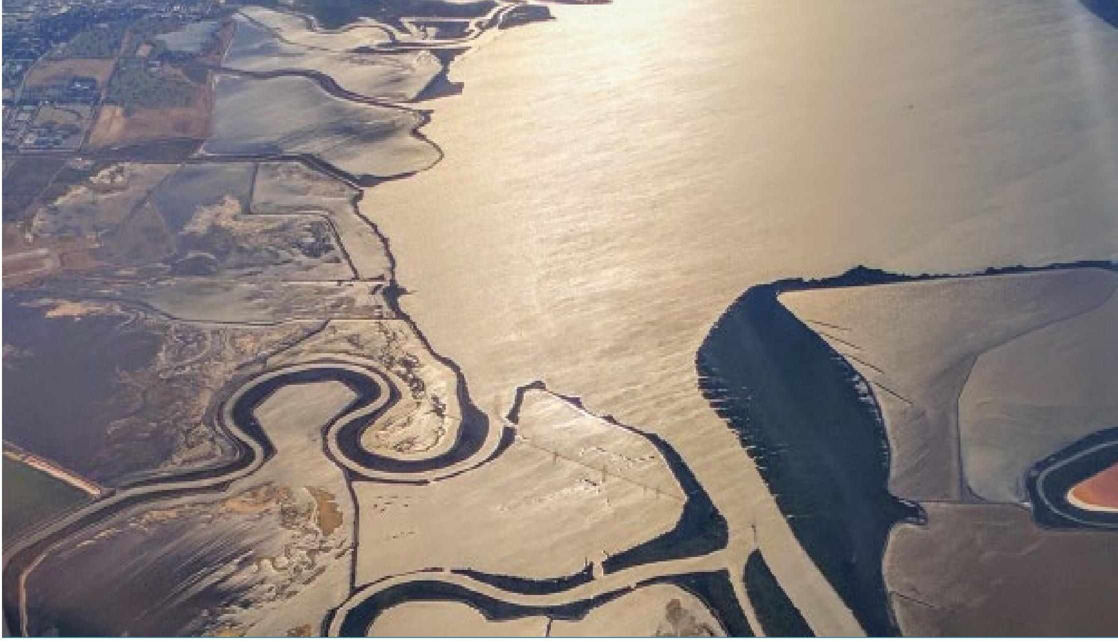

Calabazas/ San Tomas Aquino Creek-Marsh Connection Project

FINAL ◦ FEBRUARY 2025

FEASIBLE ALTERNATIVES REPORT

PREPARED FOR

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Cover photo: Aerial view Alviso and Guadalupe sloughs entering the San Francisco Bay, San José, California (Dick Lyons 2017)

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Appendix

ACRONYMS, ABBREVIATIONS AND COMMON TERMS

Acronym / Abbreviation / Term*	Definition
µm	micron
AA	Assessment Area (for California Rapid Assessment Method documents only)
A8 Ponds	interconnected Ponds A5, A7, A8N, A8S, owned and managed by the U.S. Fish and Wildlife Service
ADCP	acoustic doppler current profiler
ALERT	Automated Local Evaluation in Real Time
ALSL	Alviso Slough
AMP	Adaptive Management Plan
APE	Area of Potential Effects
ASCII	American Standard Code for Information Interchange
ASV	Automatous Surface Vessel
AWOIS	Automated Wreck and Obstruction Information System
BA	Biological Assessment
BACI	Before After Control Impact
backwater habitat	side channels that provide slack water aquatic habitat and dead-end and off-channel habitat used by aquatic organisms
BAF	Bioaccumulation Factors
Bay Trail	San Francisco Bay Trail
BCDC	San Francisco Bay Conservation and Development Commission
berm	constructed feature to control flow of water
berm degrade	removal of a segment of pond berm to a particular elevation to allow greater water flow
berm removal	complete excavation of a portion of an existing pond berm down to natural channel bed or pond bottom elevation
BGEPA	Bald and Golden Eagle Protection Act
BMP	best management practice

Acronym / Abbreviation / Term*	Definition
BO	Biological Opinion
Board	Valley Water Board of Directors
BOEM	Bureau of Ocean Energy Management
BPAC	Bicycle and Pedestrian Advisory Commission
BRE	Biological Resources Evaluation
breach	removal of section of berm or levee to allow water flow
ºC	degrees Celsius
CAD	Computer-aided Design and Drafting
CAL FIRE	California Department of Forestry and Fire Prevention
Caltrans	California Department of Transportation
CARB	California Air Resources Board
CCC	Central California Coast
CCMA	Climate Change Mitigation and Adaptation
CCR	California Code of Regulation
CDFW	California Department of Fish and Wildlife
CDPH	California Department of Public Health
CDPR	California Department of Pesticide Regulation
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFGC	California Fish and Game Code
CFR	Code of Federal Regulations
cfs	cubic feet per second
CGS	California Geological Survey
CHRIS	California Historical Resources Information System
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
coastal flood scenario	hydraulic modeling scenario to be used for evaluating extreme high tide events with a likelihood of occurring once in a 100-year period
CRAM	California Rapid Assessment Method

Acronym / Abbreviation / Term*	**Definition**
creek re-alignment / re-route	changing the existing course of a waterway
CRHR	California Register of Historical Resources
CRPR	California Rare Plant Rank
CSCC	California State Coastal Conservancy
CSLC	California State Lands Commission
CSM	Conceptual Site Model
culvert	subterranean structure that channels water past an obstacle such as a berm or road; typically embedded and surrounded by soil; may be made from a pipe, reinforced concrete, or other material
CWA	Clean Water Act
CWMW	California Wetlands Monitoring Workgroup
DEM	digital elevation model
ditch block	placement of material within an active waterway to block natural flow
DO	dissolved oxygen
DOC	dissolved organic carbon
DPM	Deputy Project Manager
DPR	Department of Parks and Recreation
DPS	distinct population segment
DTSC	Department of Toxic Substances Control
EC	electrical conductivity
ecotone	a gradually sloping surface transitioning from tidal aquatic to upland habitats
EFH	Essential Fish Habitat
EIA	economic impact area
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act

Acronym / Abbreviation / Term*	Definition
ESU	Evolutionarily Significant Unit
°F	degrees Fahrenheit
FAC	Facultative
FACW	Facultative Wetland
FEMA	Federal Emergency Management Agency
FESA	Federal Endangered Species Act
FGC	Fish and Game Code
FHWA	Federal Highway Administration
f.MeHg	filtered methylmercury in water, passed through a 0.45-μm filter
Monitoring Work Plan	Final Monitoring Work Plan, Calabazas and San Tomas Aquino Creeks Marsh Connection Project
flashboard	removable boards to adjust height of dam or overflow weir
flood protection element	constructed or natural berm, levee, wall, or other structure used to prevent flooding
fluvial flood scenario	hydraulic modeling scenario assuming riverine discharges of variable return periods between 10 and 100 years
fps	foot or feet per second
FR	Federal Register
f.TotHg	filtered total mercury in water, passed through a 0.45-μm filter
freeboard	difference between crest elevation of flood protection structure and level of service water level
FRM	flood risk management
GHG	greenhouse gas
GIS	Geographic Information System
GPS	Global Positioning System
Guadalupe River flood scenario	hydraulic modeling scenario to be used for evaluating flood risk to the lower Guadalupe River project with a likelihood of occurring once in a 100-year period

Acronym / Abbreviation / Term*	Definition
GUSL	Guadalupe Slough
habitat islands	natural or human-made topographic features with sediment surfaces at high intertidal and upland elevations
HEC-RAS	Hydrologic Engineering Center River Analysis System
horizontal levee	a sloped subsurface treatment wetland built between uplands and tidal marshes used to provide a treatment zone for reclaimed wastewater and a habitat transition zone that would migrate landward under projected sea level rise (similar in function to an ecotone slope)
HSC	Health and Safety Code
HTL	high tide line
HU	hydrogeologic unit
HUC	Hydrologic Unit Code
HWY	highway
IPCC	Intergovernmental Panel on Climate Change
L	liter
LEDPA	Least Environmentally Damaging Practicable Alternative
levee	engineered earthen feature designed to control flow of water between rivers, ponds, and sloughs and adjacent lands
LiDAR	Light Detection and Ranging
MBTA	Migratory Bird Treaty Act
MCL	maximum contaminant level
MCV	Manual of California Vegetation
MDL	method detection limit
MeHg	methylmercury
MHW	mean high water
MHHW	mean higher high water
mL	milliliter

Acronym / Abbreviation / Term*	Definition
MLW	mean low water
MLLW	mean lower low water
mm	millimeter
mph	miles per hour
MQO	measurement quality objective
MRP	Municipal Regional Stormwater Permit
mS/cm	millisiemen per centimeter
MSDS	material safety data sheets
MTL	mean tide level
NAHC	Native American Heritage Commission
NAVD88 datum	North American Vertical Datum of 1988
NEPA	National Environmental Policy Act
NETR	National Environmental Title Research, LLC
NFP	Natural Flood Protection
ng/L	nanogram per liter
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NMS	nutrient management strategy
NOAA	National Oceanic and Atmospheric Administration
NOP	Notice of Preparation
NPDES	National Pollution Discharge Elimination System
NPPA	Native Plant Protection Act
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NTU	Nephelometric Turbidity Units
NWIC	Northwest Information Center
NWR	National Wildlife Refuge
OHP	Office of Historic Preservation

Acronym / Abbreviation / Term*	Definition
OHWM	ordinary high-water mark
ORP	oxidation/reduction potential
OSHA	Occupational Safety and Health Administration
Pond A4	former salt production pond currently owned and operated by Valley Water
Porter-Cologne Act	Porter-Cologne Water Quality Control Act
PCB	polychlorinated biphenyl
PCE	primary constituent element
PDR	Problem Definition and Refined Objectives Report
PG&E	Pacific Gas and Electric Company
pH	potential of hydrogen, measure of acidity
pilot channel	subaqueous channel excavated within a water body to direct water flow
PM	Project Manager
PMT	Project Management Team
POST	Peninsula Open Space Trust
ppt	parts per thousand
PRC	Public Resources Code
Project	Calabazas/San Tomas Aquino Creek–Marsh Connection Project
PSR	Planning Study and Staff-Recommended Alternative Report
QA/QC	quality assurance and quality control
RCRA	Resource Conservation and Recovery Act
Regional Board	San Francisco Bay Area Regional Water Quality Control Board
RHA	Rivers and Harbors Act
Rincon	Rincon Consultants, Inc.
RM	river mile
RMP	Regional Monitoring Program

Acronym / Abbreviation / Term*	Definition
RV	recreational vehicle
RTK-GPS	Real Time Kinematics Global Positioning System
ROC	reverse osmosis concentrate
RPA	Registered Professional Archaeologist
RPD	Relative Percent Difference
RPW	Relatively Permanent Water
SBSPRP	South Bay Salt Pond Restoration Project
SCC	Santa Clara County
SCC Parks	Santa Clara County Department of Parks and Recreation
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SDWA	Safe Drinking Water Act
SEC	Sunnyvale East Channel
SET	Surface Elevation Tables
SF	San Francisco
SFBJV	San Francisco Bay Joint Venture
SFBRA	San Francisco Bay Restoration Authority
SFBWQIF	San Francisco Bay Water Quality Improvement Fund
SFEI	San Francisco Estuary Institute
SFEI–ASC	San Francisco Estuary Institute–Aquatic Science Center
Shoreline Project	South San Francisco Bay Shoreline Project
SHPO	State Historic Preservation Officer
SL	standard length
SLF	Sacred Lands File
SMaRT Station	Sunnyvale-Mountain View Recovery and Transfer Station
SMHM	Salt Marsh Harvest Mouse
SMP	Stream Maintenance Program

Acronym / Abbreviation / Term*	Definition
SOW	Scope of Work
SR	State Route
SSC	suspended sediment concentration
STA	San Tomas Aquino
State Water Board	State Water Resources Control Board
s.u.	standard unit
SWA	State Wildlife Area
SWC	Sunnyvale West Channel
SWP	State Water Project
SWP Wetlands	Sunnyvale Wetland Preserve
SWPPP	Stormwater Pollution Prevention Plan
TBD	to be determined
TDS	total dissolved solids
tide gate	engineered structure used to control water levels in tidally influenced water bodies
TMDL	Total Maximum Daily Load
TNW	traditional navigable water
TSCA	Toxic Substances Control Act of 1976
UPRR	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
UC Davis	University of California at Davis, Otolith Geochemistry & Fish Ecology Laboratory
uf.MeHg	unfiltered methylmercury in water
uf.TotHg	unfiltered total mercury in water
USC	United States Code
USCS	United Soil Classification System
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
Valley Water	Santa Clara Valley Water District

Acronym / Abbreviation / Term*	Definition
Vision Report	San Francisco Estuary Institute Landscape Visioning effort
VTA	Valley Transportation Agency
VWPM	Valley Water Project Manager
WARMER	Wetland Accretion Rate Model for Ecosystem Resilience
WBS	Work Breakdown Structure
WBWG	Western Bat Working Group
WCS	water control structure (see also *tide gate* above)
WDM	Watershed Dynamic Model
wetland benches	submerged natural or human-made features at shallow subtidal elevations to promote marsh vegetation establishment and sediment trapping
WPCP	Water Pollution Control Plant
WSEL	water surface elevation level

* This table is a comprehensive list of terms used in Calabazas/San Tomas Aquino Creek–Marsh Connection Project reports. Some of the terms do not occur in this report.

1 INTRODUCTION

1.1 Purpose and Organization of Report

This Feasible Alternatives Report has been prepared in accordance with Task 3.5 of Consultant Agreement A4649A between Santa Clara Valley Water District (Valley Water) and Stillwater Sciences for the Calabazas/San Tomas Aquino Creek–Marsh Connection Project (Project). The purpose of this report is to further develop alternatives advanced from the *Final Conceptual Alternatives Report* (Stillwater Sciences 2024) to a level of detail that allows an objective assessment and provides the basis for identifying the Staff-recommended Alternative. This report includes refinement of alternatives, preliminary design, and cost estimates under Task 3.1, followed by assessment using a comprehensive decision-making framework that considers results of hydrodynamic and sediment transport modeling, geospatial analysis, and engineering analyses.

As described further in Section 1.3, this report and overall Project development follows Valley Water's Planning Phase Work Breakdown Structure document VW W-730-124 Rev P. This report details processes described under Items 12E and 12F, the evaluation of Feasible Alternatives and related outreach efforts to stakeholders to date. The report is organized as follows:

Section 1: Introduction
Section 2: Alternatives Refinement
Section 3: Feasibility Analysis
Section 4: Summary of Findings and Next Steps
Section 5: References

1.2 Project Planning Area

The Project is located at the southern boundary of the San Francisco (SF) Bay and includes restoration actions within former evaporative salt ponds, the A8 Ponds (interconnected Ponds A5, A7, A8N, and A8S) and Pond A4; brackish marsh habitats within Harvey Marsh; tidal portions of five creeks/channels (Guadalupe River, San Tomas Aquino [STA] Creek, Calabazas Creek, Sunnyvale East Channel [SEC], and Sunnyvale West Channel [SWC]); and two sloughs (Alviso Slough and Guadalupe Slough) that flow into the ponds and/or SF Bay (Figure 1-1).

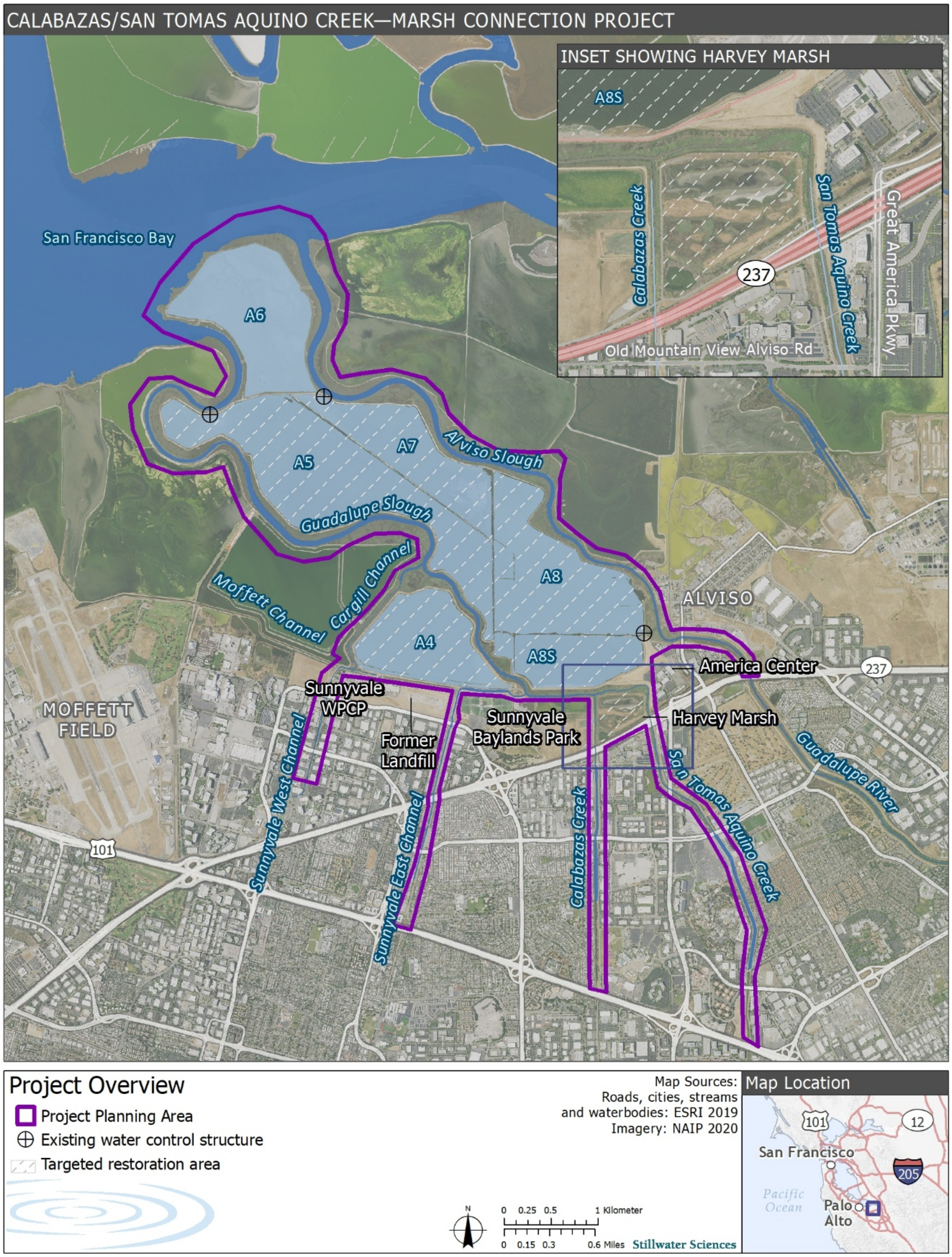


Figure 1-1. Calabazas/San Tomas Aquino Creek–Marsh Connection Project Planning Area.

The A8 Ponds are within the Don Edwards San Francisco Bay National Wildlife Refuge, owned and managed by the U.S. Fish and Wildlife Service (USFWS), and are part of the South Bay Salt Pond Restoration Project (SBSPRP), a collaborative partnership led by USFWS, California Department of Fish and Wildlife (CDFW), Valley Water, and the California Coastal Conservancy to restore tidal wetlands in SF Bay. Pond A4, located southwest of the A8 Ponds, is owned and managed by Valley Water. Valley Water constructed SEC and SWC between 1957 and 1967 to improve stormwater drainage and provide flood protection for portions of Sunnyvale, Mountain View, Cupertino, and unincorporated Santa Clara County (SCC). Calabazas and STA creeks are currently maintained by Valley Water to reduce flood risk in their lower reaches; their current condition leads to sedimentation of the channels, and Valley Water must periodically dredge them to maintain flood conveyance capacity. To improve functioning of the interconnected Calabazas and STA creeks with tidal marshes along southern SF Bay, Valley Water evaluated options for realigning the lower portions of Calabazas and STA creeks as well as other restoration actions to meet the Project objectives.

1.3 Project Goal and Objectives

The overarching goal of the Project is ecological enhancement of the Project Planning Area, while maintaining current levels of flood protection (Valley Water 2023). The four Project objectives are as follows:

1. Support the ecological restoration/enhancement of tidal marsh, freshwater marsh, transitional, and riverine habitat within the Project Planning Area.
2. Ensure resilient flood protection that adapts to projected sea level rise.
3. Reduce maintenance needs for lower Calabazas and STA creeks.
4. Provide enhanced public access and improved trails.

1.4 Project Description and Benefits

The Project would re-establish tidal connectivity between southern SF Bay and the former salt marsh enclosed by Pond A4 and the A8 Ponds, promoting ongoing inputs of sediment to support tidal marsh establishment, while reducing tidal ranges and extreme high tide elevations anticipated under future sea level rise. The Project would restore fluvial connectivity between the ponds and Calabazas and STA creeks, allowing natural delivery of fluvial sediment to the restored marsh. Reducing excessive sediment accumulation in Calabazas and STA creeks through the Project action(s) of realigning the creeks and/or redirecting flow into the A8 Ponds would also serve to reduce creek dredging and maintenance costs.

Conceptually, the Project would redirect creek flow and future sediment loads into the southern end of the A8 Ponds through a new breach in the existing pond berm of Pond A8S. In addition, the perimeter berms of the A8 Ponds and Pond A4 may be breached at several locations along the adjacent reaches of Guadalupe Slough and Alviso Slough to achieve increased tidal connectivity and facilitate future sediment accretion within the ponds. Other restoration elements that may increase the effectiveness and benefits of the Project include vegetated ecotone slopes,[1] wetland benches, and island features. Current water management strategies to address long-standing water quality issues in Pond A4 may not be viable in the future; future Pond A4 restoration may include potential nature-based solutions for wastewater, stormwater, and/or reverse osmosis concentrate using a horizontal levee concept (Valley Water 2022). Lastly, Project planning and design alternatives also consider benefits to public access such as improvements to planned San Francisco Bay Trail (Bay Trail) segments, which pass near the Project and provide public coastal access.

