

APPENDIX C
Tecolote PER

Preliminary Engineering Report Tecolote Creek Wetland Restoration & Fiesta Island Causeway

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Presented To

City of San Diego Public Works Department

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Acronyms/Abbreviations

Acronym/Abbreviation	Definition
ADA	Americans with Disabilities Act
AMC	Antecedent Moisture Condition
APCD	Air Pollution Control District
AR4	International Panel on Climate Change Fourth Assessment Report
AR5	International Panel on Climate Change Fifth Assessment Report
BA	Biological Assessment
bgs	below ground surface
BTR	Biological Technical Report
CADD	computer aided drafting and design
CCC	California Coastal Commission
CCS83	California Coordinate System of 1983
CDFW	California Department of Fish and Wildlife
CIP	Capital Improvement Project
City	City of San Diego
CWA	Clean Water Act
DEM	Digital Elevation Model
cy	cubic yard
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FIS	Flood Insurance Study
ft	foot, feet
ft/s	foot per second
GHG	greenhouse gas
GIS	Geographic Information System
HA	hydrologic area
HOT	Highest Observed Tide
IPCC	International Panel on Climate Change
LECC	Law Enforcement Coordinating Council
LiDAR	Light Detection and Ranging
LOT	Lowest Observed Tide
M&N	Moffatt & Nichol
MHW	Mean High Water
MLLW	Mean Lower-Low Water

MLW	Mean Low Water
MSL	Mean Sea Level (0 Ft. elevation on NGVD 1929)
NAD 83	North American Datum of 1983
NAVD 88	North American Vertical Datum of 1988
NGA	National Geospatial-Intelligence Agency
NGVD 29	National Geodetic Vertical Datum of 1929
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
OPC	Ocean Protection Council
PCW	Project Clean Water
PEIR	Program Environmental Impact Report
PER	Preliminary Engineering Report
PZN	Precipitation Zone Number
RCP	Representative Concentration Pathways
RGP	Regional General Permit
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SANDAG	San Diego Association of Governments
SanGIS	San Diego Geographic Information Source
SFHA	Special Flood Hazard Area
SLR	sea level rise
SSURGO	Soil Survey Geographic Database
SWL	still water level
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WDR	Waste Discharge Requirements
WMA	Watershed Management Area

1 Introduction

The City of San Diego Public Works Department has engaged a consultant team to assist in the preparation of a Program Environmental Impact Report (PEIR) for multiple prioritized improvement projects within the Mission Bay Park Improvement Zone (Improvement Zone). The Improvement Zone includes “those areas encompassed within the boundaries of Mission Bay Park, Oceanfront Walk from the Mission Bay Jetty to Crystal Pier and the adjoining coastal parks...” It also includes portions of Rose Creek, Tecolote Creek, and the San Diego River. The ultimate goal is to enhance the conditions of the Improvement Zone for the enjoyment of residents and visitors. As part of the PEIR, Preliminary Engineering Reports (PER) are being prepared for the prioritized improvement projects. The prioritized improvement projects include: Rose Creek Wetland, North Fiesta Island, Tecolote Creek & Fiesta Island Causeway, Leisure Lagoon Marsh (Cudahy Creek), Shoreline Restoration, Habitat Preservation, Bike/Pedestrian Paths and Bridges, Seawall Restoration, and Deferred Maintenance.

1.1 Project Overview

The 2002 Update to the Mission Bay Master Plan identifies Tecolote Creek Wetland as one of several locations for restoration of tidal wetlands, which balance the need for mitigation, water quality, flood control, aquatic recreation and public safety (City of San Diego 2002). Additionally, the existing Fiesta Island Causeway is proposed to be modified (i.e., an open channel or culvert connection) with improvements to tidal circulation and, in turn, water quality on the eastern portion of Mission Bay (see Figure 1-1 and Figure 1-2). From a water quality standpoint, the waters east of Fiesta Island have the poorest quality in Mission Bay. This is augmented with the input of contaminants from Tecolote Creek. Creation and restoration of tidal wetlands in this area and modifications to the existing causeway will improve the water quality of Mission Bay, enhance the natural environment, and create coastal salt marsh habitat in Southern California.

As a part of the Mission Bay Park PEIR, this PER provides environmental, design, and construction details for the Tecolote Creek site within Mission Bay. This PER is prepared for the City of San Diego (City) by Moffatt & Nichol (M&N) as a subconsultant to Dudek. M&N and Dudek developed the wetland restoration design to be utilized in Mission Bay, and the preliminary engineering details are provided herein. The concept was approved for analysis by the City in project-related meetings in 2019.

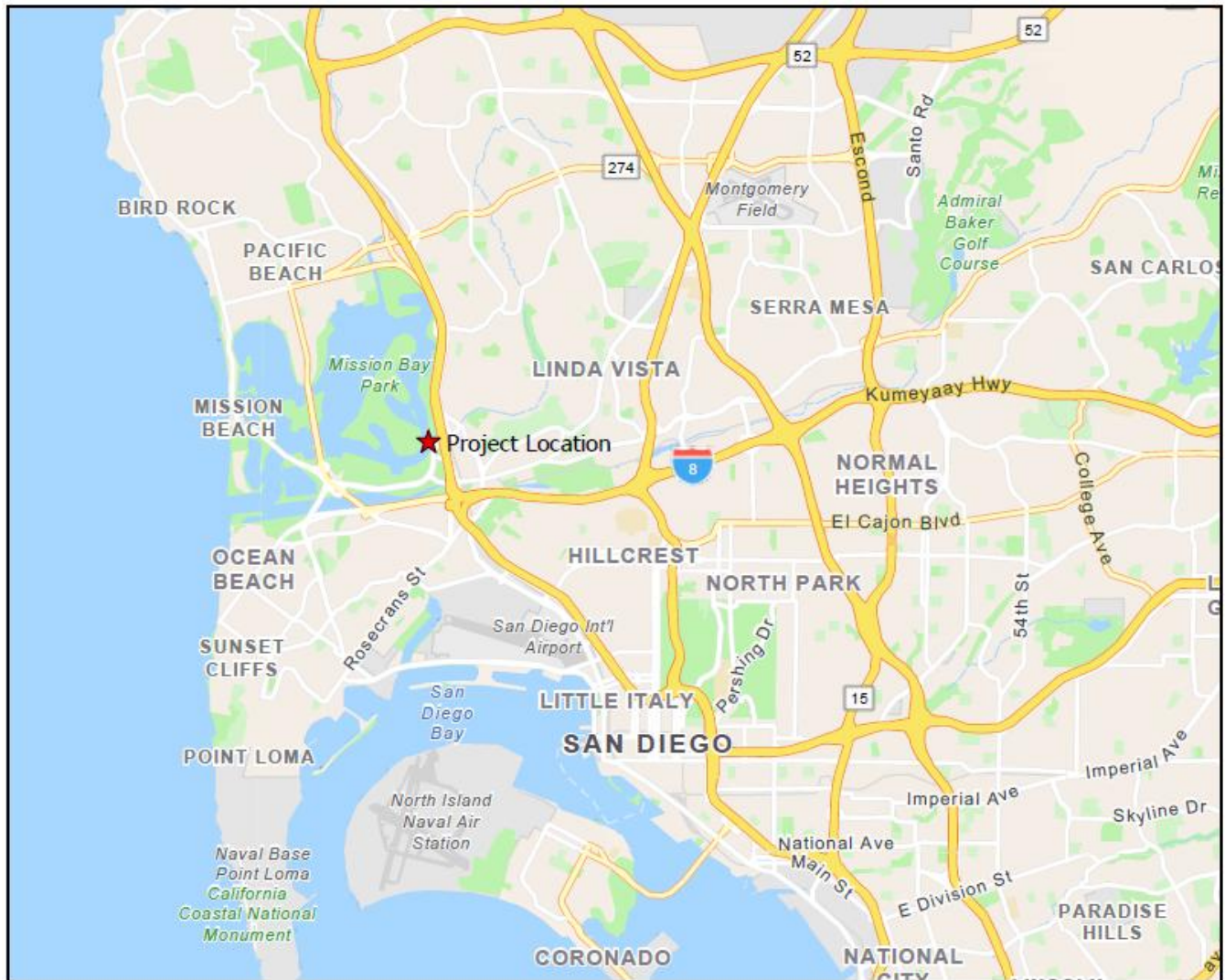


Figure 1-1. Vicinity Map

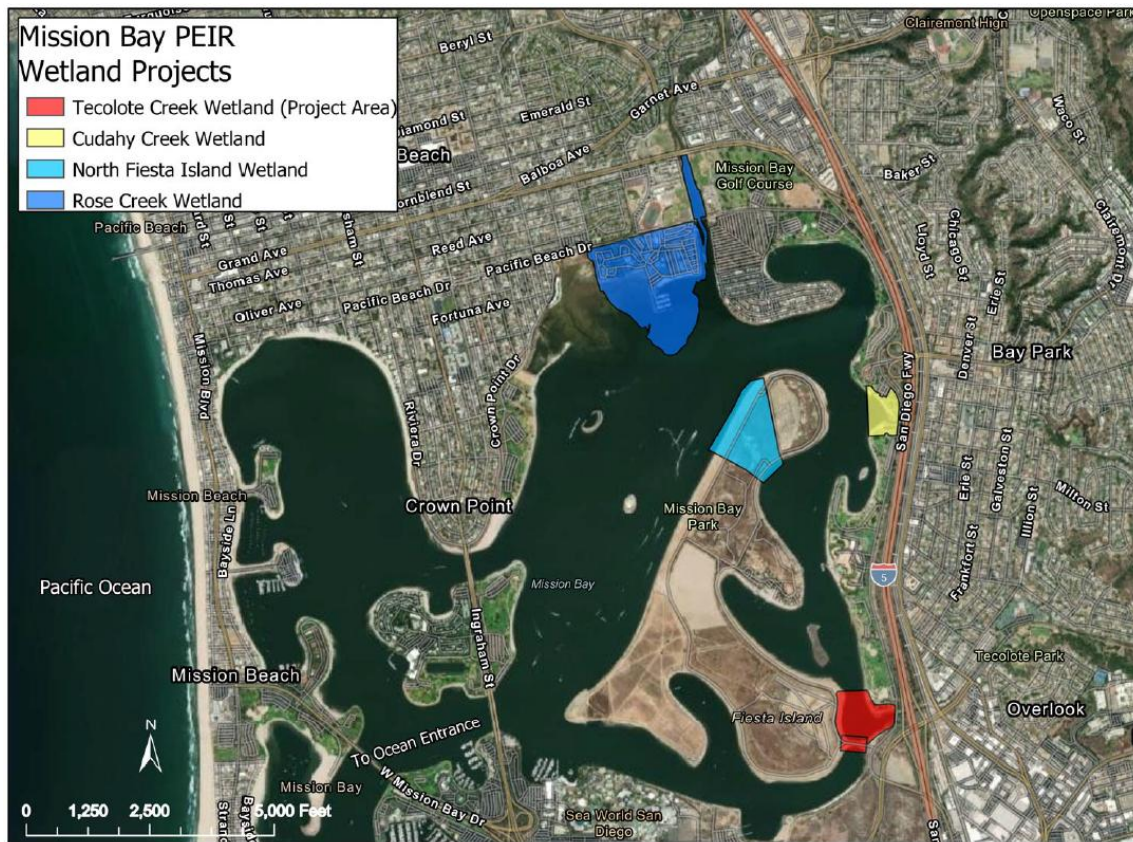


Figure 1-2. Mission Bay Park PEIR Wetland Restoration Project Areas

1.2 Project Location

Mission Bay is located within the City of San Diego, California. This coastal inlet was created over the last 18,000 years, after the last glacial period, as sea level rose to present level and riverine drainage incised the inlet. As sea level rose, the San Diego River deposited large volumes of alluvial sediment to create the delta that became the landmass for Mission Bay, previously known as False Bay (see Figure 1-3). During the 1820s, the San Diego River was redirected from False Bay into the San Diego Bay. This left False Bay as a low-flow marshland. False Bay was made up of fluvial and estuarine fine sand, silts, and clays from the surface to approximately 60 feet below ground surface (bgs), which were underlain by Quaternary-age dense clayey sands, hard clays, and gravel/cobble from approximately 50-70 feet bgs south of North Mission Bay Drive, and approximately 10-30 feet bgs north of North Mission Bay Drive.

