) regarding Valley Water's obligations to the Downtown and Lower Guadalupe River
   - 1992 Local Cooperation Agreement: "The District shall ensure that (1) The District channel improvements from interstate Highway 880 downstream to San Francisco Bay and the locally constructed bypass conduit upstream of San Fernando Street and Downstream of Interstate 280 are ***operated and managed in such a way to convey design floodflows***; and (2) The existing Guadalupe River basin reservoirs owned by the District shall continue to be operated, or managed by the District for water conservation purposes consistent with past practices." (emphasis added). No specific flood flows are mentioned.
   - 2005 FEMA Certification Letter: "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)"
2. **Achieve LGRP LOS through hydromodification**
   Estimations of flow event probabilities can vary, based on the assumptions and data available at the time they are created. The LGRP's one percent flood flows were determined using the 1977 Hydrologic Engineering Office Report, authored by USACE (17,000-18,325cfs).

   In 2009, USACE released an updated hydrology study that found higher flows reaching the Guadalupe River (17,967-19,292 cfs).

   Valley Water is currently performing updated hydraulic modeling of the Guadalupe River system. This modeling uses the 2009 USACE hydrology, but uses updated hydraulic modeling tools such as ICM and 2D modeling to estimate how water moves through City storm drains and how runoff reaches the river

channels. The preliminary findings indicate that the flows reaching the lower Guadalupe River are closer to 17,000 cfs at Interstate 880. These flows end up being very similar to the 1977 estimated flows at Interstate 880 (17,000 cfs), but the downstream estimated local inflow from drainage pumps is much less in the updated study.

In addition to updating the hydraulic models of the Guadalupe Watershed, additional flow reduction can be achieved using hydromodification. This would use the same one percent design storm but change reservoir operations or detain flood waters somewhere else in the watershed to reduce the peak flow that reaches the Lower Guadalupe River.

In May and July of 2019, Valley Water met with consultants with previous USACE experience to seek advice on whether it would be acceptable to USACE to achieve one percent flood risk reduction through reservoir operation. Staff was advised that it may be possible but would need a written letter to the USACE Sacramento District (SPK) indicating our intent to operate the reservoir in this fashion. Project staff interpreted this response to mean that it is worth considering flow modification alternatives as part of the alternatives analysis for this Project.

The Project will consider both methods 1 and 2 detailed above as alternatives to restore one percent flood flow capacity to the Guadalupe River and meet FEMA freeboard requirements. These methods are explored in further depth in the Selection of Feasible Alternatives section.

In addition to the primary objective of restoring one percent LOS flows, the Project will also aim to:

1. Maintain and/or enhance ecological conditions
2. Minimize the need for and better define future operations and maintenance activities
3. Maintain and/or enhance public recreation and access
4. Obtain community support and participation for the Project

Changes to Project Extents

Early calibrations of one-dimensional steady state HEC-RAS models showed reduced channel capacity between Interstate 880 and Tasman Drive. However, later peer-reviewed calibrations of Manning's n values identified freeboard insufficiencies that stretched downstream of Tasman Drive to Gold Street (Reaches F and G, see Figure 1), including the Alviso neighborhood to the north and east of the river. Therefore, the Project now encompasses the Guadalupe River between Gold Street and Interstate 880.

Between State Route 237 and Tasman Drive (Reach F), 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 land from Gold Street to State Route 237 (Reach G) 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.

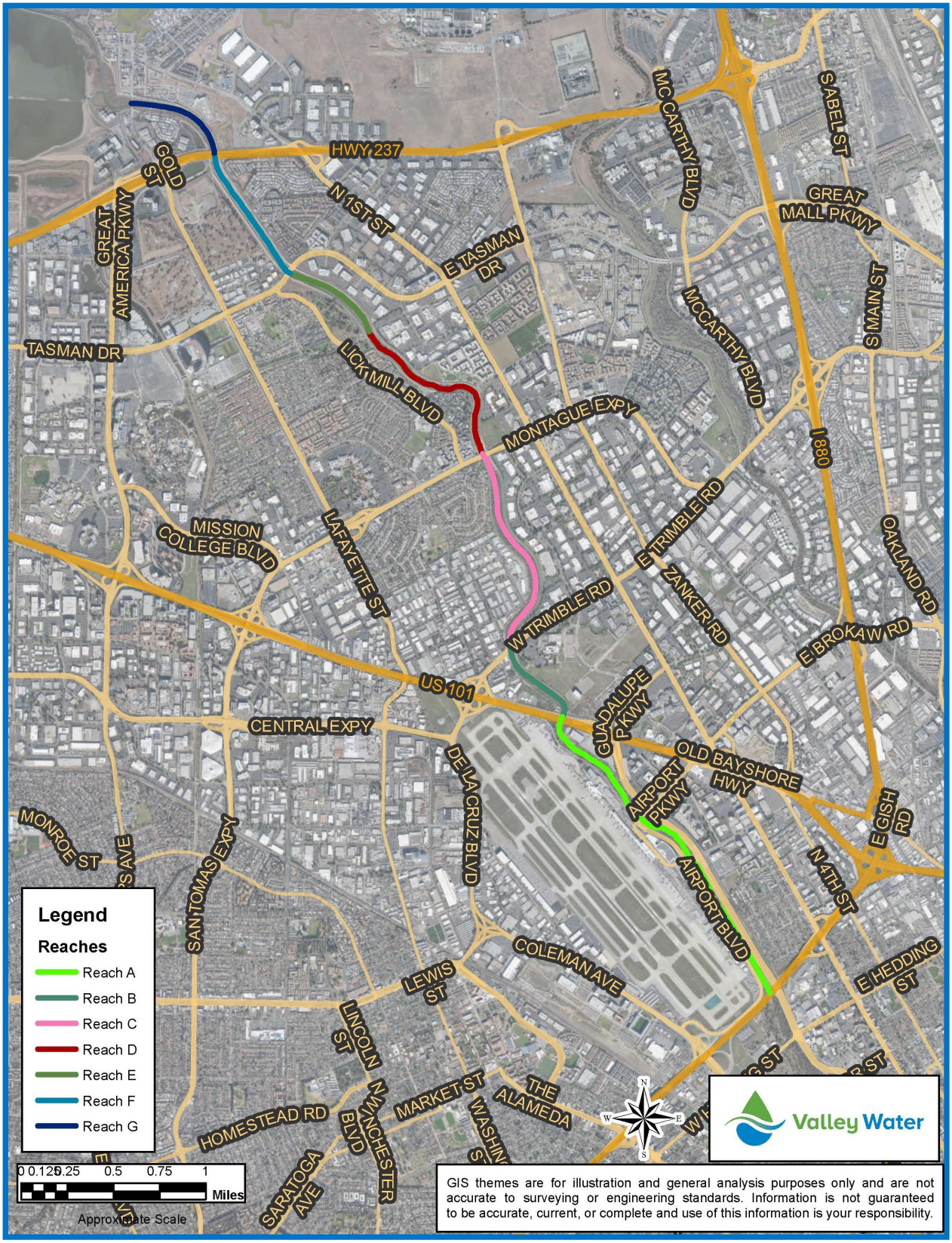


Figure 1: Lower Guadalupe River Reaches

Alternatives Approach

The Planning Project used the following methodology to identify alternatives that could satisfy the Project objectives. This methodology is dictated by the Planning Phase Work Breakdown Structure[1]:

1. Identify Conceptual Project Elements (CPE)
    - CPEs are any solution 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). These are partial solutions meant to be combined to create a complete alternative.
2. Identify Conceptual Alternatives
    - These are solutions made up of one or more CPEs, providing complete alternatives that have the potential to satisfy the Project's objectives.
3. Conduct Public Outreach
    - The conceptual alternatives are presented to the public and other relevant stakeholders to gather public input.
4. Conduct Preliminary Screening
    - The preliminary screening of conceptual alternatives (Level 1 Screening) eliminates the alternatives that, once further developed, could not meet the Project objectives.
5. Develop Feasible Alternatives
    - Alternatives that pass the preliminary screening are considered feasible alternatives. They are developed in further detail, considering maintenance, preliminary plan layout, and cost.
6. Conduct Public Outreach
    - The feasible alternatives are presented to the public and other relevant stakeholders to gather public input.
7. Evaluate Feasible Alternatives
    - Rate the feasible alternatives against each other using Valley Water's Natural Flood Protection (NFP) framework. The outcome of the NFP analysis is to identify the project that is the Least Environmentally Damaging Practicable Alternative (LEDPA).
8. Select Staff-Recommended Alternative
    - The alternative that emerges from NFP analysis as the highest rated alternative is selected for recommendation to the Board of Directors.

Design Criteria

The Project team selected preliminary design criteria to guide the course of the alternatives' development and evaluation. A complete documentation of the design criteria is listed in Appendix A: Draft Design Criteria. The summarized criteria are as follows:

Vegetation – Maintained Condition

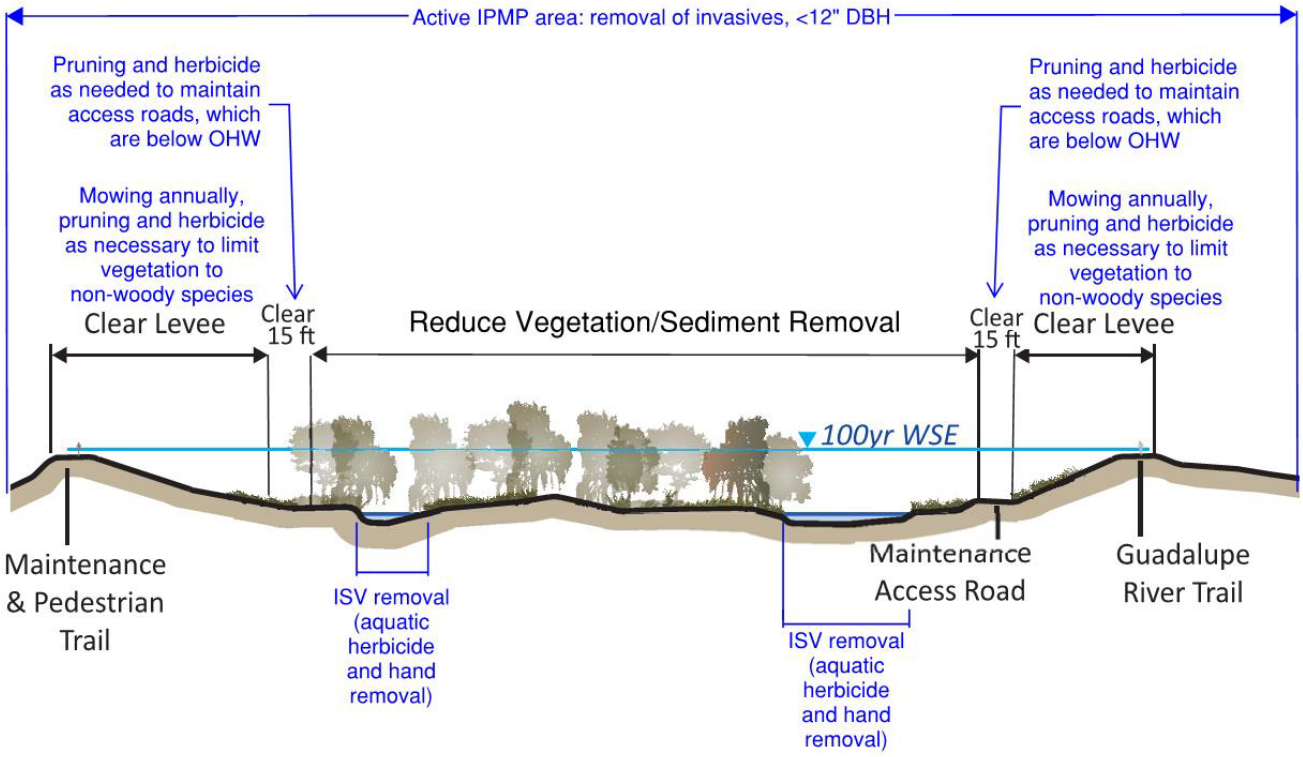
For all alternatives, the assumed future vegetation maintenance will be approximately the same level of maintenance that has been performed by Valley Water's Vegetation Field Operations (VFO) under the Stream Maintenance Program (SMP) since completion of the LGRP. This is a lower level of maintenance than is expected in the LGRP operations and maintenance guidelines.

This decision is a culmination of multiple discussions with VFO, the Operations and Maintenance Engineering Support Unit, and other subject matter experts. Despite the LGRP's assumptions for maintenance in the channel, almost two decades of experience managing the channel has revealed that the original design's "maintained

[1] Valley Water. 2019. Planning Phase WBS Item Descriptions. W-730-124.

condition" is unrealistic. This is due to the compounding factors of high groundwater that fuels rapid and extensive vegetation growth across the entire cross-section of the Project area, staff facing an increased number of Valley Water projects to actively maintain, and increasingly challenging and costly mitigation requirements for vegetation removal.