1.5 Project Funding

In 2022, the San Francisco Bay Restoration Authority awarded a Measure AA grant to Valley Water in the amount of $3.37 million for planning studies, design, permitting, and monitoring of the Project. The Project has received additional funding from the U.S. Environmental Protection Agency (EPA) under assistance agreement 98T55101 with Valley Water and a CDFW Proposition 1 grant (agreement number Q2196004). The Project builds on many years of studies, including a visioning effort led by San Francisco Estuary Institute–Aquatic Science Center (2018) funded by EPA, a Feasibility Report completed by Valley Water (2021), and Project Definition and Refined Objectives Report prepared by Valley Water (2023). The Project includes close coordination and collaboration with many different agencies, including USFWS, which manages the A8 Ponds;

[1] The terms *habitat* or *upland transition zone*, *ecotone*, *habitat slope*, and *horizontal levee* are variously used to describe a gradually sloping surface at the intersection of aquatic and terrestrial habitats, designed to provide intertidal and high marsh habitats under a range of water surface elevations, including under extreme high tides or projected sea level rise. The term *ecotone slope* is used to describe these constructed wetlands, and the term *horizontal levee* is reserved for circumstances when treated wastewater is applied to these features for either habitat or water quality benefits.

California State Coastal Conservancy (CSCC); City of Sunnyvale; City of San José; SCC; and others.

1.6 Valley Water Planning Process

The Valley Water Planning Process (VW W-730-124 Rev P) generally includes three phases:

- **Phase 1:** Development of Conceptual Alternatives (includes background information collection, problem definition, alternatives development, analysis, and outreach—Items 12-A through 12-E, covered in the *Final Conceptual Alternatives Report*, Stillwater Sciences 2024);
- **Phase 2:** Development and evaluation of Feasible Alternatives (Items 12-F and 12-G, covered in this report); and
- **Phase 3:** Documentation of the Staff-recommended Alternative (Item 12-H, anticipated in 2025).

In Phase 1, the set of Conceptual Alternatives was developed and ranked using methodologies and criteria developed during Project workshops (Stillwater Sciences 2024). During Phase 2, the highest-ranking Conceptual Alternatives were evaluated for feasibility and refined (see Section 2 of this report), including development of preliminary designs in sufficient detail to estimate Project costs and to identify the highest-ranked Feasible Alternative. In the final step (Phase 3), the highest-ranked Feasible Alternative will be documented in a Planning Study and Staff-recommended Alternative Report. Throughout this process, outreach activities are ensuring that the development and evaluation of alternatives are informed by input from Project Partners and stakeholders (including local agencies, regulatory agencies, community members):

- Project Partners
  - CSCC
  - SBSPRP
  - USFWS
- Local agencies
  - California Department of Transportation (Caltrans)
  - City of Santa Clara
  - City of San José
  - City of Sunnyvale
  - Metropolitan Transportation Commission SF Bay Trail
  - SCC

- Regulatory agencies
  - CDFW
  - EPA
  - San Francisco Bay Area Regional Water Quality Control Board
  - San Francisco Bay Conservation and Development Commission
  - NMFS
  - U.S. Army Corps of Engineers (USACE)
  - USFWS
- Community stakeholders
  - Nongovernmental organizations
  - Private landowners
  - Tribal representatives
  - Members of the public

1.6.1 Problem Definition

The Problem Definition Report (Valley Water 2023) was the first formal milestone in the Valley Water Planning Process for the Project. The Problem Definition Report details existing conditions, states the problem definition, describes initial community outreach efforts, and identifies changes in scope, as well as opportunities and constraints associated with the Project. Key Project issues detailed in the Problem Definition Report include the following:

- **Historical habitat loss/degradation**. Changes in historical creek alignment and land use conversions have resulted in habitat loss and fragmentation, with an overall increase in open water habitat and smaller increases in upland, riverine, and brackish/freshwater habitat.
- **Sediment removal for maintenance of channel capacity**. Changes in historical creek alignment and urbanization have resulted in reductions in channel conveyance capacity, requiring extensive sediment and vegetation removal that results in disruption of aquatic and riparian habitat of the creek corridors.
- **Increased flood risks due to sea level rise**. In anticipation of projected sea level rise, additional analysis is needed to assess the degree to which changes in tidal connectivity of Pond A4 and the A8 Ponds can be expected to reduce flood risks to existing urban infrastructure during coastal and riverine flood events.
- **Maintenance and improvements in public access.** The Project will maintain existing public access and trail connections and assess whether improvements in public access are feasible.

- **Expansion of Project Planning Area to include restoration of Pond A4**. Adding Pond A4 to the Project would increase the area available for restoration of tidal marsh and transitional habitats and provide opportunity for water quality improvements.

1.6.2 Conceptual Alternatives Development

The Conceptual Alternatives Report (Stillwater Sciences 2024) describes the development and evaluation of 20 Conceptual Alternatives. The alternatives were weighted and scored using a comprehensive decision-making framework that considered a wide range of factors in determining the degree to which combinations of restoration elements met the identified Project objectives (see Section 3.5). The Project Team[2] considered indicators of ecological health and water quality, resilient flood protection and sediment management, and Project feasibility constraints. For the Feasible Alternatives analysis, the Project Team selected the highest-ranked Conceptual Alternatives and those that were expected to provide a broad range of hydrodynamic modeling results. Five alternatives were recommended for modeling and additional assessment as Feasible Alternatives in this report.

1.6.3 Previous Stakeholder Outreach

Public outreach and the public meetings held during the development of Conceptual Alternatives are consistent with Valley Water's Planning Process, as well as with Valley Water Board of Directors General Principles Policy E-1. The Policy focuses on equity, environmental justice, collaboration, and natural flood protection, and includes a commitment to environmental justice and the fair treatment and meaningful engagement of all people regardless of race, color, gender identity, disability status, national origin, tribe, culture, income, immigration status, or English language proficiency, with respect to the planning, projects, policies, services, and operations of Valley Water. Environmental justice within Valley Water's service area is achieved when all people receive the following:

- Equitable consideration in the planning and execution of flood protection, water supply, safe drinking water, water resources stewardship projects, and protection from environmental and health hazards; and
- Equal access to Valley Water's decision-making process (Valley Water 2021).

[2] Project Team is defined in the Project Work Plan (Stillwater Sciences 2023) as Valley Water key staff and consultant team including Stillwater Sciences, Anchor QEA, Cinquini & Passarino, Kearns & West, Pathways Climate Institute, Rincon Consultants, San Francisco Estuary Institute, and Schaaf & Wheeler.

Valley Water, in partnership with the Project Team, previously engaged with a wide range of stakeholders and interest groups in the development of initial Conceptual Alternatives beginning in 2022, including participation in workshops held on October 21 and 27, 2022, by representatives from the cities of San José, Santa Clara, and Sunnyvale; SCC; CSCC; Caltrans; USFWS; and SBSPRP. An additional workshop was held on December 15, 2022, to select and rank factors to be used as part of the Conceptual Alternatives Assessment Methodology (Stillwater Sciences 2024). Following this screening and assessment process, five Conceptual Alternatives were selected and presented on January 26, 2023, to Project Partners, who were asked to provide comments[3] on the alternatives to be selected for hydrodynamic modeling.

A public meeting was held on May 16, 2023, to solicit additional feedback on alternatives to carry forward for additional modeling and analysis. Public comments received were used to gain insight into public preferences on assessment factors and ranking of alternatives and led to the development of additional restoration elements and two additional Conceptual Alternatives for this report (Section 2).

2 ALTERNATIVES REFINEMENT

Restoration elements considered during initial Conceptual Alternatives development included (1) human-made and tidally maintained channels and berm breaches to facilitate exchange of materials and organisms between emergent marsh and open water habitats; (2) tide gates to control water levels within the re-connected ponds; (3) vegetated ecotone slopes[4] at strategic locations; and (4) intertidal benches and other topographic features contoured to take advantage of appropriate tidal datums to (a) provide surfaces for wildlife habitat use (e.g., nesting) and marsh and upland vegetation establishment, and (b) promote sediment trapping and flood control benefits (Stillwater Sciences 2024).

[3] Comments were received from Caltrans, CDFW, City of Santa Clara, City of San José, City of Sunnyvale, CSCC, EPA, National Marine Fisheries Service, Pacific Gas and Electric Company, San Francisco Bay Area Regional Water Quality Control Board, San Francisco Bay Conservation and Development Commission, SCC Department of Parks and Recreation, USACE, and USFWS.

[4] The vegetated ecotone along the southern berm of the A8 Ponds is an existing feature under construction as part of the ongoing SBSPRP and is common across all alternatives. As noted in Section 1.4, Pond A4 restoration may include implementation of a horizontal levee concept for future water quality management of treated wastewater effluent, stormwater, and/or reverse osmosis concentrate.

Hydrodynamic and sediment transport modeling results, as well as feedback from members of the public, Project Partners, agencies, and stakeholders on the Conceptual Alternatives developed to date (Stillwater Sciences 2024), were considered in developing two new alternatives for additional modeling and subsequent Feasibility Analysis. Of the five alternatives recommended for modeling in the Final Conceptual Alternatives Report, two alternatives were replaced—Alternative 2 and Alternative 4. Alternative 2 ranked lowest in the Final Conceptual Alternatives Report and Alternative 4 was abandoned after modeling because other alternatives had higher sediment delivery to Pond A8S (Anchor QEA 2024). The three remaining alternatives recommended for modeling (Alternatives 1, 3, and 5) and the two new alternatives (Alternatives 6 and 7) are described below. Each of these Feasible Alternatives was further developed for ranking within an updated assessment methodology (see Section 3, *Feasibility Analysis*).

2.1 Alternative 1: Minimum Tidal Connectivity

Alternative 1 was originally developed as a Conceptual Alternative to represent a "bookend" of minimum tidal connectivity (Figure 2-1). Under this alternative, Calabazas and STA creeks would be reconnected to the A8 Ponds, the existing pump and siphon would be replaced between Pond A4 and Pond A8S with a tide gate connecting Pond A4 to Guadalupe Slough, and one bird nesting habitat island would be established along the interior berms of A8 Ponds. Alternative 1 represents the minimum amount of construction and disturbance required to achieve the goal of reconnecting Calabazas and STA creeks to the A8 Ponds without realignment of STA Creek through Harvey Marsh. This alternative includes creating a 200-foot-wide breach in the artificial berm separating the creeks from Pond A8 replacing the current water control structures at the downstream ends of Pond A5 and Pond A7 with 160-foot-wide breaches. The alternative also assumes a small island feature for bird nesting habitat would be constructed along the existing berm between Pond A5 and Pond A7.

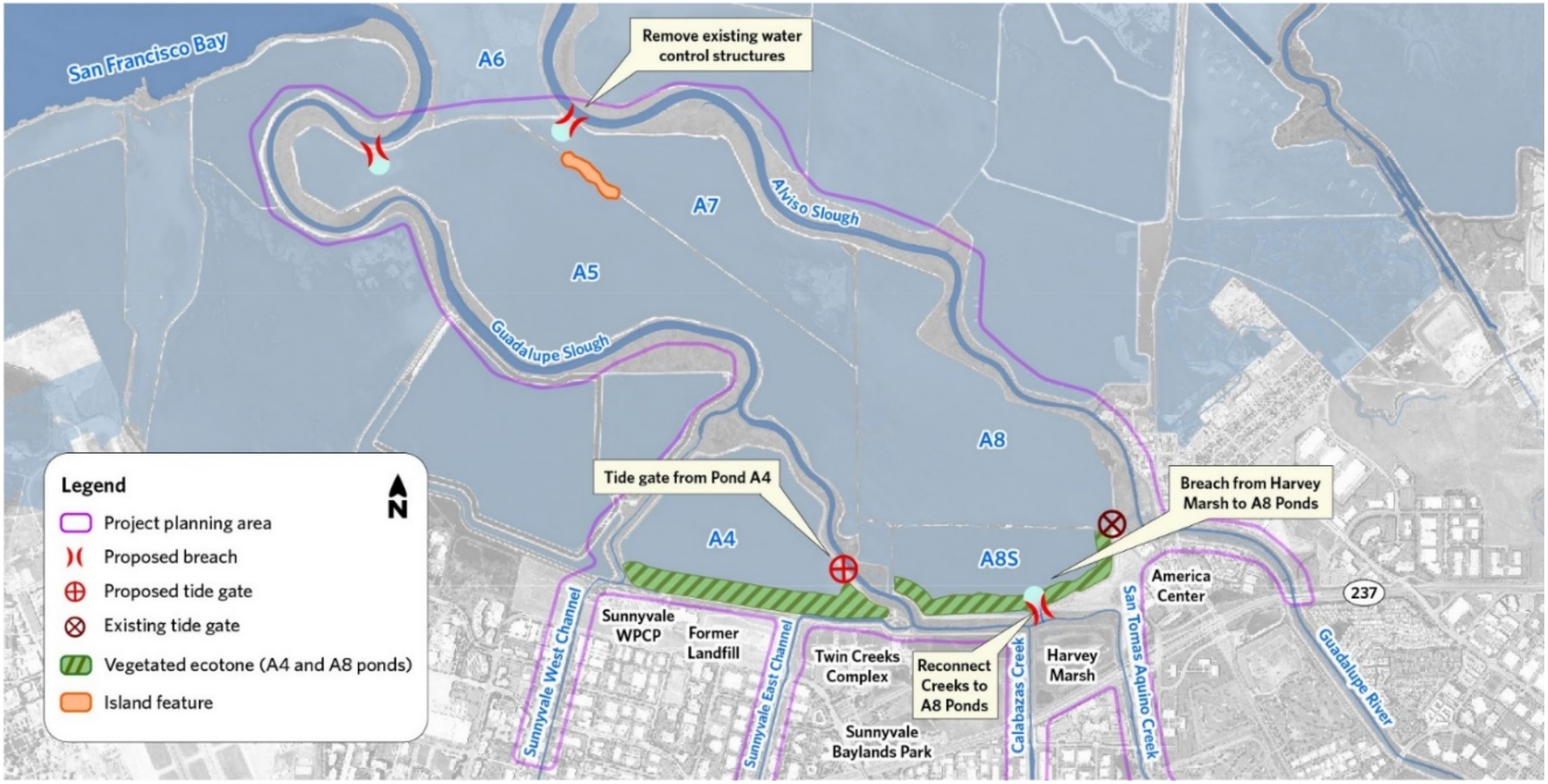


Figure 2-1. Alternative 1.

Under Alternative 1, the pond perimeter berms bordering Harvey Marsh would not be breached, and the existing muted tidal freshwater and brackish marsh habitats would continue to be supported via the culvert and slide gate at the northwest corner. Over time, the existing low points in the perimeter berms are expected to erode further during king tide and high-flow events, and the freshwater and brackish marsh habitats would gradually transition toward fully tidal salt marsh.

Within Pond A4, the existing siphons (not shown in Figure 2-1) connecting the pond to the Cargill Channel and Pond A8S would be closed off permanently, and a new tide gate would be constructed on the east side of Pond A4 with a total opening width of 15 feet. This new tide gate would allow for the continued operation of Pond A4 as a muted tidal pond. Alternative 1 also assumes that a vegetated ecotone, or potentially a horizontal levee, would be constructed along the southern berm of Pond A4.

2.2 Alternative 3: Creek Realignment and Alviso Slough and Pond A4 Breaches

Under Alternative 3, STA creek would be realigned through Harvey Marsh, STA creek would be connected to the A8 Ponds and SEC would be connected to Pond A4, and sediment for helping build tidal marsh habitat in the A8 Ponds and Pond A4 would be delivered at breach connections with Alviso Slough and Guadalupe Slough, respectively (Figure 2-2). This alternative includes creating a 200-foot-wide breach in Pond A8S for the Calabazas and STA creeks reconnection to the A8 Ponds and assumes that the current water control structures at the downstream ends of Pond A5 and Pond A7 would be replaced with 100-foot-wide and 90-foot-wide breaches, respectively. Two additional breaches would be created along Alviso Slough. Alternative 3 does not include any island features in the A8 Ponds.

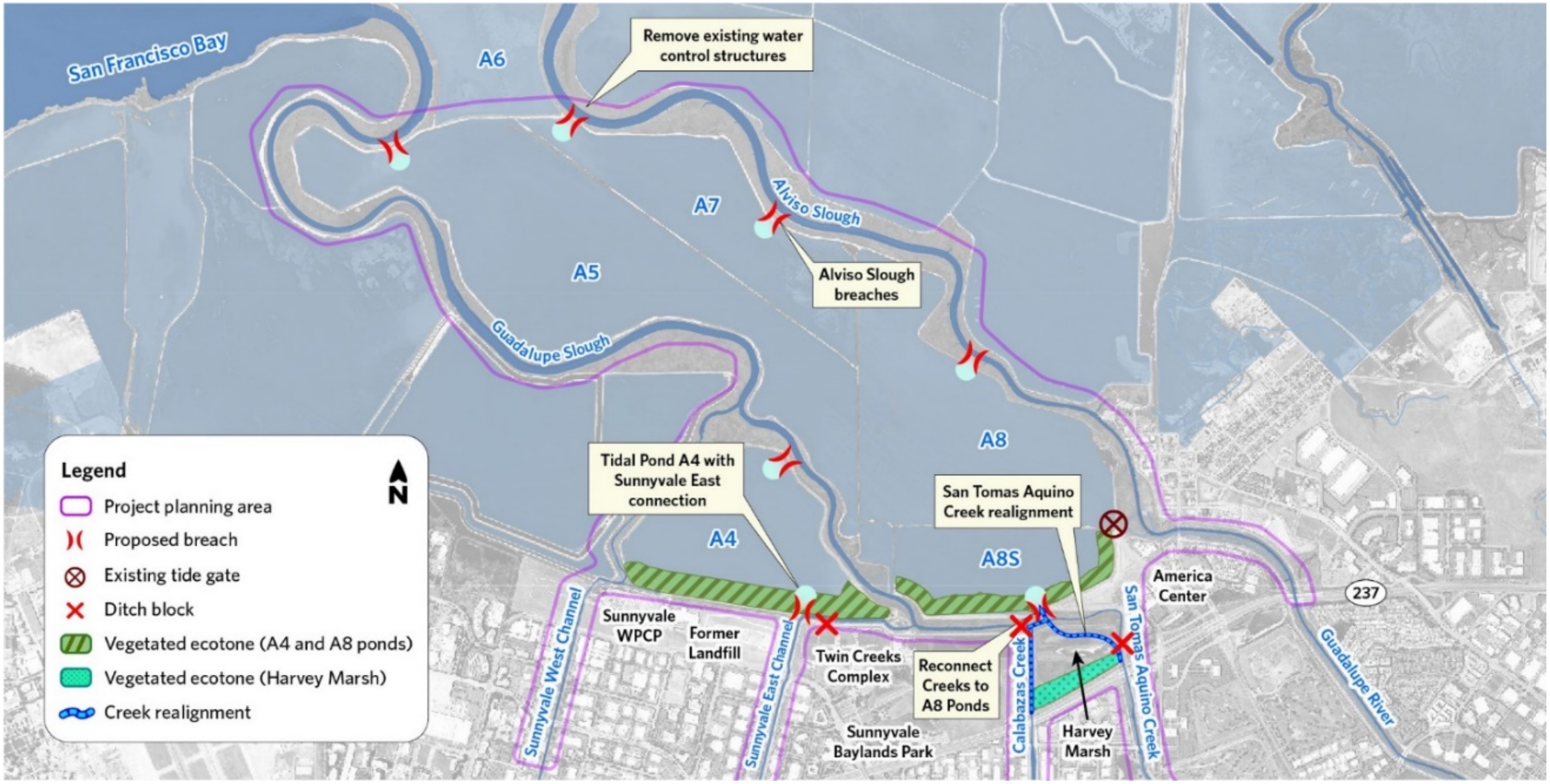


Figure 2-2. Alternative 3.

Within Harvey Marsh, STA Creek would be realigned using a ditch block north of California Highway 237 to divert creek flows through a new, excavated channel that connects to the new Pond A8S breach by removing the existing culvert and slide gate at the northwest corner of the marsh, blocking the informal pedestrian access around Harvey Marsh. An additional ditch block west of the mouth of Calabazas Creek would separate the creeks from the head of Guadalupe Slough and would reconnect the combined flows from both Calabazas and STA creeks to Pond A8S. To provide transitional wetland to upland habitats, a vegetated ecotone would be constructed along the southern side of Harvey Marsh adjacent to California Highway 237.

Within Pond A4, the existing siphons (not shown in Figure 2-2) connecting the pond to the Cargill Channel and Pond A8S would be permanently closed off, and the berm surrounding Pond A4 would be breached in two locations. A breach would be constructed along the southern side of Pond A4 to direct flow from SEC through Pond A4, and a ditch block across the existing channel east of this breach would be used to direct all flow from SEC through Pond A4. A second breach would be constructed to connect Pond A4 to Guadalupe Slough to allow for full tidal connectivity in Pond A4. This alternative also assumes that a vegetated ecotone, or potentially a horizontal levee, would be constructed along the southern berm of Pond A4.

2.3 Alternative 5: Maximum Tidal Connectivity

Alternative 5 was originally developed as a Conceptual Alternative to represent a “bookend” of maximum tidal connectivity (Figure 2-3). Under Alternative 5, STA Creek would be realigned through Harvey Marsh, a creek connection would be established to both A8 Ponds and Pond A4, sediment for helping build tidal marsh habitat in A8 Ponds and Pond A4 would be delivered at breach connections with Alviso and Guadalupe Sloughs, and one nesting habitat island would be established in the A8 Ponds and wetland bench features would be included in Pond A4. Alternative 5 is the maximum tidal connectivity bookend with the maximum number of breaches and no additional ditch blocks. This alternative includes creating a 200-foot-wide breach in Pond A8S for the Calabazas and STA creeks reconnection to the A8 Ponds and assumes that the current water control structures at the downstream ends of Ponds A5 and A7 would be replaced with 100-foot-wide and 90-foot-wide breaches, respectively. Two additional breaches each would be included along Alviso and Guadalupe sloughs and the existing tide gate in the southeastern berm of A8 Ponds would be replaced with a breach. One small island feature would be constructed along the existing berm between Pond A5 and Pond A7.