False Bay was historically unnavigable as the channels were narrow and shallow. The City began dredging in 1946 to create Mission Bay Park. Dredging operations, and subsequent land creation with dredged and upland material, occurred between 1946 and 1956, 1959 and 1961, and 1963 and 1964 to create the current configuration of Mission Bay. Landforms, such as Fiesta Island, were formed with what is geologically described as Artificial Fill. This Artificial Fill consists primarily of loose to medium dense silty sands with intermittent layers of soft clay.

Tecolote Creek discharges stormwater into the southeastern corner of Mission Bay, the furthest point from the Pacific Ocean connection. To the north is Tecolote Shores park; to the east is East Mission Bay Drive and Interstate-5; to the south is an unpaved parking lot and Fiesta Island Road; and to the west is Fiesta Island.

The existing terrain of the project area consists of two component land types: low-lying fill at beach elevations, and upland fill areas. With the exception of narrow patches of marsh and mudflat around its perimeter, extensive coastal salt marsh habitat does not exist within the downstream end of Tecolote Creek.



Figure 1-3. Aerial View of Mission Beach and False Bay – 1930 (www.sandiego.gov)

1.3 Project Goals and Objectives

The purpose of this report is to provide a preliminary engineering recommendation for salt marsh restoration efforts and causeway design at Tecolote Creek based on analysis of the existing channel conditions, constraints, and opportunities. Project design considerations are focused on wetland habitat, jurisdictional limits, topography, bathymetry, storm water, and tidal influence. This design was formulated to provide potential benefits related to the overall project goals, which are listed below:

- Water quality improvements;
- Aquatic resources;
- Fish and wildlife species;

- Environmental enhancement; and
- Recreation.

The stated overall project goals and objectives are discussed through the report narrative and a summary table is provided in Appendix E. The summary table shows the overall project goals and objectives along with qualitative and quantitative outcomes.

Wetland restoration of salt marsh habitat is beneficial to the public. These habitats contribute ecological processes to the environment that are currently rare. The ecological processes filter water, absorb carbon, produce vegetation and organisms, host sensitive and endangered wildlife, buffer climate change conditions, protect the shoreline, provide natural viewsheds and scenery, promote learning, interpretation, education, and appreciation, represent passive recreational opportunities, peace and quiet, and otherwise contribute to the well-being of human beings. It is an all-inclusive opportunity for citizens to experience.

The City of San Diego sees a unique opportunity around Mission Bay to realize these benefits by this one simple action of wetland restoration due to the appropriate site conditions in existence.

2 Collection and Review of Existing Data

The scope of this Project required performing analyses of existing topographic and bathymetric data to identify a working wetland design at Tecolote Creek. In support of the hydraulic analyses performed for the proposed tidal salt marsh design at this site, the Project included data collection of available topographic, bathymetric and hydrologic data, and a review of available Geographic Information System (GIS) reference documents. Watershed hydrology data were also evaluated for the design and are included in this section. In addition, limited soils data were measured by geotechnical means; those data are presented in Section 5.2.3 of this document.

2.1 Topography and Bathymetry

Topographic data was obtained from the U.S. Geological Survey (USGS) 2014 Light Detection and Ranging (LiDAR) survey. Bathymetry data was obtained from the Mission Bay Park, 2013 Bathymetry and Eelgrass Inventory (Merkel & Associates 2013). These were incorporated into computer aided drafting and design (CADD) files and compiled with aerial data to provide ground surface elevations of the open water and ground surface areas of the Project. It should be noted that topography and bathymetry data were obtained in the North American Vertical datum of 1988 (NAVD 88). A conversion between the NAVD 88 and National Geodetic Vertical Datum (NGVD 29) was performed, ensuring all analyses have been referenced to the NGVD 29 datum. Additional topographic survey data was collected by Photo Geodetic Corporation in April 2019. The horizontal basis of coordinates for this survey is referenced to the California Coordinate System of 1983 (CCS83) Zone 6, North American Datum of 1983 (NAD 83), and elevations are referenced to NGVD 29. Features from the 2019 survey, such as stormwater structures, asphalt concrete, sidewalks, fire pits, power poles, etc. were compiled into CADD.

Existing topography and bathymetry of the Project area are depicted in Figure 2-1 and summarized below:

- Tecolote Creek bridge ~ +14 ft NGVD 29
- Tecolote Creek mouth ~ -3 ft NGVD 29
- Tecolote Creek basin, lowest point ~ -12 ft NGVD 29
- Tecolote Shores Park ~ +13 ft NGVD 29
- Fiesta Island Rd ~ +14 ft NGVD 29
- Fiesta Island Causeway ~ varies from +7 ft NGVD 29 in the center of the causeway to +12 feet NGVD29 at each end of the causeway

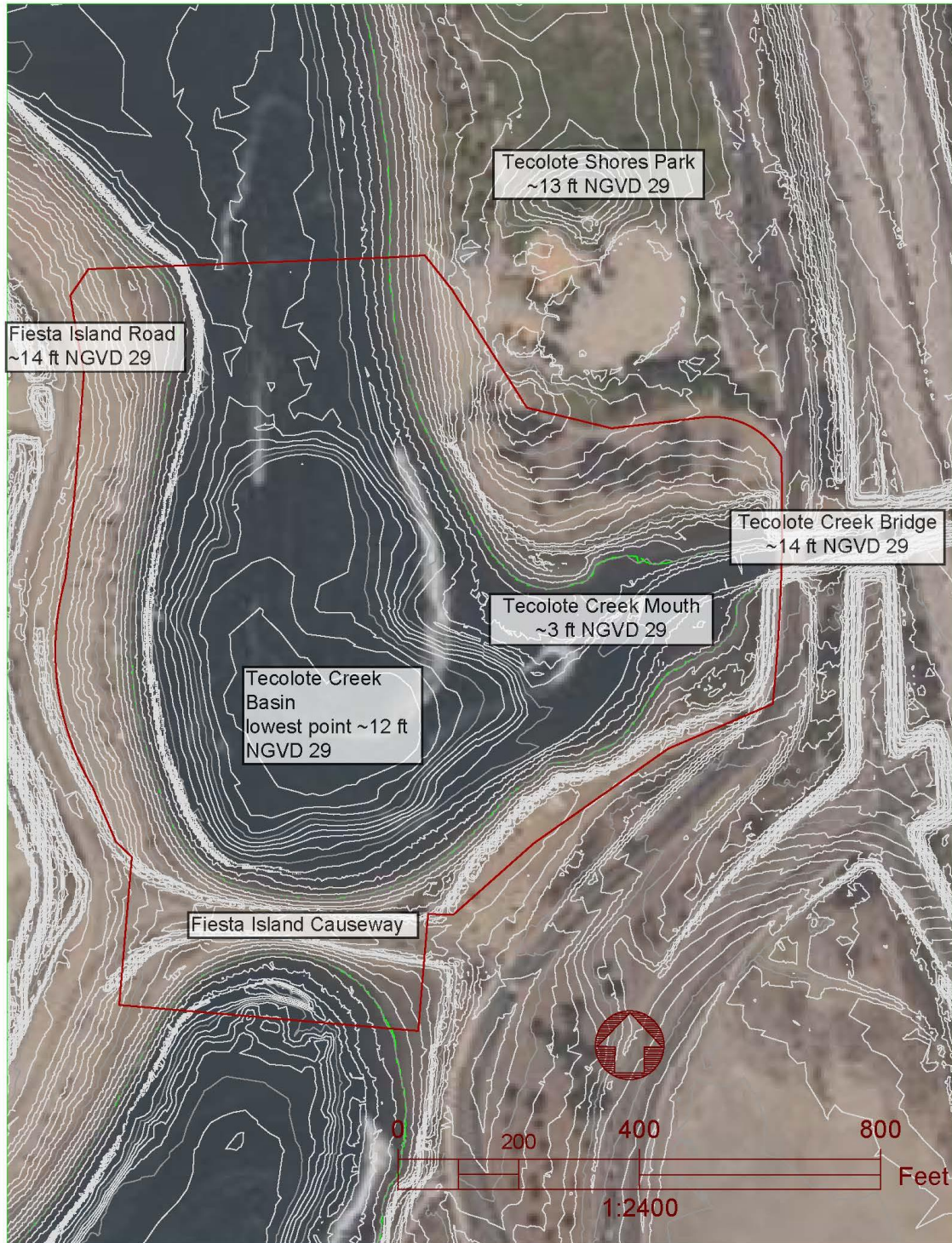


Figure 2-1. Existing Conditions - Tecolote Creek

2.2 Available GIS Data

GIS data were collected from San Diego Geographic Information Source (SanGIS) and reviewed for information regarding land use and utilities in the area (see Table 2-1). The utility data from SanGIS was analyzed to determine whether or not any existing utilities cross the proposed wetland area. The available GIS data show water and sewer utilities within the Fiesta Island Causeway located within the Project area. Also, two concrete storm drains were identified in the 2019 topographic survey and, accordingly, these features were added to the project basemap. A detailed survey and full review of existing utilities is recommended prior to any final engineering design for the Project area.

The data layers used from SanGIS inventory are shown in the following table.

Table 2-1. SanGIS Data Inventory

Data Layer	Version Date	Source (Agency)
LiDAR	2014	SanGIS, San Diego Association of Governments (SANDAG), National Geospatial-Intelligence Agency (NGA), Law Enforcement Coordinating Council (LECC), Regional Public Safety GIS, 18 Incorporated Cities
Aerial Imagery	September 14, 2011	City of San Diego
Storm Drain Network Files (Drain Conveyance, Drain Structures)	October 17, 2018	City of San Diego, SanGIS, SANDAG
Land Use	January 1, 2017	SanGIS, SANDAG
Soil Survey Geographic Database (SSURGO)	November 11, 2013	National Resources Conservation Service
Parcel Layer	February 15, 2018	SanGIS, SANDAG, Assessor/Recorder/County Clerk
Floodplain Layers	April 7, 2016	Federal Emergency Management Agency (FEMA)
Utility Layers (Sewer Main, Water Main, Storm Drainage)	March 5, 2018	SanGIS, City of San Diego Public Utilities Department, SANDAG

3 Existing Conditions

Tecolote Creek, located in western San Diego County, serves a hydrologic area of approximately 9.71 square miles. The creek drains directly into Mission Bay as part of the Tecolote hydrologic area (HA), and the larger Mission Bay/La Jolla Watershed Management Area (WMA) encompassing an area of 64 square miles (PCW 2020). The Tecolote HA contains some of the more intensely urbanized areas in San Diego County. Mission Bay provides habitat for numerous sensitive species indigenous to the Southern California coastline and is home to several wildlife preserves that provide important habitat for the federally endangered least tern, brown pelican, and light-footed clapper rail (City of San Diego 2013).