Therefore, the assumed future vegetation maintenance will be as illustrated in Figure 2. Levee slopes and areas 15 feet from the toe of the levee will be mowed every year, per USACE requirements for levee clearance (Figure 3 and Figure 4 below). The zone adjacent to the bankfull channel will be actively managed to remove invasive plants and clear aquatic vegetation that would hinder the low flow channel. Between the bankfull channel and cleared levee toes, vegetation and sediment removal would be limited and much reduced compared to current LGRP maintenance assumptions.



*IPMP: Invasive Plant Management Plan; DBH: Diameter at Breast Height, OHW: Ordinary High Water, ISV: In Stream Vegetation, WSE: Water Surface Elevation

Figure 2: Proposed Maintenance Condition for the Project

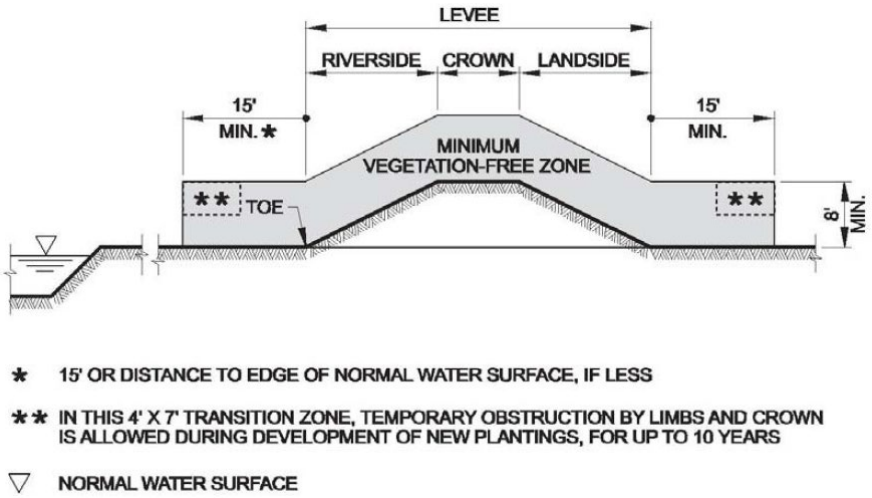


Figure 3: Levee Section - Basic, from USACE EP 1110-2-18[2]

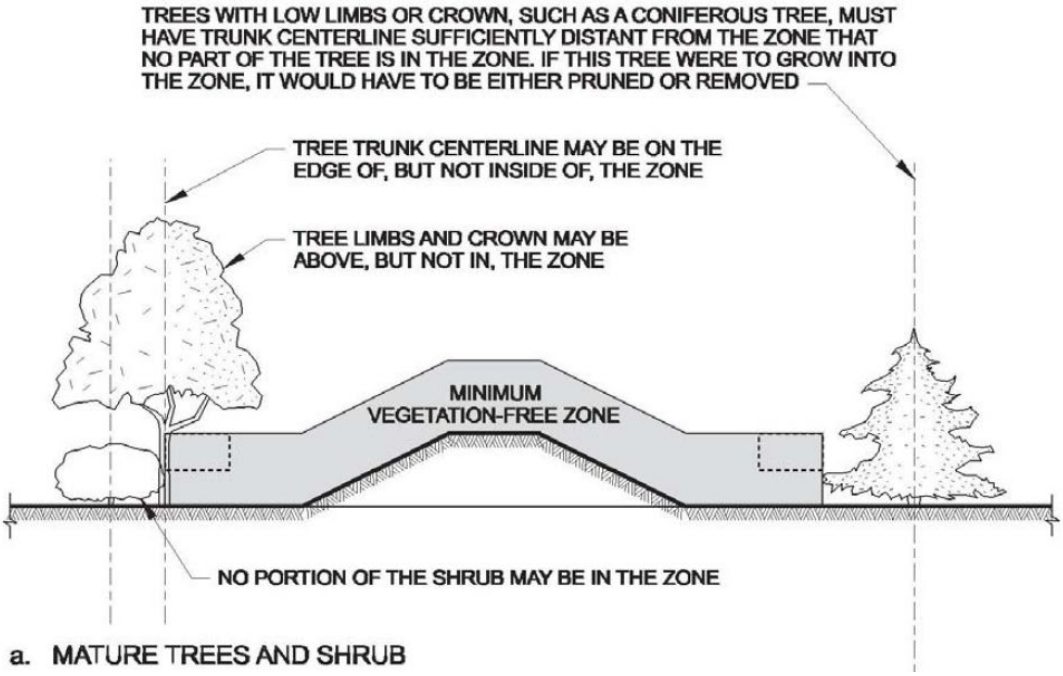


Figure 4: Proper Application of the Vegetation-Free Zone, from USACE EP 1110-2-18

Freeboard Requirements

All Project elements and alternatives use levee freeboard heights specified in the Valley Water Hydraulic Design Manual: 3.5 feet generally, and 4 feet within 100 feet from bridges. The LGRP used the FEMA standard levee freeboard height of 3 feet generally and 4 feet within 100 feet of bridges.

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

Design Life

The 2004 LGRP was designed to last 100 years. The Project will design for the original Project's lifetime, which has a target end-of-life of 2104.This is 82 years from the year 2022.

Design Flows

The Project will provide the one percent flood level of service defined by the LGRP from Gold Street to Interstate 880. There are two sets of flows for each of the two strategies for restoring LOS. The first strategy, maintaining the LGRP LOS through channel expansion, has flows that range from 17,000 cfs at Interstate 880 to 18,325 cfs at Highway 237.

Table 1: LGRP Design Flows for Channel Expansion Alternatives

Location Along Guadalupe River	100-Year Design Flows (cfs)
D/S of Los Gatos Creek confluence	16,000
Interstate 880	17,000
Highway 101	17,300
Trimble Road	17,500
Montague Expressway	17,900
Tasman Drive	18,100
Highway 237	18,325
Gold Street	18,325

The second strategy, achieving LGRP LOS through hydromodification, stores a portion of the peak flow in Lexington Reservoir in order to reduce the flows that reach the Lower Guadalupe River. These reduced flows use the draft hydrology that Valley Water is currently updating. In addition to having some of the peak flow stored in Lexington Reservoir, the estimated urban inflow from storm pump stations is less than the LGRP as well.

Because the Lower Guadalupe receives flow from the entire Guadalupe watershed, it is affected by any upstream flood improvement projects. The Upper Guadalupe River Project (UGRP) is planned to construct one percent flood risk reduction improvements to the Guadalupe River between Interstate 280 and Blossom Hill Road. This project is designed in partnership with USACE but has not received federal funding since 2014. In 2021, USACE began a General Re-evaluation study of the UGRP to try to find a project that is more competitive for federal funding. This means potentially building 25 to 50-year flood improvements instead of 100-year improvements. The Tentatively Selected Plan is expected by Fall 2022. 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 one percent flood risk reduction from the UGRP). The hydromodification flows used in the alternatives analysis assume either no flood improvements to UGRP (current condition) or 25-year improvements to UGRP to be constructed in the future.

To be conservative, the scenario with no improvements to the UGRP applied the downstream flow distribution from the LGRP. The scenario with 25-year improvements to UGRP applied the downstream flow distribution from the updated hydraulic modeling being studied by Valley Water's Hydrology, Hydraulics, and Geomorphology Unit. The flows are summarized below:

Table 2: Hydromodification Alternatives Flows

Location Along Guadalupe River	No Change to Upper Guadalupe Flows	25-yr Improvements to Upper Guadalupe
D/S of Los Gatos Creek confluence	11,460cfs	14,880cfs
Interstate 880	12,460cfs	14,970cfs
Highway 101	12,772cfs	15,330cfs
Trimble Road	12,938cfs	-
Montague Expressway	13,324cfs	15,400cfs
Tasman Drive	13,564cfs	-
Highway 237	13,785cfs	15,430cfs

Conceptual Project Elements

The Project team identified a variety of approaches to meet the Project's flood protection restoration requirements. These various solutions were called CPEs. Some of the CPEs were capable of being stand-alone solutions, while others were intended to be used like building blocks in combination with others to build a comprehensive solution. Further discussion on the development of CPEs is discussed in the Guadalupe River Project – Tasman Drive to Interstate 880 Conceptual Alternatives Report[3]. A total of 22 CPEs were identified (CPE 1 to CPE 22) and listed below:

1. No Action
2. Modify Guadalupe, Almaden, and/or Calero Dams
3. Raise Lenihan Dam (Lexington Reservoir)
4. Modify the Operation of Lexington Reservoir
5. Add Outlet Capacity to Lexington Reservoir
6. Modify Vasona Reservoir
7. Fluvial Geomorphological Alignment
8. Channel Widening
9. Off-stream Storage at Coleman Loop
10. Off-stream Storage at Los Gatos Creek Recharge Ponds
11. Levee/Channel Paving
12. Raise Levees
13. Floodwalls
14. Passive Barriers
15. Setback Levee at Ulistac
16. Lengthen Bridges
17. Bridge Headwalls
18. Raise Bridges
19. Sediment Removal
20. Vegetation Removal
21. Channel Bypass
22. Close Road Crossings with Passive Barriers

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. Further discussion on the development of Conceptual Alternatives is discussed in the Guadalupe River Project – Tasman Drive to Interstate 880 Conceptual Alternatives Report. The following is a brief description of the conceptual alternatives analyzed:

A. No Project Alternative
This alternative would make no changes to the current condition. It contains the following CPEs:

[3] Valley Water. 2020. Guadalupe River Project – Tasman Drive to Interstate 880 Conceptual Alternatives Report.

- CPE 1 – No Action

B. Floodwalls and Headwalls
This alternative constructs floodwalls and headwalls to restore the capacity of the river channel. It is composed of the following CPEs:
    - CPE 13 – Floodwalls
    - CPE 17 – Bridge Headwalls

B.1. Passive Barriers, Floodwalls, and Headwalls
This alternative constructs floodwalls and passive barriers combined with headwalls to restore the capacity of the river channel. It is composed of the following CPEs:

- CPE 13 – Floodwalls
- CPE 14 – Passive Barriers
- CPE 17 – Bridge Headwalls

B.2. Floodwalls and Headwalls with Closed Roadways
This alternative constructs floodwalls and passive barriers combined with headwalls to restore the capacity of the river channel. It is composed of the following CPEs:

- CPE 13 – Floodwalls
- CPE 17 – Bridge Headwalls
- CPE 22 – Close Road Crossing with Passive Barriers

C. Levees with Retaining wall and Headwalls
This alternative would raise the existing levees to provide additional capacity in the river channel. It consists of the following CPEs:
    - CPE 12 – Raise Levees
    - CPE 17 – Bridge Headwalls

C.1. Levees, Floodwalls, and Headwalls
This alternative would limit floodwall height to 3 ft and raise levees for the additional height needed. It consists of the following CPEs:

- CPE 12 – Raise Levees
- CPE 13 – Floodwalls
- CPE 17 – Bridge Headwalls

D. Off-stream Detention, Floodwalls, and Headwalls
This alternative would use off-stream detention upstream of the Project limits to store floodwaters and reduce the peak flows. It consists of the following CPEs:
    - CPE 9 – Off-Stream Storage at Guadalupe Gardens
    - CPE 13 – Floodwalls
    - CPE 17 – Bridge Headwalls

D.1. Off-stream Detention to Avoid Work on 101, Floodwalls, and Headwalls

This alternative would use off-stream detention upstream of the Project limits to store floodwaters and reduce the peak flows enough to avoid headwall modifications to Highway 101. It consists of the following CPEs:

- CPE 9 – Off-stream Storage at Guadalupe Gardens
- CPE 13 – Floodwalls
- CPE 17 – Bridge Headwalls

D.2 Off-Stream Detention with Minimal ROW Acquisition

This alternative would use off-stream detention upstream of the Project limits to store floodwaters and reduce the peak flows, minimizing areas that would require property acquisition. It consists of the following CPEs:

- CPE 9 – Off-stream Storage at Guadalupe Gardens
- CPE 13 – Floodwalls
- CPE 17 – Bridge Headwalls

E. Raised Bridges and Floodwalls

This alternative would raise five bridges crossing the Guadalupe River to allow the design flow to pass underneath the bridge decks unimpeded. It consists of the following CPEs:

- CPE 13 – Floodwalls
- CPE 18 – Raise Bridges

F. Channel Bypass

This alternative would create a bypass culvert to reduce the peak flow in the river channel. It consists of the following CPEs:

- CPE 13 – Floodwalls
- CPE 21 – Channel Bypass

G. Replace Levee with Floodwall

This alternative would replace the west levee with a high floodwall at the location of the outboard toe of the existing levee. It consists of the following CPEs:

- CPE 13 – Floodwalls
- CPE 17 – Bridge Headwalls

H. Add Outlet Capacity to Lenihan Dam in New Tunnel

This alternative would create an additional outlet at Lenihan Dam to allow Lexington Reservoir to partially empty before a storm event. This alternative consists of the following CPEs.

- CPE 5 – Add Outlet Capacity to Lenihan Dam
- CPE 13 – Floodwalls
- CPE 17 – Bridge Headwalls

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

This alternative would replace the existing outlet pipe at Lenihan Dam with a larger outlet to allow re-operation of Lexington Reservoir to partially empty before a storm event. This alternative consists of the following CPEs.