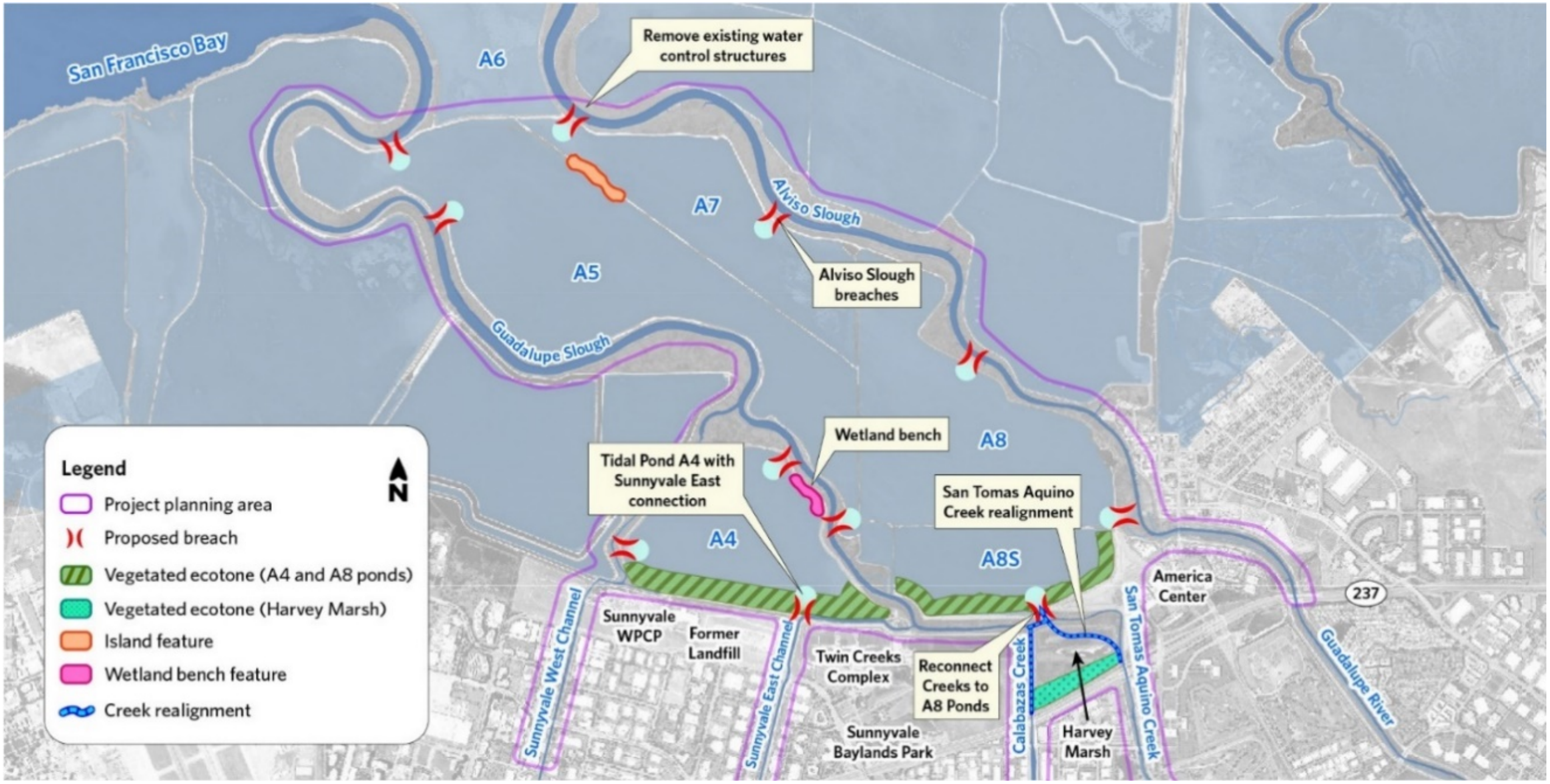


Figure 2-3. Alternative 5.

Within Harvey Marsh, STA Creek would be realigned to divert creek flows through a newly excavated channel that would connect to the new Pond A8S breach by removal of the existing culvert and slide gate at the northwest corner of the marsh, blocking the informal pedestrian access around Harvey Marsh. No ditch blocks are included under this alternative, which allows alternative flow paths of the historical and realigned STA Creek, and it also allows the combined flows from both Calabazas and STA creeks to flow into either Pond A8S or Guadalupe Slough. To provide transitional wetland to upland habitats, a vegetated ecotone would be constructed along the southern side of Harvey Marsh adjacent to California Highway 237.

Within Pond A4, the existing siphons (not shown in Figure 2-3) connecting the pond to the Cargill Channel and Pond A8S would be permanently closed off, and the berm surrounding Pond A4 would be breached in three locations. A breach would be constructed along the southern side of Pond A4 to direct flow from SEC through Pond A4, and a ditch block across the existing channel east of this breach would be used to direct all flow from SEC through Pond A4. A second breach would be constructed in Pond A4 to re-establish tidal connectivity with Guadalupe Slough. A third breach would connect Pond A4 to the Moffet Channel. This alternative also assumes that a vegetated ecotone, or potentially a horizontal levee, would be constructed along the southern berm of Pond A4 and the berm between Pond A4 and Guadalupe Slough would be lowered to create a wetland bench.

2.4 Alternative 6: Creek Reconnection, Alviso Slough and Pond A4 Breaches

Building on Alternative 3, which was ranked the highest of the five alternatives included in the Conceptual Alternatives (Stillwater Sciences 2024), Alternative 6 and Alternative 7 (Section 2.5) were developed to examine differences in sediment transport to Pond A8S without and with realignment of STA Creek through Harvey Marsh, respectively. Under Alternative 6, Calabazas and STA creeks would be reconnected to the A8 Ponds, and Pond A4 would be connected with SEC and SWC (Figure 2-4). In addition, sediment for helping build tidal marsh habitat in the A8 Ponds and Pond A4 would be delivered at breach connections with Alviso Slough and Guadalupe Slough, respectively. A ditch block would be added west of the mouth of Calabazas Creek, resulting in flow from STA and Calabazas Creeks to be directed through the new 200-foot-wide breach into Pond A8S. This alternative assumes that the current water control structures at the downstream ends of Ponds A5 and A7 would each be replaced with 250-foot-wide breaches. Two additional breaches would be included along

Alviso Slough. Alternative 6 does not include any island features in the A8 Ponds, but it does include the partial removal (i.e., lowering or degrade) of internal pond berms in A8 Ponds to promote sediment transport within the A8 Ponds.

Under Alternative 6, the Harvey Marsh perimeter berms would not be breached, and the existing muted tidal freshwater and brackish marsh habitats would continue to be supported by tidal exchanges through the existing culvert and slide gate at the northwest corner. Over time, the existing low points in the perimeter berms are expected to erode further during king tide and high-flow events, and the freshwater and brackish marsh habitats would gradually transition toward fully tidal salt marsh.

Within Pond A4, the existing siphons (not shown in Figure 2-4) connecting the pond to the Cargill Channel and Pond A8S would be permanently closed off, and the berm surrounding Pond A4 would be breached in two locations. A breach would be constructed along the southern side of Pond A4 to direct flow from SEC through Pond A4; however, the ditch block adjacent to this breach that was included in Alternative 3 is not included in Alternative 6. A second breach would be constructed in Pond A4 to re-establish tidal connectivity with Guadalupe Slough. This alternative also assumes that a vegetated ecotone, or potentially a horizontal levee, would be constructed along the southern berm of Pond A4.

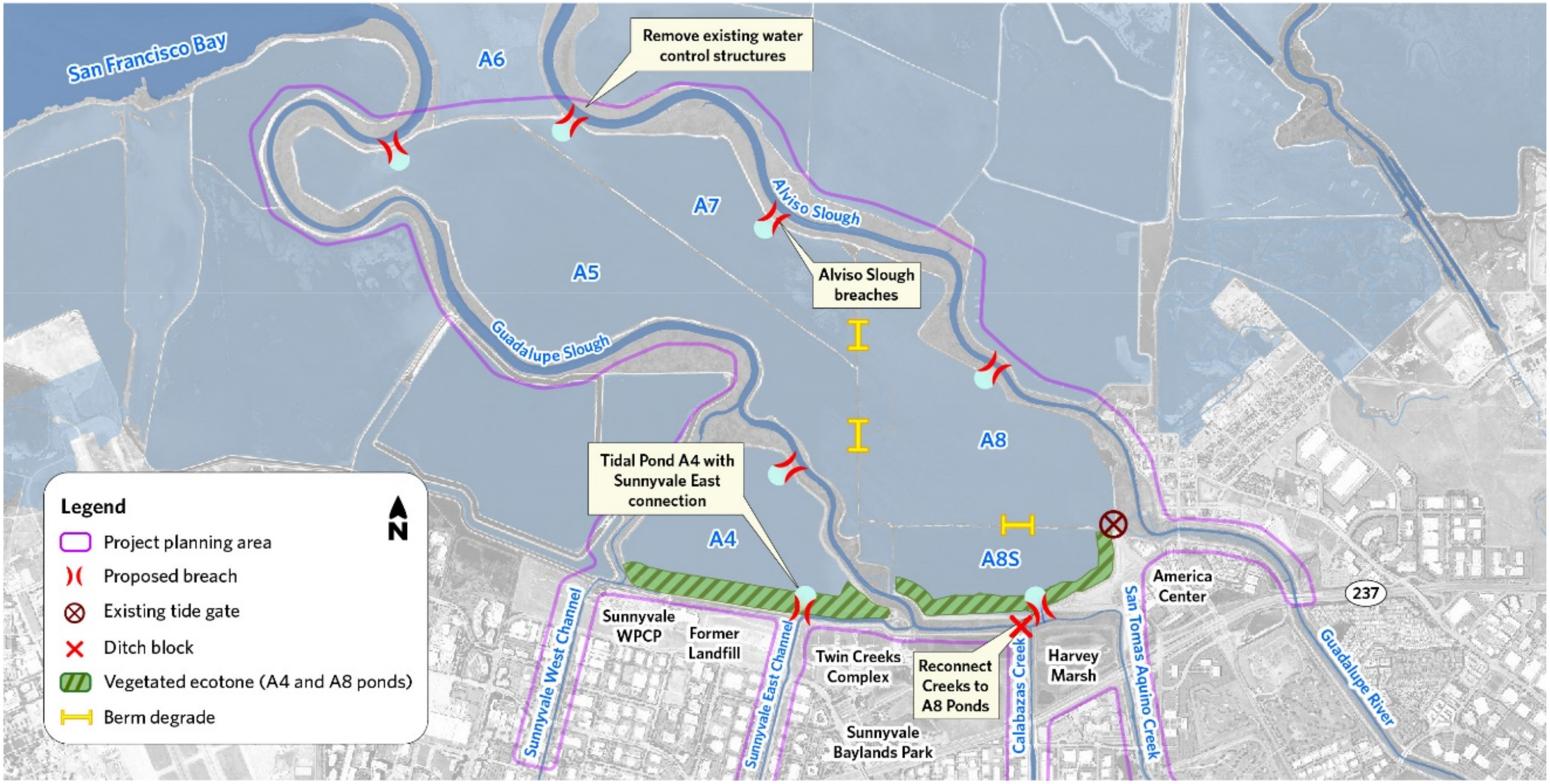


Figure 2-4. Alternative 6.

2.5 Alternative 7: Creek Realignment, Alviso Slough and Pond A4 Breaches

Building upon Alternative 3, which was ranked the highest of the five alternatives included in the Conceptual Alternatives (Stillwater Sciences 2024), Alternative 7 and Alternative 6 (Section 2.4) were developed to examine differences in sediment transport to Pond A8S with and without realignment of STA Creek through Harvey Marsh, respectively. Under Alternative 7, STA Creek would be realigned through Harvey Marsh, creek connections to both A8 Ponds and Pond A4 would be created, and sediment for helping build tidal marsh habitat in A8 Ponds and Pond A4 would be delivered at breach connections with Alviso and Guadalupe sloughs, respectively (Figure 2-5). This alternative includes creating a 200-foot-wide breach in Pond A8S for the Calabazas and STA creeks reconnection to the A8 Ponds and assumes that the current water control structures at the downstream ends of Pond A5 and Pond A7 would be replaced with 100-foot-wide and 90-foot-wide breaches, respectively. Two additional breaches would be included along Alviso Slough. Alterative 7 also includes construction of nesting island features along the existing berms separating Ponds A5, A8N, and A8S, as well as the construction of internal pond berm degrades to promote sediment transport within the A8 Ponds.

In addition to examining differences in sediment transport to Pond A8S with (Alternative 7) and without (Alternative 6) realignment of STA Creek, Alternative 7 was designed to test the assumption that tidal habitat enhancement of Harvey Marsh would be as beneficial as Alternative 6. Under Alternative 7, STA Creek would be realigned north of California Highway 237 to allow the creek to flow through either the historical channel, or a new excavated channel, across the marsh. The existing culvert and slide gate at the northwest corner of the marsh would be removed, blocking the informal pedestrian access around Harvey Marsh. The ditch block west of the mouth of Calabazas Creek would direct the combined flows of Calabazas and STA creeks through the Pond A8S breach. A vegetated ecotone would be constructed along the southern side of Harvey Marsh adjacent to California Highway 237 to provide transitional wetland to upland habitats.

Figure 2-5. Alternative 7.

Within Pond A4, the existing siphons (not shown in Figure 2-5) connecting the pond to the Cargill Channel and Pond A8S would be permanently closed off, and the berm surrounding Pond A4 would be breached in two locations. A breach would be constructed along the southern side of Pond A4 to direct flow from SEC through Pond A4, and a ditch block across the existing channel east of this breach would be used to direct all flow from SEC through Pond A4. A second breach would be constructed in Pond A4 to re-establish tidal connectivity with Guadalupe Slough. This alternative also assumes that a vegetated ecotone, or potentially a horizontal levee, would be constructed along the southern berm of Pond A4.

3 FEASIBILITY ANALYSIS

Consistent with the Valley Water Planning Process for the Project, five alternatives advanced from the Conceptual Alternatives Report (Stillwater Sciences 2024) and were evaluated and ranked as part of a Feasibility Analysis. Including supplemental alternatives developed to optimize sediment capture and ecological habitat values and following preliminary design (Schaaf & Wheeler 2024), each alternative was analyzed using a combination of hydrodynamic and sediment transport modeling (Anchor QEA 2024) and geospatial and engineering analyses. The alternatives were then ranked using an updated assessment methodology.

3.1 Design Development

To support hydrodynamic and sediment transport modeling and other geospatial analyses, preliminary designs were developed to a 5% completion for each of the Feasible Alternatives using AutoCAD Civil3D software (Schaaf & Wheeler 2024). The preliminary plans were used to visualize each alternative and estimate earthwork quantities associated with the specific restoration elements for each alternative. Each alternative includes specific modifications (such as breaches, ecotones, etc.) to existing ponds that facilitate tidal flow between adjacent sloughs and the existing ponds, thereby supporting ecosystem restoration. Within the A8 Ponds, the ecotone features shown along the southern shore of Pond A8S were previously developed and partially constructed as part of the ongoing SBSPRP and therefore are not included in the alternatives' estimates of earthwork quantities. The planned ecotone or horizontal levee feature in Pond A4 assumes the construction of foundational materials as part of the Pond A4 Resilient Habitat Restoration Project (H.T. Harvey & Associates 2024), which is planned to provide tidal mudflat habitat once tidal connectivity is established under any of the Feasible Alternatives. For additional information including restoration element specifications (e.g., number and sizes of breaches) see *Calabazas–STA Creek Marsh Connection Project – 5 Percent Design and Cost Estimate Technical Memorandum* (Schaaf & Wheeler 2024).

3.2 Preliminary Cost Estimates

The preliminary 5% designs for each Feasible Alternative (Task 3.1) were used to develop initial cost estimates for the construction of each alternative. Excluding elements that will be constructed as part of other restoration projects (e.g., A8 Ponds ecotone, Pond A4 mudflat features), preliminary cost estimates were prepared on a unit-cost (e.g., area, volume) basis, using Association for the Advancement of Cost Engineering International (AACEI) Class 5 for each alternative. A variety of available information was used for cost estimates, including the following:

- Cost estimate guides (e.g., RS Means[5])
- Actual cost and bid data from similar Schaaf & Wheeler projects
- City of Palo Alto Public Regional Water Quality Control Plant-Fed Horizontal Levee Conceptual Design
- Engineering judgement

Table 3-1 provides the direct and total construction cost estimates for each Feasible Alternative based on the 5% design plans. Costs associated with common design elements were applied across all alternatives sharing each element. Direct cost estimates encompass construction elements such as protection of existing improvements, stormwater pollution prevention permits for environmental compliance, site clearance and preparation, demolition of existing water control structures, earthwork including excavation, hauling and placement of berm soils, procurement and placement of additional soils, and slope protection such as seeding and planting. For additional information on Project costs (e.g., quantity estimates and unit costs applied), *see Calabazas–STA Creek Marsh Connection Project – 5 Percent Design and Cost Estimate* technical memorandum (Schaaf & Wheeler 2024).

Table 3-1. Construction Costs for Feasible Alternatives.

Alternative	Direct cost subtotal	Total cost[1,2]
1	$18,300,000	$36,000,000

[5] Database of current construction cost estimates.

3	$15,750,000	$31,000,000
5	$24,000,000	$47,000,000
6	$13,700,000	$27,000,000
7	$20,850,000	$41,000,000

[1] Preliminary costs include 57% construction fee on top of direct costs and an additional 25% bid contingency on the subtotal

[2] Does not include costs for engineering design, California Environmental Quality Act, permitting, or construction management

3.3 Modeling Evaluation

A three-dimensional hydrodynamic, wave, and sediment transport model was used to simulate baseline conditions in the Project Planning Area and the suite of five Feasible Alternatives (described in Section 2). Each of the Feasible Alternatives included different sets of breaches and creek realignments to evaluate a wide range of possible Project alternatives. The model was used to evaluate the effects of each Feasible Alternative on predicted sediment deposition and scour in the Project Planning Area as well as the hydrodynamics, including changes in water surface elevation level (WSEL), tidal prism, and elements of water quality. See Anchor QEA (2024) for modeling background and validation as well as a full description of methods and results.

3.3.1 Changes in Tidal Range

Tidal prism is the volume of water that flows through a cross section on each incoming (flood) and outgoing (ebb) tidal cycle, excluding any contribution from freshwater inflows. Under historical conditions, the channel networks of tidal marshes and sloughs across the former salt pond complexes were maintained in part by the tidal prism of the intertidal zone which regulates depositional and scour processes. One of the primary restoration benefits of re-establishing tidal connectivity to the A8 Ponds and Pond A4 is to increase tidal prism in the south SF Bay, which is expected to promote development of tidal channels and marsh plain habitats, as well as reduce tide ranges and the potential for flooding in adjacent neighborhoods and at tributary locations (Section 3.3.4). To evaluate changes in tide ranges and tidal prism, each of the Feasible Alternatives was modeled with the predicted tidal prism determined by the differences in water volume across the modeling domain upstream of key locations in Alviso and Guadalupe sloughs (Anchor QEA 2024). The tidal prism was evaluated during a king tide period, when there is potential for local flooding at some locations, and a period of relatively low tidal range and low inflows to the Project Planning Area.

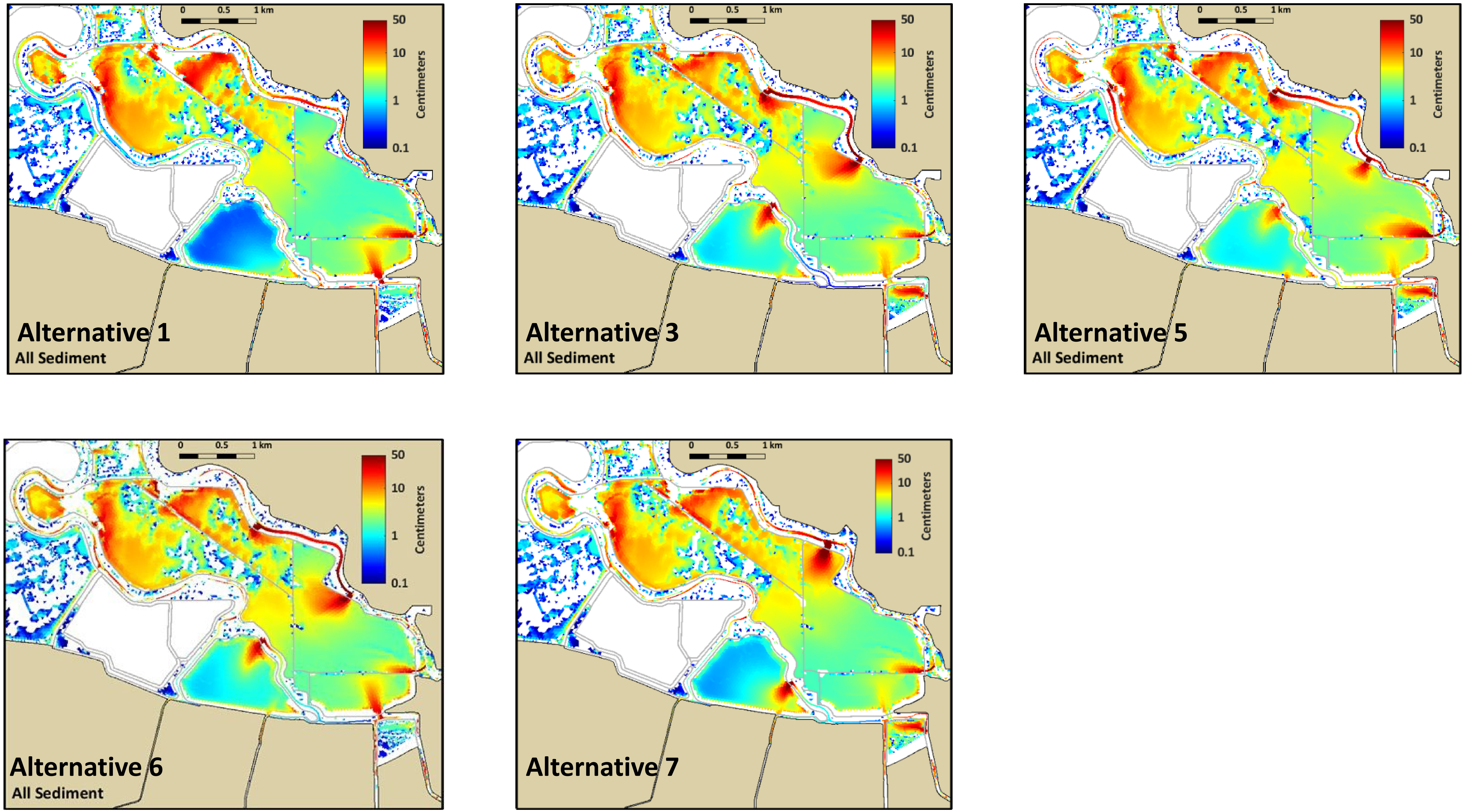
At the mouths of Alviso and Guadalupe sloughs nearest SF Bay, the alternatives resulted in an overall increase in the predicted tidal prism compared to the baseline (i.e., alternatives resulted in more predicted water flow into and out of Guadalupe Slough during each tidal cycle). This increase in tidal prism results from increased filling and draining of the A8 Ponds and Pond A4 in the alternatives relative to the baseline. In STA Creek, Calabazas Creek, SEC, SWC, and Guadalupe River, all the alternatives had lower predicted tidal prism than the baseline. The lower predicted tidal prism in the creeks results from the breaching of the salt ponds, which reduces the tidal range upstream of the ponds and leads to less tidal water flow in the creeks (Anchor QEA 2024).