The Project includes the design of stormwater infrastructure features and, pursuant to City policy, the design of the proposed improvements must be based on hydrologic analyses performed in accordance with the current City guidance. In addition, existing water level conditions and projected sea level rise (SLR) will affect the project design.

3.1 Hydrology/Hydraulics of Stormflows

This section initially addresses Tecolote Creek hydrology and hydraulics during stormflows (by Rick Engineering), and then summarizes wetland tidal hydrology and hydraulics under tidal influence during both wet and dry weather conditions (by Moffatt & Nichol). Authorship is a combined effort between team members.

3.1.1 General Background

Tecolote Creek is a recognized creek by the Federal Emergency Management Agency (FEMA) and is mapped as a Special Flood Hazard Area (SFHA) Zone AE. Flow rates for the 10-year, 50-year, 100-year, and 500-year storm events in Tecolote Creek are provided in FEMA's Flood Insurance Study (FIS). It should be noted that an FIS data request for Tecolote Creek was completed to obtain the FEMA effective hydraulic model. The FEMA effective model was received in the form of a PDF scan of the HEC-2 model for Tecolote Creek. After reviewing the effective model, the flow rates used match the flow rates listed in the FIS. Additionally, RICK Engineering Company performed hydrologic analysis of the Tecolote Creek drainage area that utilized the Natural Resources Conservation Service (NRCS) hydrologic method. The hydrologic analysis included delineating the drainage area, determining the hydrologic parameters for the watershed, and performing the applicable hydrologic calculations to determine the peak flow rates and hydrographs. The Tecolote Creek watershed for this study was delineated using the GIS software tools based on topographic data obtained from SANDAG. SANDAG data were obtained from a 2015 data set consisting of 5-foot contours, interpreted from raw LiDAR and a hydro-flattened digital elevation model (DEM). Land use types and soil types, obtained from SanGIS, were used to determine the watershed composite curve number and weighted watershed runoff coefficients. This analysis is attached as Appendix A to this report.

3.1.2 NRCS Method Analyses

The Tecolote Creek watershed is 9.71 square miles in area. Thus, in accordance with the with The *City of San Diego, Transportation & Storm Water Design Manual, Drainage Design Manual* (Drainage Design Manual), dated January 2017 (City of San Diego 2017), the NRCS hydrologic method was used to determine the existing condition peak flow rate for the 100-year frequency storm event.

The U.S. Army Corps of Engineers (USACE) HEC-1 computer program was used to determine the NRCS Method 100-year peak discharge flow rate. The HEC-1 program allows the engineer to simulate both natural and improved or developed watersheds. Program parameters include basin area, lag time, rainfall distribution, NRCS curve number (related to infiltration rates), and precipitation amount. The rainfall distribution followed the Type B distribution, pursuant to the Drainage Design Manual. The other parameters were determined from soil and vegetative cover/land use maps, and topographic data. Runoff was estimated using NRCS curve numbers for the watershed. Estimated curve numbers are a function of land use or vegetative cover and soil type. The land uses were based on the SanGIS data, aerial imagery, and applicable data from the review of the existing data (i.e., FIS data). Consistent with the Drainage Design Manual guidance, a composite curve number was determined for the watershed using an area-weighted average of the individual land use areas and corresponding curve numbers. A watershed map, a soils map, and a land use map are provided in Appendix A. A summary of the applicable hydrologic characteristics for each watershed is presented in Table 3-1.

Table 3-1. Watershed Characteristics

Hydrologic Parameter	Tecolote Creek
Basin Area	9.71 square miles (6,216 acres)
Watercourse Length (Length to Centroid)	7.64 miles (3.82 miles)
Topography	Min. 0 feet, Max. 381 feet (MSL)
100-year Design Storm 6-hour Precipitation (from City of San Diego rainfall isopluvials)	2.4 inches
100-year Design Storm 24-hour Precipitation (from City of San Diego rainfall isopluvials)	4.0 inches
Precipitation Zone Number (PZN)	1.5
Antecedent Moisture Condition (AMC)	2.5 ¹
Composite Curve Number	90 (AMC = 2.0) 93 (AMC = 2.5)

Combination: Urban Cover (Streets and Storm Drain) Minor Stream, Fairly Regular Section (Per <i>Drainage Design Manual</i>)	Combination: Street n=0.018, Pipe n=0.013 Some Weeds, Light Brush on Banks, n=0.04 Watershed Average, n=0.03
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¹AMC = AMC of 2.5 based on *Drainage Design Manual Table B-3 adjustment*.

Additional HEC-1 input parameters were calculated. Rainfall distributions were developed using the criteria as outlined in the *Drainage Design Manual*. Lag time for the watershed was calculated using criteria presented in the *Drainage Design Manual*. The PZN adjustment was performed using *Drainage Design Manual* methodology. The HEC-1 model file is provided in Appendix A.

The NRCS synthetic unit hydrograph with curvilinear transformation was used to develop runoff hydrographs for the watershed. This unit hydrograph is dimensionless and is a function of the watershed area and lag time.

3.1.3 Stormflow Hydrologic Analysis Results

Hydrologic analyses were performed for the Tecolote Creek watershed for the existing condition. The FEMA recognized 100-year peak flow rates were compared to calculated 100-year peak flow rates for determination of the design flow rates. The two different peak flow rates resulted from the analyses: a FEMA FIS flow rate and a calculated flow rate based on precipitation values obtained from the City rainfall isopluvials. The two peak flow rates were compared in Table 3-2. The support materials for the hydrologic calculations are provided in Appendix A.

Table 3-2. Summary of 100-year Peak Flow Rates

Source	Tecolote Creek
FEMA FIS for Tecolote Creek at Interstate Highway 5	4,900 cfs
NRCS Method – City of San Diego Isopluvial rainfall data	3,609 cfs

Because the two methods vary by a significant amount, the more conservative flow rate was chosen. The analysis performed to evaluate the hydraulic function of the proposed wetland was based on the FEMA FIS value. This provides the additional advantage of being consistent with the FEMA designated effective hydraulic model for the watershed. A hydrograph was generated by modifying the HEC-1 analysis prepared in accordance with the *Drainage Design Manual*. The modification included increasing the 24-hour precipitation value until the peak flow rate of approximately 4,900 cfs was achieved. This was accomplished using a 24-hour precipitation rate of 5.3 inches (in comparison to the *Drainage Design Manual* value of 4.0 inches). Both the *Drainage Design Manual* method HEC-1 and “modified” HEC-1 output files are included in Appendix A.

3.2 Hydrology/Hydraulics of Astronomical Tides

Astronomical tides are crucial to understanding daily inundation potential in Mission Bay and habitat establishment constraints and opportunities. Still water level (SWL) is defined as average water surface elevations at any instant, excluding local variation due to waves, wave run-up, and wave setup, but including the contributions of tide, storm surge, and SLR. SWL for various tidal levels are presented in Table 3-3.

The Mean Lower-Low Water (MLLW) elevation of -2.32 ft NGVD 29 represents the change from sub-tidal to tidal zones. The Mean Higher-High Water (MHHW) elevation of 3.00 ft NGVD 29 represents the change from tidal daily wetting and drying to transitional areas that are only periodically inundated during extreme tides, and upland areas above that which are never inundated. The Highest Observed Tide (HOT) represents the extreme SWL scenario.

Table 3-3. Existing Still Water Levels in Mission Bay (NOAA Station 9410230)

Datum	Abbreviation	Existing SWL (ft, NGVD 29)
Highest Observed Tide (11/25/2015)	HOT	5.49
Mean Higher-High Water	MHHW	3.00
Mean High Water	MHW	2.28
Mean Sea Level	MSL	0.41
National Geodetic Vertical Datum of 1929	NGVD 29	0.00
Mean Low Water	MLW	-1.42
North American Vertical Datum of 1988	NAVD 88	-2.13
Mean Lower-Low Water	MLLW	-2.32
Lowest Observed Tide (12/17/1937)	LOT	-5.19

3.3 Measured Tides

As a part of the Mission Bay PEIR Hydrology Study (M&N 2019), four pressure gauges were placed at sub-tidal locations collecting tide measurements to assess the tidal behavior of Mission Bay. No anomalous behavior of Mission Bay tides was identified in comparison with tidal measurements from the La Jolla, CA Station 9410230 (NOAA 2019). Figure 3-1 shows existing tides as measured near south Fiesta Island as compared to ocean tides. There is virtually no measurable difference between bay tides and those of the ocean. There is no attenuation of tides (muting) nor lags in time between the ocean and the inner bay.