- CPE 5 – Add Outlet Capacity to Lenihan Dam
- CPE 13 – Floodwalls
- CPE 17 – Bridge Headwalls

I. Raise Lenihan Dam

This alternative would raise Lenihan Dam to provide additional peak storage during a storm. It consists of the following CPEs:

- CPE 3 – Raise Lenihan Dam
- CPE 13 – Floodwalls
- CPE 17 – Bridge Headwalls

J. Modify Lexington Reservoir Operations

This alternative would operate Lexington Reservoir to increase the amount of storage available before a large storm using the existing outlet. It consists of the following CPEs:

- CPE 4 – Modify the Operation of Lexington Reservoir
- CPE 13 – Floodwalls
- CPE 17 – Headwalls

K. Channel Widening

This alternative would widen the existing channel to increase capacity. It consists of the following CPEs:

- CPE 8: Channel Widening
- CPE 13 – Floodwalls
- CPE 17 – Headwalls

L. Vegetation Removal

This alternative would remove a large amount of vegetation in the channel to reduce the roughness in the channel and lower the water surface elevation. It consists of the following CPEs:

- CPE 20: Vegetation Removal

M. Levee/Channel Paving

This alternative would pave the existing river channel to reduce the roughness and increase capacity. It consists of the following CPEs:

- CPE 11: Levee Paving
- CPE 20: Vegetation Removal

Conceptual Alternatives Screening Methodology (Level 1)

The preliminary screening during the conceptual alternatives phase of the Project is referred to as Level 1 screening, which eliminates projects that do not meet the following criteria:

Project Objectives: Does the conceptual alternative satisfy the Project objectives?

Project Cost: Is the cost of the conceptual alternative within Valley Water's budget range? ($80 million Capital budget with 10% upper tolerance, 2020 costs)

Technical Feasibility: Are all the alternatives' elements buildable using widely available construction materials and knowledge?

Right-of-Way Availability: Are all the properties needed in the alternative available for Valley Water's intended use? Can the property be purchased in fee or easement, or can a joint use agreement be agreed upon?

Level 1 Screening

The screening criteria were applied to the conceptual alternatives to determine which alternatives will progress to the feasible alternatives analysis. The screening results are summarized in Table 3.

Table 3: 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	✓	✗	✓	✓	✗

Selection of Feasible Alternatives

The following alternatives met the Level 1 screening criteria and were considered feasible alternatives:

Alternative A – No Project

Alternative Description

Although this alternative does not meet the Project's objectives and does not pass the Level 1 screening, it is 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 unsustainable but is still the official maintenance level specified in the LGRP.

Technical Feasibility

This alternative is technically feasible.

Costs

Capital costs would be $0

Maintenance costs would be $180,000 per year based off average amount spent over the years since project completion

Maintenance & mitigation efforts cost $1.6 million to reduce the roughness in the channel after insufficient capacity was identified (performed in 2019 and 2020)[4]

Flood damage losses could be $1.7 billion[5] in the event of a catastrophic levee failure in the City of Santa Clara

Flood damage losses could be $1 billion[6] in the event of a catastrophic levee failure in the City of San Jose

Strengths

- No capital cost

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 will be very high
- Ongoing environmental impacts from vegetation removal

Alternative B – Floodwalls and Headwalls

This alternative would install new floodwalls or raise existing floodwalls on the outboard side of the existing levees. 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 improvements needed for this alternative are summarized by reach below:

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[4]Jen Codianne. 2021. Summary of Lower Guadalupe River Work.

[5] Hazus. 2020. Flood Global Risk Report.

[6] Hazus. 2020. Flood Global Risk Report.

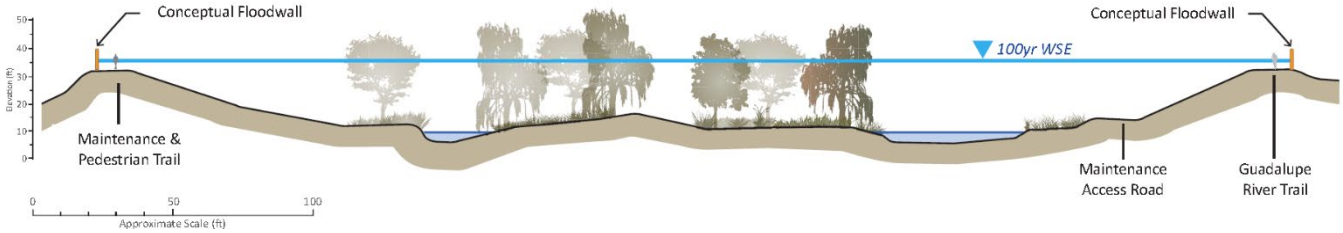

Figure 5: Typical Section – Alternative B Floodwalls

Reach A (I-880 to Hwy 101):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	2.4	4260	West Bank
	2.6	3170	East Bank
Passive Barrier	varies	varies	Maintenance road entry/exits

Bridge Improvements

	Height (ft)	Exist. Height (ft)	Location
Headwall	3.75	0	Airport Parkway Bridge
	7	3	Highway 101 Bridge U/S
	6	3	Highway 101 Bridge D/S
	5	3	Highway 101 On-Ramp Bridge U/S
	4	3	Highway 101 On-Ramp Bridge D/S

Potential Utility Conflicts

Station	Levee/Bank	Utility	Notes
157+20	west	SS	-
156+96	west	SD	-
156+70	west	W	-
155+10	west	SD	-
154+50	west	SD	-
154+20	both	SD	-
153+00	east	SD	-
148+20	west	SD	-
147+01	both	G, W	-
146+10	both	SD	-
-	west	Pump Station	Conflicts U/S of Hwy 101 Bridge
-	west	W	Runs parallel to trail

Bridge Improvements:

The Highway 101 bridge crossing is a series of three bridges that span the Guadalupe River. The original bridge was constructed in 1937, and widenings were constructed in 1960, 1970, 1992, 2005. Under one percent design

conditions, Highway 101 experiences pressurized flow since the water surface elevation is higher than the soffit of the bridge. The bridges require some modifications to accommodate such a large headwall addition:

- Strengthen existing north and south wingwall by increasing thickness from 6 in to 12 in and adding additional mat reinforcement
- Strengthen existing wingwalls at North On-Ramp bridge by increasing thickness from 6 in to 12 in and adding additional mat reinforcement
- Add watertight expansion joins
- Retrofit the North On-Ramp structure to help mitigate the increased uplift forces
- Relocate existing lighting conduits and luminaries

Project Staff hired a consultant to assist with the feasibility analysis of Highway 101 bridge[7]. They concluded that the modifications to Highway 101 mainline and on-ramp bridges should be considered a Minor Modification Project, and therefore would not require additional re-analysis of the strength or seismic capacity of the entire structure. The Project Team's initial conversations with Caltrans, however, were not as clear as to what Caltrans would expect Valley Water's responsibility would be. There was some indication that once work was initiated on Highway 101 Bridge, Valley Water may be required to perform additional code upgrades as well.

Reach B (Hwy 101 to Trimble Rd):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	4.7	2530	West Bank
	4.3	2650	East Bank
Passive Barrier	varies	varies	Maintenance road entry/exits

Bridge Improvements

	Height (ft)	Exist. Height (ft)	Location
Headwall	9	3	Trimble Road Bridge

Potential Utility Conflicts

Station	Levee/Bank	Utility	Notes
143+70	east	SD	-
140+10	both	SS, SD	-
139+20	west	SS, SD	-
139+20	both	SD	-
136+87	both	SD	Trimble Road Bridge

Other Identified Conflicts

Location	Conflict
Component Parkway	Proposed Guadalupe River Trail access point

[7] 2021. Feasibility Study for Bridge Headwall Raisings Lower Guadalupe River. Mark Thomas.

Bridge Improvements

To accommodate such a large headwall addition, Trimble bridge requires the following modifications:

- Install a below deck drainage system to prevent backflow
- Relocate existing lighting conduits and luminaires

The bridge analysis consultant concluded that the modifications to Trimble bridge should be considered a Minor Modification Project, and therefore would not require additional re-analysis of the strength or seismic capacity of the entire structure.

Reach C (Trimble Rd to Montague Expwy):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	6.0	6100	West Bank
	5.7	6100	East Bank
Passive Barrier	varies	varies	Maintenance road entry/exits

Bridge Improvements

	Height (ft)	Exist. Height (ft)	Location
Headwall	10.5	4	Montague Expressway

Potential Utility Conflicts

Station	Levee/Bank	Utility	Notes
135+60	both	G	-
135+30	east	SD	-
133+80	west	SD	-
132+60	west	SD	-
124+80	west	SD	-
132+78	west	Pump Station	

Other Identified Conflicts

Location	Conflict
Plumeria Drive	Proposed Guadalupe River Trail access point

Bridge Improvements:

Montague Expressway bridge requires extensive bridge modifications to accommodate such a large headwall addition. The potential retrofits include:

- Retrofit deck with additional bar reinforcing steel matt layer and additional deck thickness
- Retrofit wingwalls
- Extend bent caps, pier wall, and abutment
- Add pile caps below pier wall extensions
- Add class 200 pile at each pile cap to resist uplift
- Add class 200 piles at each abutment extension to resist uplift
- Install vertical restrainers at all pier bent caps

- Install below deck drainage system to prevent backflow
- Relocate existing lighting conduits and luminaires
- Replace existing expansion Joints
- Extend the existing 66" RCP on the southwest corner of the bridge
- Relocate existing flow gage at southeast corner of the bridge

Reach D (Montague Expwy to SFPUC Pipeline):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	5.0	5540	West Bank
	4.6	5540	East Bank
Passive Barrier	varies	varies	Ramps near Pedestrian Bridge

Bridge Improvements

	Height (ft)	Exist. Height (ft)	Location
None	-	-	Pedestrian Bridge

Potential Utility Conflicts

Station	Levee/Bank	Utility	Notes
117+90	east	Pump Station	-
117+60	west	Pump Station	-
117+60	west	SD	-
112+50	west	SD	-
110+70	west	SD	-
109+80	both	SD	-
108+90	west	SD	-
107+70	west	SD	-
106+80	east	SD	-
106+50	west	SD	-
105+90	west	SD	-
101+70	both	W	Hetch Hetchy Pipeline, 2 pipes
101+40	west	Pump Station	Fairway Glen

Other Identified Conflicts

Location	Conflict
Pedestrian Bridge	existing ramps for trail/bridge access

Bridge Improvements:

A pedestrian bridge crosses the river in this reach. There are no proposed changes to the bridge in this alternative. Floodwalls will enclose the outboard side of the levees, and the bridge can overtop. This would temporarily impact access to the bridge.

Reach E (SFPUC Pipeline to Tasman Dr):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	3.3	2770	West Bank
	3.1	2760	East Bank

Bridge Improvements

	Height (ft)	Exist. Height (ft)	Location
None	-	-	-

Potential Utility Conflicts

Station	Levee/Bank	Utility	Notes
97+80	west	SD	-
95+40	west	SD	-
93+30	west	SD	-

Other Identified Conflicts

Location	Conflict
Hetch Hetchy Crossing	Proposed Guadalupe River Trail access point

Reach F (Tasman Dr to Hwy 237):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	1.0	3740	West Bank
	1.0	3660	East Bank

Bridge Improvements

	Height (ft)	Exist. Height (ft)	Location
None	-	-	-

Potential Utility Conflicts

Station	Levee/Bank	Utility	Notes
86+40	east	SD	-
83+70	both	G	-
83+40	east	SD	-
80+70	both	SS, SD	-
80+56	both	W	-
-	west	RCW	Runs parallel to trail

Other Identified Conflicts

Location	Conflict
Highway 237	Wingwalls may need additional height
Oakmead Pump Station	Existing staircase on east bank
-	Existing inboard floodwalls on both banks

Reach G (Hwy 237 to Gold St):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	1.5	970	West Bank
	1.1	870	East Bank

Bridge Improvements

	Height (ft)	Exist. Height (ft)	Location
None	-	-	-

Potential Utility Conflicts

Station	Levee/Bank	Utility	Notes
79+98	east	SD	-
79+98	both	W	Highway 237
74+40	east	SD	-
71+21	both	G	-

Other Identified Conflicts

Location	Conflict
Highway 237	Wingwalls may need additional height
Topgolf Property	Proposed Guadalupe River Trail access point
D/S Highway 237	VTA drainage basin, levees on both sides of basin
D/S Highway 237	Needs updated survey information

Other Identified Conflicts

Existing wetland mitigation basin owned by VTA downstream of Hwy 237 with levees on the outboard side of the basin. It appears that the outboard side is higher than the Guadalupe River levee indicating that the VTA levee on the outboard side is intended to provide the flood protection.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $67,500,000

Maintenance costs would be $450,000 annually

Strengths

- The existing public trails are preserved
- Floodwalls are typically considered less maintenance than levees of similar height
- Comparatively lower capital cost, and within 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 past 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 past feedback from public meetings
-
- Coordination and permitting will 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
- Highway 101 bridge modifications may trigger Caltrans to request additional retrofits