3.3.2 Sediment Deposition and Scour in A8 Ponds and Pond A4

The amount of sediment from SF Bay and creek sources transported through breaches and water control structures was modeled for representative periods to compare the relative magnitudes of sediment transport under baseline conditions with each Feasible Alternative (Anchor QEA 2024). Representative modeling periods were selected using a combination of criteria based upon the availability of sediment delivery modeling predictions (Zi et al. 2022) and U.S. Geological Survey suspended sediment monitoring data, periods encompassing normal and more extreme (king) tide ranges, and periods with high and low flows in SEC and SWC, Calabazas and STA creeks, and the Guadalupe River. Water year 2017 was selected as the preferred water year during which the simulation period would occur because 2017 included at least 1 of the 10 highest watershed model daily flows within the evaluated tributaries, had a large total sediment load, and the U.S. Geological Survey suspended concentration data were available.

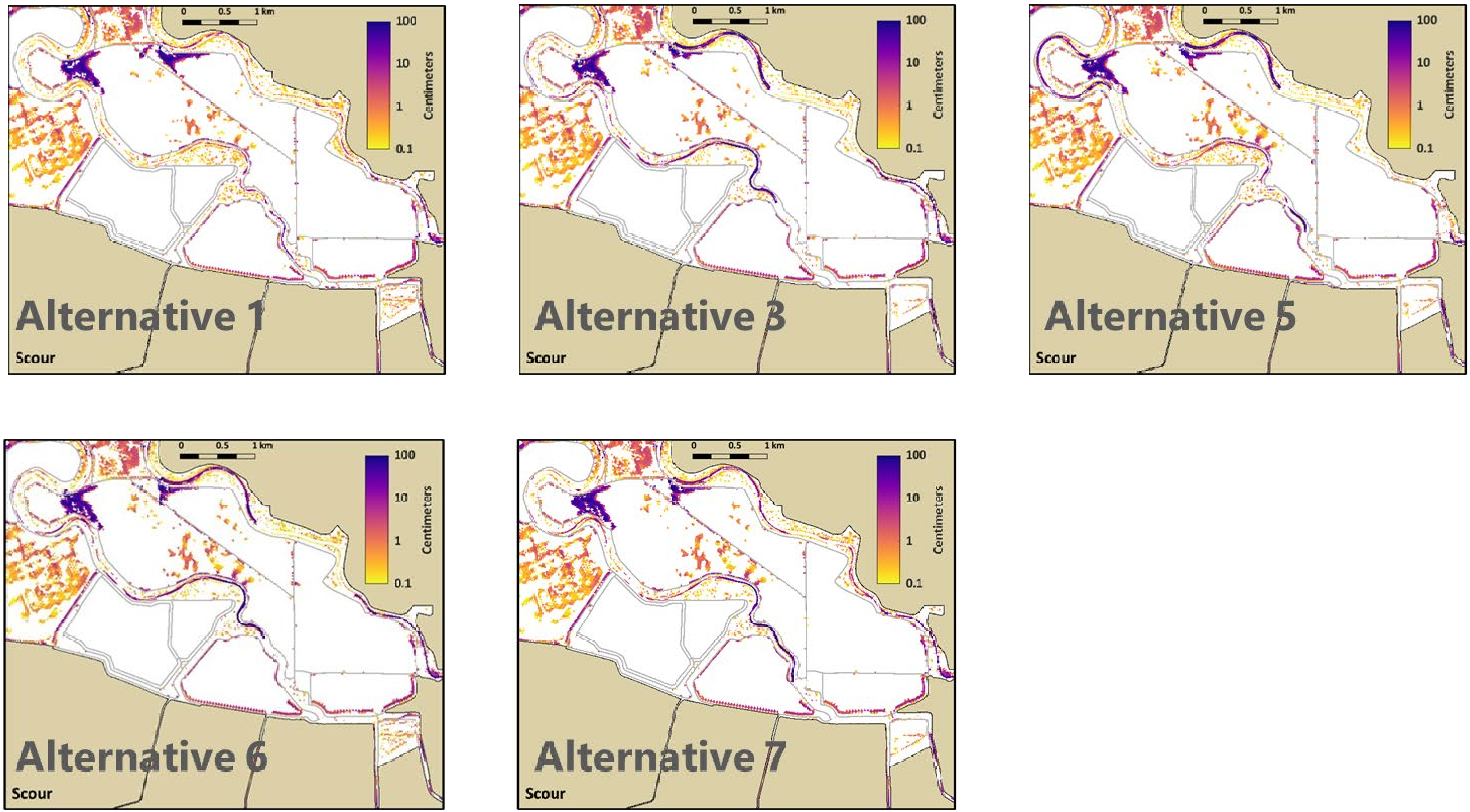
Based upon the completed sediment transport and hydrodynamic modeling, the resulting patterns of predicted sediment deposition and scour in the A8 Ponds and Pond A4 as well as the adjacent sloughs are intended to show potential future sediment accretion and tidal marsh habitat areas (Figures 3-1 and 3-2). During the representative modeling period (December 1, 2016, to May 31, 2017), sediment being transported from SF Bay along Guadalupe and Alviso sloughs was deposited into the A8 Ponds, with the greatest deposition occurring at the breaches nearest the north end of the A8 Ponds, as well as into Pond A4 nearest the breach into Guadalupe Slough (Figure 3-1). Sources of sediment from Calabazas and STA creeks were primarily deposited in the A8 Ponds during periods of high flows from the Project Planning Area inflows, with very little contribution from the watersheds of the SEC and SWC being deposited into Pond A4. These channels collect stormwater from a relatively small watershed area within the urbanized limits of Sunnyvale, which significantly limits the sediment supply from upstream. Alternatives including the realignment of Calabazas and STA creeks through Harvey Marsh (Alternatives 3, 5, and 7) exhibited increased sediment deposition in Harvey Marsh over the modeling period compared with alternatives without creek realignment (Alternatives 1 and 6, as well as baseline conditions).

Implementation of any of the Feasible Alternatives increased the area of predicted sediment scour compared with baseline conditions (Figure 3-2), which has the potential to mobilize legacy mercury deposits originating from the Guadalupe River watershed. Recognizing that previous studies found only short-term food web effects from mercury mobilization (Marvin-DiPasquale et al. 2022), all alternatives exhibited scour in the vicinity of the Pond A5 and Pond A7 water control structures as well as scour at slough locations bayward of the farthest upstream breach.



Notes: Representative modeling period December 1, 2016, to May 31, 2017. Predicted sediment deposition is shown on a log scale.

Figure 3-1. Relative sediment deposition in A8 Ponds, Pond A4, and adjacent sloughs during the representative modeling period.



Notes: Representative modeling period December 1, 2016, to May 31, 2017. Predicted scour is shown on a log scale.
Figure 3-2. Relative sediment scour in A8 Ponds, Pond A4, and adjacent sloughs during the representative modeling period.

To support assessment of potential future tidal marsh habitat under projected sea level rise (see Section 3.5.1), the combined sediment scour and deposition (net change) of SF Bay and creek sources were compared under baseline conditions and each of the Feasible Alternatives (Figure 3-3). Under all the Feasible Alternatives, sediment accumulation increased over baseline conditions, and the sediment supply from SF Bay was a larger proportion of the total sediment deposition into the A8 Ponds and Pond A4 than was creek sediment from the Project Planning Area inflows. The baseline condition and Alternative 1, representing the fewest breaches, exhibited the lowest sediment accumulation, with other alternatives with more breaches exhibiting greater, and generally similar to one another, sediment accumulation. Alternatives that included realignment of STA Creek (Alternatives 3, 5, and 7) promoted sediment deposition within Harvey Marsh, whereas Alternatives 1 and 6 increased deposition at the southern end of the A8 Ponds (Figure 3-1).

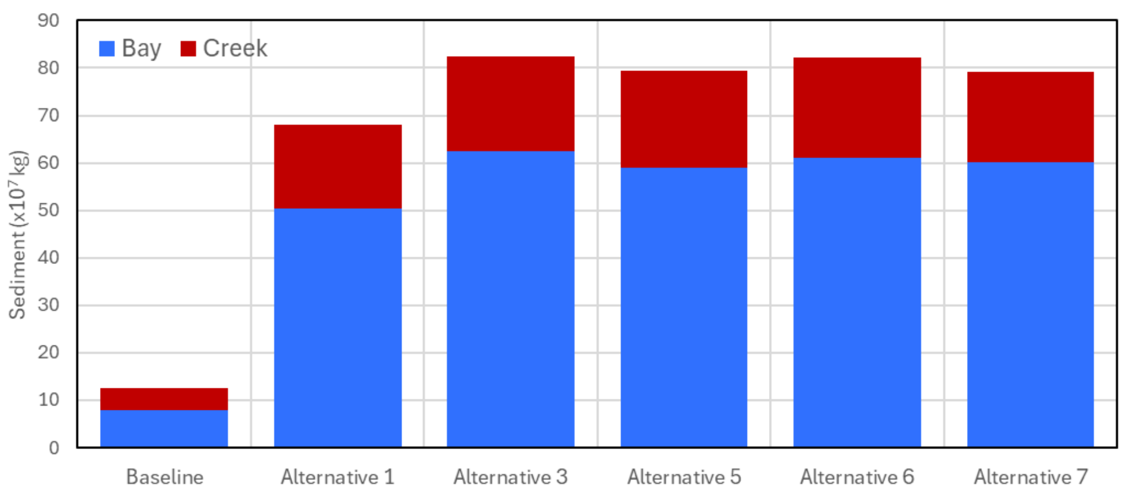


Figure 3-3. Relative sediment accumulation for Feasible Alternatives from San Francisco Bay and creek sediment sources within the A8 Ponds, Pond A4, and Harvey Marsh during the representative modeling period.

3.3.3 Sediment Deposition and Scour in San Tomas Aquino Creek, Calabazas Creek, and Sunnyvale East Channel

To support assessment of future sediment management needs (Section 3.5.1), the Project Planning Area was divided into the discrete analysis regions of the lower portions of Calabazas and STA creeks as well as SEC (Figure 3-4). These analysis reaches allowed for detailed tracking of where the SF Bay as well as creek and channel sediment (collectively referred to as creek sediment) was transported throughout the duration of the simulations. The analysis reaches also allowed for evaluation of the predicted fate of the creek sediment at the end of the simulations (Anchor QEA 2024). The combined sediment scour and deposition of SF Bay and creek sources across all creek locations is shown for the existing baseline and each of the Feasible Alternatives (Figure 3-5). Additional information regarding the relative contribution of sources from the Guadalupe River and tributary creeks to Guadalupe Slough may be found in Anchor QEA (2024).

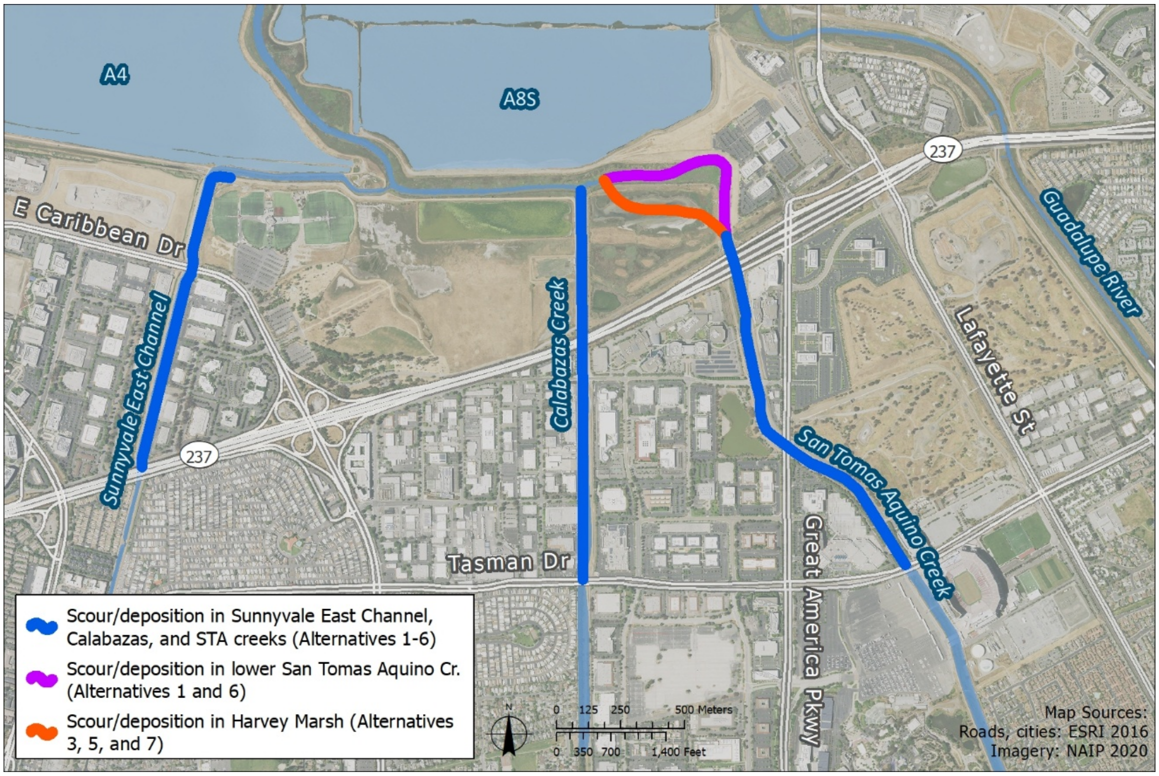


Figure 3-4. Analysis reaches for sediment deposition and scour of San Francisco Bay and creek sediment sources within San Tomas Aquino Creek, Calabazas Creek, and Sunnyvale East Channel.

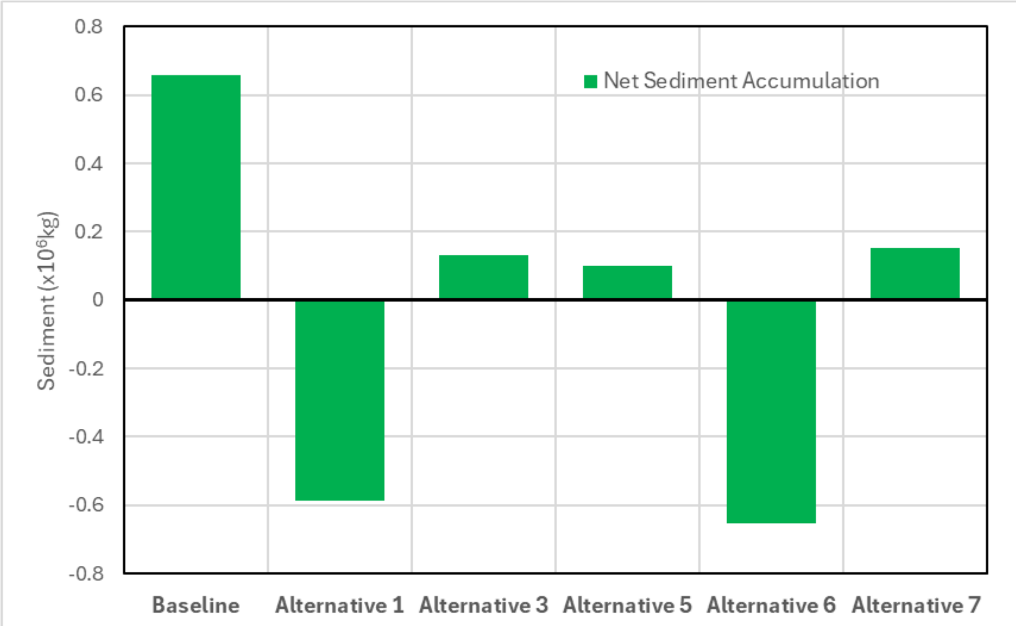


Figure 3-5. Net sediment deposition and scour for Feasible Alternatives from San Francisco Bay and creek sediment sources within San Tomas Aquino Creek, Calabazas Creek, and Sunnyvale East Channel during the representative modeling period.

Due to the reconnection of lower STA and Calabazas Creeks to Pond A8S, which is included in all Feasible Alternatives (Section 2), implementation of any of these alternatives resulted in reduced sediment accumulation relative to baseline conditions in these creeks and SEC (Figure 3-5). Consistent with patterns of increased sediment deposition in Pond A8S relative to Harvey Marsh (Figure 3-1), alternatives that did not include the realignment of STA Creek through Harvey Marsh (e.g., Alternative 1 and Alternative 6) exhibited net scour in STA Creek.

3.3.4 Changes in Peak Water Surface Elevations under Simulated King Tide and High-flow Events

Hydrodynamics, including changes in WSEL, were simulated to evaluate the effects of all alternatives on tidal inundation across the sloughs, A8 Ponds, Pond A4, STA and Calabazas creeks, SEC, and SWC. WSEL was evaluated during a period of high inflows to the Project Planning Area (i.e., during storm events) and during a period of king tides (Anchor QEA 2024). As expected from the increase in tidal prism accompanying the reconnection of the creeks and channels to A8 Ponds and Pond A4, tidal range in the ponds increased under all alternatives relative to the baseline. Instead of tidal exchanges being limited to the sloughs and tidal portions of the tributary creeks, water filled and drained the breached

A8 Ponds and Pond A4 during each tidal cycle, with a lower tidal range within the adjacent Alviso and Guadalupe sloughs, lower Gudalupe River, and local creeks.

Anchor QEA (2024) simulated variations in water levels at 16 locations throughout the Project Planning Area. Two index modeling locations were selected to support the assessment of potential future flood risks associated with Project implementation (Section 3.5.1), including one at the California Highway 237 crossing of the Guadalupe River and one in Pond A4 (Figure 3-6). Changes in tidal range during simulated high-flow events and king tides within the overall modeling period (December 1, 2016, to May 31, 2017) were evaluated (Figure 3-7). Within Pond A4, tidal reconnection with Guadalupe Slough generally increased the modeled tidal range with peak WSELs remaining below the elevation along the southern berm (approximately 9.5 feet North American Vertical Datum of 1988). At the California Highway 237 crossing of the Guadalupe River, peak WSELs were reduced during both high-flow events and king tides relative to existing baseline conditions (Figure 3-7). The peak WSEL during high-flow events was decreased because breaches into the A8 Ponds and Pond A4 decreased the tidal ranges in Guadalupe and Alviso sloughs and also allowed high creek flows to spread from Guadalupe and Alviso sloughs over a larger area. Alternative 5, which has the largest tidal connectivity and also includes replacement of the existing tide gate in the southeastern A8 Ponds berm with a breach (Section 2.3), had a slightly greater reduction in flood risk during Guadalupe River high-flow events, with the other Feasible Alternatives showing smaller reductions in flood risk relative to baseline conditions (Figure 3-7).

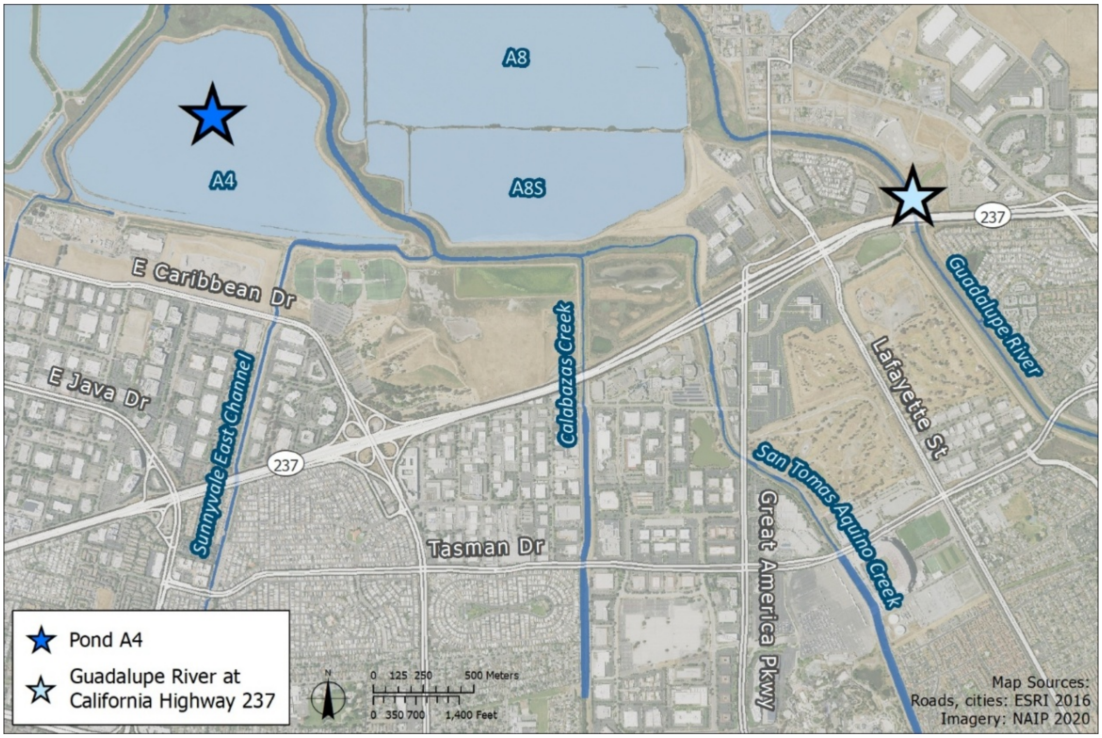


Figure 3-6. Analysis locations at Pond A4 and the Guadalupe River at California Highway 237 for assessment of changes in peak water surface elevations during high-flow events and king tides.