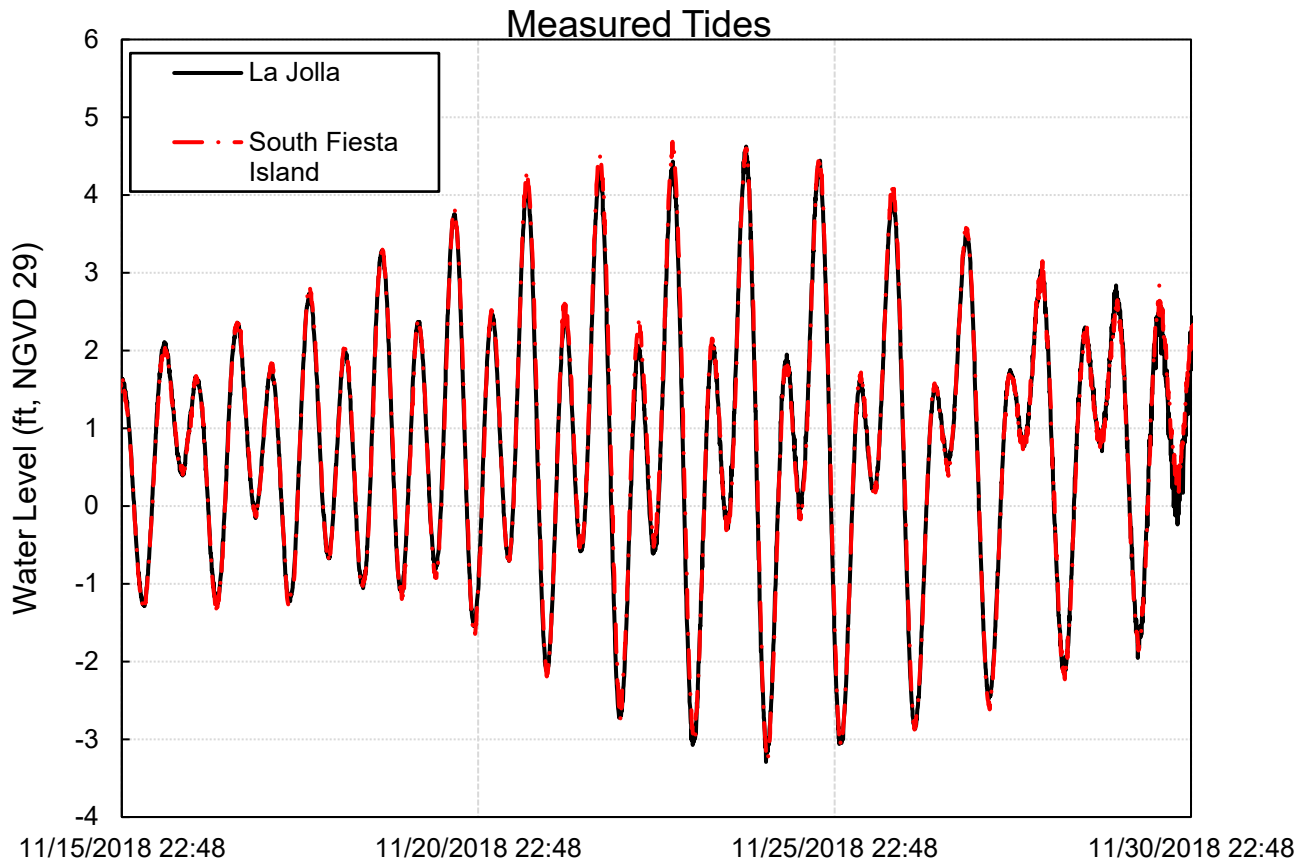


Figure 3-1. Measured Tides at Mission Bay and the Open Ocean

3.3.1 What is Sea Level Rise?

Anticipated changes in climate and sea level are a result of increasing concentrations of “greenhouse” gases in the atmosphere over time due to emissions from burning fossil fuels and natural sources. Greenhouse gases trap long-wave thermal radiation within the atmosphere, which causes warming of the Earth’s atmosphere, lands, and oceans, resulting in climate changes and SLR (IPCC 2013). SLR science involves both global and local physical processes. Models are created based on science’s best understanding of atmospheric, oceanographic, and geological processes on global and local scales and, therefore, are dynamic and periodically updated to reflect changes. On a global level, the most recent predictions come from the International Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) released in 2014. The AR5 projections for SLR were 50% higher than the IPCC Fourth Assessment Report (AR4) (released 2007) due to the addition of ice sheet dynamics on SLR. A sixth IPCC Assessment Report (AR6) was released in 2021 but that document does not affect the SLR projections in this PER because they are based State guidance as explained below.

At the state level, the California Coastal Commission (CCC) presently recommends using the best available science (CCC 2018). The State of California Ocean Protection Council (OPC) Science Advisory Taskforce

updated the regional best available science through the “Rising Seas in California: An Update on Sea Level Rise Science” report, released in April 2017, factoring polar ice sheet melting into future SLR projections (OPC 2017). This report was updated and repurposed as a State planning document with the OPC’s State of California Sea Level Rise Guidance in 2018 (OPC 2018). The 2018 Guidance projects SLR for multiple emissions scenarios and uses a probabilistic approach based on Kopp et al. 2014 (Kopp 2014).

For both low- and high-emission scenarios, a likely range was determined based on Kopp et al. 2014 that estimates a 66% probability that SLR will be within that range. For the low emissions scenario, the likely range of SLR for 2100 is 1.1 feet to 2.5 feet and for the high emissions scenario, the likely range for 2100 is 1.8 feet to 3.6 feet. The OPC’s 2017 report and 2018 guidance include a specific singular scenario called H++, which represents recent scientific findings of faster rates of SLR due to previously unknown glacial dynamics (Sweet et al. 2017), predicting 10.2 feet of SLR by year 2100. The likelihood of this scenario is unknown and is recommended by the OPC to be considered for long-term, high-stakes decisions (OPC 2018).

Climate science is a constantly changing field, often with high degrees of uncertainty about Representative Concentration Pathways (RCP), which are four greenhouse gas (GHG) concentration trajectories adopted by the IPCC for its Fifth Assessment Report in 2014. The four RCP scenarios are 2.6, 4.5, 6.0, and 8.5. RCP 2.6 is the low emissions trajectory and RCP 8.5 is the “business-as-usual” fossil-fuel-intensive emission trajectory. The intermediate scenarios represent mid-range levels of emissions reductions. RCP 8.5 represents high emissions and is the upper bound of SLR projections and is the RCP most commonly used for conservative predictions of SLR. Per OPC guidance, this report includes the RCP 8.5 trajectory because, to date, GHG emissions worldwide have followed the business-as-usual trajectory (OPC 2018). This study refers to “emissions scenarios” rather than “GHG concentration scenarios” when addressing SLR scenarios. Planning for a varying degree of SLR can be challenging and requires continual or periodic updates based on the most recent predictions.

3.3.2 Selected Sea Level Rise Scenarios

The current best available SLR science is the State of California OPC Science Advisory Taskforce April 2017 report and corresponding 2018 California State Guidance (OPC 2017 and OPC 2018). Projections for San Diego, CA, and by association Mission Bay, range widely with respect to GHG emission scenarios and probability. Projected SLR scenarios under the high emissions (i.e., worst case) scenario and varying probabilities for San Diego are presented in Table 3-4 and Figure 3-2 (Per OPC 2018).

Table 3-4. Sea Level Rise Projections – San Diego, CA

Year	50% Probability SLR Scenario	17% Probability SLR Scenario	5% Probability SLR Scenario	0.5% Probability SLR Scenario	Extreme (H++) SLR Scenario
2030	0.5 ft	0.6 ft	0.7 ft	0.9 ft	1.1 ft
2050	0.9 ft	1.2 ft	1.4 ft	2.0 ft	2.8 ft
2100	2.6 ft	3.6 ft	4.6 ft	7.0 ft	10.2 ft

(Adopted from OPC 2018, Table 34, High Emissions Scenario)

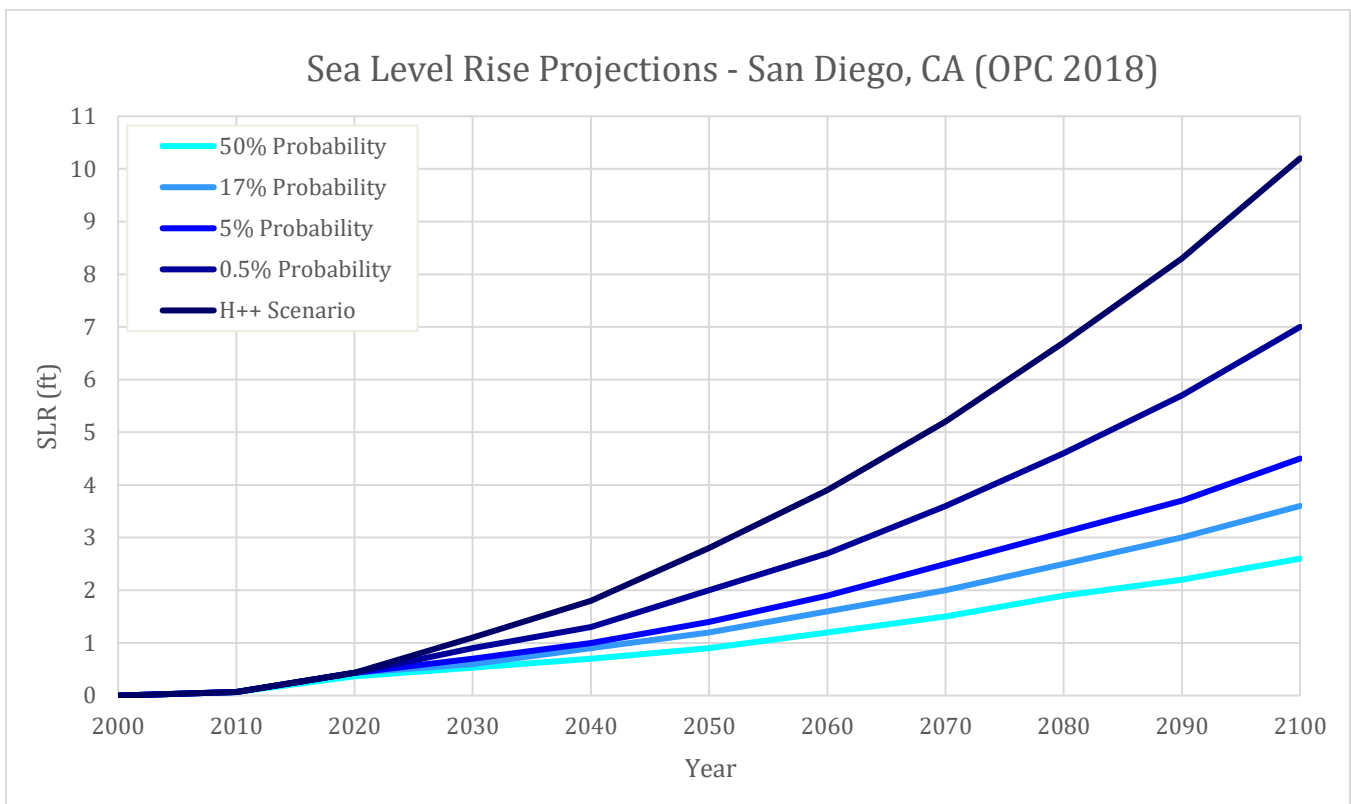


Figure 3-2. Sea Level Rise Projections – San Diego, CA

Due to the high degree of uncertainty associated with predicting when and at what rate SLR will occur, this study looks at a range of two scenarios that capture a range of predicted SLR rates and critical points for the study area. For the purposes of this study, the following two SLR scenarios are considered:

- Low Scenario: 3.6 feet (1.1 meters) and
- High Scenario: 7.0 feet (2.1 meters).

These two scenarios correspond with the Year 2100's 17% and 0.5% probabilities, respectively, and are in line with the completed City of San Diego Sea Level Rise Vulnerability Assessment (City of San Diego 2019).

SLR will result in the migration of existing Mission Bay wetland habitats upward and/or in the landward direction. For the purposes of wetland planning, SWLs under SLR scenarios are projected to pinpoint tidal elevations important to habitat and public use. Existing SWL elevations and future elevations based on the two chosen SLR scenarios are provided in Table 3-5.

Table 3-5. Sea Level Rise Projected Still Water Levels

Datum	Abbreviation	Existing SWL (ft, NGVD 29)	3.6 ft SLR SWL (ft, NGVD 29)	7.0 ft SLR SWL (ft, NGVD 29)
Highest Observed Tide (11/25/2015)	HOT	5.49	9.09	12.49
Mean Higher-High Water	MHHW	3.00	6.60	10.00
Mean High Water	MHW	2.28	5.88	9.28
Mean Sea Level	MSL	0.41	4.01	7.41
National Geodetic Vertical Datum of 1929	NGVD 29	0.00	3.60	7.00
Mean Low Water	MLW	-1.42	2.18	5.58
North American Vertical Datum of 1988	NAVD 88	-2.13	1.47	4.87
Mean Lower-Low Water	MLLW	-2.32	1.28	4.68
Lowest Observed Tide (12/17/1937)	LOT	-5.19	-1.59	1.81

4 Preliminary Design

Water quality improvement and habitat creation are the primary objectives of this Project. This section is intended to describe the preliminary design of wetlands restoration at the site, as well as the proposed modifications to the existing causeway that connects Fiesta Island to the mainland, the probable construction cost estimate, and preliminary project construction schedule.