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

This alternative would install new floodwalls or raise existing floodwalls on the outboard side of the existing levees. Concrete headwalls and wingwalls would be raised or replaced on Airport Parkway and Highway 101 bridges. Connections between outboard floodwalls and inboard wingwalls could be closed with passive barriers, or with graded earthen ramps. Instead of building headwalls at Trimble Road and Montague Expressway, the roadways would have passive barriers installed that would deploy during a flood to allow flows to pass over the bridge deck. The improvements needed for this alternative are summarized by reach below:

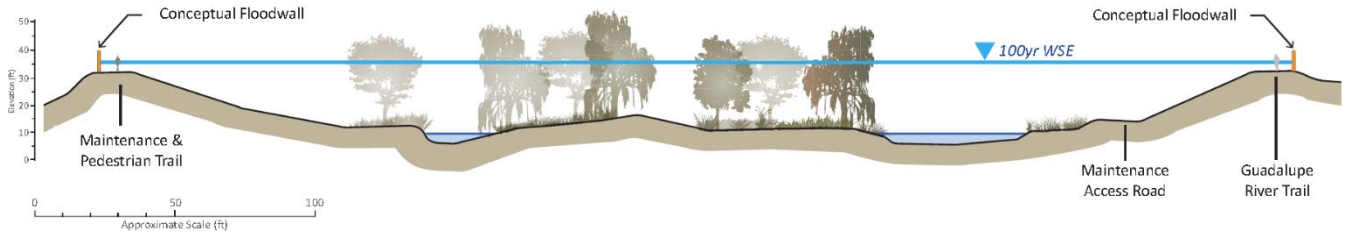

Figure 6: Typical Section – Alternative B.2 Floodwalls

Reach A (I-880 to Hwy 101):

Structural Features			
	Avg. Height (ft)	**Length (ft)**	**Location**
Floodwall	2.4	3910	West Bank
	2.6	2980	East Bank
Passive Barrier	varies	varies	Maintenance road entry/exits

Bridge Improvements
Same as Alternative B

Potential Utility Conflicts
Same as Alternative B

Reach B (Hwy 101 to Trimble Rd):

Structural Features			
	Avg. Height (ft)	**Length (ft)**	**Location**
Floodwall	4.2	2530	West Bank
	3.8	2650	East Bank
Passive Barrier	varies	varies	Maintenance road entry/exits

Bridge Improvements			
	Height (ft)	**Exist. Height (ft)**	**Location**
Passive Barriers	9.5	-	Trimble Road Bridge

Potential Utility Conflicts
Same as Alternative B

Other Identified Conflicts
Same as Alternative B

Bridge Improvements

Passive barrier installation at Trimble Road bridge would completely close the bridge when flood waters are higher than the bridge soffit. This creates a traffic issue for the period that the bridge is closed. During a triggering event, before the passive barriers are activated, safety crossing bars and flashing lights would be used to warn cars that the bridge is closed, similar to train crossings at roadways.

Reach C (Trimble Rd to Montague Expwy):

Structural Features			
	Avg. Height (ft)	**Length (ft)**	**Location**
Floodwall	5.7	6100	West Bank
	5.4	6100	East Bank
Passive Barrier	varies	varies	Maintenance road entry/exits

Bridge Improvements			
	Height (ft)	**Exist. Height (ft)**	**Location**
Passive Barriers	10.5	-	Montague Expressway

Potential Utility Conflicts
Same as Alternative B

Other Identified Conflicts
Same as Alternative B

Bridge Improvements

Passive barrier installation at Montague Expressway bridge would completely close the bridge when flood waters are higher than the bridge soffit. This creates a traffic issue for the period that the bridge is closed. During a triggering event, before the passive barriers are activated, safety crossing bars and flashing lights would be used to warn cars that the bridge is closed, similar to train crossings at roadways.

Reach D (Montague Expwy to SFPUC Pipeline):

Structural Features			
	Avg. Height (ft)	**Length (ft)**	**Location**
Floodwall	5.0	5550	West Bank
	4.6	5550	East Bank
Passive Barrier	varies	varies	Ramps near Pedestrian Bridge

Bridge Improvements
Same as Alternative B

Potential Utility Conflicts
Same as Alternative B

Other Identified Conflicts
Same as Alternative B

Reach E (SFPUC Pipeline to Tasman Dr):

Same as Alternative B

Reach F (Tasman Dr to Hwy 237):

Same as Alternative B

Reach G (Hwy 237 to Gold St):

Same as Alternative B

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $78,500,000
Maintenance costs would be $450,000 annually

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
- Coordination and permitting will be needed with Caltrans, City of San José, Santa Clara County to construct headwalls and passive barriers
- Highway 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.

Alternative C – Levees with Retaining Walls and Headwalls

This alternative would raise the existing levees to provide additional capacity in the river channel. 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 feet wide with side slopes of 2:1 (horizontal: vertical). Concrete headwalls will need to be raised or replaced at four bridges. The improvements needed for this alternative are summarized by reach below:

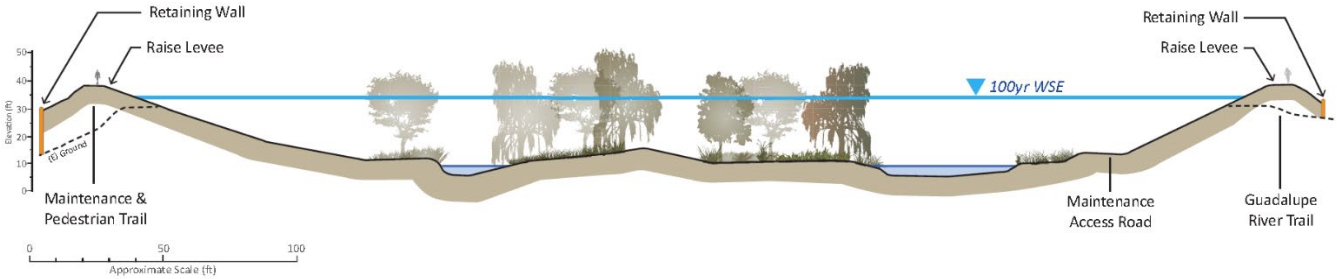

Figure 7: Typical Section – Raised Levees with Retaining Wall

Reach A (I-880 to Hwy 101):

Structural Features			
	Avg. Height (ft)	**Length (ft)**	**Location**
Levee	2.4	4110	West Bank
	2.5	3110	East Bank

Bridge Improvements
Same as Alternative B

Potential Utility Conflicts
Same as Alternative B

Other Identified Conflicts	
Location	**Conflict**
Airport Parkway Bridge	existing ramp
Airport Parking Lot Bridge	existing ramp
154+80 west bank	existing facility/infrastructure
154+20 both banks	existing facility/infrastructure
153+00 east bank	existing facility/infrastructure

Reach B (Hwy 101 to Trimble Rd):

Structural Features			
	Avg. Height (ft)	**Length (ft)**	**Location**
Levee	4.6	2540	West Bank
	4.2	2650	East Bank

Bridge Improvements			
	Height (ft)	**Exist. Height (ft)**	**Location**
Headwall	9.5	3	Trimble Road Bridge

Potential Utility Conflicts
Same as Alternative B

Other Identified Conflicts	
Location	**Conflict**
Trimble Bridge	existing ramp
Component Parkway	Proposed Guadalupe River Trail access point

Reach C (Trimble Rd to Montague Expwy):

Structural Features			
	Avg. Height (ft)	**Length (ft)**	**Location**
Levee	5.8	6100	West Bank
	5.5	6100	East Bank

Bridge Improvements
Same as Alternative B

Potential Utility Conflicts
Same as Alternative B

Other Identified Conflicts

Location	Conflict
Montague Expressway	Existing ramp
Plumeria Drive	Proposed Guadalupe River Trail access point

Reach D (Montague Expwy to SFPUC Pipeline):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Levee	5.0	5540	West Bank
	4.6	5540	East Bank

Bridge Improvements

	Height (ft)	Exist. Height (ft)	Location
raise/relocate	varies	-	Pedestrian Bridge

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Same as Alternative B

Bridge Improvements:

A pedestrian bridge crosses the river in this reach. It will either need to be raised and extended to fit the new channel width or relocated to a new location. The pedestrian bridge is subject to a Joint Use Agreement that requires the City of San José to remove or relocate the bridge if needed for flood protection purposes.

Reach E (SFPUC Pipeline to Tasman Dr):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Levee	3.3	2770	West Bank
	3.0	2670	East Bank

Bridge Improvements

Same as Alternative B

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Location	Conflict
Tasman Bridge	Existing ramps
Hetch Hetchy Crossing	Proposed Guadalupe River Trail access point

Reach F (Tasman Dr to Hwy 237):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Levee	1.0	3740	West Bank
	0.9	3660	East Bank

Bridge Improvements

Same as Alternative B

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Location	Conflict
Highway 237	Existing ramps
Highway 237	Wingwalls may need additional height
Oakmead Pump Station	Existing staircase on east bank
-	Existing inboard floodwalls on both banks

Reach G (Hwy 237 to Gold St):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Levee	1.5	970	West Bank
	1.1	870	East Bank

Bridge Improvements

Same as Alternative B

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Same as Alternative B

Other Identified Conflicts

Existing wetland mitigation basin owned by VTA downstream of Hwy 237 with levees on the outboard side of the basin. It appears that the outboard side is higher than the Guadalupe River levee indicating that the VTA levee on the outboard side is intended to provide the flood protection.

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $102,000,000

Maintenance costs would be $450,000 annually

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 will 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
- Highway 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

Alternative C.1 – Levees, Floodwalls and Headwalls

This alternative would construct concrete floodwalls on the outboard side of the existing levees. Floodwall height would be limited to 3 ft, levees would be raised for the additional height 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 constructed on the outboard side of the levees to prevent encroachment on other properties. Concrete headwalls would be raised or replaced at four bridges. The improvements needed for this alternative are summarized by reach below:

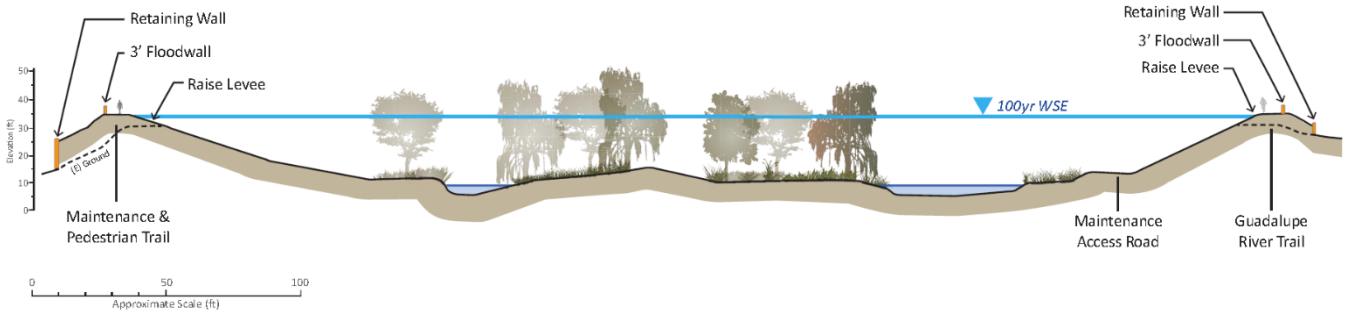

Figure 8: Typical Section – Levees and Floodwall

Reach A (I-880 to Hwy 101):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	2.1	4110	West Bank
	2.1	1410	East Bank
Levee	0.9	2110	West Bank
	1.3	780	East Bank

Bridge Improvements

Same as Alternative B

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Same as Alternative C

Reach B (Hwy 101 to Trimble Rd):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	3.0	2540	West Bank
	3.0	2650	East Bank
Levee	1.6	2540	West Bank
	1.3	2440	East Bank

Bridge Improvements

Same as Alternative B

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Same as Alternative C

Reach C (Trimble Rd to Montague Expwy):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	3.0	6100	West Bank
	3.0	6100	East Bank
Levee	2.8	6100	West Bank
	2.5	6100	East Bank

Bridge Improvements
Same as Alternative B

Potential Utility Conflicts
Same as Alternative B

Other Identified Conflicts
Same as Alternative C

Reach D (Montague Expwy to SFPUC Pipeline):

Structural Features			
	Avg. Height (ft)	**Length (ft)**	**Location**
Floodwall	5.0	5540	West Bank
	2.0	5540	East Bank
Levee	4.2	5540	West Bank
	1.6	5540	East Bank

Bridge Improvements
Same as Alternative C

Potential Utility Conflicts
Same as Alternative B

Other Identified Conflicts
Same as Alternative C

Reach E (SFPUC Pipeline to Tasman Dr):

Structural Features			
	Avg. Height (ft)	**Length (ft)**	**Location**
Floodwall	2.7	2770	West Bank
	2.6	2670	East Bank
Levee	0.9	1870	West Bank
	0.7	1670	East Bank

Bridge Improvements
Same as Alternative B

Potential Utility Conflicts
Same as Alternative B

Other Identified Conflicts
Same as Alternative C

Reach F (Tasman Dr to Hwy 237):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	1.0	3740	West Bank
	1.0	3660	East Bank

Bridge Improvements

Same as Alternative B

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Location	Conflict
Oakmead Pump Station	existing staircase on east bank
-	existing inboard floodwalls on both banks

Reach G (Hwy 237 to Gold St):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwalls	1.5	970	West Bank
	0.8	870	East Bank
Levee	0.2	300	West Bank
	1.1	180	East Bank

Bridge Improvements

Same as Alternative B

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Same as Alternative C

Technical Feasibility

All project elements are technically feasible.