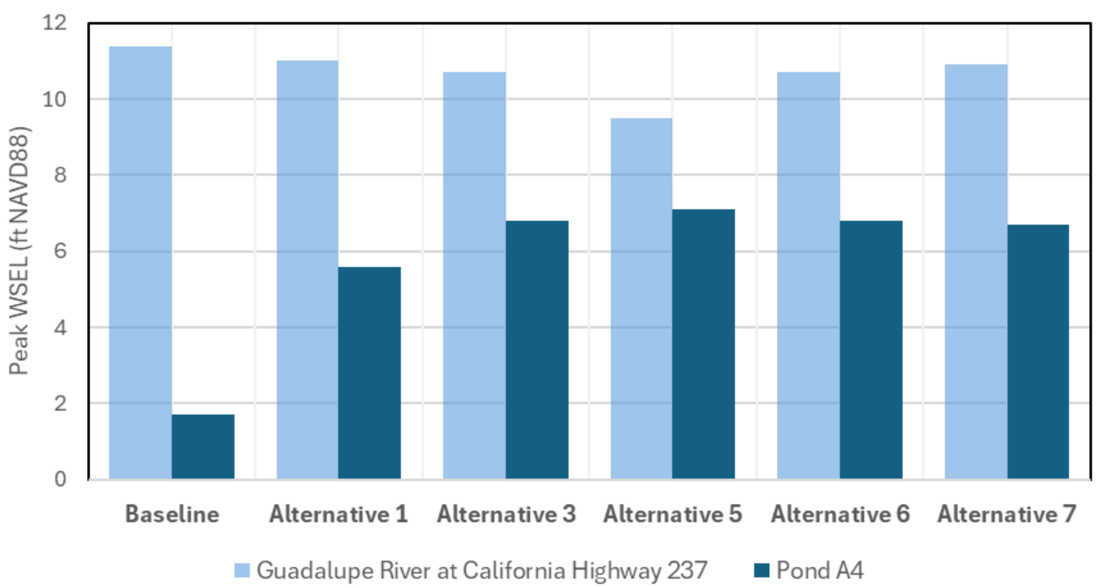


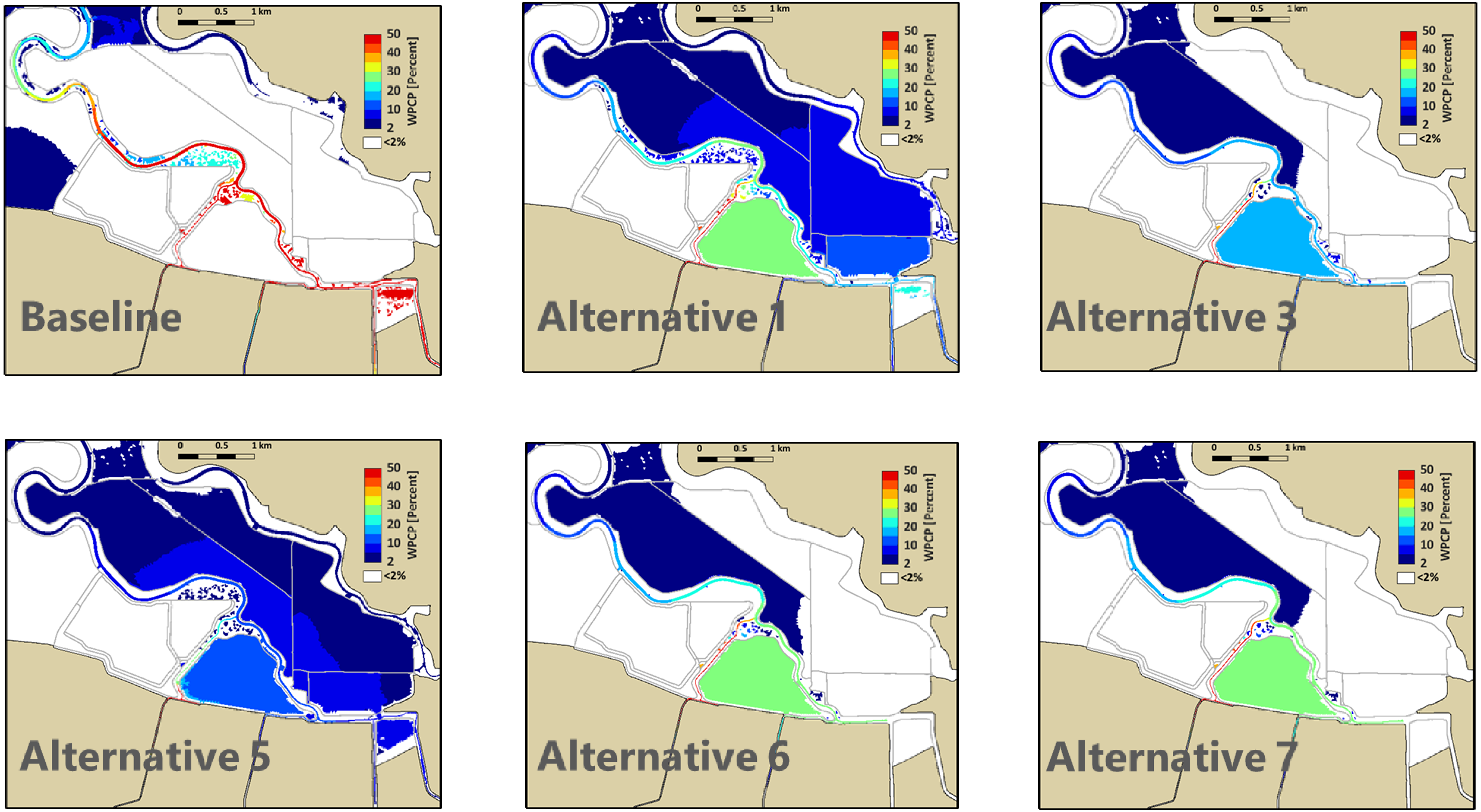
Figure 3-7. Modeled peak water surface elevations in Pond A4 during king tides and in the Guadalupe River at California Highway 237 during high-flow events.

Inside Pond A4, which is isolated from Guadalupe Slough under baseline conditions, there was very little to no predicted tidal range under baseline conditions, and the average WSEL and tidal range increased under all Feasible Alternatives. Alternative 1, with water control structures between Guadalupe Slough and Pond A4 (Section 2.1), exhibited smaller tidal ranges and lower peak WSEL compared with alternatives with breaches into the slough (Figure 3-7). Peak WSELs in Pond A4 during king tides were below the existing pond berm elevation (approximately 9.5 feet North American Vertical Datum of 1988) for all Feasible Alternatives.

3.3.5 Tidal Mixing and Water Quality Considerations

Tidal mixing was evaluated to assess changes in salinity with tidal reconnection, as well as to evaluate the potential for transport and mixing of effluent from the Sunnyvale Water Pollution Control Plant (WPCP) across the Project Planning Area (Anchor QEA 2024). In general, the increased tidal prism associated with reconnection of the ponds resulted in small increases in salinity levels within lower Guadalupe River, STA and Calabazas creeks, SEC, and SWC. This increase in salinity was similar under all Feasible Alternatives and was partially offset by reductions in tidal range at upstream locations, which reduces tidal excursion in local creeks and is expected to shift tidally influenced portions of the creeks bayward.

Although the Sunnyvale WPCP is in compliance with its National Pollutant Discharge Elimination System discharge permit requirements for the protection of aquatic beneficial uses, residual nutrients (i.e., nitrogen, phosphorus) in the discharge are broadly associated with increased potential for algal blooms. To evaluate this potential, tracer modeling was used to track the WPCP effluent water and determine the percentage of the water that originated from the WPCP at any given location and time for the representative modeling period (December 1, 2016, to May 31, 2017; Anchor QEA 2024). Figure 3-8 shows patterns of water originating from Sunnyvale WPCP in the A8 Ponds and Pond A4.



Note: Representative modeling period December 1, 2016, to May 31, 2017.

Figure 3-8. Predicted distribution of water originating from Sunnyvale Water Pollution Control Plant within the A8 Ponds, Pond A4, and adjacent sloughs.

Under baseline conditions and during low creek inflows, water discharged from the WPCP was predicted to be generally confined to the sloughs, making up a large percentage of the water in Guadalupe Slough and the lower portions of Calabazas and STA creeks (Figure 3-8). WPCP water was predicted to be transported into the lower portions of the creeks on flood tide, and into Harvey Marsh at high tide when the berm along Harvey Marsh overtopped. Relatively low percentages of WPCP water were predicted in the A8 Ponds and in Pond A4, which is currently isolated from Guadalupe Slough. Implementation of any of the Feasible Alternatives increased the percentage and the mixing of WPCP water through the A8 Ponds and Pond A4 relative to baseline conditions. Feasible Alternatives with breaches along Guadalupe Slough, and those without a ditch block in the slough preventing tidal exchanges through the breach into Pond A8S (Alternatives 1 and 5), generally exhibited a greater percentage of WPCP water across the A8 Ponds (Figure 3-8).

3.4 Public Access

Within the Project Planning Area, there are currently opportunities for biking, hiking, and walking along the existing Bay Trail system. All Feasible Alternatives will maintain existing public access to the current Bay Trail. Further, the Project Team assessed a variety of potential trail enhancements that would improve public access, including additional trail segments and amenities, through agency input and further discussions at the Trails and Public Access Stakeholder Meeting held on October 24, 2023 (Appendix A). In general, public access improvements are feasible as part of the Project subject to access easements and long-term maintenance agreements on lands not owned by Valley Water. In particular, all Feasible Alternatives will address the existing gap in the Bay Trail adjacent to the Alviso neighborhood by providing Project support for the planned Reach 9 trail segment (pink dashed line in Figure 3-9). In every Feasible Alternative, Valley Water will support the acquisition of easements for construction of the Reach 9 trail segment. Any temporary impacts on the Bay Trail due to Project construction activities will be minimized.

USFWS issues permits for waterfowl hunting on portions of the A8 Ponds, including access to Ponds A5, A7, A8, and A8S via an existing boat ramp in the southwestern corner of the A8 Ponds. USFWS allows hunting in the A8 Ponds for 3 days per week (Wednesday/Saturday/Sunday) during the hunting seasons. Although each Feasible Alternative will affect access to the boat ramp, all Feasible Alternatives include the potential relocation of the existing boat launch ramp to the accessible southeastern side of the A8 Ponds to maintain existing access for this recreational activity (Figure 3-10).

Because all the public access elements under consideration are common to all the Feasible Alternatives, implementation of the trail concepts under consideration does not influence selection of one alternative over another (see Section 3.5). To rank alternatives on the basis of public access, a decision was made to evaluate access using the length of non-Bay Trail pedestrian access along pond berms between the A8 Ponds and Alviso Slough, as well as the segment of the non-Bay Trail pedestrian access along marsh berms around Harvey Marsh (see Section 3.5.1).

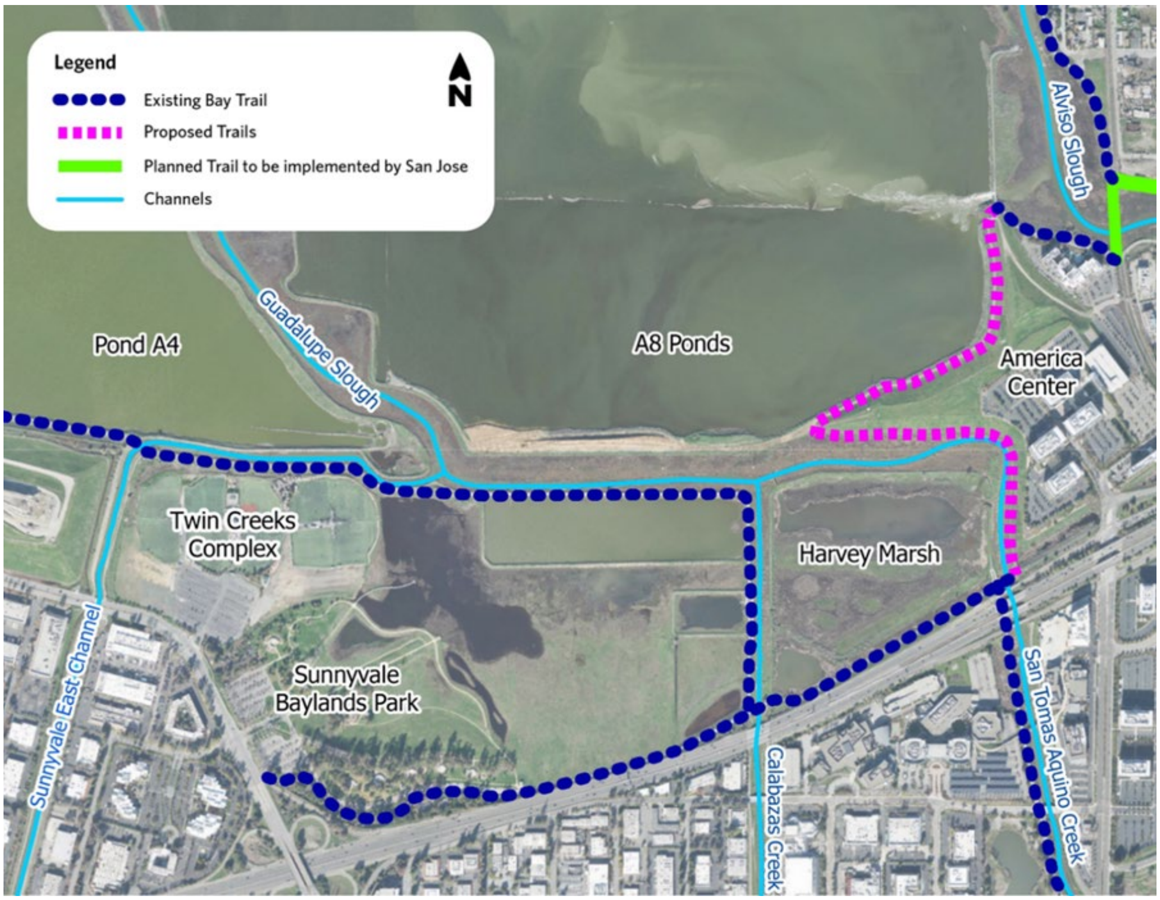


Figure 3-9. Existing and proposed trails in the Project Planning Area local to Calabazas and San Tomas Aquino creeks.

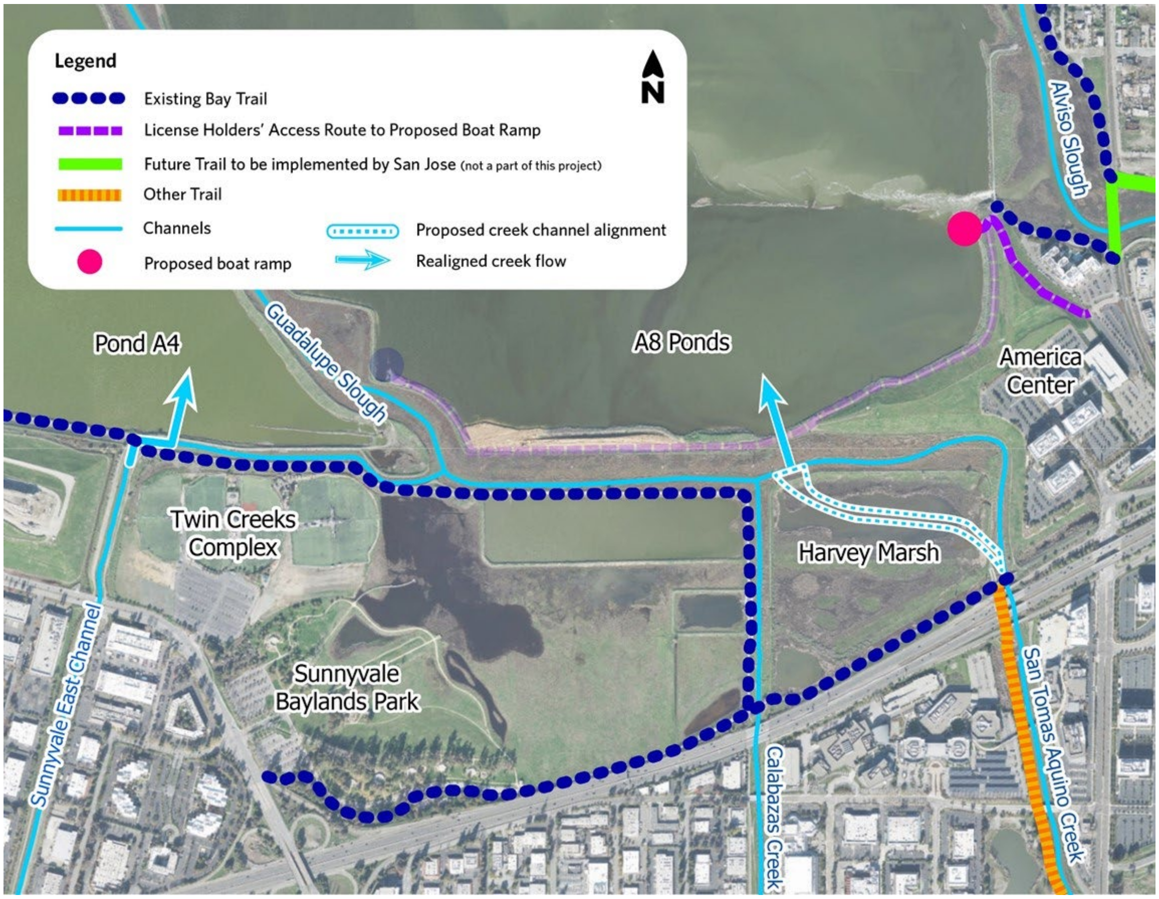


Figure 3-10. Proposed boat ramp relocation area.

3.5 Assessment Methodology

In accordance with Item 12F of the Valley Water Planning Process, an updated assessment methodology was developed to evaluate the Feasible Alternatives that emerged from the screening of Conceptual Alternatives (Stillwater Sciences 2024). A variety of multi-criteria decision support tools are available to inform environmental restoration project planning (e.g., Convertino et al. 2013). In general, these tools support solving complex problems and decision-making when many criteria and a shared understanding across multiple decision-makers are required. Consistent with Valley Water Planning guidelines, this process includes (1) formulating the problem or project, (2) identifying opportunities and constraints, (3) setting goals and objectives, (4) developing alternatives, (5) establishing criteria (or factors), and (6) identifying and applying an agreed-upon decision-making tool, process, or technique. Steps 1 through 3 were defined as part of the Valley Water (2021) feasibility study, with Steps 4 and 5 completed as part of Conceptual Alternatives screening (Stillwater Sciences 2024). As part of the Feasible Alternatives analysis, an updated assessment methodology was developed to complete Step 6 of the Valley Water Planning Process.

Because weighing potentially competing Project objectives inherently entails a value-based judgement, determining which factors should be considered and prioritized presents a considerable challenge. For example, identification of a preferred alternative may need to consider multiple competing goals, such as protecting habitats, or maintaining current levels of flood protection, while addressing needs of recreational users. To resolve this, Project objectives and assessment factors were assigned relative weights based on the results of a collaborative Analytic Hierarchy Process (Saaty 1980, 2008) adapted to the Project, which was used to provide a framework for scoring and comparing alternatives based on the extent to which they support each Project objective (Section 1.3). This process is a mathematical approach to multi-criteria decision-making that has been applied to a range of projects in solving large and complex decision problems (Saaty and Vargas 1994). To develop a rational and repeatable framework to select between alternatives, four steps of the Analytic Hierarchy Process were applied:

1. **Analytic hierarchy.** Initially, factors considered in a decision are identified and organized as a hierarchy of interrelated decision elements. Typically, this is visualized as a tree containing the overall decision or goal at the top and lower levels (tiers) of contributing criteria and sub-criteria.
2. **Pairwise comparisons.** To determine which factors are more important in reaching a decision, a series of pairwise comparisons is made among all the decision elements. This is generally arranged as a series of questions as to whether each factor is more or less important in decision-making compared with other factors within the same tier. Factors are then weighted on a numeric scale from 1 to 9 (Table 3-2).
3. **Weighting.** The eigenvalue method was used to estimate the relative importance (weights) of the decision factors being compared, which includes pairwise comparisons using a square matrix (see $B_{M \times M}$ example below). A factor compared with itself is always assigned the value 1, so the main diagonal entries of the pairwise comparison matrix are all 1. Below the main diagonal is the inverse of the pairwise comparisons. With the matrix completed, the relative normalized weight of each factor is calculated from the geometric mean of the i-th row, and by normalizing the geometric means of rows in the comparison matrix.

$$
\boldsymbol{B}_{M\times M}=\begin{array}{c} \boldsymbol{B}_1 \\ \boldsymbol{B}_2 \\ \boldsymbol{B}_3 \\ \vdots \\ \boldsymbol{B}_M \end{array}\begin{bmatrix} \boldsymbol{1} & \boldsymbol{b}_{12} & \boldsymbol{b}_{13} & \cdots & \cdots & \boldsymbol{b}_{1M} \\ \boldsymbol{b}_{21} & \boldsymbol{1} & \boldsymbol{b}_{23} & \cdots & \cdots & \boldsymbol{b}_{2M} \\ \boldsymbol{b}_{31} & \boldsymbol{b}_{32} & \boldsymbol{1} & \cdots & \cdots & \boldsymbol{b}_{3M} \\ \vdots & \vdots & \vdots & \vdots & \cdots & \vdots \\ \boldsymbol{b}_{M1} & \boldsymbol{b}_{M2} & \boldsymbol{b}_{M3} & \cdots & \cdots & \boldsymbol{1} \end{bmatrix}
$$

4. **Alternatives decision.** The relative weights of decision elements were then aggregated to arrive at a set of ratings for the alternatives under comparison. In Step 4 of the of the Analytic Hierarchy Process, only metrics and criteria at terminal branches of the hierarchy are assigned scores, with the results of the weighting exercise (Steps 1–3) used to arrive at a final score.