As discussed earlier, the Mission Bay Park – Master Plan Update (City of San Diego 2002) identifies the Tecolote Creek area as a wetland restoration project. Moreover, with the main objective of enhancing tidal circulation and water quality, the Mission Bay Master Plan discusses modifications to the existing Fiesta Island Causeway. Due to insufficient water circulation and tidal flushing, in addition to high input of pollutants from Tecolote Creek, the eastern region of Mission Bay (east of Fiesta Island, in particular) suffers from poor water quality. Water quality can be assessed by means of residence time, which for this case is an indicator of the frequency of tidal exchange. Assuming contaminant loads (bacteria, for example) are held constant, more frequent tidal flushing (shorter residence times) result in higher water quality. Alternatively, with the same assumption, less frequent tidal flushing (longer residence times) results in poorer water quality. Tidal hydraulics analyses were conducted to quantify tidal residence times at the Tecolote Creek Wetland under existing conditions as well as with the proposed modifications of the Fiesta Island Causeway.

Water quality and SLR factors were used to formulate a design approach for the Tecolote Creek Wetlands project. Consistent with the Project goals, the design intent is to create a diverse self-sustaining habitat area with representation of non-vegetated and vegetated areas that contribute to the overall health of Mission Bay. The diversity of habitat types supports the zonation of aquatic resources that benefit all trophic levels from macroinvertebrate species on the low end of the food chain to diverse avian species that preferentially feed within specific habitat types. The design response to anticipated SLR includes an emphasis on upper marsh habitat that functions under existing SWL elevations and will convert to lower marsh habitat types under future SLR elevations, as discussed in Section 5.2.9.

Figure 4-1 shows the concept habitat design for Tecolote Creek Wetlands. Figure 4-2 shows a cross-section of the proposed wetland design. See Section 4.1 for a detailed description of the grading design, habitats, and other project components.

The design incorporates the existing tidal channel, which has the appropriate depth and capacity to introduce the full tide range into the proposed restoration site. Freshwater input and storm runoff from Tecolote Creek will also influence the wetlands. It is the tidal hydrology, however, that will drive the wetland ecology to a large extent and support diverse, self-sustaining salt marsh habitat. The wetland grading design provides for a gentle slope (e.g., 52 feet horizontal:1 foot vertical, or H:V) from the constructed wetlands restoration area into the northern shoreline of the project area. Also, an open channel (or culvert) is proposed through Fiesta Island Causeway. The open channel (or culvert) will connect the waters north and south of the causeway that will promote tidal circulation and enhance water quality in areas surrounding east Fiesta Island. Construction

of a bridge or culvert is proposed to maintain access across the proposed connection. The exact connection feature is not yet determined and will be specified by the City at a later date.

The preliminary design described below includes substantial earthwork and grading of the site to create a suitable mosaic of salt marsh habitat: subtidal, mudflat, low marsh, mid marsh, high marsh, and transitional area over most of the Project area. Higher habitat representing upland occupies the farthest northern and western edges. The existing beach and upland area on the western project boundary will be transformed into sand dunes with associated coastal strand vegetation. Excavation and grading are also required to create the tidal connection under Fiesta Island Causeway. The dune will have a base elevation of +7 feet NGVD 29 and a top elevation of approximately +18 feet and will be approximately 3-4 feet above the existing elevation of Fiesta Island Road. The dunes are designed to have a slope of 5H:1V on the wetland side and a slope of 3H:1V on the roadway side. This dune design creates a physical barrier and visual screen of vehicular movements on Fiesta Island Road. The dune features will also add to the biodiversity at Tecolote Marsh. Once established, temporary and permanent strategies for coordinating recreational public uses and use by dog owners to maintain the dune environment will be important to long term success.

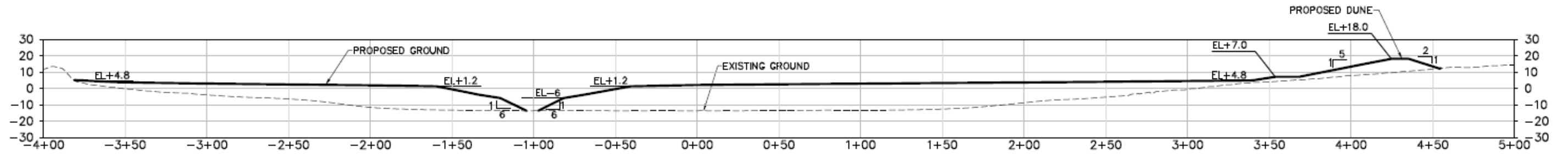


Figure 4-2. Cross-Section of Proposed Wetlands (Number 4 on Figure 4-1)

4.1 Project Components

The following sections summarize the proposed components of the Project.

4.1.1 Fiesta Island Causeway

The Mission Bay Park – Master Plan Update (City of San Diego 2002) discusses implementation of one-way tidal culverts beneath the existing Fiesta Island Causeway to establish a controlled hydraulic connection between the north and south basins that are currently bisected by the causeway. The idea behind the one-way culverts was to take advantage of phase lags between the tides on either side of the causeway to provide pulses of clean water from south to north. Nevertheless, as reported in the Mission Bay Hydrology Study (M&N 2019), direct measurements and numerical modeling of tides in Mission Bay have been used to identify that there are no lags between the high and low tides on either side of the causeway. The head differential that would activate (i.e., open) the gates and enable flow to the north has been identified to be in the order of tenths of a foot (at its maximum). This alternative was, therefore, deemed inadequate for the purpose of enhancing tidal circulation and water quality in the eastern region of Mission Bay.

An open channel is proposed at the time of this study to create the desired hydraulic connection between the basins on either side of the existing causeway. An option to the open channel is a culvert, but that option is not analyzed with modeling in this study. Channel stability, performance, and probable construction costs were evaluated for several channel geometries. The proposed channel (i.e., identified as the most cost-effective geometry) is 20 feet wide at its bottom, has an invert elevation of -6 feet (NGVD 29), and has a bank slope of 3:1 to match the crest elevations of the existing causeway. Section 4.1.3 discusses hydraulics of a proposed open channel and provides a discussion of its effect on tidal residence time. The City will ultimately decide whether an open channel or a culvert are the best connection features for this site. This study analyzes a conceptual open channel to initiate consideration of the connection and for purposes of program-level environmental review.

A bridge is envisioned to span over the open channel and maintain the existing connection between East Mission Bay Drive and Fiesta Island Road, see Figure 4-1. The bridge will potentially include concrete pre-cast girders hauled to the site and placed. Although bridge and roadway design are beyond the scope of this Project, the bridge will be ADA compliant and approximately 100 feet in length by 60 feet wide and will fully span the open channel. Alternatively, a (two-way) culvert beneath the existing causeway can be used to connect the Mission Bay water basins north and south of the causeway if the City does not wish to consider the open channel/bridge alternative. The culvert is a less optimal alternative compared to an open channel because it could hamper connectivity and tidal flow and can pose a safety hazard to users of Mission Bay. A culvert could also present an impediment to wildlife movement, while the open channel/bridge alternative would allow for clear passage for shore birds and other wildlife.

If a culvert is determined as the proposed connection, the sizing will be developed to optimize tidal circulation through Tecolote Creek Wetlands. Preliminary dimensions of the conceptual causeway culvert are provided below. The opening could consist of a large box culvert, or several smaller pipes or boxes that provide an equivalent cross-sectional area to that shown below.

- Base Elevation: -6 feet NGVD 29;
- Top Elevation: +10 feet NGVD 29; and
- Maximum Width: 20 feet (at bottom).

4.1.2 Wetland Habitats

Under this proposed Project, coastal salt marsh habitat will be created by filling in a portion of the existing Mission Bay waterway with sediment excavated from the existing slopes along Tecolote Creek mouth. This earthwork will be required to create an elevation range suitable for tidal wetland habitat. Other factors, such as soils being suitable for marsh habitats and the frequency in which tidal wetlands are inundated (referred to as tidal inundation frequency), determines the type of habitat that colonizes a particular location. Tidal hydrology will vary throughout a site depending on tidal conveyance, seawater supply, and site topography/bathymetry. Site topography is above-water elevation, while bathymetry is below-water elevation. Site modifications will occur above and below water for this project.

The grading design includes wetland habitat along the three shorelines of Tecolote Creek Wetland (see Figure 4-1). The proposed Project would create a gradient of balanced habitat types relative to existing conditions through site grading modifications (excavation and filling). Filling a portion of the waterway will raise the below-water elevations of the Project site and convert the existing subtidal habitat to salt marsh habitat. Existing beaches within the Project area will also be converted to salt marsh habitat. The wetlands are designed to slope upward and join existing upland along the perimeter.

As reported in the Mission Bay Hydrology Study (M&N 2019), there is no tidal lag between ocean conditions and Mission Bay. This means the water level of the channels will fluctuate with the ocean tide conditions. Therefore, during ocean low tide cycles, the water level of the tidal channels will be low; during ocean high tide cycles, the water level of the channels will be high. Conveyance of seawater throughout the main channels will create the mix of salt marsh habitat mentioned in Section 4.0 that includes: subtidal, mudflat, low marsh, mid marsh, and high marsh. The proposed Project also includes a transitional habitat area that allows for upward migration of the marsh as sea level rises. Non-tidal and upland habitat will persist around the higher perimeter area of the Project.

Freshwater pulses will be supplied from Tecolote Creek during stormflows. These pulses will be relative brief and somewhat limited compared to the seawater supply, however they can significantly benefit a marsh by enhancing habitat quality and increasing diversity near the freshwater source. The project includes a “bulbed” area in channel planform at the mouth of the creek to allow for retention of freshwater and enhancement of marsh habitat.

The existing habitat and proposed salt marsh habitat areas for the Project are listed in Table 4-1.

Table 4-1. Existing and Proposed Habitat Areas

Existing Habitats	Mapped Acreage	Proposed Habitats	Designed Acreage	% Total
Subtidal/Open Water	15.64	Subtidal/Open Water	3.52	13.5
Mudflat	-	Mudflat	2.48	9.5
Low marsh	-	Low marsh	3.35	12.8
Mid marsh	-	Mid marsh	6.83	26.1
High marsh	-	High marsh	3.70	14.1
Transitional	-	Transitional	0.61	2.3
Disturbed Habitat/Upland	1.74	Upland/Dunes	1.14	4.4
Developed/Upland	2.63	Upland/Dunes	1.11	4.3
Coastal Salt Marsh	1.61	Marsh	0.43	1.6
Beach	4.53	Upland/Dune	2.98	11.4
TOTAL AREA	26.15	TOTAL AREA	26.15	100

A detailed breakdown of the proposed wetland habitats and their elevation range is provided below.

Subtidal (elevation range is from below -6.0 feet to below -3.7 feet NGVD 29)

Subtidal habitat is defined as shallow areas of open water that do not drain during each tidal period. Creating or restoring shallow subtidal habitat would benefit primarily benthic invertebrates, birds, and fishes. Some plant species, especially eelgrass (*Zostera marina*), require subtidal conditions and may colonize the deeper subtidal habitats. Eelgrass beds function as nurseries for fishes and invertebrates and are directly grazed by some bird species.

Common benthic infauna occurring in subtidal habitats include worm-like forms, such as polychaetes and spionids, and filter-feeding bivalves, such as California jackknife clam (*Tagelus californica*), little neck clam (*Protothaca staminea*), and bent-nose clam (*Macoma nasuta*). Epifaunal organisms, such as sea hare (*Aplysia californica*) and rock crab (*Cancer productatus*) forage on detritus and other food sources. These and other invertebrate taxa would benefit from restored subtidal habitats, in turn supporting higher order consumers that utilize these taxa as prey.