Costs

Capital costs would be $85,800,000

Maintenance costs would be $450,000 annually

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
- Capital cost is close to the $80 million budgeted for this project

Weaknesses

- 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 will be needed. They also have the potential to disrupt wildlife movement to and from the river corridor.
- Coordination and permitting will 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
- Highway 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

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

This alternative would use off-stream detention upstream of the Project limits to store floodwaters and reduce the peak flows, minimizing areas that would require property acquisition. It would also install or raise existing floodwalls and raise or replace concrete headwalls at four bridges.

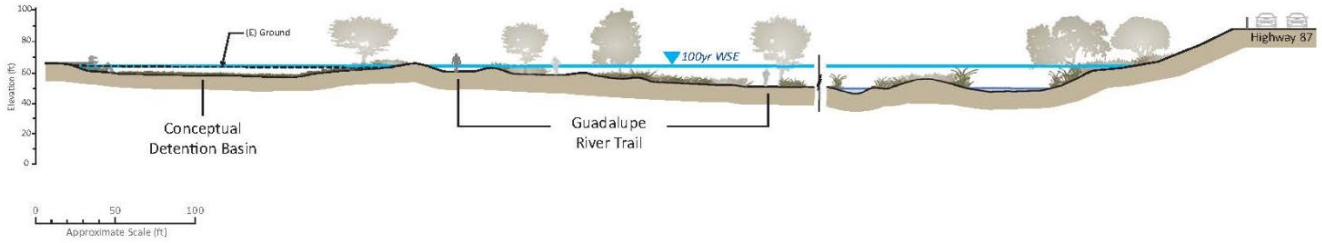

Figure 9: Typical Section – Off-Stream Detention

Guadalupe Gardens (Upstream of I-880):

Structural Features:

This alternative would utilize 46 acres of land upstream of Interstate 880 in the Guadalupe Gardens area between W Hedding Street and Asbury Street. This would create a 5 ft deep detention basin with a storage capacity of 200 ac-ft, lowering the peak discharge by 900 cfs. Groundwater is high in this area and could result in ponding if a deeper basin is desired. To maximize storage area, this element assumes some right-of-way acquisition for privately owned properties. Securing use of this area would require coordination with agencies including the FAA, NMFS, RWQCB, and City of San José (CSJ).

Potential Utility Conflicts:

- Valley Water's 66-inch diameter Central Pipeline runs through the proposed detention basin that spans about 1,300 ft long. This pipeline is buried 5 ft below the ground and is located between W Hedding St and Asbury St, running parallel to those streets, southwest of Hwy 87.
- Storm drainage and sanitary sewer utility lines under Spring St and other abandoned streets may conflict with excavation.

Technical Feasibility

This alternative is not technically feasible.

The bottom of the detention basin created at Guadalupe Gardens would be sloped toward the Guadalupe River to facilitate drainage. The existing ground slope at the proposed detention basin site is approximately 0.3%-0.4% towards the river. The ideal bottom slope of a vegetated detention basin is 2% sloped toward the basin outlet to facilitate drainage[8]. To satisfy the 2% bottom slope design guideline, the basin elevation would have to drop approximately 34-feet across the 1,700-foot length. Given that the proposed detention basin would be only 5-feet deep, it is not feasible to achieve a 2% slope as specified in the design guidelines. This kind of elevation difference would cut the amount of storage in the site significantly. Also, this area is known to have high groundwater, sometimes less than 10' below existing ground. If the proposed detention basin can be sloped less than 2%, this alternative may be considered feasible. Otherwise, it cannot be considered a feasible alternative.

Costs

Capital costs would be $108,300,000
Maintenance costs would be $500,000 annually

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

- Grading of the basin and slope requirements for drainage makes this alternative infeasible

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

This alternative would replace the existing outlet pipe at Lenihan Dam with a larger outlet to allow Lexington Reservoir to partially empty before a storm event. This alternative assumes that Upper Guadalupe River remains in current restricted capacity and no flood improvements on the Upper Guadalupe River will be made in the future. Adding additional outlet capacity to Lenihan Dam would increase the dam's ability to release water 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 either Lexington Reservoir or Guadalupe, Almaden, and Calero Reservoirs. Several combinations of storm centerings 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

[8] Santa Clara Valley Water District. (2009). Design Manual Open Channel Hydraulics and Sediment Transport. San Jose

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[9]. The design flows for this alternative are listed in the Table below and are the same flows as Table 2 in the Design Criteria section.

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

Because the reduced 1% flood flow is still higher than the channel's capacity, floodwalls would 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 improvements needed for this alternative are summarized by reach below:

Lenihan Dam at Lexington Reservoir:

Lexington Reservoir has a total capacity of 18,534 ac-ft at the existing spillway ogee crest. A starting reservoir volume of 12,000 ac-ft leaves 6,500 ac-ft of available storage in the reservoir before a large storm. The 2009 USACE Hydrology model for the Guadalupe Watershed assumes a starting volume in Lexington Reservoir of 16,000 ac-ft. In order to reduce the volume in the reservoir from 16,000 ac-ft to 12,000 ac-ft, 4,000 ac-ft needs to be drained from the reservoir before a large storm.

The base flow between storms has been estimated to be 200 cfs, based on the heavy rainfall observed during the 2016-2017 winter season. This was calculated by performing a volume balance based on Lexington Reservoir storage change and outlet release for four storms in January and February of 2017. The time ranges began when the water surface elevation (WSEL) dropped below the spillway elevation through the next large storm, which caused an increase in WSEL. The calculated baseflows from the four storms were averaged to provide a conservative assumption for baseflow.

The existing 54 in outlet pipe, which has a maximum capacity of 450 cfs, would be replaced with a 72 in pipe with a capacity of 800 cfs. A secondary 60-inch intake would be constructed adjacent to the existing 54 in sloping intake to carry the additional flow. The existing 54 in outlet can drain 4,000 ac-ft plus 200 cfs baseflow in 194 hours (about 8 days). The proposed 72 in pipe could drain the same amount in 81 hours (about 3 and a half days). The reduced time to drain the reservoir would increase the reliability of the reservoir to operate for flood peak reduction and reduce the chances of prematurely releasing flow in the event the weather forecast changes and the peak storm does not materialize over the watershed. This alternative would reduce the 1% flow at I-880

[9] 2021. Design Flows for Alternatives. Jack Xu. Technical Memorandum.

to 12,460 cfs. Increasing the size of the pipe or the initial storage in the reservoir would not further reduce the 1% peak flow due to inflow downstream of the reservoir.

Structural Features			
	Size (in)	**Length (ft)**	**Location**
Conduit	72	2100	in existing tunnel
Intake shaft	60	40	near low level intake

There are two ways the 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 cfs temporary rule curve as shown in Figure 10 as a precautionary measure while the Lower Guadalupe River is under capacity. To achieve full one percent storage capacity in the reservoir, the rule curve needs to be set at 12,000 ac-ft.

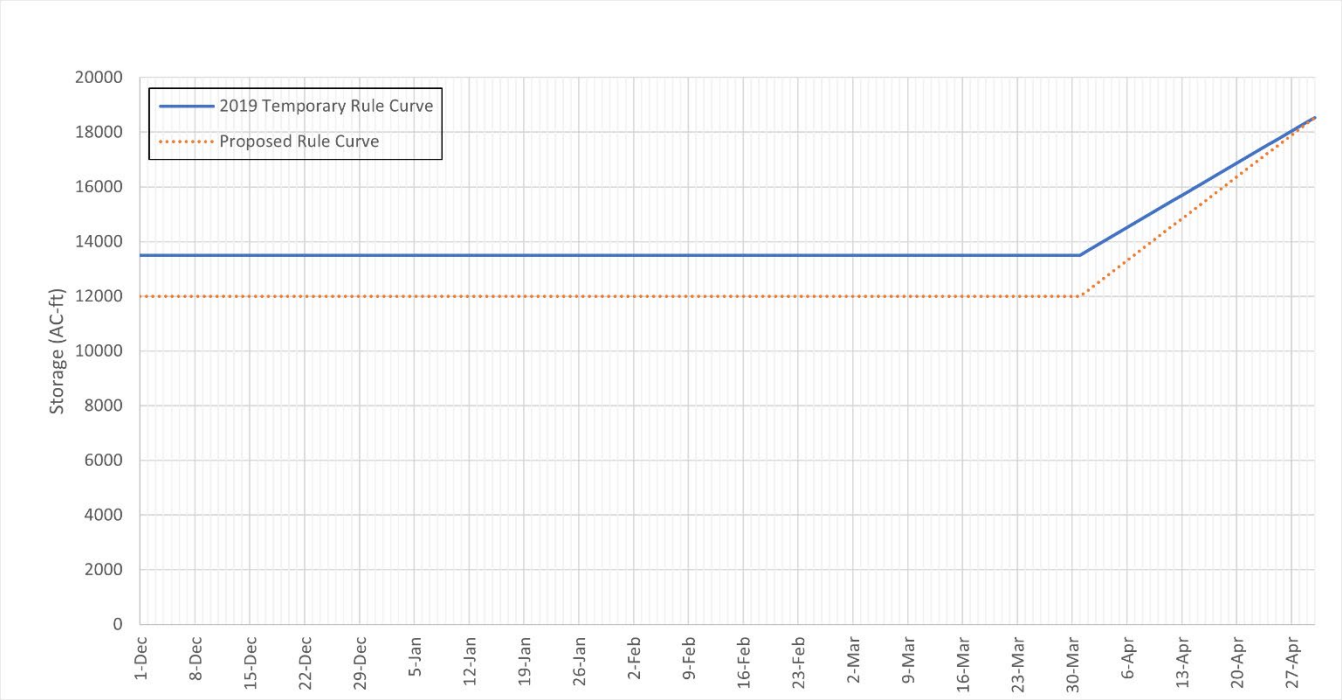

Figure 10: Temporary and Proposed Rule Curves at Lexington Reservoir

The second way to achieve additional storage in the reservoir is by using Forecast-Informed Reservoir Operations (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, as shown in Figure 11.

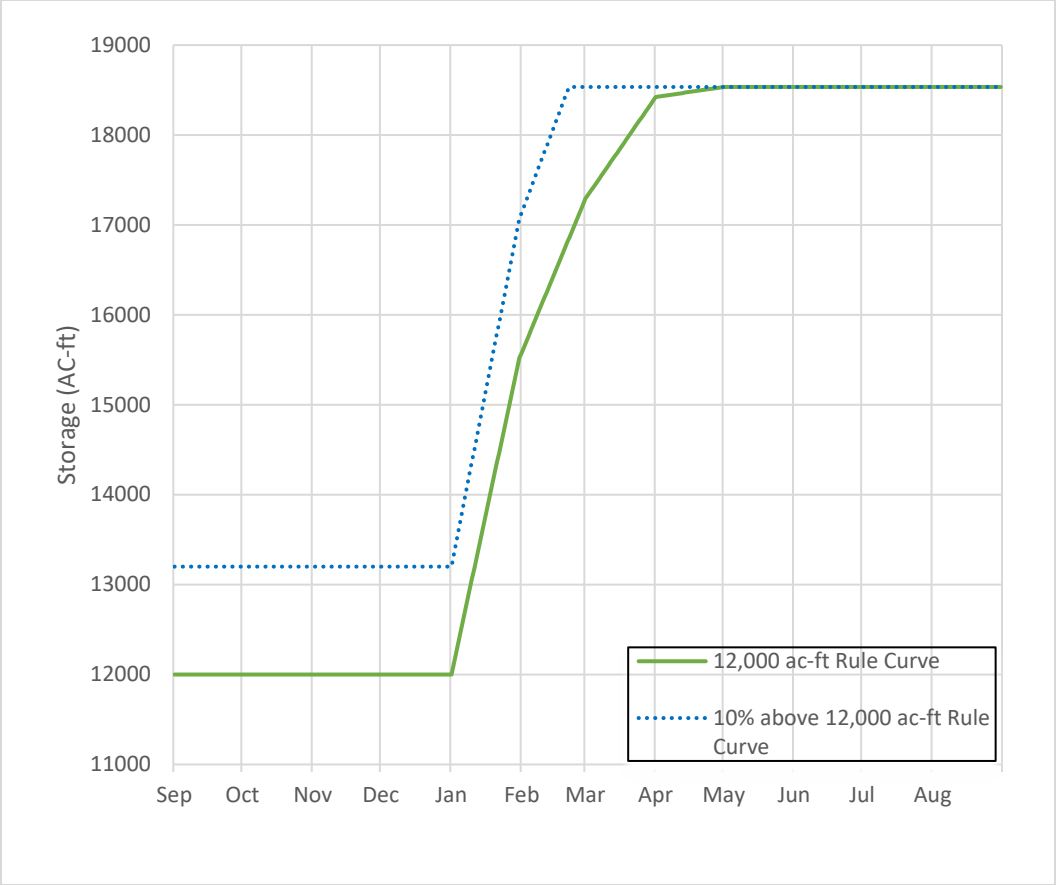

Figure 11: FIRO Target Operation Range for Lexington Reservoir

Of the two reservoir operation methods listed above, the Project Team prefers the FIRO method because it is a promising option to operate more responsively to incoming storms as well as providing more water supply at the end of a winter rainy season. Whether Lexington Reservoir can be operated for FIRO is being studied further by Valley Water, with a preliminary viability assessment expected by the end of 2022.