Table 3-2. Scale of Relative Importance.

Intensity of importance	Definition of factor importance	Explanation
1	Equal Importance	Two factors contribute equally to comparison
3	Moderate Importance	Experience and judgement moderately favor one factor over another
5	Strong Importance	Experience and judgement strongly favor one factor over another
7	Very Strong Importance	A factor is strongly favored and its dominance demonstrated in practice
9	Absolute Importance	The evidence favoring one factor over another is of the highest possible order of affirmation
2, 4, 6, 8	Intermediate values between the two adjacent judgements	When compromise is needed

Source: Saaty (1980)

In applying Analytic Hierarchy Process to the Feasible Alternatives assessment, individual factors used to assess the degree to which a Project objective would be realized were assigned scores from zero to one. Factors may be quantitative (e.g., habitat amounts, suitability based on water quality criteria) or may be more subjective and qualitative. Both qualitative and quantitative assessments may be used in performing the evaluations.

3.5.1 Assessment Factors

The selection of factors used to assess which Feasible Alternatives best meet the Project objectives included a variety of approaches, including physical process-based approaches, criteria-based approaches considering habitat needs of aquatic and terrestrial focal species, and ecosystem function approaches in response to changes in water movement, sediment and tidal dynamics, and inundation following Project implementation. At the highest tier in the Analytic Hierarchy Process, the following categories were assigned based on the identified Project objectives (Section 1.3) and preliminary costs for each alternative (Table 3-1):

- Promote ecological restoration
- Minimize flood risk
- Reduce sediment management needs
- Minimize impact on existing public access
- Decrease construction costs

At the second tier within each of the categories above, quantitative factors and associated metrics were developed based on initial brainstorming sessions conducted as part of the Conceptual Alternatives Analysis (Stillwater Sciences 2024). Refinements of these factors were based on the availability of hydrodynamic and sediment transport modeling results, and an increased understanding of post-restoration conditions. In keeping with guidelines provided by Saaty (2008), potential factors were omitted from the assessment of alternatives in some cases, including: judgements that the factor is only marginally relatable to changes following restoration, may produce similar assessment scores across all alternatives, may be highly correlated with other factors and thereby result in over-weighting of that factor, or that it cannot be accurately predicted across the alternatives based upon completed hydrodynamic modeling. Table 3-3 includes the 12 factors used to assess the degree to which each of the alternatives meets the identified Project objectives, including quantitative metrics and information sources.

Table 3-3. Assessment Factors and Associated Metrics.

Assessment factor	Metric definition	Data/information source
Promote ecological restoration		
1. Tidal marsh habitat under projected sea level rise	Sediment accumulation in A8 Ponds and Pond A4 (kg)	See Tables 6.1-1 and 6.2-1 in Anchor QEA (2024)
2. Isolated island habitat for nesting	Area of island/berm above estimated future tidal datums (MHHW +2 feet) under sea level rise (acre)	GIS estimates from preliminary designs in Schaaf & Wheeler (2024)
3. Scour-induced mercury mobilization	Area with >10 cm predicted scour inside of ponds, sloughs, and in lower Guadalupe River (acre)	See Table 6.1-2 in Anchor QEA (2024)
4. Tidal mixing	Area with >2% increase of WPCP origin water relative to baseline inside of ponds, sloughs, and local creeks (acre)	GIS areas for each alternative (see Figure 3-8) adapted from Anchor QEA (2024)
Minimize flood risk		
5. Flood risk during Guadalupe River events	Decrease from baseline WSEL under modeled high flows (feet)	See Table 7.1-2 at California Highway 237 in Anchor QEA (2024)
6. Tidal flood protection needs for Pond A4 berm	Increase in king tide WSEL in Pond A4 (feet)	See Table 7.1-1 at California Highway 237 in Anchor QEA (2024)
7. Tidal flood protection needs for the SEC levee	Decrease from baseline WSEL under modeled high flows (feet)	See Table 7.1-1 at California Highway 237in Anchor QEA (2024)

Assessment factor	Metric definition	Data/information source
Reduce sediment management needs		
8. Calabazas Creek sediment scour/deposition	Reduction in sediment removal needs in lower Calabazas Creek relative to Baseline	See Table 6.4-3 in Anchor QEA (2024)
9. STA Creek sediment scour/deposition	Reduction in sediment removal needs in lower STA Creek relative to Baseline	See Tables 6.4-1 and 6.4-2 (Alts. 1 and 6 only), and 6.4-3 (Alts. 3, 5, and 7 only) in Anchor QEA (2024)
10. SEC sediment scour/deposition	Reduction in sediment removal needs in lower SEC relative to Baseline	See Table 6.4-4 in Anchor QEA (2024)
Minimize impact on existing Public access		
11. Minimize impacts on existing access/recreational opportunities	Total unimpacted non-Bay Trail pedestrian trail length along Alviso Slough berm within Pond A8 and around Harvey Marsh (feet)	GIS estimates from preliminary restoration alternative designs included in Schaaf & Wheeler (2024)
Lowest construction costs		
12. Construction costs	Preliminary cost estimates for each alternative ($)	See Table 3-1, adapted from Schaaf & Wheeler (2024)

Notes: $ = 2024 US dollars
% = percent
cy = cubic yard
GIS = Geographic Information System
kg = kilogram
MHHW = mean higher high water
STA = San Tomas Aquino
SEC = Sunnyvale East Channel
WPCP = Sunnyvale Water Pollution Control Plant
WSEL= water surface elevation level

3.5.2 Weight of Factors

Weighting of the selected assessment factors was based on input from consultant team members, Project Partners, and subject matter experts using the best professional judgment of individuals as well as in a group workshop setting. On December 14, 2023, the Project Team held an Assessment Methodology Workshop (Appendix B) where participants (1) reviewed the proposed approach to ranking Feasible Alternatives, (2) reached consensus on the inclusion of factors to be used in the assessment, and (3) developed relative importance of individual factors (weighting).

Workshop participants were asked to fill out a worksheet to describe the relative importance of each assessment factor in meeting Project objectives based on their best professional judgment. Weighting was conducted in a two-step process:

1. Individuals conducted pairwise comparisons of the relative importance of each assessment factor as it related to Project objectives using the Analytic Hierarchy Process, as described above, and their best professional judgement.
2. Within each pair of assessment factors, participants then indicated which contributes more to meeting each Project objective based on the Saaty Scale (see Table 3-1; Saaty 1980). For example, if two factors contribute equally to a decision, then they would receive a ‘1’ on the Saaty Scale.

Following the workshop, the pairwise comparison worksheets from 17 participants were compiled to develop composite weighting for the 12 assessment factors[6] listed in Table 3-3. Figure 3-11 provides a graphical representation of the weighting of each assessment factor grouped by Project objectives and cost.

[6] Note: An additional factor was originally proposed to consider the amount of active habitat management required (e.g., operation and maintenance, pump/gate maintenance) and was included in the weighting worksheets (Appendix B). However, because the costs used to quantify this factor could not be reliably estimated, this factor was discarded and weighting was calculated on the basis of the remaining 12 factors.

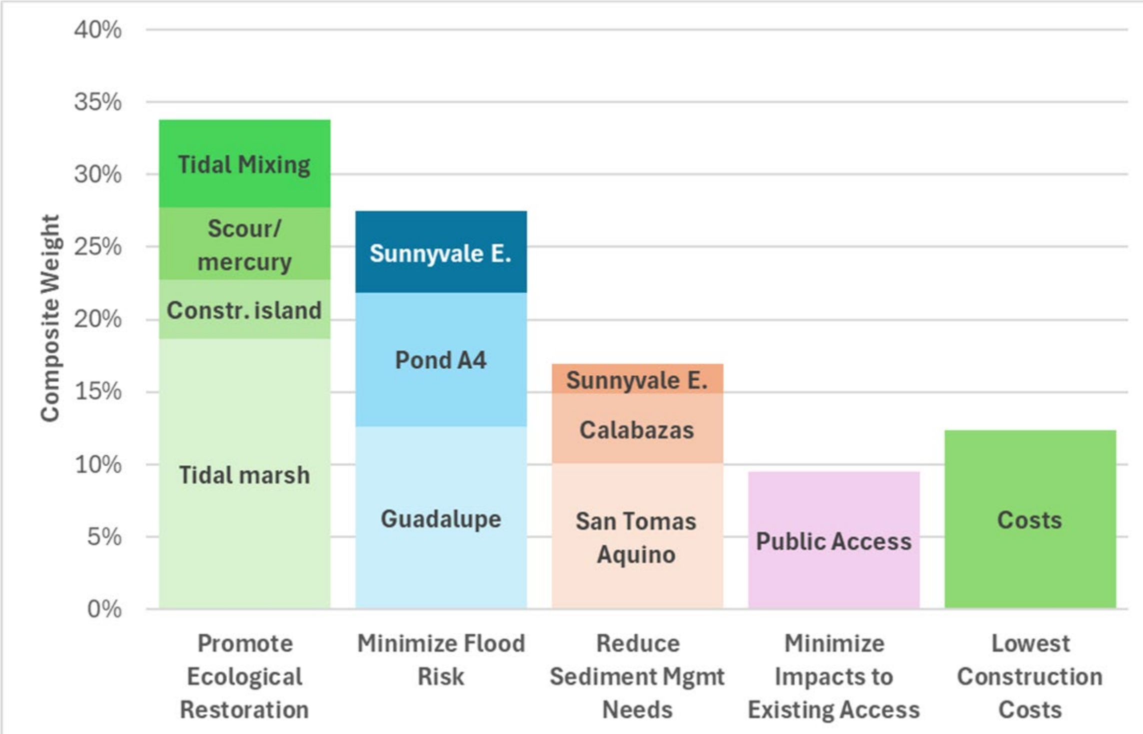


Figure 3-11. Assessment Factor Weights by Project Objective and Cost.

3.5.3 Scoring and Ranking of Feasible Alternatives

Following the December 14, 2023, Assessment Methodology Workshop and completion of weighting of individual assessment factors, each of the Feasible Alternatives were scored based upon the selected metrics (Table 3-4). Design information (Section 3.1), cost estimates (Section 3.2), modeling results (Section 3.3), and Geographic Information System analyses were used to calculate the metrics with the worst- and best-performing alternative's result assigned a raw score 0 and 1.0, respectively, establishing the overall metric range used to determine scores of other alternatives by proportion. The weighted scores were calculated by multiplying the individual scores by the corresponding weights through the hierarchy. The overall ranking for each alternative was determined by summing the weighted scores across all factors (Table 3-4).

Table 3-4. Alternatives Scoring and Overall Rankings by Assessment Factor.

Assessment factor/metric	Scoring	Factor weight	Metric and scoring	Alternative 1	Alternative 3	Alternative 5	Alternative 6	Alternative 7
Promote ecological restoration								
1. Tidal marsh habitat under projected sea level rise Metric: Modeled sediment accumulation in the A8 Ponds and Pond A4 (kg)	Score from lowest (0) to highest (1) as a % of maximum mass	0.1863	Mass ($kg x 10^7$)	6.82	8.49	8.17	8.26	8.16
			Raw Score	0.00	1.00	0.81	0.86	0.80
			Weighted Score	0.00	0.19	0.15	0.16	0.15
2. Isolated island habitat for nesting Metric: Area above future tidal datums under sea level rise (MHHW+2 feet) (acre)	Score from lowest (0) to highest (1) as a % of maximum area of constructed islands	0.0407	Area (acre)	7.9	0.0	7.9	0.0	5.3
			Raw Score	1.00	0.00	1.00	0.00	0.67
			Weighted Score	0.04	0.00	0.04	0.00	0.03
3. Scour-induced mercury mobilization Metric: Area with >10 cm predicted scour (acre)	Score from highest (0) to lowest (1) as a % of maximum scour area	0.0501	Area (acre)	63.9	79.6	77.0	78.7	74.6
			Raw Score	1.00	0.00	0.17	0.06	0.32
			Weighted Score	0.05	0.00	0.01	0.00	0.02
4. Tidal mixing Metric: Area with >2% increase of WPCP origin water relative to baseline (acre)	Score from highest (0) to lowest (1) as a % of maximum area of >2% WPCP origin water	0.0604	Area (acre)	1,155	297	1,101	368	307
			Raw Score	0.00	1.00	0.06	0.92	0.99
			Weighted Score	0.00	0.06	0.00	0.06	0.06

Assessment factor/metric	Scoring	Factor weight	Metric and scoring	Alternative 1	Alternative 3	Alternative 5	Alternative 6	Alternative 7
Minimize flood risk								
5. Flood risk during Guadalupe River events Metric: Modeled decrease from Baseline WSEL at California Highway 237 under modeled high flows (feet)	Score from lowest (0) to highest (1) as a % of maximum decrease relative to baseline	0.1263	Water Level (feet)	0.4	0.7	1.9	0.6	0.5
			Raw Score	0.00	0.20	1.00	0.13	0.07
			Weighted Score	0.00	0.03	0.13	0.02	0.01
6. Tidal flood protection needs for Pond A4 berm Metric: Modeled increase in king tide WSEL in Pond A4 (feet)	Score from highest (0) to lowest (1) as a % of maximum increase in king tide WSEL	0.0923	Water Level (feet)	4.3	5.8	6.4	5.6	5.6
			Raw Score	1.00	0.29	0.00	0.38	0.38
			Weighted Score	0.09	0.03	0.00	0.04	0.04
7. Tidal flood protection needs for the SEC levee Metric: Modeled decrease from Baseline WSEL at Caribbean Dr. under modeled high flows (feet)	Score from lowest (0) to highest (1) as a % of maximum decrease relative to baseline	0.0562	Water Level (feet)	1.3	2.2	1.6	2.4	2.4
			Raw Score	0.00	0.82	0.27	1.00	1.00
			Weighted Score	0.00	0.05	0.02	0.06	0.06
Reduce sediment management needs								
8. Calabazas Creek sediment scour/deposition Metric: Difference between baseline sediment accumulation in Calabazas Creek to accumulation under each alternative (kg)	Score from highest (1) to lowest (0) as a % of maximum reduction[1]	0.0481	Mass (kgx10^6)	0.36	0.38	0.37	0.37	0.26
			Raw Score	0.85	1.00	0.91	0.90	0.00
			Weighted Score	0.04	0.05	0.04	0.04	0.00

Assessment factor/metric	Scoring	Factor weight	Metric and scoring	Alternative 1	Alternative 3	Alternative 5	Alternative 6	Alternative 7
9. STA Creek sediment scour/deposition Metric: Difference between baseline sediment accumulation in STA Creek to accumulation under each alternative (kg)	Score from highest (1) to lowest (0) as a % of maximum reduction[1]	0.1005	Mass (kgx10^6)	0.81	0.04	0.10	0.83	0.14
			Raw Score	0.97	0.00	0.07	1.00	0.13
			Weighted Score	0.10	0.00	0.01	0.10	0.01
10. SEC sediment scour/deposition Metric: Difference between baseline sediment accumulation in SEC to accumulation under each alternative (kg)	Score from highest (1) to lowest (0) as a % of maximum reduction[1]	0.0207	Mass (kgx10^6)	0.07	0.11	0.09	0.11	0.10
			Raw Score	0.00	0.88	0.58	1.00	0.79
			Weighted Score	0.00	0.02	0.01	0.02	0.02
Minimize impact on existing public access								
11. Minimize impacts to existing access/ recreational opportunities Metric: Non-Bay Trail pedestrian trail length along Alviso Slough within Pond A8 and around Harvey Marsh (feet)	Score from lowest (0) to highest (1) based upon % of maximum decrease relative to baseline	0.0946	Trail Length (feet)	20,815	5,078	--	5,078	8,598
			Raw Score	1.00	0.15	0.00	0.15	0.26
			Weighted Score	0.09	0.01	0.00	0.01	0.02

Assessment factor/metric	Scoring	Factor weight	Metric and scoring	Alternative 1	Alternative 3	Alternative 5	Alternative 6	Alternative 7
Lowest construction costs								
12. Construction costs Metric: Preliminary cost estimates ($)	Score from highest (0) to lowest (1) as a % of maximum costs for all alternatives	0.1238	Cost (USD)	$35,873,000	$30,883,000	$47,038,000	$26,831,000	$40,878,000
			Raw Score	0.55	0.80	0.00	1.00	0.30
			Weighted Score	0.07	0.10	0.00	0.12	0.04
Overall Weighted Score:				**0.49**	**0.52**	**0.41**	**0.63**	**0.44**
Overall Rank:				**3**	**2**	**5**	**1**	**4**

Notes: $ = 2024 US dollars
% = percent
cy = cubic yd
kg = kilogram
SEC = Sunnyvale East Channel
STA = San Tomas Aquino
WPCP = Sunnyvale Water Pollution Control Plant
WSEL= water surface elevation level

[1] Mass estimates and scores represent reduction in sediment management compared with baseline conditions (i.e., higher mass and scores for net reduction represent lower absolute amounts of future sediment removal require).

3.6 Preliminary Recommended Alternative

Although each of the Feasible Alternatives meets the Project objectives to varying degrees, Alternative 6 is the top-ranked alternative overall and represents the lowest overall preliminary construction cost and projected future sediment removal needs. Consistent with the Valley Water Planning Process and USACE 404 permitting guidelines at 40 CFR 230.10(a) regarding selection of the Least Environmentally Damaging Practicable Alternative, each of the alternatives would result in temporary construction impacts on Waters of the U.S. (as defined as 40 CFR 230.3(s)) to achieve the overall Project objectives, including excavation of berm breaches and construction of restoration elements within the A8 Ponds and Pond A4. Although temporary impacts of Alternative 1 would be lower than Alternative 6 due to lower numbers of breaches into Guadalupe and Alviso sloughs, Alternative 1 would have the lowest projected future tidal marsh habitat under projected sea level rise and lowest flood risk reduction during simulated Guadalupe River flood events when compared with all other alternatives. As a result, Alternative 6 represents the Least Environmentally Damaging Practicable Alternative for planning and future permitting purposes.

3.7 Public Outreach on Feasible Alternatives

Consistent with Valley Water's Planning Process, public outreach and public meetings were conducted during the development and ranking of Feasible Alternatives. Public access and trail improvements associated with this Project were shared at a meeting with Project Partners and stakeholder agencies on September 27, 2023. Stakeholder agencies' comments were solicited regarding public access amenities and the opportunities and challenges in developing the public access elements of the Project. Agency input gathered in September 2023 was used to further develop the public access and trails concepts shared at the Trails and Public Access Stakeholder Meeting held on October 24, 2023. Representatives from the Citizens Committee to Complete the Refuge, City of Santa Clara Bicycle and Pedestrian Advisory Committee, South Bay Yacht Club, and USFWS provided input on public access and trails (Appendix A).

To ensure equitable consideration and equal access to the planning and decision-making process, the Project Team held a public meeting on the Feasible Alternatives on May 15, 2024, to invite Project Partners and stakeholders to provide feedback on the refined alternatives (Section 2), assessment results, and preliminary alternative rankings (Appendix A). The meeting also included discussion of modeling results, cost estimates, and public access considerations. Lastly, additional refinements to the preliminary recommended alternative, including the final breach locations for Alternative 6 (Section 2.4), were also shared as part of a stakeholder agency meeting held on September 18, 2024. Agency and public comments received will be used to inform decisions on the Staff-Recommended Alternative as well as future decisions regarding public access and additional restoration elements that may be developed.

4 SUMMARY OF FINDINGS AND NEXT STEPS

Through a combination of agency and public outreach used to refine initial Conceptual Alternatives for the Project, this Feasibility Analysis examined the support of Project objectives for five Feasible Alternatives based on geospatial analysis, hydrodynamic and sediment transport modeling, and engineering design. Implementation of Alternative 6 was found to provide the following benefits compared with the other alternatives:

- Increased capture and recruitment of suspended sediments arriving from SF Bay and tributary creeks to the former salt marsh enclosed by the A8 Ponds and Pond A4, supporting tidal marsh habitat restoration and limiting the degree of scour-induced mercury mobilization.
- Increased tidal mixing throughout the Project Planning Area, including small increases in salinity as well as broader distribution of residual nutrients from the Sunnyvale WPCP.
- Increased tidal prism across the Project Planning Area, which was shown to reduce tidal ranges and the potential for flooding in the lower reaches of the Guadalupe River, Alviso Slough, STA Creek, Calabazas Creek, SEC, SWC, and Guadalupe Slough.
- Reduced sediment accumulation in lower Calabazas and STA creeks, as well as SEC.
- Increased opportunities for public access through support of future implementation of the Reach 9 Bay Trail segment.

Although all the remaining alternatives met the Project objectives to varying degrees through re-establishment of fluvial and tidal connectivity to the A8 Ponds and Pond A4, the Preliminary Recommended Alternative (Alternative 6, Figure 2-4) would achieve these objectives while providing the greatest reductions in sediment accumulation in lower STA and Calabazas Creeks at the lowest overall estimated construction cost.