Fish species associated with the nearshore ocean habitat are supported by subtidal habitat. Such species as white croaker (*Genyonemus lineatus*) and northern anchovy (*Engraulis mordax*) that inhabit the mid-upper water column would be supported by subtidal wetland habitats, as would demersal species such as California halibut (*Paralichthys californicus*) and leopard shark (*Triakus semifasciata*). Resident estuarine fishes, such as

arrow gobies (*Clevelandia ios*) and California killifish (*Fundulus parvipinnis*) would also exploit subtidal habitat and provide food for higher order consumers in the food web. Fish and benthic invertebrate species associated with eelgrass beds, such as bay pipefish (*Syngnathus leptorhynchus*), giant kelpfish (*Heterostichus rostratus*), grass shrimp (*Hippolyte californiensis*), and speckled scallop (*Argopectin aequisulcatus*) would potentially benefit from creation of subtidal habitats. Herbivorous birds, such as brant (*Branta bernicla*), graze directly on eelgrass and may be expected to utilize eelgrass beds in areas of substantial subtidal habitat.

Increased populations of gulls and terns, including the endangered California least tern (*Sternula antillarum browni*) that nest nearby, and other fish-eating birds, such as osprey (*Pandion haliaetus*) and brown pelican (*Pelicanus occidentalis*), would be supported by the increased fish production associated with subtidal habitats.

Mudflat (elevation range from -3.7 feet to +1.1 feet NGVD 29)

Intertidal mudflat habitat is defined as unvegetated, unconsolidated mud or sand bottom habitat. Mudflat habitat is typically situated low in the intertidal zone, between subtidal habitat and low intertidal salt marsh. Mudflats are inundated and exposed during most tidal cycles.

Creating or restoring intertidal mudflat habitat would benefit primarily benthic invertebrates and birds, particularly shorebirds that forage on benthic invertebrates. Common benthic infauna associated with mudflats are similar to those described above for subtidal habitats and include polychaetes, spionids, and filter-feeding bivalves. Common epibenthic mudflat fauna include detritivorous molluscs, such as California horn snail (*Cerithidea californica*) and bubble snail (*Bulla gouldiana*), and omnivorous crustaceans, such as lined shore crab (*Pachygrapsus crassipes*), yellow shore crab (*Hemigrapsus oregonensis*), and fiddler crab (*Uca crenulata*). Numerous varieties of insects also occur on mudflats at low tides where they forage on detritus, algae, and other food sources left by the receding tide.

Perhaps the most conspicuous animals of the intertidal mudflats are the shorebirds that forage on invertebrates and insects, and rest there during low tide. Most shorebirds are migratory and use the food-rich mudflats to build the energy reserves necessary for long flights. Wading birds, such as Western sandpiper (*Calidris mauri*), semipalmated sandpiper (*Calidris pusilla*), and dowitchers (*Limnodromus* spp.) would be expected to forage on the restored mudflats during their annual migrations.

Low marsh (elevation range from +1.1 feet to +1.9 feet NGVD 29)

Intertidal salt marsh ranges from low marsh, dominated by California cordgrass (*Spartina foliosa*), to a mosaic of primarily succulent species that comprise the mid-salt marsh, to high salt marsh dominated by species tolerant of infrequent inundation and high salinities. Each species occurs at its highest frequency within a unique elevation zone determined by the frequency of tidal inundation, salinity, duration of saturated soil, and temperature, although the salt marsh vegetation forms a continuum across the marsh plain as opposed to occurring in discrete elevation bands. Low salt marsh occurs from approximately +1.1 feet to +1.9 feet NGVD 29.

The salt marsh is the base of the food chain in estuaries and lagoons, converting energy from sunlight to plant tissue, which supports a host of consumers. Thus, the more intertidal salt marsh habitat that is created, the greater the benefit to additional taxonomic groups that depend on the salt marsh for energy, including vascular and non-vascular plants, aquatic invertebrates, terrestrial invertebrates, aquatic vertebrates, and terrestrial vertebrates.

The low marsh provides food and structure for a number of invertebrate taxa, including insects, such as *Incertella* sp., and snails, such as the salt marsh snail (*Melampus olivaceus*). These invertebrates provide food for fish species that forage within the vegetated low marsh during high tides. These include the longjaw mudsucker (*Gillichthys mirabilis*) and California killifish (*Fundulus parvipinnis*). The low salt marsh provides food, cover, and structure for nesting and roosting birds. Birds of the low marsh include rails, such as Virginia rail (*Rallus limicola*), sora (*Porzana carolina*), and the endangered Ridgeway rail (*Rallus obsoletus*).

Mid marsh (elevation range from +1.9 feet to +3.7 feet NGVD 29)

Salt marsh habitat that occurs between low and high salt marsh (mid-salt marsh) is inundated irregularly by tides relative to the low marsh, but at a higher frequency than the high marsh. As a result, the plant species that inhabit the mid-salt marsh are adapted to high soil salinities and long periods of exposure. Food is abundant in the form of algae and epifaunal invertebrates and insects that feed on algae. The vascular plants of the mid-high marsh also contribute to detritus-based food chain associated with salt marsh productivity, but not to the extent of the low marsh. Many of the invertebrates that inhabit the low salt marsh also occur in the mid- and high-salt marsh, although algal productivity declines with increased elevation with an associated decline in invertebrate species that depend on algal food sources. Similarly, fish species that exploit the flooded salt marsh are inhibited from exploiting the irregularly flooded higher salt marsh habitats.

Bird species are perhaps the most conspicuous animal of the mid marsh. Species such as willet (*Limosa fedoa*), long-billed curlew (*Numenius americanus*), and great blue heron (*Ardea herodias*) occur in these habitats. These species prey on fishes and aquatic invertebrates in adjacent channels and, in the case of herons, on terrestrial animals such as small mammals and herpetofauna. The state-endangered Belding's savannah sparrow nests and forages in the mid-high salt marsh. The sensitive butterfly known as the wandering skipper (*Panoquina errans*) depends on saltgrass (*Distichlis spicata*) that grows in the mid-high marsh, and the endangered salt marsh bird's beak (*Cordylanthus maritimus* ssp. *maritimus*) occurs in the high-salt marsh. Mid-salt marsh habitat typically supports the state-endangered Belding's savannah sparrow, as well as other bird species discussed above.

High marsh (elevation range from +3.7 feet to approximately +4.8 feet NGVD 29)

Intertidal high-salt marsh occurs at elevations between mid-salt marsh and supratidal transition zone habitat. The high marsh is irregularly to intermittently flooded and the plants of this marsh habitat are adapted to hypersaline soil conditions. The upper elevation limit for high marsh is identified as being slightly higher than the theoretical value shown in the tidal inundation frequency curve in the following report section. This is

based on information presented in the Feasibility Study for ReWild Mission Bay (Everest International Consultants 2018) and the fact that high marsh and transitional habitat intermingle and can occupy some of the same elevations. Algae and its role in the food web is almost non-existent in the high-salt marsh due to desiccation from infrequent tidal inundation. As a result, invertebrates that depend on algae for food are similarly absent, or present in low numbers. Similarly, fish and invertebrates associated with intertidal creeks do not occur in the high marsh. Plant species of the high-salt marsh contribute to the over primary productivity of the marsh system, but not to the extent of the mid- or low-salt marsh. Bird species that forage on insects and aquatic biota are less common and may use the high marsh as loafing areas. Small mammals, such as mice, may exploit the higher elevations of the high marsh above the reach of spring tides.

Transitional (elevation range from +4.8 feet to +6.8 feet NGVD 29)

Supratidal transition zone habitat occurs between the range of the highest high tides and non-tidal supratidal uplands. These areas represent a transition from the highest salt marsh plant species to upland plant species with both plant assemblages occurring within this relatively narrow elevation band. High soil salinities prevent upland species from invading the lower transition zone while upland species out-compete salt tolerant species at the higher transition zone elevations.

Transition zone habitat is very rare in Southern California coastal wetlands where development has encroached upon the edges of tidal lagoons and estuaries. As a result, this habitat is perhaps the least understood of all wetland-associated habitats. What is known, is that these habitats provide refugia for salt marsh species, such as the Ridgeway rail, during extreme weather and tides, as well as additional foraging habitat. As stated previously, great blue herons are known to prey on small mammals and herpetofauna that inhabit transition and upland habitats. It has been postulated that important plant pollinators, such as ground dwelling bees, occur in the transition zone.

The transition zone is also important in terms of climate change and predicted SLR. Should sea levels rise as predicted, areas of low and mid salt marsh will be inundated more frequently and by increasingly deeper water, ultimately converting to subtidal habitat. Under this scenario, the transition zone will convert to intertidal salt marsh. Thus, inclusion of transition zone in restoration alternatives provides a potential mechanism for maintaining the biological diversity of the wetland in the future.

Upland and Dune (elevation range from +6.8 feet to +16.0 feet NGVD 29)

Upland and dunes are provided around the perimeter of the site and occupy larger areas on Fiesta Island. Upland areas are important as habitat boundaries because they add to the buffering of wetland areas and provide for useful habitat in themselves. Typically, upland consists of coastal sage scrub or chaparral that serves as habitat for birds and mammals. Dunes are important habitat types for bordering wetlands because they are often found there in nature and provide a soft shoreline transition that can move with waves, tides, and currents, yet still protect the backshore. Dunes are sensitive habitat that are rare in Southern California and provide increased value to the overall site habitat mix as a whole. Rare dune habitat and existing

recreational uses will need to be coordinated carefully. Any impacts to parking associated with the added dune environment will need to be fully evaluated. Temporary fencing for dunes may also be necessary to prevent unauthorized access by dogs and their owners during their establishment.

4.1.3 Wetland Hydrology and Water Quality Analysis

Impacts of the proposed design to tidal hydraulics were assessed with the use of the overall Mission Bay hydrodynamic model (M&N 2019) that was set up to assess the tidal hydraulic/hydrologic performance of all salt marsh wetlands proposed within the Mission Bay PEIR Project area. This assessment allows:

- verification that the proposed wetland habitat distribution is consistent with tidal inundation distribution;
- insight on changes to tidal circulation within the proposed wetland and connections;
- quantified improvements to residence times and water quality in the area; and
- quantification of hydraulics at the proposed wetland during an extreme fluvial storm flood event.

Tidal Elevations

To evaluate day-to-day tidal hydraulics, as well as tidal hydrology at the proposed Tecolote Creek Wetland, the Mission Bay model was used to simulate a 15-day Spring-Neap tidal cycle that is representative of the long-term average conditions. Details on the imposed boundary conditions for the assessment of average tidal hydraulics can be found in the Mission Bay Hydrology Study (M&N 2019).

Figure 4-3 plots modeled water surface elevations for the proposed wetland and the open ocean. As previously discussed, the tide at the proposed wetland site rises and falls concurrently with the tide at the open ocean, with no significant variation between high and low tide elevations between the Bay and ocean. This allows establishment of the full range of wetland habitats (subtidal, mudflat, low marsh, mid marsh, high marsh) within the Project area. Table 4-2 and Table 4-3 list modeled tidal datums for the proposed Tecolote Creek Wetland. The spring tidal range (Spring High Water – Spring Low Water) is 8.2 feet while the Diurnal Range (MHHW – MLLW) is 5.8 feet.