Other Identified Conflicts:

The field reconnaissance and analysis of aerial photography and LiDAR imagery[10] indicates that there are numerous young, active landslides around the margins of the reservoir. Six of the identified landslides around the reservoir margin are classified as high hazard. The rapid drawdown of Lexington reservoir may trigger landslides in the six high hazard landslide areas and other areas that have not been identified as high hazard. A landslide in this area could threaten water supply and quality, as well as biological resources near the reservoir as well as downstream.

The San Andreas fault zone passes near the southern end of the reservoir. Given the proximity of the San Andreas fault and existence of the massive landslides mapped in the area, it is a near certainty that additional landslides will be triggered by future earthquakes along the San Andreas fault zone.

[10] GEI Consultants. 2021. "Reconnaissance-Level Landslide Hazard Assessment at Lexington Reservoir." Technical Memorandum

Reach A (I-880 to Hwy 101):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	1.4	210	West Bank
	0.1	200	East Bank

Bridge Improvements

	Height (ft)	Exist. Height (ft)	Location
None	-	-	-

Reach B (Hwy 101 to Trimble Rd):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	0.3	200	West Bank
	-	-	East Bank
Passive Barrier	varies	varies	Maintenance road entry/exits

Bridge Improvements

	Height (ft)	Exist. Height (ft)	Location
Headwall	4	3	Trimble Road Bridge

Potential Utility Conflicts

Station	Levee/Bank	Utility	Notes
139+20	west	SS, SD	-
139+20	both	SD	-
136+87	both	SD	Trimble bridge

Other Identified Conflicts

Same as Alternative B

Reach C (Trimble Rd to Montague Expwy):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	1.0	5790	West Bank
	0.7	5900	East Bank
Passive Barrier	varies	varies	Maintenance road entry/exits

Bridge Improvements

	Height (ft)	Exist. Height (ft)	Location
Headwall	6	4	Montague Expressway

Potential Utility Conflicts
Same as Alternative B

Other Identified Conflicts
Same as Alternative B

Bridge Improvements:

With Alternative H.1a, like Alternatives B & C, the Montague Expressway Bridge may require extensive modifications to accommodate the headwall addition. However, since the headwall only needs to be raised to 6 ft instead of 10.5 ft, the modifications may be less. The potential retrofits include:

- Retrofit deck with additional bar reinforcing steel mat layer and additional deck thickness
- Retrofit wingwalls
- Extend bent caps, pier wall, and abutment
- Add pile caps below pier wall extensions
- Add class 200 pile at each pile cap to resist uplift
- Add class 200 piles at each abutment extension to resist uplift
- Install vertical restrainers at all pier bent caps
- Install below deck drainage system to prevent backflow
- Relocate existing lighting conduits and luminaires
- Replace existing expansion Joints
- Extend the existing 66" RCP on the southwest corner of the bridge
- Relocate existing flow gage at southeast corner of the bridge

Reach D (Montague Expwy to SFPUC Pipeline):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	1.0	5380	West Bank
	0.6	5380	East Bank
Passive Barrier	varies	varies	Ramps near Pedestrian Bridge

Bridge Improvements

	Height (ft)	Exist. Height (ft)	Location
None	-	-	Pedestrian Bridge

Potential Utility Conflicts
Same as Alternative B

Other Identified Conflicts
Same as Alternative B

Bridge Improvements:

A pedestrian bridge crosses the river in this reach. There are no proposed changes to the bridge in this alternative. Floodwalls would enclose the outboard side of the levees, and the bridge could overtop. This would temporarily impact access to the bridge.

Reach E (SFPUC Pipeline to Tasman Dr):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	0.4	1670	West Bank
	0.4	890	East Bank

Bridge Improvements

Same as Alternative B

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Same as Alternative B

Reach F (Tasman Dr to Hwy 237):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	0.6	100	West Bank
	-	-	East Bank

Bridge Improvements

Same as Alternative B

Potential Utility Conflicts

Station	Levee/Bank	Utility	Notes
none	-	-	-

Reach G (Hwy 237 to Gold St):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	1.5	500	West Bank
	2.7	200	East Bank

Bridge Improvements

Same as Alternative B

Potential Utility Conflicts

Station	Levee/Bank	Utility	Notes
79+98	east	SD	-
79+98	both	W	Highway 237

Other Identified Conflicts

Location	Conflict
Highway 237	Wingwalls may need additional height
D/S Highway 237	VTA drainage basin, levees on both sides of basin
D/S Highway 237	Needs updated survey information

Other Identified Conflicts

Existing drainage basin owned by VTA downstream of Hwy 237 with levees on the inboard and outboard side of the basin. It appears that the outboard side is higher, indicating that the LGRP intended the outboard side to provide the flood protection.

Technical Feasibility

Adding outlet capacity to the Lexington Reservoir element is constructible; however, Lexington Reservoir's rapid drawdown may trigger landslides. The reconnaissance-level study has identified numerous young, active landslides around the reservoir's west side. These landslides appear to present the highest risk to properties and infrastructure such as Alma Fire Station, Lexington Elementary School, Aldercroft Creek Bridge, and State Route 17. Subject matter experts judge that these landslide areas can't be mitigated with conventional stabilization measures such as removal-and-replacement, retaining walls, or in-situ stabilization due to the enormous size of the landslide areas, and extents across multiple public and private properties[11].

Another concern surrounding reservoir reoperation using FIRO is the possibility of changing the amount of water stored in the reservoir at the end of the rainy season. If weather forecasts indicate a large storm, triggering reservoir release, but the storm never materializes, the water loss would be detrimental to water supply and beneficial environmental use. Studies of FIRO's use in other California reservoirs has indicated that it is more likely that reservoirs will end up with more water in them at the end of a rainy season[12]. This is being studied further by Valley Water to get more specifics on how this would work for Lexington Reservoir.

Costs

Capital costs would be $51,300,000
Maintenance costs would be $450,000 annually
Any 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

Weaknesses

- This alternative relies on Upper Guadalupe River remaining in its current restricted capacity. If Upper Guadalupe River capacity is raised 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

[11] GEI Consultants. 2021. "Reconnaissance-Level Landslide Hazard Assessment at Lexington Reservoir." Technical Memorandum
[12] Forecast Informed Reservoir Operations Steering Committee. (2017). Preliminary Viability Assessment of Lake Mendocino.

- 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

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

This alternative would replace the existing outlet pipe at Lenihan Dam with a larger outlet to allow the reservoir to partially empty before a storm event. This alternative assumes that Upper Guadalupe River remains in current restricted capacity and no flood improvements will be made in the future that would increase the capacity of the river. Adding additional 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 one percent design flows are the same as Alternative H.1a:

Because the reduced 1% flood flow is still higher than the channel's capacity, levees would 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 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 feet wide with side slopes of 2:1 (horizontal: vertical). Headwalls would need to be constructed or re-constructed at two bridges. The improvements needed for this alternative are summarized by reach below:

Lenihan Dam at Lexington Reservoir:

Same as Alternative H.1a

Other Identified Conflicts:

Same as Alternative H.1a

Reach A (I-880 to Hwy 101):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Levees	1.4	210	West Bank
	0.1	200	East Bank

Bridge Improvements

Same as Alternative H.1a

Reach B (Hwy 101 to Trimble Rd):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Levees	0.3	200	West Bank
	-	-	East Bank

Bridge Improvements

Same as Alternative H.1a

Potential Utility Conflicts

Same as Alternative H.1a

Other Identified Conflicts

Same as Alternative C

Reach C (Trimble Rd to Montague Expwy):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Levees	1.0	5790	West Bank
	0.7	5900	East Bank

Bridge Improvements

Same as Alternative H.1a

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Same as Alternative C

Reach D (Montague Expwy to SFPUC Pipeline):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Levees	1.0	5380	West Bank
	0.6	5380	East Bank

Bridge Improvements

Same as Alternative C

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Same as Alternative C

Bridge Improvements:

A pedestrian bridge crosses the river in this reach. It would either need to be raised and extended to fit the new channel width or relocated to a new location. The pedestrian bridge is subject to a Joint Use Agreement that requires the City of San José to remove or relocate the bridge if needed for flood protection purposes.

Reach E (SFPUC Pipeline to Tasman Dr):

Structural Features			
	Avg. Height (ft)	**Length (ft)**	**Location**
Levees	0.4	1670	West Bank
	0.4	890	East Bank

Bridge Improvements
Same as Alternative B

Potential Utility Conflicts
Same as Alternative B

Other Identified Conflicts
Same as Alternative C

Reach F (Tasman Dr to Hwy 237):

Structural Features			
	Avg. Height (ft)	**Length (ft)**	**Location**
Levees	0.6	100	West Bank
	-	-	East Bank

Bridge Improvements
Same as Alternative B

Potential Utility Conflicts
Same as Alternative H.1a

Reach G (Hwy 237 to Gold St):

Structural Features			
	Avg. Height (ft)	**Length (ft)**	**Location**
Levees	1.5	500	West Bank
	2.7	200	East Bank

Bridge Improvements
Same as Alternative B

Potential Utility Conflicts
Same as Alternative H.1a

Other Identified Conflicts
Same as Alternative H.1a

Technical Feasibility

Same as Alternative H.1a

Costs

Capital costs would be $51,700,000
Maintenance costs would be $450,000 annually
Any loss of water compared to normal operations would need to be reimbursed to the Water Utility Division

Strengths

- The existing public trails are preserved
- Levees minimize visual barriers
- Minimal additional maintenance is required
- Retaining walls may reduce pioneer trails from neighborhoods
- Only two bridges need headwall additions, as opposed to four in Alternatives B and C
- Bridge work on Highway 101 is avoided
- Potential for increased water supply in the reservoir if operating using Forecast-Informed Reservoir Operation (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
- This alternative relies on Upper Guadalupe River remaining in its current restricted capacity. If Upper Guadalupe River capacity is raised as currently planned, this alternative would not work
- 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

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

This alternative would replace the existing outlet pipe at Lenihan Dam with a larger outlet to allow the Lexington Reservoir to partially empty before a storm event. This alternative assumes that 25-year improvements to Upper Guadalupe River would be constructed in the future. Adding additional 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 either Lexington Reservoir or 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[13].The design flows for this alternative are listed in the Table below and are the same flows as Table 2 in the Design Criteria section.

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

Because the reduced 1% flood flow is still higher than the channel's capacity, floodwalls would be needed. Floodwalls are 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 improvements needed for this alternative are summarized by reach below:

Lenihan Dam at Lexington Reservoir:

Same as Alternative H.1a

Other Identified Conflicts:

Same as Alternative H.1a

Reach A (I-880 to Hwy 101):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	1.3	2540	West Bank
	1.1	1790	East Bank
Passive Barrier	2.5	varies	Maintenance road entry/exits

Bridge Improvements

	Height (ft)	Exist. Height (ft)	Location
Headwall	2.5	0	Airport Parkway Bridge
	4.5	3	Highway 101 Bridge U/S
	4.5	3	Highway 101 Bridge D/S
	3.5	3	Highway 101 On-Ramp Bridge U/S
	3.5	3	Highway 101 On-Ramp Bridge D/S

Potential Utility Conflicts

Same as Alternative B

[13] 2021. Design Flows for Alternatives. Jack Xu. Technical Memorandum.

Reach B (Hwy 101 to Trimble Rd):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	2.5	2540	West Bank
	2.1	2650	East Bank
Passive Barrier	4	varies	Maintenance road entry/exits

Bridge Improvements

	Height (ft)	Exist. Height (ft)	Location
Headwall	7.5	3	Trimble Road Bridge

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Same as Alternative B

Reach C (Trimble Rd to Montague Expwy):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	3.9	6100	West Bank
	3.6	6100	East Bank
Passive Barrier	8.75	varies	Maintenance road entry/exits

Bridge Improvements

	Height (ft)	Exist. Height (ft)	Location
Headwall	8.75	4	Montague Expressway

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Same as Alternative B

Bridge Improvements:

Like Alternatives B & C, under Alternative H.1c, the Montague Expressway Bridge may require extensive modifications to accommodate the headwall addition. The potential retrofits include:

- Retrofit deck with additional bar reinforcing steel matt layer and additional deck thickness
- Retrofit wingwalls
- Extend bent caps, pier wall, and abutment
- Add pile caps below pier wall extensions
- Add class 200 pile at each pile cap to resist uplift
- Add class 200 piles at each abutment extension to resist uplift

- Install vertical restrainers at all pier bent caps
- Install below deck drainage system to prevent backflow
- Relocate existing lighting conduits and luminaires
- Replace existing expansion Joints
- Extend the existing 66" RCP on the southwest corner of the bridge
- Relocate existing flow gage at southeast corner of the bridge

Reach D (Montague Expwy to SFPUC Pipeline):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	3.4	5540	West Bank
	3.0	5540	East Bank
Passive Barrier	varies	varies	Ramps near Pedestrian Bridge

Bridge Improvements

	Height (ft)	Exist. Height (ft)	Location
None	-	-	Pedestrian Bridge

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Same as Alternative B

Bridge Improvements:

A pedestrian bridge crosses the river in this reach. There are no proposed changes to the bridge in this alternative. Floodwalls would enclose the outboard side of the levees, and the bridge could overtop. This would temporarily impact access to the bridge.