4.1 Planning Study and Staff-recommended Alternative Report

In the final phase of the Valley Water Planning Process (Phase 3), the Preliminary Recommended Alternative will be refined further and documented in a combined Planning Study and Staff-recommended Alternative Report. A summary of the overall selection process and any selection criteria used beyond those described in this Feasible Alternatives Report will be documented in the Planning Study and Staff-recommended Alternative Report. It is expected that future Project design and permitting, including additional public access improvements will be informed by input from key Project Partners, public resource agencies, regional planning agencies, tribal representatives and the public.

4.2 Modeling of Future Habitat Conditions with Sea Level Rise

Following selection of the Staff-recommended Alternative, additional modeling will be undertaken to analyze sediment accumulation and changes in tidal marsh habitat under projected sea level rise assumptions. Additionally, hydraulic modeling will be used to examine changes in peak WSELs and flood risk during fluvial, coastal, and Guadalupe River flood events.

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Appendices

Appendix A

Agendas and Notes from Stakeholder and Community Outreach Workshops and Meetings

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Agenda from Public Access Stakeholder Meeting on October 24, 2023

Calabazas/San Tomas Aquino Creek Marsh Connection Project

Project Partners and Local Agencies Meeting

October 24, 2023
5:30 – 7:00 p.m.

LOCATION: South Bay Yacht Club (1491 Hope Street, Alviso, CA 95002)
ZOOM:
https://kearnswest.zoom.us/j/89626777534?pwd=zeabnZfvm7Iv6VJNzctAXepuJ7cmCT.1
MEETING ID: 896 2677 7534 (Passcode: 210447)
CALL IN (audio only): (669) 444-9171 (Conference ID: 210447#)

MEETING OBJECTIVES:

- Share Project overview, including objectives, process to-date and schedule.
- Provide context and background about trails and public access in the Project area and describe the trail concepts under consideration.
- Gather questions and input from stakeholders and build understanding around their trails and public access interests.

Agenda

5:30 p.m. – 5:45 p.m. Welcome, Opening Remarks, Agenda Review

5:45 p.m. – 6:10 p.m. Project Overview

- Project Objectives, Area, and Schedule
- Overview of Conceptual Alternatives
- Q&A and Discussion

6:10 p.m. – 6:50 p.m. Trails and Public Access Overview and Concepts

- Context Setting and Background
- Concepts
    - Trail Concept 1 – Proposed Reach 9
    - Trail Concept 2 – Proposed Reach 9 with Harvey Marsh Viewing Platform
    - Maintaining Recreation and Pond Access
- Q&A and Discussion

6:50 p.m. – 7:00 p.m. Wrap-Up and Next Steps

7:00 p.m. Adjourn

Meeting Summary for Public Access Stakeholder Meeting on October 24, 2023

Calabazas/San Tomas Aquino Creek-Marsh Connection Project
Stakeholder Meeting
Draft Meeting Notes

DATE/TIME: Tuesday, October 24, 2023; 5:30 PM - 7:00 PM

MEETING LOCATION: South Bay Yacht Club (1491 Hope Street, Alviso, CA 95002)
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https://kearnswest.zoom.us/j/89626777534?pwd=zeabnZfvm7Iv6VJNzctAXepuJ7cmCT.1
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MEETING NOTES:

Opening Remarks
The Calabazas/San Tomas Aquino Creek-Marsh Connection Project (Project) Stakeholder Meeting commenced with Kelsey Rugani, Kearns & West, facilitating and welcoming participants to the meeting. Kelsey shared that the purpose of the meeting was to provide an update on the progress of the Project and to have a discussion focused on trails and public access.

Lisa Bankosh, Santa Clara Valley Water District (Valley Water), shared opening remarks. Lisa outlined the Project's four objectives, noting that the primary focus is on ecological restoration. Of note is the goal to enhance public access, the central theme for today's meeting. Lisa presented the trails and public access opportunities that the Project is exploring and thanked the City of San Jose and other Project Partners for their close coordination and participation. Lisa reminded participants of Valley Water's role in providing resources for public access trails wherein they rely on the municipal partners (City of San Jose here) for post-construction operations, patrols, and trail maintenance.

Kelsey reviewed the meeting agenda, setting a clear schedule for what topics will be discussed, when Q&A would take place and that the meeting would conclude by 7:00 PM. Kelsey reiterated that the meeting's goal is to share Project information and gather input on trails, recreation, and public access. Ground rules were outlined, and it was mentioned that sticky notes for input were available on poster boards for in-person attendees.

Project Overview
Noah Hume, Stillwater Sciences, presented an overview of the Project objectives, conceptual alternative development process, and the planning timeline. Noah mentioned the visioning effort in 2018 and securing over $3 million in Measure AA grant funding from the San Francisco Restoration Authority. The Project, initiated a year ago

in the South Bay salt ponds, has the primary goal of restoring tidal habitat connectivity and various marsh and riverine habitats and four key objectives. The Project timeline involves the development of over 20 conceptual alternatives, narrowed down to five; currently the project is initiating the feasibility analysis and there will future agency and public meetings to present the ranked feasible alternatives, which will include the recreational changes under discussion. Noah mentioned the next public meeting will focus on the feasible alternative and will take place in Winter or Spring 2024. Conceptual maps/diagrams of the Project's conceptual alternatives were presented, showing locations of restoration elements like berm breaches, island habitat features, and active creek re-alignment vs passive (breach only) restoration approaches in Harvey Marsh. Other Projects in the area were mentioned, such as the Pond A4 Resilient Habitat Restoration Project, and the larger South Bay Salt Pond Restoration Project, which serves as a Project partner and close collaborator with Valley Water.

Q&A:
Kelsey welcomed discussion and questions related to the Project overview. Attendees were encouraged to seek clarification on Project objectives, conceptual alternatives development process, the timeline, and the future direction of the Project.
The following summarizes the questions asked from attendees both in the meeting room and in the virtual Zoom audience.

- **Roy Hays, South Bay Yacht Club -** *I notice there's a number of new gaps on the Alviso slough side of the pond and there's no new gaps on the Guadalupe slough side. Was there a reason for that?*
    - Stillwater Sciences shared the alternatives considered for the Project, focusing on the placement of berm breaches. The project explored various options for the restoration elements, including examining impacts of breaches on only Guadalupe slough, only Alviso slough or breaches on both sloughs. Preliminary modeling revealed that though the SF Bay was providing the most sediments through the breaches at the existing WCS, the Alviso slough breaches were more successful at delivering sediments to the ponds than breaches on the Guadalupe slough side of the A8 Ponds.
- **Eileen McLaughlin, Citizens Committee to Complete the Refuge -** *Will today's presentation be made available?*
    - Kearns & West stated the presentation will be available after the meeting and invited participants to reach out to the Project Team with any questions that may come up after today.
- **Melisa Amato, U.S. Fish and Wildlife Service (USFWS) and San Pablo Bay National Refuge -** *It looks like the Project is proposing to make Ponds A5, 7, and 8 fully tidal. Is that correct? Are there going to be any water control structures associated with those breaches?*

    - Stillwater Sciences discussed the existing water control structures at Ponds A4, A7. As well as the large A8 notch WCS south of the SBYC near the America Center. They explained that the current condition of the ponds is referred to as muted tidal, with a tidal range of approximately 2 feet. However, depending on the number and location of breaches implemented, there is a likelihood that the tidal range will expand. Further modeling work is ongoing to better understand these dynamics.
    - The tidal effect in the ponds is anticipated to be less than the tidal range observed in the sloughs, which is around 4 feet or more.
    - Melisa highlighted the current use of ponds A5, A7, A8, and A8 South for waterfowl hunting on the refuge. The levees surrounding these ponds are exclusively accessible to hunters. She stressed the need for the Project to consider this usage, especially if the Bay Trail is expanded. They also requested clear signage to inform both waterfowl hunters and trail users about ongoing activities in the area, emphasizing the importance of balancing different activities within the Project vicinity.
- **Eileen McLaughlin, Citizens Committee to Complete the Refuge** - *Are the breaches going to be controlled by gates?*
    - Stillwater Sciences clarified that the planned breaches will be open and not gated or maintained; the USFWS currently lacks funding to maintain the existing berms or the planned breaches. The existing aging water control structures at Ponds A5 and A& in the northern area of the A8 Ponds, are near the end of their operational life. If/when these structures fail, the ponds will naturally convert to tidal habitats. The Project offers a controlled approach to manage this transition, as opposed to unintentional, natural breaching of the berms where timing, location and breach size is uncertain.

Trails and Public Access Overview and Concepts

Context Setting and Background

Kelsey initiated discussion of trails and public access within the Project area by providing an overview of the existing recreation and access in the area, noting the San Francisco Bay Trail system which provides opportunities for biking, hiking and walking. When completed, the Bay Trail will be a 500-mile transportation and recreation route connecting Napa and Sonoma Counties to Santa Clara County. The Bay Trail segments within the Project vicinity are natural surfaced while connecting trails are paved. Additionally, an existing social trail encircles the berm around Harvey Marsh, and a waterfowl hunting boat launch and check station are located in the southwest section of the A8 ponds.

Kelsey outlined some of the opportunities and challenges the Project Team is considering. The Project is excited to partner in the opportunity to add a one-mile trail segment (Reach 9) connecting Sunnyvale and Alviso. This segment would bridge a portion of the existing gap in the Bay Trail, bringing the Trail closer to the Bay and improving connectivity to and from the Alviso neighborhood. The Project will also be able to bring visitor amenities to the Bay Trail such as benches and interpretive signage which will improve wildlife and open water viewing opportunities.

The Project is currently evaluating how to balance multiple Project objectives, including balancing habitat restoration with public access, including maintaining A8 ramp access post-project and establishing buffers between trails and habitats. Continuous use of the Bay trail during construction is a vital considerations. Future maintenance costs will also be considered in project planning.

Kelsey mentioned that the Project Team has met with Project Partners and Local Agencies regularly over the last year to share updates and collect input. The Project Team also began hearing some initial community interests and is looking forward to learning more tonight and in the future.

Trail Concepts

Melissa Lane, Stillwater Sciences, provided an overview of public access enhancements and began by discussing potential changes in pond access. Melissa noted the presence of an existing waterfowl hunters' boat launch area in the southwest corner of the ponds, which would become isolated by proposed breaches from Harvey Marsh into the A8 Ponds. The relocation of the boat ramp is under consideration, with one idea being to move it to the southeast corner, though the exact location will be determined in consultation with the landowner, USFWS.

Melissa then introduced two trail concepts. Trail Concept 1 involves a one-mile trail segment called Reach 9, which has already been planned and approved by the City of San Jose as a paved bikeway. This leverages existing plans and provides support for future funding. Liz Sewell from the City of San Jose shared additional background on the Reach 9 planning process.

Trail Concept 2 is similar to Trail Concept 1, and also includes a viewing platform for the public to observe the A8 ponds, Harvey Marsh, and the flow through the berm breach. Notably, the pond breaches associated with the Project's restoration alternatives do not impact either trail option. Both concepts address various opportunities and challenges related to enhancing public access, such as reducing the Bay Trail gap, relocating it closer to San Francisco Bay, and improving wildlife viewing while ensuring continuous Bay Trail use during construction and providing buffer zones for the newly restored habitat. Feedback from the recent environmental community meeting has been crucial in shaping these concepts.

Q&A and Discussion

The following summarizes the questions asked from attendees both in the meeting room and in the virtual Zoom audience.

- **Mark Yoder, Citizen -** *I'm curious about the access for canoe and kayaks into the ponds.*

  - Stillwater Sciences explained that the ponds are currently off-limits to canoes and kayaks, a restriction that will continue due to hunting activities.
  - South Bay Yacht Club commented on the possibility of kayak and canoe access, which they had previously discussed with Valley Water regarding the old Blue Whale Sailing School property. While there was initial interest in the idea, the challenge revolved around determining who would manage it. South Bay Yacht Club mentioned their interest in revisiting this concept if circumstances permit. The property once had a launch dock and a small ramp for canoes due to its prior use by the Blue Whale Sailing School. Therefore, it's a feasible option for such access.
- **Eileen McLaughlin, Citizens Committee to Complete the Refuge** Concerns about trail's impact on wildlife habitats in the refuge were expressed, emphasizing the Refuge Improvement Act's priority for wildlife benefits and compatibility determinations. Discrepancies in trail plans and interactions with the refuge were highlighted.
  - Stillwater Sciences clarified that the trail is located on private property, and the City is working to obtain an easement from America Center. The Project involves partnering with USFWS and ongoing discussions will focus on addressing property boundary complexities.
  - A member of the public, initially concerned, expressed skepticism about property ownership.
  - The response mentioned the ongoing boundary survey needs to determine property ownership and emphasized coordination with stakeholders, including USFWS. The City of San Jose shared historical context about past trail planning and expressed their intention to contact USFWS for further discussions.
  - San Pablo Bay National Wildlife Refuge shared important context and concerns, emphasizing that some of the proposed breaches could remove foot access for hunters, which would affect approximately 1,300 acres of hunting areas. Furthermore, the proposed location for a boat ramp coincides with the intended site for a new Bay trail. San Pablo Bay National Wildlife Refuge pointed out the potential for conflict if the public encounters a boat ramp since the refuge currently lacks a compatibility determination for public boating in these ponds. These comments highlight the need to address the potential impact on hunting access and public use while respecting the established compatibility determinations for the area.
  - Valley Water addressed San Pablo Bay National Wildlife Refuge concerns about pond access, explaining that the berms around the A8 Ponds are not engineered levees. Over time, these berms are deteriorating, which could affect access for hunters whether the restoration Project is conducted or not. The goal of the Project is to restore the ponds while

also increasing public access and maximizing the length of foot accessible berms was part of meeting that objective. It was emphasized that there are no plans by USFWS to maintain the A8 Ponds berms over the long-term.

- **Betsy Megas, City of Santa Clara Bicycle and Pedestrian Advisory Committee (BPAC) -** *What impacts, if any, are anticipated towards creeks in the Project area?*
    - Stillwater Sciences clarified that the Project aims to connect existing trails, which would enhance the trail system without causing adverse effects on the current trails. The Project's boundary includes some tributary creeks and areas.
- **Eileen McLaughlin, Citizens Committee to Complete the Refuge** - *I hope that the City of San Jose will consider the ecological restoration aspect, emphasizing that such efforts take time, including land-building, vegetation growth, and the return of endangered species like the Ridgway's rail. I caution against rushing trail construction, because of the potential negative impact on wildlife habitats. We need to balance the desire for trails with the necessary time for habitat development and planning trail development carefully to create vibrant wildlife habitats while addressing potential challenges and timeframes involved.*
    - Stillwater Sciences mentioned the disturbed grasslands on the America Center (former landfill) and the need to protect the landfill cap integrity will mean that no restoration actions will be conducted in this area. They expressed the challenge of balancing restoration goals with the desire to create a trail for public use. They acknowledged the current unofficial use of the area by people and the potential changes in public uses if breaches are chosen in specific locations.
- Additionally, meeting participants expressed concerns about the appeal and functionality of the proposed Reach 9 trail segment, stating that it lacks commuter appeal, offers an indirect route, and doesn't effectively connect residential and commercial centers. Some suggested that the trail might primarily serve occasional recreational use and be better suited for wildlife viewing.
- Lastly, concerns were raised about the proposed new boat launch location, emphasizing the potential danger due to the strong water flow near the weir, particularly during the winter. Even a minor mistake by a boater could lead to a dangerous situation with the A8 notch. Stillwater emphasized that ramp relocation will be coordinated with USFWS staff.

Next Steps

Kelsey reviewed the following next steps:

- The next public meeting focused on the feasible alternative will be scheduled for some time in Winter 2024.

- The meeting presentation and recording will be made available to invitees and participants via email.
- Meeting participants are encouraged to reach out to the Project Team with any questions:
    - Judy Nam, Valley Water: JNam@valleywater.org
    - Noah Hume, Stillwater Sciences: noah@stillwatersci.com
    - Melissa Lane, Stillwater Sciences: mlane@stillwatersci.com
    - Kelsey Rugani, Kearns & West: krugani@kearnswest.com

Conclusion & Closing Remarks:
Kelsey Rugani expressed gratitude to the presenters and all the stakeholders for their participation in the meeting. Kelsey encouraged meeting participants to contact the Project Team if they had any further questions and formally closed the meeting.

Agenda from Public Meeting on May 15, 2024

Public Meeting
Calabazas/San Tomas Aquino Creek-Marsh Connection Project
May 15, 2024

WELCOME
5:30 p.m.
The Honorable Richard Santos
Director, District 3
Valley Water Board of Directors

Mike Potter
Valley Water

INTRODUCTIONS AND BACKGROUND
5:40 p.m.
John Bourgeois
Deputy Operating Officer, Watershed Stewardship and Planning
Valley Water

Noah Hume
Aquatic Ecologist/Senior Scientist, Stillwater Sciences

PRELIMINARY RECOMMENDED ALTERNATIVE
5:50 p.m.

Noah Hume
Aquatic Ecologist/Senior Scientist, Stillwater Sciences

Michael MacWilliams
Partner and Principal Engineer, FlowWest, LLC

PUBLIC COMMENT
6:40 p.m.

NEXT STEPS AND ADJOURN
7:00 p.m.

IN PARTNERSHIP WITH AND FUNDED BY:

Notes from Public Meeting on May 15, 2024

Calabazas/San Tomas Aquino Creek-Marsh Connection Project
Public Meeting Notes

Location: Alviso Branch Library 5050 North 1st Street, San Jose, CA

Format: In-person and Virtual (Zoom)

Date/Time: May 15, 2024, 5:30 to 7:00 PM

Summary

Mike Potter, Valley Water opened the meeting and welcomed in-person and virtual attendees.

Richard Santos, Vallet Water Board of Directors welcomed the public to Alviso and spoke of the importance of this project.

John Bourgeois, Valley Water, summarized the meeting purpose and the project's relationship to South Bay Salt Pond Restoration Project (SBSPRP). Both projects have common objectives. He also introduced the Project team.

Noah Hume, Stillwater Sciences, discussed project location, objectives, and the planning process. He proceeded to describe potential restoration elements considered and Project Alternatives 1, 3, 5, 6, and 7 developed by the Project team. He described the alternatives analysis process and assessment methodology used to rank alternatives.

Michael MacWilliams, Flow West, presented modeling results by alternative for sediment accretion, erosion and scour, water quality, and water surface elevations.

Michael, In-person member of audience, asked if creek flow paths affected deposition. Dr. MacWilliams answered yes it did. Realignment of San Tomas Aquino (STA) Creek results in reduced sediment accretion in southern A8 Ponds, where it is needed due to distance to Bay and thus minimal amount go Bay sediment inflow. Michael asked if the location of sediment deposition was important. John Bourgeois replied yes, we need sediment in deeply subsided subsided A8 Ponds to facilitate tidal marsh development.

Melissa Lane, Stillwater Sciences, presented public access enhancements common to all alternatives, especially buildout of Reach 9 of the Bay Trail.

Chuck Anderson, Schaff & Wheeler, presented estimates of construction cost for each alternative.

Noah Hume presented an overview of the alternative evaluation methodology and preliminary rankings of the alternatives. Alternatives 3 and 6 rafted highest with Alternative 6 slightly better.

Michael, audience member, asked about the value of berm degrades. Noah responded that the internal berms within the A8 Ponds restrict flow of water and sediment. Removing small sections of berm would improve circulation and help sediment spread throughout the ponds.

Barbara, audience member, stated that she used to see large numbers of pelican in the area, but they have disappeared since construction started. Dave Halsing, SBSPRP, said he was probably seeing construction of the nearby South San Francisco Bay Shoreline Protection Project. It is a U.S. Army Corps of Engineers project to provide flood risk reduction. It has some temporary construction impacts on wildlife but will enhance large area of habitat. In the long run conditions will be better for birds and wildlife, even if there is some short-term impact. The Calabazas/STA Creek-Marsh connection project will have similar construction-period impacts but will also provide net long-term benefits to wildlife.

Michael, audience member: Will ecotone require fill placement? Noah replied yes but we try to balance cut and fill amounts during design and re-use material as much as possible. John B. added that we need to balance the value of any features with the cost of constructing it.

Michael, audience member: Will adaptive management be used? John B. stared yes, we will be following the lessons learned from SBSPRP which extensively used adaptive management to maximize benefits to habitat and wildlife.

Zoom Question: Can this project provide mitigation credit to external agencies that provide funding? John B. Replied that VW needs any mitigation credits the project earns to cover our own operations so credits may not be available. Having said that, John is open to discussing this with external agencies and they should contact him directly.

Zoom Question: Eileen MacLaughlin of the Committee to Complete the Refuge was surprised to see that realigning STA Creek dos not provided sediment transport improvements. She thought that was a basic assumption from the SFEI Visioning exercise. The committee will consider that further before reaching any conclusion. Also, where will the existing A8 Ponds boat ramp be relocated? What will be the wildlife impacts? John B. responded that VW is considering process-based restoration of Harvey Marsh as opposed to active restoration which entails greater construction activity. Judy Nam added that the most urgent priority for sediment is to get it into A8 Ponds and we are racing against sea level rise (SLR). We need to raise A8 Ponds bottom elevation to get tidal marsh established before SLR makes it difficult. Based on modeling results, nature-based restoration of Harvey Marsh does a better job of getting sediment to A8 Ponds during early years (when it is most needed) than realigning STA Creek.

ZOOM Question: How will public be informed of VW decisions? Judy replied that the selection of the staff-recommended alternative will be presented to the VW Board of Directors at a public meeting with public input encouraged. There will be additional public meetings between now and then.

Director Santos Question: Will the project reduce salinity levels? Noah responded that the channels would become more brackish but the specific effect on wildlife and vegetation is hard to ascertain. We do not believe the Project will cause vegetation to clog flood protection channels.

Zoom Question: How will project change wildlife? Noah replied we are performing extensive baseline studies to document existing ecological conditions and will have a robust baseline to measure changes. Studies are being posted to the Project web page.

Audience Question: Will the Google enhancement project on Sunnyvale West Channel be threatened? Noah Responded that the project would reduce tide levels in the creeks so flood risks to the Google enhanced creek area will not see increased flood risk.