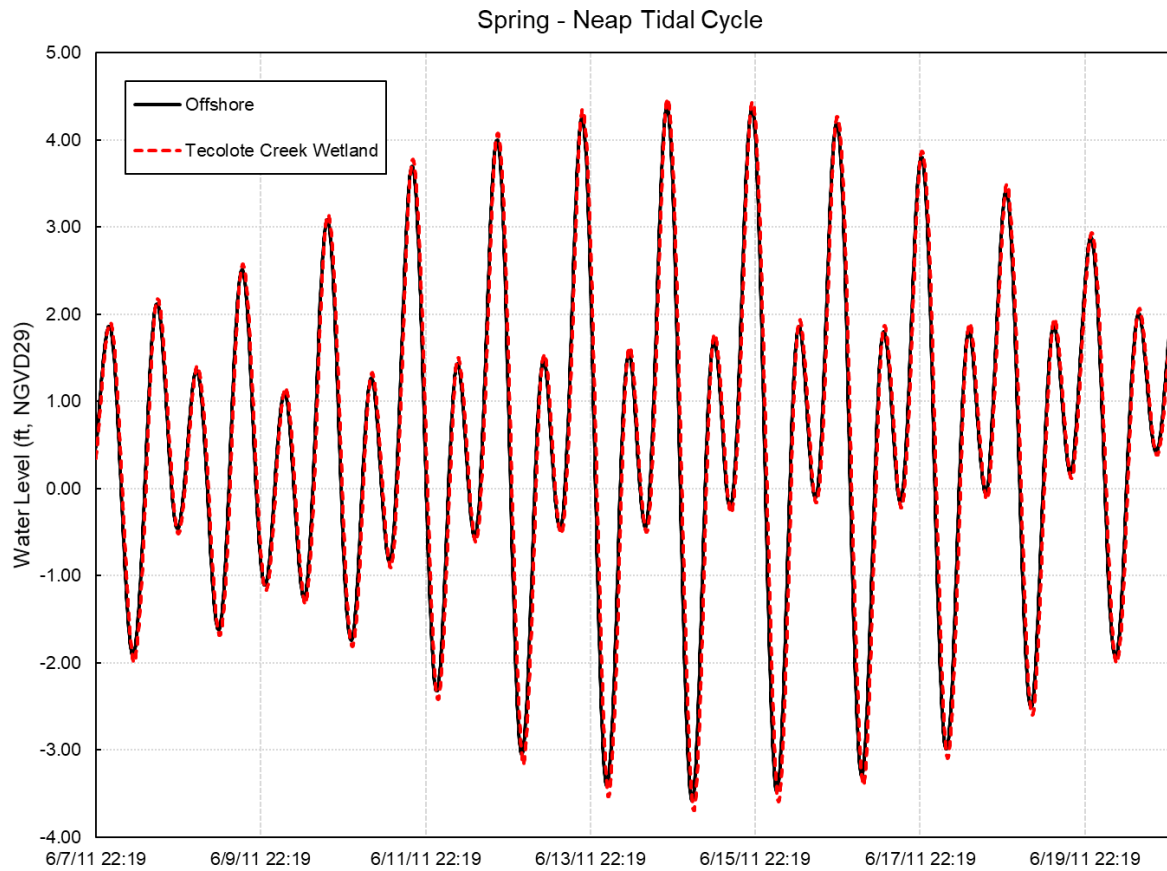


Figure 4-3. Modeled Tides at the Offshore Ocean and at the Proposed Wetland

Table 4-2. Predicted Spring Tidal Elevations Offshore and at the Proposed Wetland

Station	Spring High Water (ft, NGVD 29)	Spring Low Water (ft, NGVD 29)	Spring Tidal Range (ft)
Offshore	4.4	-3.6	8.0
Tecolote Creek Wetland	4.5	-3.7	8.2

Table 4-3. Predicted Average Tidal Elevations Offshore and at the Proposed Wetland

Station	MHHW (ft, NGVD 29)	MLLW (ft, NGVD 29)	Diurnal Range (ft)
Offshore	3.3	-2.4	5.7
Tecolote Creek Wetland	3.4	-2.4	5.8

Tidal Inundation Frequency

Tidal Inundation frequency is the percentage of time that the tidal elevation exceeds a certain elevation, an important factor for habitat distribution design because plant species become established at particular inundation frequencies. Modeled water surface elevations at the proposed wetland and at the open ocean were used to develop the inundation frequency curves presented in Figure 4-4. As there is no muting of high and low tides between the proposed Tecolote Creek Wetland (post-construction condition, red curve) and the open ocean (black curve), the two locations have virtually the same tidal inundation frequencies. Therefore, the vertical zonation (range of occurrence) of intertidal habitat is relatively broad compared to a muted condition and is approximately 8 feet. The elevation ranges of habitats to colonize the site (i.e., subtidal, mudflat, low marsh, mid marsh, high marsh, and transitional/upland habitats) are delimited in Figure 4-4.

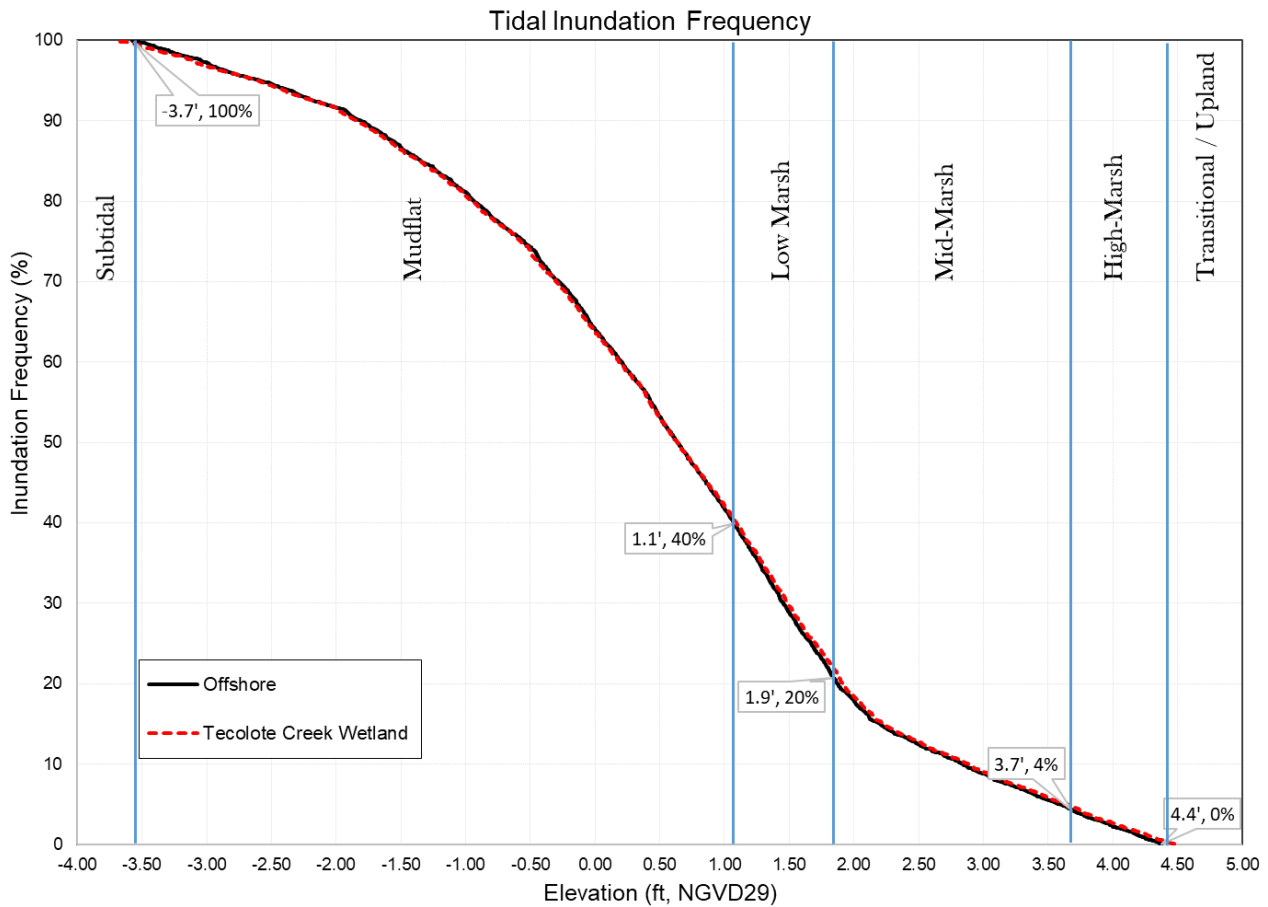


Figure 4-4. Tidal Inundation Frequency Offshore and at the Proposed Tecolote Creek Wetland

Tidal Flow Velocities

Tidal current velocities associated with the rising and falling tides (i.e., the tidal flow velocities) in Mission Bay have a more variable distribution in time and space, as opposed to the water surface elevations. The largest current speeds, typically reaching 2.5 foot per second (ft/s), occur at the Mission Bay ocean entrance channel. Tidal currents at the proposed wetland site are, in contrast, very weak. Figure 4-5 shows three representative locations around the proposed wetland where model results have been extracted. Depth averaged current speeds at these locations are listed in Table 4-4. Peak tidal velocities during flood (rising tide) and ebb (falling tide) are less than 0.05 ft/s at the proposed wetland location. Larger tidal velocities occur at the proposed open channel, reaching 0.57 and 0.77 ft/s at peak flood and peak ebb, respectively.