Reach E (SFPUC Pipeline to Tasman Dr):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	2.1	2670	West Bank
	1.8	2460	East Bank

Bridge Improvements

Same as Alternative B

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Same as Alternative B

Reach F (Tasman Dr to Hwy 237):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	0.3	2280	West Bank
	0.3	2480	East Bank

Bridge Improvements

Same as Alternative B

Potential Utility Conflicts

Same as Alternative B

Reach G (Hwy 237 to Gold St):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Floodwall	1.1	1360	West Bank
	0.7	1460	East Bank

Bridge Improvements

Same as Alternative B

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Same as Alternative B

Technical Feasibility

Same as Alternative H.1a

Costs

Capital costs would be $76,800,000
Maintenance costs would be $450,000 annually
Any loss of water compared to normal operations would need to be reimbursed to the Water Utility Division

Strengths

- The existing public trails are preserved
- Potential for increased water supply in the reservoir if operating using Forecast-Informed Reservoir Operation (FIRO)
- Capital cost is lower than Project budget of $80 million
- Floodwall heights and extents are slightly reduced compared to Alternatives B and C

Weaknesses

- Coordination and permitting would be 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 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 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. Highway 101 bridge modifications may trigger Caltrans to request additional retrofits
- Reduced maintenance access to dam outlet tunnel due to larger pipe

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

This alternative would replace the existing outlet pipe at Lenihan Dam with a larger outlet to allow the Lexington Reservoir to partially empty before a storm event. This alternative assumes that 25-year improvements to Upper Guadalupe River would be constructed in the future. Adding additional 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 one percent design flows are the same as Alternative H.1c

Because the reduced 1% flood flow is still higher than the channel's capacity, levees would 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 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 feet wide with side slopes of 2:1 (horizontal: vertical). Headwalls would need to be constructed or re-constructed at four bridges. The improvements needed for this alternative are summarized by reach below:

Lenihan Dam at Lexington Reservoir:

Same as Alternative H.1a

Other Identified Conflicts:

Same as Alternative H.1a

Reach A (I-880 to Hwy 101):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Levees	1.3	2540	West Bank
	1.1	1790	East Bank

Bridge Improvements

Same as Alternative H.1c

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Same as Alternative C

Reach B (Hwy 101 to Trimble Rd):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Levees	2.5	3540	West Bank
	2.1	2650	East Bank

Bridge Improvements

Same as Alternative H.1a

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Same as Alternative C

Reach C (Trimble Rd to Montague Expwy):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Levees	3.9	6100	West Bank
	3.6	6100	East Bank

Bridge Improvements

Same as Alternative H.1c

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Same as Alternative C

Reach D (Montague Expwy to SFPUC Pipeline):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Levees	3.4	5540	West Bank
	3.0	5540	East Bank

Bridge Improvements

Same as Alternative C

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Same as Alternative C

Bridge Improvements:

A pedestrian bridge crosses the river in this reach. It would either need to be raised and extended to fit the new channel width or relocated to a new location. The pedestrian bridge is subject to a Joint Use Agreement that requires the City of San José to remove or relocate the bridge if needed for flood protection purposes.

Reach E (SFPUC Pipeline to Tasman Dr):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Levees	2.1	2760	West Bank
	1.8	2460	East Bank

Bridge Improvements

Same as Alternative B

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Same as Alternative C

Reach F (Tasman Dr to Hwy 237):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Levees	0.3	2280	West Bank
	0.3	2480	East Bank

Bridge Improvements

Same as Alternative B

Potential Utility Conflicts

Same as Alternative C

Reach G (Hwy 237 to Gold St):

Structural Features

	Avg. Height (ft)	Length (ft)	Location
Levees	1.1	1360	West Bank
	0.7	1460	East Bank

Bridge Improvements

Same as Alternative B

Potential Utility Conflicts

Same as Alternative B

Other Identified Conflicts

Same as Alternative C

Technical Feasibility

Same As Alternative H.1a

Costs

Capital costs would be $94,300,000
Maintenance costs would be $450,000 annually

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 Forecast-Informed Reservoir Operation (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 is raised to 100-year as currently planned, this alternative would not work.
- 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. Highway 101 bridge modifications may trigger Caltrans to request additional retrofits
- Reduced maintenance access to dam outlet tunnel due to larger pipe

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

This alternative would operate Lexington Reservoir to increase the amount of storage available before a large storm using the existing outlet. This alternative would modify Lexington Reservoir operations 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 either Lexington Reservoir or Guadalupe, Almaden, and Calero Reservoirs. Several combinations of storm centerings 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[14].The design flows for this alternative are listed in the Table below and are the same flows as Table 2 in the Design Criteria section.

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

Because the reduced 1% flood flow is still higher than the channel's capacity, floodwalls would be needed. Floodwalls are 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 improvements needed for this alternative are summarized by reach below:

Lenihan Dam at Lexington Reservoir

The specifics of Lexington Reservoir are identical to the H alternatives, but use 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.

Reach A (I-880 to Hwy 101):

Structural Features
Same as Alternative H.1a

Other Identified Conflicts	
Location	**Conflict**
Highway 101	Wingwalls may need additional height

Reach B (Hwy 101 to Trimble Rd):

Same as Alternative H.1a

[14] 2021. Design Flows for Alternatives. Jack Xu. Technical Memorandum.

Reach C (Trimble Rd to Montague Expwy):

Same as Alternative H.1a

Reach D (Montague Expwy to SFPUC Pipeline):

Same as Alternative H.1a

Reach E (SFPUC Pipeline to Tasman Dr):

Same as Alternative H.1a

Reach F (Tasman Dr to Hwy 237):

Same as Alternative H.1a

Reach G (Hwy 237 to Gold St):

Same as Alternative H.1a

Technical Feasibility

Re-operating Lexington Reservoir requires drawdown of the reservoir before a storm event. Using the existing outlet would maintain the current drawdown rate (around 450 cfs). Valley Water's current reservoir operations do not consider landslide risk as a concern that would affect outlet release. However, the presence of landslides on the reservoir's southwest side is well documented. These landslides appear to present the highest risk to properties and infrastructure such as Alma Fire Station, Lexington Elementary School, Aldercroft Creek Bridge, and State Route 17. It is difficult to quantify the increased risk of landslides if the reservoir was drained more frequently, compared with current operations, to create storage for large storms.

There is also the complicated issue of changes to water supply based on this operation plan. It is difficult to quantify how water supply in the reservoir would change. If the reservoir is operated on a strict rule curve of 12,000 ac-ft, the average water utility reimbursement costs would be $2.5 million annually[15]. If the reservoir were operated using a forecast informed approach (FIRO), it is possible that this loss would be less severe. Based on a recent study of FIRO in another California reservoir, it seems possible that FIRO could even achieve a greater amount of water stored in the reservoir at the end of a rainy season[16]. These results would likely be tempered by the long time it takes to drain the reservoir with its current outlet capacity (8 days). This will need to be further studied to demonstrate how Lexington Reservoir would benefit from FIRO, as well as how climate change and weather extremes would affect flood risk reduction and water supply.

Costs

Capital costs would be $15,100,000
Maintenance costs would be $450,000 annually
Any loss of water compared to normal operations would need to be reimbursed to the Water Utility Division

Strengths

- The existing public trails are preserved
- Floodwall heights are reduced
- Only two bridges need headwall additions, as opposed to four in Alternatives B and C
- Bridge work on Highway 101 is avoided

[15] Santa Clara Valley Water District. (2020). Lexington Reservoir Operations Analysis. Technical Memo.
[16] Forecast Informed Reservoir Operations Steering Committee. (2017). Preliminary Viability Assessment of Lake Mendocino.

- Comparatively lower capital cost, and within provided budget of $80 million
- Potential for increased water supply in the reservoir if operating using Forecast-Informed Reservoir Operation (FIRO)

Weaknesses

- Coordination and permitting with City of San José and Santa Clara County would be required 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 rate 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)

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

This alternative would operate 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 one percent design flows are the same as Alternative J.a

Because the reduced 1% flood flow is still higher than the channel's capacity, 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 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 feet wide with side slopes of 2:1 (horizontal: vertical). Headwalls would need to be constructed or re-constructed at two bridges. The improvements needed for this alternative are summarized by reach below:

Lenihan Dam at Lexington Reservoir

Same as Alternative J.a

Reach A (I-880 to Hwy 101):

Same as Alternative H.1b

Reach B (Hwy 101 to Trimble Rd):

Same as Alternative H.1b

Reach C (Trimble Rd to Montague Expwy):

Same as Alternative H.1b

Reach D (Montague Expwy to SFPUC Pipeline):

Same as Alternative H.1b

Reach E (SFPUC Pipeline to Tasman Dr):

Same as Alternative H.1b

Reach F (Tasman Dr to Hwy 237):

Same as Alternative H.1b

Reach G (Hwy 237 to Gold St):

Same as Alternative H.1b

Technical Feasibility

Same as Alternative J.a

Costs

Capital costs would be $22,000,000
Maintenance costs would be $450,000 annually
Any loss of water compared to normal operations would need to be reimbursed to the Water Utility Division

Strengths

- The existing public trails are preserved
- Levees minimize visual barriers
- Only two bridges need headwall additions, as opposed to four in Alternatives B, C, H.1c, and H.1d
- Bridge work on Highway 101 is avoided
- Comparatively lower capital cost, and within provided budget of $80 million
- Potential to mitigate, at least in part, water supply/recharge losses if operating reservoir using Forecast-Informed Reservoir Operation (FIRO)

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 rate 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)

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. Further explanation of this alternative's technical feasibility is provided in the Technical Feasibility section of Alterative D.2 above.

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[17]." The CEO's policy interpretation together with the Board's Ends Policy goals were used to develop specific objectives which are the basis for the NFP alternative evaluation framework[18].

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

Table 4: 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

[17] Santa Clara Valley Water District. (2021). Governance Policies of the Board, Ends. Last Revised July 22, 2013.

[18] Santa Clara Valley Water District. (2014). QEMS work instruction WW75125 – Guidance on Alternative Evaluation and Selection for Natural Flood Protection Projects.

NFP Objectives	Objective Weight	Justification for Objective Weight	NFP Criteria	Default Criteria Weight
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
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
Objective 9. 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	
			9.2 Maintenance Cost	
			9.3 Grant or Cost-Sharing opportunities	
Objective 10. 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 or Central Coast Basin Plan	0.5
			10.2 Identify the Least Environmentally Damaging Practicable Alternative (LEDPA)	0.5

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 5. 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 6 shows the summary scores for all the alternatives. Completed NFP rating sheets are included in Appendix B.

Table 5: NFP Criteria Rating

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

Table 6: 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:

- Alternative C – Levees with Retaining Walls and Headwalls
- Alternative C.1 – Levees, Floodwalls and Headwalls
- Alternative H.1a – Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Floodwalls (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 is helpful to break down the results by objective. Table 7 through Table 10 tabulates the number of times each alternative received the highest score for each objective.

Table 7: 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 are five objectives with a "high" objective weight (Objectives 1, 3, 5, 9, and 10). Objectives H.1b and J.b both had the most high-scores per high-weighted objective with a total of 4.

Table 8: 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 are two objectives with a "medium" objective weight (Objectives 6 and 8). Objectives H.1a, H.1b, and J.b had the most high-scores per medium-weighted objective with a total of 2.

Table 9: 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 are three objectives with a "low" objective weight (Objectives 2, 4, and 7). Objectives B, B.2, C, and C.1 had the most high-scores per low-weighted objective with a total of 3.

Table 10: 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. H.1a and J.b are in second place with a total of 7 high scores. The highest scoring non-reservoir alternative is Alternative C, with a total of 6 high scores.

Staff-Recommended Alternative

Based on the results of the analysis, Alternative H.1b: *Add Outlet Capacity to Lenihan Dam in Existing Tunnel and Levees (No Upper Guadalupe Improvements)* emerges as the best choice. However, there are multiple complicating factors that could alter the NFP analysis findings and staff recommendation for this alternative.

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

The Upper Guadalupe River Project (UGRP) could drastically change how much flow will reach the Lower Guadalupe River during high flow events. Alternative H.1b assumes no improvements to the UGRP reaches. Although this reflects the current condition of the Upper Guadalupe River, it is unlikely that this will be the future condition: the UGRP is currently undergoing a general re-evaluation study by USACE, with an expected project recommendation by Fall 2022. Increases in flow to the Lower Guadalupe River from improvements in the UGRP reaches may 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 of 4 feet per day or 600 cfs (800 cfs adjusting for 200 cfs baseflow), which is a higher rate than normal operations (450 cfs). There are several large historical landslides adjacent to Lexington Reservoir that could be triggered by drawdown rates this high. These landslides are in areas that would affect existing residents and infrastructure if they were activated.