ZOOM Question: What will happen to the PG&E natural gas line across Harvey Marsh? Noah replied that we will design the Project to avoid it. The Project does not want to assume the considerable cost of relocating that pipeline.

Former San Jose Councilmember Morretti: Will effluent from the San Jose and Sunnyvale Water Pollution Control Plants (WCPCs) pollute the ponds? Noah replied that the Sunnyvale WPCP is the bigger concern since it is closer than the San Jose WPCP to the project area. We are modeling that potential impact to minimize it through project design.

The meeting adjourned at 6:45 P.M.

Appendix B

Assessment Methodology Workshop Materials

Valley Water Calabazas-STA Creek Marsh Connection Project

Feasible Alternatives Assessment Methodology

December 14, 2023, 12pm – 2:30 pm

LOCATION: **MS Teams**
Meeting ID: 219 268 201 584 (Passcode: hJTeAP); or
Call in (audio only) (415)-915-3841 (Passcode 208516894#)

Agenda

Introductions and Background

1. Project Objectives and Workshop Purpose
2. Alternatives Developed to Date

Assessment Methodology Approach and Proposed Factors

1. Refined Project Objectives
2. Factors Proposed for Feasibility Analysis
3. Preliminary Weighting
4. Discussion

Next Steps

Calabazas/San Tomas Aquino Creek—Marsh Connection Project Feasible Alternatives Assessment Methodology

Background

Consistent with Valley Water Planning Process for the Calabazas/San Tomas Aquino Creek—Marsh Connection Project (Project), five Conceptual Alternatives are to be evaluated and ranked as part of a planned Feasibility Analysis. Informed by the results of hydrodynamic and sediment transport modeling, geospatial and engineering analyses, each alternative will be ranked using weighted assessment factors using methods similar to the Conceptual Alternatives Assessment Methodology. The previous factors will be reviewed and updated to account for changes in habitat types, effects of projected sea level rise, tidal mixing, flow conveyance and sediment transport, changes in recreation access, and constructability/costs. Information from the feasibility analysis will be used to select the Staff-Recommended Alternative.

Because weighing potentially competing Project objectives inherently entails a value-based judgement, determining which factors should be considered and prioritized presents a considerable challenge. For example, identification of a preferred alternatives may need to consider multiple competing goals, such as protecting habitats, or maintaining current levels of flood protection, while addressing needs of recreational users. To resolve this, project objectives and assessment factors will be assigned relative weights based on the results of a collaborative Analytic Hierarchy Process (Saaty 1980, 2008) adapted to the Project, which provides a framework for scoring and comparing alternatives based on the extent to which they support each Project objective.

Overview of Analytic Hierarchy Process

The Analytic Hierarchy Process (AHP) is a mathematical approach to multiple criteria decision making that has been applied to a range of applications in solving large and complex decision problems (Saaty and Vargas 1994). To develop a rational and repeatable framework to select between alternatives, we have applied the AHP by the following four steps:

1. **Analytic Hierarchy** – Initially, factors considered in a decision are identified and organized as a hierarchy of interrelated decision elements. Typically, this is visualized as a tree containing the overall decision or goal at the top and lower levels (Tiers) of contributing criteria and sub-criteria.
2. **Pairwise comparisons** – To determine which factors are more important in reaching a decision, a series of pairwise comparisons are made amongst all of the decision elements. This is generally arranged as a series of questions as to whether each factor is more or less important in making a decision than other factors within the same tier, and secondarily by how much on a numeric (Saaty) scale from 1-9 (Table 1).
3. **Weighting** – Use the eigenvalue method to estimate the relative importance (weights) of the decision factors being compared. To make pairwise comparison of the selected factors it is essential to put them in a square matrix $B_{M \times M}$. The comparison is made by identifying the impact of the factors on the left side of the matrix to the elements at the top of the matrix. A factor compared with itself is always assigned the value 1, so the main diagonal entries of the pair-wise

comparison matrix are all 1. Below the main diagonal there are the inverse of the pairwise comparisons.

$$B_{M\times M}= \begin{matrix} B_1 \\ B_2 \\ B_3 \\ \vdots \\ B_M \end{matrix} \begin{bmatrix} 1 & b_{12} & b_{13} & \cdots & \cdots & b_{1M} \\ b_{21} & 1 & b_{23} & \cdots & \cdots & b_{2M} \\ b_{31} & b_{32} & 1 & \cdots & \cdots & b_{3M} \\ \vdots & \vdots & \vdots & \vdots & \cdots & \vdots \\ b_{M1} & b_{M2} & b_{M3} & \cdots & \cdots & 1 \end{bmatrix}$$

With the matrix completed the relative normalized weight of each factor is calculated from the geometric mean of the i-th row, and by normalizing the geometric means of rows in the comparison matrix.

4. **Alternatives Decisio**n – Aggregate the relative weights of decision elements to arrive at a set of ratings for the alternatives under comparison. In step 4 of the process, only metrics and criteria at terminal branches of the hierarchy are assigned scores, with the results of the weighting exercise (Steps 1–3) used to arrive at a final score.

Table 1. Scale of Relative Importance (according to Saaty [1980])

Intensity of Importance	Definition of Factor Importance	Explanation
1	Equal Importance	Two factors contribute equally to comparison
3	Moderate Importance	Experience and judgement moderately favor one factor over another
5	Strong Importance	Experience and judgement strongly favor one factor over another
7	Very Strong Importance	A factor is strongly favored and its dominance demonstrated in practice
9	Absolute Importance	The evidence favoring one factor over another is of the highest possible order of affirmation
2, 4, 6, 8	Intermediate values between the two adjacent judgements	When compromise is needed

In applying AHP to the Feasible Alternatives Assessment below, individual factors used to assess the degree to which a Project objective is realized are assigned scores from zero (0) to one (1). Factors may be quantitative (e.g., habitat amounts, suitability based on water quality criteria) or may be more subjective and qualitative. Both qualitative and quantitative assessments may be used in performing the evaluations.

Proposed Assessment Factors and Weighting

Selection of factors used to assess which Alternatives best meet the Project Objectives can include a variety of approaches, including physical process-based approaches, criteria-based approaches including habitat needs of aquatic and terrestrial focal species, as well as ecosystem functions approaches in response to changes in water movement, sediment and tidal dynamics, and inundation following Project implementation.

Building upon the factors developed for the Conceptual Alternatives Assessment Methodology, factors for the Feasible Alternatives Assessment Methodology have been refined based on the availability of hydrodynamic and sediment transport modeling results, and an increased understanding of post-restoration conditions. In some cases, potential factors may be omitted from the assessment of alternatives due to judgements that the factor is only marginally relatable to changes following restoration; may produce similar assessment scores across all alternatives; may be highly correlated with other factors and thereby result in over-weighting of that factor; or that it cannot be accurately predicted across the alternatives based upon completed hydrodynamic modeling.

Directions for Objective and Factor Weighting

Please review the "Project Objectives" and 'Assessment Factors" tab in the attached ***Phase 1 and 2 Factors.xlsx*** spreadsheet and note we have added a new objective based on minimizing life cycle costs. Next consider the relative importance of each Assessment Factor in meeting Project objectives based upon your best professional judgement. Once the review of the proposed objectives and factors is complete, weighting amongst factors will be conducted on both an individual basis and in a group setting by the steps below.

- Step 1) Save a personal copy of the Phase 1 and 2 Factors.xlsx spreadsheet and select the Objectives Weighting tab. Please complete the pairwise comparisons of the relative importance of Project Objectives in Columns E to G and indicate the strength of your selection using the importance (Saaty) scale (1-9) in columns A to C. This part is difficult but if you feel that meeting the two objectives contributes equally to a decision to select an Alternative, the A or B selection is arbitrary (choose either) and enter a '1' for the Saaty scale. Trust your judgment.
- Step 2) Next, select the Factor Weighting tab and complete the comparisons in the same columns. More specifically, within each pair of Factors, indicate which contributes more to meeting each Project Objective. Use the Saaty Scale (1-9) to determine how much more important the factor you chose is. If you feel the two factors contribute equally to a decision to select an Alternative, the A or B selection is arbitrary (choose either) and enter a '1' for the Saaty scale.

Once you have completed the worksheets, save it to the SharePoint and we will have the opportunity to discuss the factors, their relative importance, metrics, and scoring. Completed worksheets will be used to calculate overall weights and prioritization of objectives and factors in ranking the Feasible Alternatives.

Assessment Factor/Indicator	MODEL RESULTS	FACTOR EVALUATION	POTENTIAL METRICS AND SCORING NOTES
Ecological and Water Quality Indicators			
Tidal marsh habitat under projected sea level rise	Model shows sediment deposition across ponds varied by alternative	Retain factor to account for differences in future marsh plain extent under projected SLR	Map areas inside of ponds and HM with modeled short term sediment accretion depths > 2cm?? Score from lowest (0) to highest (1) as a % of maximum area increase relative to baseline.
Isolated island habitat	Tidal range similar in all alts	Retain factor to account for potential future nesting habitat using differences in constructed islands and isolated berm segments.	Use modeled tidal datum estimates and GIS to estimate island habitat area in ponds and adjacent berms above estimated future tidal datums (MHHW +2) under SLR Score from lowest (0) to highest (1) as a % of maximum area increase relative to baseline.
Scour induced mercury mobilization	Scour inside of A5 and A7 breaches as well as in segments of sloughs.	Retain factor to account for potential short-term mercury mobilization due to sediment scour after breaching. Note previous USGS studies suggest food web effects of mercury mobiliization will be temporary.	Map areas with >10 cm predicted scour inside of Ponds, Sloughs, and in lower Guadalupe River. Score from highest (0) to lowest (1) as a % of maximum scour area increase relative to baseline.
Tidal mixing	Similar changes in salinity in Ponds and creeks across alternatives for all alts including Pond A4 breaches. Small differences in distribution of Sunnyvale WPCP origin waters based on location and number of breaches.	Retain factor to account for differences in areas affected by Sunnyvale WPCP discharges. Note that salinity increases are related to Pond breaching with little differences between alternatives.	Map areas with > 10% increase of WPCP origin water relative to baseline inside of Ponds, Sloughs, and local creeks. Score from highest (0) to lowest (1) as a % of maximum area increase relative to baseline
Flood Protection			
Flood risk during Guadalupe River Events	Model indicates decreased tidal range and flood stage in Guad River with increasing numbers of Alviso Slough breaches	Retain factor to account for decreased backwater effects of tidal maxima in Alviso Slough. Note, we won't evaluate a combined fluvial, coastal event at this stage of analysis	Compare peak WSEL under modeled high flows at locations in lower Guadalupe River Score from lowest (0) to highest (1) as a % of maximum decrease relative to baseline
Tidal flood protection needs for Pond A4 berm	Peak flood stage under king tides reduced under all alts. with some differences in Pond A4 WSELs .	Retain factor to account for decreased backwater effects of tidal maxima in now open Pond A4 and upper Guadalupe Slough. Note, we won't evaluate a combined fluvial, coastal event at this stage of analysis.	Compare peak king tide WSELs in Pond A4 Score from lowest (0) to highest (1) as a % of maximum increase relative to baseline
Tidal flood protection needs for Sunnyvale East Levee	Peak flood stage under king tides reduced under all alts. with some differences in Sunnyvale E/W based upon Sunnyvale E breach.	Retain factor to account for decreased backwater effects of tidal maxima in Sunnyvale East Channel. Note, we won't evaluate a combined fluvial, coastal event at this stage of analysis	Compare peak king tide WSELs in Sunnyvale East Channel Score from lowest (0) to highest (1) as a % of maximum increase relative to baseline.
Sediment Management			
Calabazas sediment scour/deposition, transport to Pond A8S	Small differences in Calabazas deposition as well as delta extent in Pond A8S by alternative.	Retain factor to account for differences in sediment deposition in lower Calbazas Creek.	Compare mass of sediment deposition from creek and bay sources in lower Calabazas Creek. Score from lowest (0) to highest (1) as a % of maximum decrease relative to baseline
STA sediment scour/deposition, transport to Pond A8S	Small differences in STA deposition as well as delta extent in Pond A8S by alternative.	Retain factor to account for differences in sediment deposition in lower STA.	Compare mass of sediment deposition from creek and bay sources in lower STA. Score from lowest (0) to highest (1) as a % of maximum decrease relative to baseline
Sunnyvale East Channel sediment scour/deposition	Small differences in Sunnyvale East Channel deposition as well as delta extent in Pond A4 by alternative.	Retain factor to account for differences in sediment deposition in lower Sunnyvale East Channel.	Compare mass of sediment deposition from creek and bay sources in lower Sunnyvale East Channel Score from lowest (0) to highest (1) as a % of maximum decrease relative to baseline.
Public Access & Trails			
Minimize impacts to existing access/recreational opportunities	Factor unrelated to modeling.	Add factor to account for accessibiity to recreational opportunities.	Use GIS to estimate total trail length (Pond A8 ALSL continuous berm to first breach + Harvey Marsh berm) Score from highest (1) to lowest (0) based upon % of maximum decrease relative to baseline
Life Cycle Costs and Feasibility			
Construction Costs	Factor unrelated to modeling.	Add factor to account for project costs for excavation volumes and constructed features	Develop preliminary cost estimates for each alternative Score from highest (0) to lowest (1) as a % of maximum costs for all alternatives
Amount of active habitat management required (e.g., O&M, pump/gate maintenance)	Factor unrelated to modeling.	Retain factor to account for ongoing costs associated with O&M costs of operable elements (e.g. tide gates, pumps?)	Associate O&M costs for operable elements Score from high (0) to low (1) based upon best professional judgement

Factors Considered but Omitted			
Area of Pond A4 ecotone with nature-based treatment of RO/WW/stormwater			
Open water habitat availability			
Area of tidally influenced habitat	Not Applicable	No discrimination between alts. since they include the same amount of tidally influenced habitat	Factor related to breaching and tide gate features only
Upland habitat availablity	Increased tidal range in Ponds but similar tidal range and inundation of upland habitats between alternatives.	No discrimination between alts. Other than ecotones shared by all alternatives there are only small differences in upland berm extent due to differing breach areas.	Factor originally proposed to re-use some excavated materials to create upland habitat.
Habitat diversity	Similar changes in tidal range and salinity across alternatives	No discrimination between alts. since they include the same amount of tidally influenced habitat	Although factor could account for changes in non-tidal habitat by breaching Pond A4 as well as changes in salinity in lower creek there will no elimination of existing habitat types and so little changes in overall habitat diversity.
Marsh edge habitat	Tidal range similar in all alts, with some differences in deposition in starter channels	Use model results to estimate future marsh edge habitat.	Use GIS to map modeled differences in sediment deposition/scour in starter channels and breach areas to indicate areas of future open water vs marsh and allow length estimates of marsh edge habitats.
Area of managed pond habitat	Tidal range similar in all alts	No discrimination between alts. since they include the same amount of tidally influenced habitat	Factor only measures whether ponds are breached or not. No alternative will affect the pond salinity compared to fluvial flood events. Factor may not useful since the modeling showed that muted tidal pond will have large shifts in salinity, similar to current conditions.
Overlap or relocation of preferred trail route	Factor unrelated to modeling.	No discrimination between alts	Expect this factor to have minimal distinction.
Encroachment with adjacent property or access easements.	Factor unrelated to modeling.	No discrimination between alts	

VW Calabazas/STA Creek—Marsh Connection Project Analytic Hierarchy Process

Factors Weighting Worksheet

Reviewer:

Instructions: Rank Project Objectives from most to least important to help with consistency. Use this worksheet to go through each pair of objectives and indicate which objective is most important and by how much using the Saaty Scale below.

Intensity of Importance (Saaty Scale)	Definition of Factor Importance	Explanation
1	Equal Importance	Two factors contribute equally to comparison
3	Moderate Importance	Experience and judgement moderately favor one factor over another
5	Strong Importance	Experience and judgement strongly favor one factor over another
7	Very Strong Importance	A factor is strongly favored and its dominance demonstrated in practice
9	Absolute Importance	The evidence favoring one factor over another is of the highest possible order of affirmation
2, 4, 6, 8	Intermediate values between the two adjacent judgements	When compromise is needed

Choice A	vs	Choice B	Choice A or B?	by how much (Saaty scale 1-9)?
Factors considered within Objective 1 Ecological Restoration				
Tidal marsh habitat under projected sea level rise	vs	Isolated island habitat		
Tidal marsh habitat under projected sea level rise	vs	Scour induced mercury mobilization		
Tidal marsh habitat under projected sea level rise	vs	Tidal mixing		
Isolated island habitat	vs	Scour induced mercury mobilization		
Isolated island habitat	vs	Tidal mixing		
Scour induced mercury mobilization	vs	Tidal mixing		
Factors considered within Objective 2 Flood Protection				
Flood risk during Guadalupe River Events	vs	Tidal Flood Protection Needs for Pond A4 berm		
Flood risk during Guadalupe River Events	vs	Tidal Flood Protection Needs for Sunnyvale East Levee		
Tidal Flood Protection Needs for Pond A4 berm	vs	Tidal Flood Protection Needs for Sunnyvale East Levee		
Factor considered within Objective 3 Sediment Management				
Calabazas sediment scour/deposition, transport to Pond A8S	vs	STA sediment scour/deposition, transport to Pond A8S		
Calabazas sediment scour/deposition, transport to Pond A8S	vs	Sunnyvale East Channel sediment scour/deposition, transport to Pond A8S		
STA sediment scour/deposition, transport to Pond A8S	vs	Sunnyvale East Channel sediment scour/deposition, transport to Pond A8S		
Factor considered within Objective 4 Public Access				
Minimize impacts to existing access/recreational opportunities	vs	NA		

Factor considered within Lifecycle Cost Objective				
Construction Costs	vs	Amount of active habitat management required (e.g., O&M, pump/gate maintenance)		

VW Calabazas Analytic Hierarchy Process

digest of twelve January 2024 submissions)

		Worksheet Respondents:	1		2		3		4		5-8		9		10		11		12		14-15		16		17	
AHP Tier	Factor 1	Factor 2	preferred	judgement	preferred	judgement	preferred	judgement	preferred	judgement	preferred	judgement	preferred	judgement	preferred	judgement	preferred	judgement	preferred	judgement	preferred	judgement	preferred	judgement	preferred	judgement
1	ECOWQ	FLOOD	1	7	1	1	1	1	1	6	2	3	1	3	1	7	1	6	2	7	1	3	2	1	1	1
1	ECOWQ	SEDIMENT	1	1	1	3	1	5	1	3	1	4	2	5	1	7	1	5	1	5	1	3	1	4	1	9
1	ECOWQ	ACCESS	1	3	1	5	1	8	1	1	1	5	1	5	1	5	1	3	1	7	1	5	1	5	1	9
1	ECOWQ	COSTS	2	5	1	5	1	3	1	9	1	5	2	3	1	7	1	3	2	2	1	3	1	5	1	3
1	FLOOD	SEDIMENT	2	7	1	3	1	8	2	3	1	3	2	5	2	7	2	7	1	7	2	3	1	3	1	6
1	FLOOD	ACCESS	2	3	1	5	1	9	2	3	1	5	1	5	2	3	2	3	1	9	1	3	1	5	1	9
1	FLOOD	COSTS	2	5	1	5	1	3	1	2	1	2	2	3	1	7	2	3	1	5	1	3	1	2	1	3
1	SEDIMENT	ACCESS	1	8	1	3	1	7	2	2	1	3	1	5	2	5	1	5	1	5	1	3	1	3	1	5
1	SEDIMENT	COSTS	1	1	1	5	2	3	1	2	1	3	2	1	1	5	2	3	2	3	1	3	1	3	2	3
1	ACCESS	COSTS	2	5	1	3	2	6	1	7	1	3	2	3	1	7	2	1	2	5	1	1	1	3	2	5
2	ECOWQ:marsh	ECOWQ:island	1	3	1	3	1	8	1	7	1	7	1	5	1	7	1	3	1	5	1	3	1	7	1	9
2	ECOWQ:marsh	ECOWQ:mercury	1	4	1	5	1	6	1	5	1	5	1	3	1	7	1	5	1	3	1	1	1	5	1	7
2	ECOWQ:marsh	ECOWQ:tide	1	1	1	3	1	5	1	8	1	3	1	3	1	7	2	3	1	4	1	3	1	3	1	5
2	ECOWQ:island	ECOWQ:mercury	2	2	1	5	2	5	2	6	2	3	2	1	1	5	1	5	2	3	2	3	1	3	2	5
2	ECOWQ:island	ECOWQ:tide	2	4	1	3	2	5	2	2	2	1	2	3	1	5	1	1	2	3	2	3	1	2	2	5
2	ECOWQ:mercury	ECOWQ:tide	2	5	2	5	2	2	1	2	2	1	2	3	2	3	2	5	1	5	1	3	2	1	2	1
2	FLOOD:guadalupe	FLOOD:pond A4	1	1	2	3	1	9	1	2	1	1	1	5	2	6	1	5	1	3	1	3	2	2	1	9
2	FLOOD:guadalupe	FLOOD:sunnyvale east	2	1	2	3	1	9	1	6	1	1	1	5	2	2	1	5	1	5	1	5	1	1	1	9
2	FLOOD:pond A4	FLOOD:sunnyvale east	2	1	1	3	1	1	1	1	1	3	1	1	1	1	2	1	2	3	1	1	1	3	1	1
2	SEDIMENT:calabazas	SEDIMENT:STA	1	1	2	3	2	2	2	3	2	5	1	1	1	1	2	1	2	3	1	1	2	5	2	5
2	SEDIMENT:calabazas	SEDIMENT:sunnyvale east	1	1	1	5	1	4	1	3	1	5	1	5	1	1	1	5	1	3	1	5	1	5	2	5
2	SEDIMENT:STA	SEDIMENT:sunnyvale east	2	1	1	7	1	6	1	3	1	7	1	5	1	1	1	5	1	7	1	5	1	7	1	5
2	COSTS:construction	COSTS:management	1	6	2	3	2	5	2	6	2	7	2	3	2	3	2	5	1	3	2	3	2	7	2	7