Because of these factors, it seems unwise to choose H.1b, or any H alternative that would upgrade Lenihan Dam's outlet structure only for these changes to be made ineffective by the UGRP, or to trigger landslides that would severely disrupt the Lexington Reservoir area.

Alternative J.b: Re-Operate Lenihan Dam and Construct Levees is the next highest-scoring alternative. Because of the lower water surface elevation, this alternative would minimize visual barriers to the creek, which is important to the community and to public agencies. Only two bridges would need headwall additions to

accommodate 4 ft of freeboard (Montague Expwy and Trimble Rd). The Capital cost is also the lowest of all the alternatives ($22 million). Concerns with this alternative are that it shifts the perception of risk to our reservoir operations as opposed to our structural improvements (higher levees and headwalls). Also, because this is a reservoir reoperation alternative, it is still at risk of being made ineffective if UGRP improvements are ever made. The risk of landslides, however, may be less since the outlet cannot lower the reservoir as quickly as is proposed in the H alternatives. It is also difficult to quantify how this operation will change the water supply in the reservoir at the end of the rainy season. Early estimates of Forecast Informed Reservoir Operations (FIRO) appear to indicate that it will increase the amount of water stored in the reservoir, when compared to strict rule-curve operation. Valley Water is currently conducting a Viability Assessment of FIRO operation at Lexington Reservoir, with expected results by Fall 2022[19].

Alternative C: Levees with Retaining Walls and Headwalls is the next highest-scoring alternative that does not rely on reservoir operations to reduce the peak flow. It would be able to carry the full one percent design flow capacity coming from the DGRP (17,000 cfs) and would be able to accommodate the future one percent flood improvements to the UGRP if they are ever constructed. If UGRP decides to construct a lower level of service than the 100-year previously promised (25 or 50 year seems more likely), then the one percent flows that reach the Lower Guadalupe River will decrease (25-year improvements to UGRP would only allow 15,000 to reach LGRP). In these scenarios, Alternative C would be overdesigned, although only be a few thousand cfs. Concerns with this alternative include the necessity for four bridge modifications, including significant modifications to Highway 101 and Montague Expressway. The higher levees and headwalls at bridges are not desired by the community and public agencies due to aesthetic and safety concerns. Retaining walls and headwalls create more surfaces that will attract graffiti, and can create access issues for maintenance. The estimated Capital cost for construction is $102 million, which is above the amount budgeted for this project.

Final Recommendation

For these reasons, the project team recommends 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 Upper Guadalupe River Project decision making process is complete. If then necessary,

Phase 2: Construct Alternative C: *Levees with Retaining Walls and Headwalls* with levee and floodwall heights designed once the flows reaching the Lower Guadalupe River are better understood.

The interim project, Alternative J.b, is estimated to cost $22 million, which is well within the budget of $80 million. The project will provide interim 100-year flood protection to the Lower Guadalupe River area and fulfill the other project objectives: maintaining and/or enhancing ecological conditions, minimizing the need for future operations and maintenance activities, maintaining and/or enhancing public recreation and access, and obtaining community support.

Alternative C is the best alternative if Lexington Reservoir is no longer effective at reducing peak flows. The USACE General Re-evaluation study of the Upper Guadalupe River Project is expected to identify a Tentatively Selected Plan by Fall 2022. The USACE team is aware of the connection to the Lower Guadalupe River, but they are not basing their decision on this connection.

[19] Personal Communication. Liang Xu. January 2022.

Based on the thorough research and analysis performed for the Guadalupe River – Tasman Drive to Interstate 880 Project, the Planning Team is confident that this two-phase approach is the best solution for the Lower Guadalupe River.

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Appendix I
Staff Recommended Alternative Report—Technical Memorandum

Technical Memorandum
Guadalupe River – Tasman Drive to Interstate 880 Staff Recommended Alternative Report

Prepared By: *Katie Muller, P.E.*
Date: 9/06/23

The Guadalupe River – Tasman Drive to Interstate 880 Project (Project) has completed the Feasible Alternatives portion of Valley Water's Capital Planning Phase. Since the completion of the feasible alternatives analysis, there have been several new pieces of information that changed the Project's recommendations. Based on this new information, four feasible alternatives were refined and evaluated to select the Staff-Recommended Alternative.

Purpose:

The purpose of this technical memorandum is to present the Staff-Recommended Alternative from the Planning Phase of the Project.

Conclusion:

The recommendations for the Guadalupe River Tasman Drive to Interstate 880 Project are:

- Transition Alternative C.a (lower 1% flow – 14,160 cfs) to Design Phase - $90 Million
- Continue to study modifying reservoir operations for flood risk reduction, including Forecast-Informed Reservoir Operations (FIRO), at Lexington and Almaden Reservoirs, as well as Guadalupe Ponds.

The recommendations presented in this memorandum are intended for review by District staff and comment before proceeding with design.

Introduction

Background

The Lower Guadalupe River Project (LGRP) was completed in 2004 with the objective to provide one percent flood flow Level of Service (LOS) for all river reaches downstream of Interstate 880. High water marks collected during storms in 2014, 2017, and 2019 indicated that the channel is not carrying the flows as designed. Detailed studies by Valley Water and consultant experts using updated and calibrated channel roughness values in HEC-RAS models show that the Lower Guadalupe River is unable to convey the design one-percent flood. The primary reason for this reduction in capacity compared to the design LOS is that there has been far more extensive vegetation growth in the channel than originally anticipated. The purpose of the Guadalupe River Tasman to Interstate 880 Project (Project) is to restore the one percent annual chance exceedance flood LOS to the Lower Guadalupe River.

Over the past four years, the problem has been fully investigated and alternatives to restore the flood protection LOS have been developed. Staff evaluated the Project's feasible alternatives with Valley Water's Natural Flood Protection (NFP) evaluation framework, which is meant to identify the most suitable alternative that will meet state and federal regulatory requirements. The Project's Feasible Alternatives Report documented the NFP process and made the recommendation for a two-phase project (Valley Water, 2022). The interim project, Alternative J.b – *Modify Lexington Reservoir Operations and Construct Levees (No Upper Guadalupe Improvements)*, was to be designed until the Upper Guadalupe River General Reevaluation Study with the U.S. Army Corps of Engineers (USACE) was completed. Then, once the design flows from Upper Guadalupe were better understood, Alternative C – *Levees with Retaining Walls and Headwalls*, would be constructed if necessary.

Evaluation of Issue

There have been several changes since the Feasible Alternatives Report's recommendation:

1. The Guadalupe River - Upper, Interstate 280 to Blossom Hill Road Project (UGRP) in partnership with the US Army Corps of Engineers has arrived at a Tentatively Selected Plan (TSP) (USACE, 2022). Flows coming from the Upper Guadalupe Project are now estimated to be a 2% annual chance of exceedance flow (50-year).
2. Post-pandemic constructions 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 which redefined the 1% flow to 14,160 cfs for the Guadalupe River at Highway 237 (Wood Rogers, 2023). This updated hydrology accounts for the Upper Guadalupe Project flows mentioned above.

As a result of these changes:

- Alt J.b is no longer possible to achieve with modifications to Lexington Reservoir operations alone. This is due to the UGRP's increased flow capacity. To account for this increased flow, flow modifications to the Upper Guadalupe River subwatershed are needed, which requires additional analysis (Xu & Baral, 2022).
- Alternative C cost estimates have increased to $237 million, which is no longer close to the desired Project budget of $80 million.

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

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

This alternative would raise the existing levees to provide additional capacity for the original LGRP design flow. 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 feet wide with side slopes of 2:1 (horizontal: vertical). Concrete headwalls will need to be raised or replaced at four bridges. The improvements needed for this alternative are summarized by reach below:

Table 1: Design Flows for Alternative C

Location Along Guadalupe River	1% Design Flows (cfs)
D/S of Los Gatos Creek confluence	16,000
Interstate 880	17,000
Highway 101	17,300
Trimble Road	17,500
Montague Expressway	17,900
Tasman Drive	18,100
Highway 237	18,325
Gold Street	18,325

Table 2: Bridge Headwall Heights for Alternative C

Bridge Location	Existing Headwall Height (ft)	Additional Headwall Needed (ft)	Total Headwall Height (ft)
Airport Parkway	0	4.5	4.5
Hwy 101 North	3	5	8
Hwy 101 South	3	4	7
Hwy 101 North On-Ramp	3	3.25	6.25
Trimble Road	3	4.75	7.75
Montague Expressway	4	6.5	10.5

Table 3: Levee Length and Height by Reach for Alternative C

	Total Levee Length (ft)	Average Levee Height (ft)
Reach A	7200	2.4
Reach B	5200	4.4

	Total Levee Length (ft)	Average Levee Height (ft)
Reach C	12200	5.7
Reach D	11100	4.8
Reach E	5400	3.2
Reach F	7400	1.0
Reach G	1800	1.3

Costs:
Capital costs would be $237,000,000.

Benefits:
- This alternative can be transitioned to Design Phase now.
- The original LGRP design LOS is provided structurally.

Disadvantages:
- Capital Cost is significantly above the $80 million budget limit.
- Significant bridge improvements are needed at four bridge crossings including Montague Expressway and Hwy 101. Coordination and permitting with Caltrans, City of San José, Santa Clara County may impact design and construction timeline.
- In feasibility meetings with bridge owners, high headwalls were not viewed favorably, due to visibility and public safety concerns.

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

This alternative would raise the existing levees to provide capacity for the updated 2023 hydrology flows (Wood Rogers, 2023). 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 feet wide with side slopes of 2:1 (horizontal: vertical). Concrete headwalls will need to be raised or replaced at four bridges. The improvements needed for this alternative are summarized by reach below:

Table 4: 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
Highway 101	13,986
Trimble Road	13,986
Montague Expressway	13,930
Tasman Drive	14,004
Highway 237	14,160
Gold Street	14,160

Table 5: Bridge Headwall Heights for Alternative C.a

Bridge Location	Existing Headwall Height (ft)	Additional Headwall Needed (ft)	Total Headwall Height (ft)
Airport Parkway	0	0.5	0.5
Hwy 101 North	3	0.75	3.75
Trimble Road	3	1.25	4.25
Montague Expressway	4	3.25	7.25

Table 6: Levee Length and Height by Reach for Alternative C.a

	Total Levee Length (ft)	Average Levee Height (ft)
Reach A	200	0.1
Reach B	5000	1.1
Reach C	12200	2.4
Reach D	11100	2.1
Reach E	4600	1.2
Reach F	400	0.8
Reach G	700	2.8

Costs:
Capital costs would be $88,000,000.

Benefits:
- Capital cost is close to $80 million budget.
- This alternative can be transitioned to Design Phase now.
- This alternative avoids major bridge impacts at Highway 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.

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

This alternative would modify operations at Lexington Reservoir to increase the amount of storage available in the reservoir before a large storm event. Alternative J.c uses the existing Lexington outlet system to release water prior to a large storm, thus increasing the volume available in the reservoir to store the 1% peak flow. Forecast-Informed Reservoir Operation (FIRO) is also being considered to maximize the amount of peak flow storage that can be achieved, while also benefitting the water supply in the reservoir at the end of the water year.

Because the Lower Guadalupe 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 Tentatively Selected Plan (TSP) proposes constructing flood risk reduction improvements to the Guadalupe River between Interstate 280 and Blossom Hill Road at variable levels of percent chance of exceedance. 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 one percent flood risk reduction from the UGRP). The hydromodification flows used in Alternative J.c assume 2% flood flow (50-year) improvements to UGRP will be constructed (Xu & Baral, 2022).

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 subwatershed 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 H&H unit concluded that these additional elements are conceptually feasible, but additional analysis is needed to refine these elements (Xu & Baral, 2022). This analysis is still in progress and is not expected to be complete until the end of 2023. Using the preliminary flows from UGRP in combination with FIRO, the following 1% flow distribution is assumed for this alternative:

Table 7: 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
Highway 101	13,000
Trimble Road	13,000
Montague Expressway	13,200
Tasman Drive	13,200
Highway 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 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 feet 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 8: 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 9: 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) 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 will 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 $80 million budget.
- This alternative avoids major bridge impacts at Highway 101, Airport Parkway and Trimble Road.
- Less visual impacts at bridge crossings.

Disadvantages:

- Technical and policy concerns will 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.

Alternative L – Vegetation Removal

Due to the high cost and complex nature of the other alternatives considered, the Planning Team is 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. This scenario 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 that would likely need to be repeated in the future as vegetation would continue to grow. Estimated cost for vegetation removal, mitigation and monitoring is $62 million. Real estate acquisition of land required for mitigation could add another $750 million (Valley Water, 2018). 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.

Disadvantages:
- Cost of property acquisition is significantly higher than $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.

Conclusion

Based on the comparison of the alternatives above, Valley Water Staff recommends a two-part Project:
1. Transition Alternative C.a (lower 1% flow – 14,160 cfs) to Design Phase - $90 Million
2. Continue to study reservoir operations for flood risk reduction (FIRO) in Lexington and Almaden Reservoirs, as well as Guadalupe Ponds.

With this recommendation, Valley Water staff can begin design more quickly on 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 even all of Valley Water.

Works Cited

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