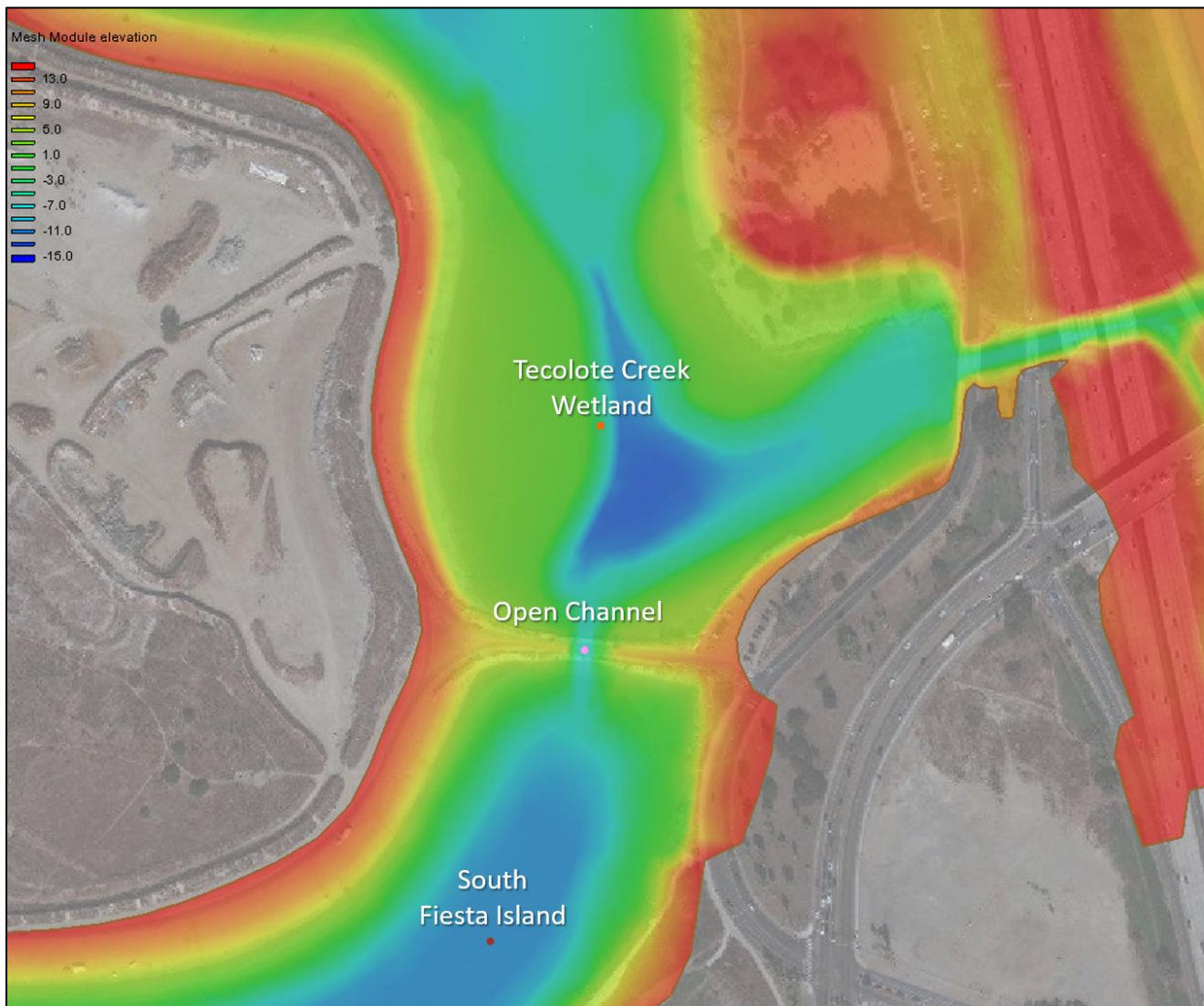


Figure 4-5. Model Data Extraction Locations

Table 4-4. Predicted Peak (Depth-Averaged) Tidal Current Velocities

Station	Peak Flood (ft/s)	Peak Ebb (ft/s)
Tecolote Creek Wetland	0.03	0.04
Open Channel	0.57	0.77
South Fiesta Island	0.06	0.09

Residence Time

Residence time is defined as the average time a water molecule/particle resides in a hydraulic system and provides a useful metric of the rate at which waters in a hydraulic system are renewed. It is an indicator of

the frequency of tidal turnover. As a means for assessing first order changes in water quality within the proposed wetland; the Mission Bay hydrodynamic model was used to conduct a residence time analysis.

Table 4-5 lists computed residence times at the Tecolote Creek Wetland and South Fiesta Island locations (see Figure 4-5) for both existing conditions (i.e., no wetland) with the existing Fiesta Island Causeway, and for proposed conditions (i.e., with the proposed wetland) and a 20-foot-wide open channel at the location of the existing causeway.

Under existing conditions, water residence time at the Tecolote Creek Wetland is more than two times greater than at South Fiesta Island. With the introduction of an open channel at the location of the existing causeway, a connection between the two basins is established, locally enhancing tidal circulation and, in turn, improving water quality. Residence time at the wetland site decreases by approximately 6 days under proposed conditions. South Fiesta Island exhibits a longer residence time under proposed conditions. The residence times of the two locations become more similar and the water quality should also become more similar and improved along the east side of Fiesta Island. Overall, the differences in residences times decrease from 20.6 days under existing conditions to 6.9 days under proposed conditions.

Table 4-5. Computed Residence Times at Tecolote Creek Wetland and South Fiesta Island*

Station	Existing Condition	Proposed Condition
Tecolote Creek Wetland	33.8 days	27.8 days
South Fiesta Island	13.2 days	20.9 days
Δ Residence Time	20.6 days	6.9 days

**Hydrodynamic modelling results are based on best available information at the time of report preparation and are subject to change upon future availability of relevant data.*

Water Quality Implications on Habitat Design

Relatively poor water quality at the Tecolote Creek mouth provides an opportunity for water quality improvements through improved tidal circulation and habitat creation. Water quality has a direct effect on all trophic levels of the food chain in Mission Bay. Reduced water residence time is a first order approximation predicting water quality improvements. Areas of Mission Bay with higher tidal exchange exhibit healthy eelgrass populations. Eelgrass supports bay fisheries and nurseries that replenish important fish stocks. These fisheries are utilized for forage by sensitive and listed species such as the endangered least tern. Water quality also promotes microbenthic invertebrates that are important foraging areas for shorebirds within Mission Bay. Accordingly, efforts to improve water quality through non-vegetated and vegetated marsh habitat establishment provides multiple benefits to the Mission Bay ecosystem. Currently, less eelgrass is present in the waters east of Fiesta Island compared to other areas of the Bay (Dudek 2020). Improvements to tidal exchange and through increased biotic functions may improve water quality and expand eelgrass populations in east Mission Bay.

Extreme Storm Flood Hydraulics

Assessment of extreme storm flood hydraulics for the proposed design was also conducted to identify peak current velocities and water levels. The 24-hour flood hydrograph corresponding to the FEMA FIS 100-year fluvial storm event at Tecolote Creek (see section 3.1.3 and Appendix A) was imposed into the Mission Bay hydrodynamic model to simulate two hydraulic scenarios: 1) Peak discharge coinciding with the Lowest Observed Tide (-5.19 feet NGVD 29, occurring on 12/17/1937), and 2) Peak discharge coinciding with the Highest Observed Tide (+5.49 feet NGVD 29, occurring on 11/25/2015). Hydraulic Scenario 1 was simulated to identify peak current velocities, which are particularly relevant for stability of the proposed open channel, while Hydraulic Scenario 2 was simulated to identify peak water levels and any potential flooding.

Figure 4-6 and Figure 4-7 depict peak depth averaged current velocity contours at the proposed wetland for the modeled storm flood conditions. Hydraulic Scenario 1 results in high peak current velocities, reaching approximately 15 ft/s (orange to red shades in Figure 4-6) at the mouth (i.e., the downstream end) of Tecolote Creek. Nonetheless, the proposed grading promotes effective flow dissipation, and current velocities decrease below approximately 5 ft/s within 350 feet from the mouth of Tecolote Creek. For Hydraulic Scenario 2, peak current velocities of approximately 11 ft/s occur near the mouth of Tecolote Creek and decrease below 5 ft/s within 100 feet. Although they have the potential for mobilizing sediment, these velocities are deemed acceptable for the proposed design for the following reasons:

- 1) A rip rap flow dissipator is proposed at the mouth of the creek as part of the project that will decrease flow velocities rapidly.
- 2) The proposed grading plan promotes a more rapid dissipation of higher-velocity flows in the wetland area compared to the existing conditions at the site. Refer to Mission Bay Hydrology Study (M&N 2019) for the 100-yr storm current velocities under existing conditions shown in Table 5-4 on page 32 and Figure 5-15 on page 36 of that report.
- 3) Modeled flow velocities assume a fixed bed. In reality, currents of this magnitude would result in redistribution of the bed sediment and adjustment of its morphology. The proposed wetland will function with certain areas experiencing erosion and other areas sedimentation that would further enhance dissipation of flow until an equilibrium is reached.
- 4) The potential for erosion will be higher if the considered event, i.e., the 100-yr storm, occurs prior to the establishment of the proposed intertidal habitats. Once developed, vegetation will dampen current velocities and stabilize the substrate, making the wetland more resilient to storms.

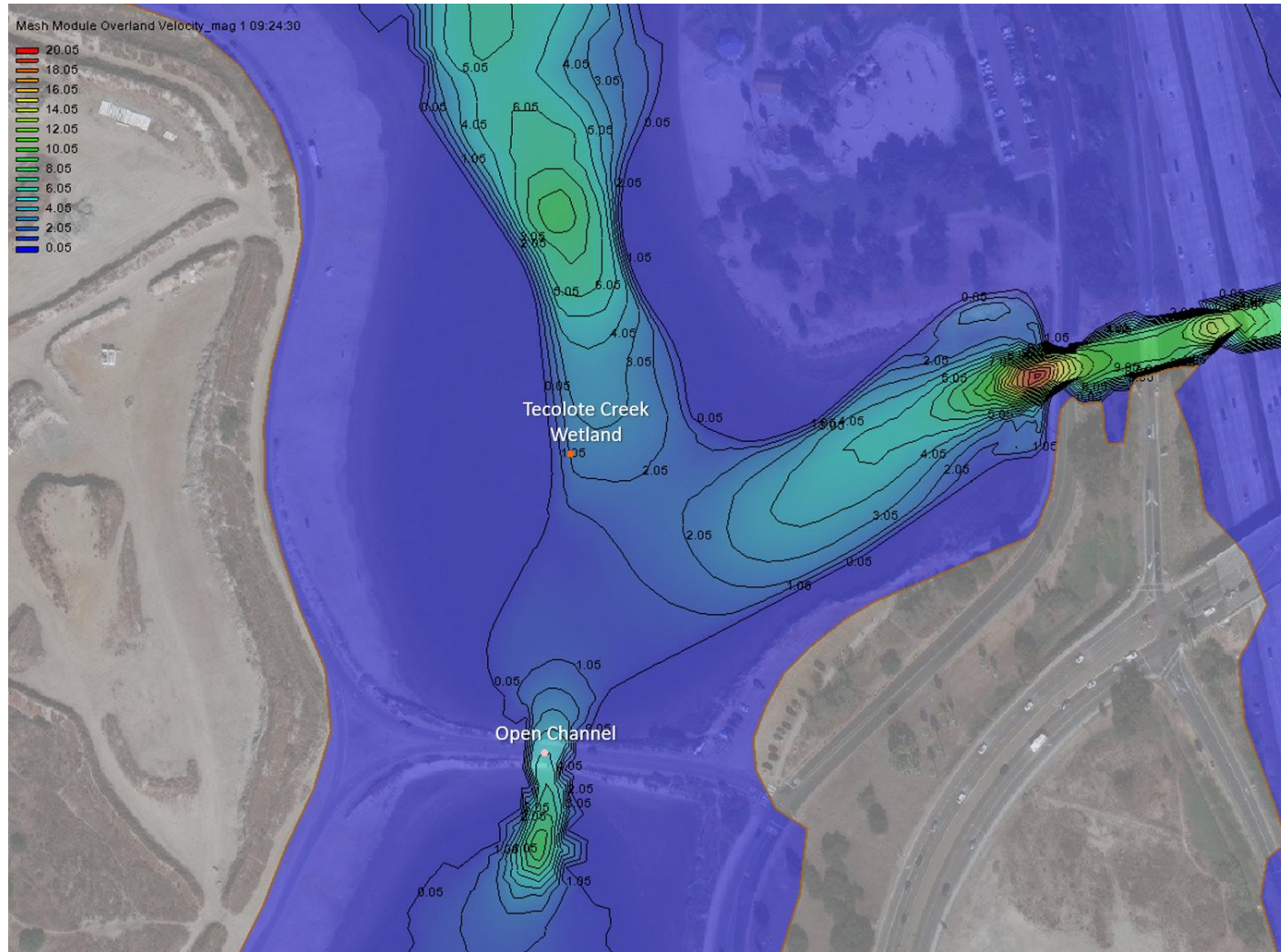


Figure 4-6. Depth Averaged Peak Current Velocities at Proposed Wetland: Storm Flood Hydraulic Scenario 1

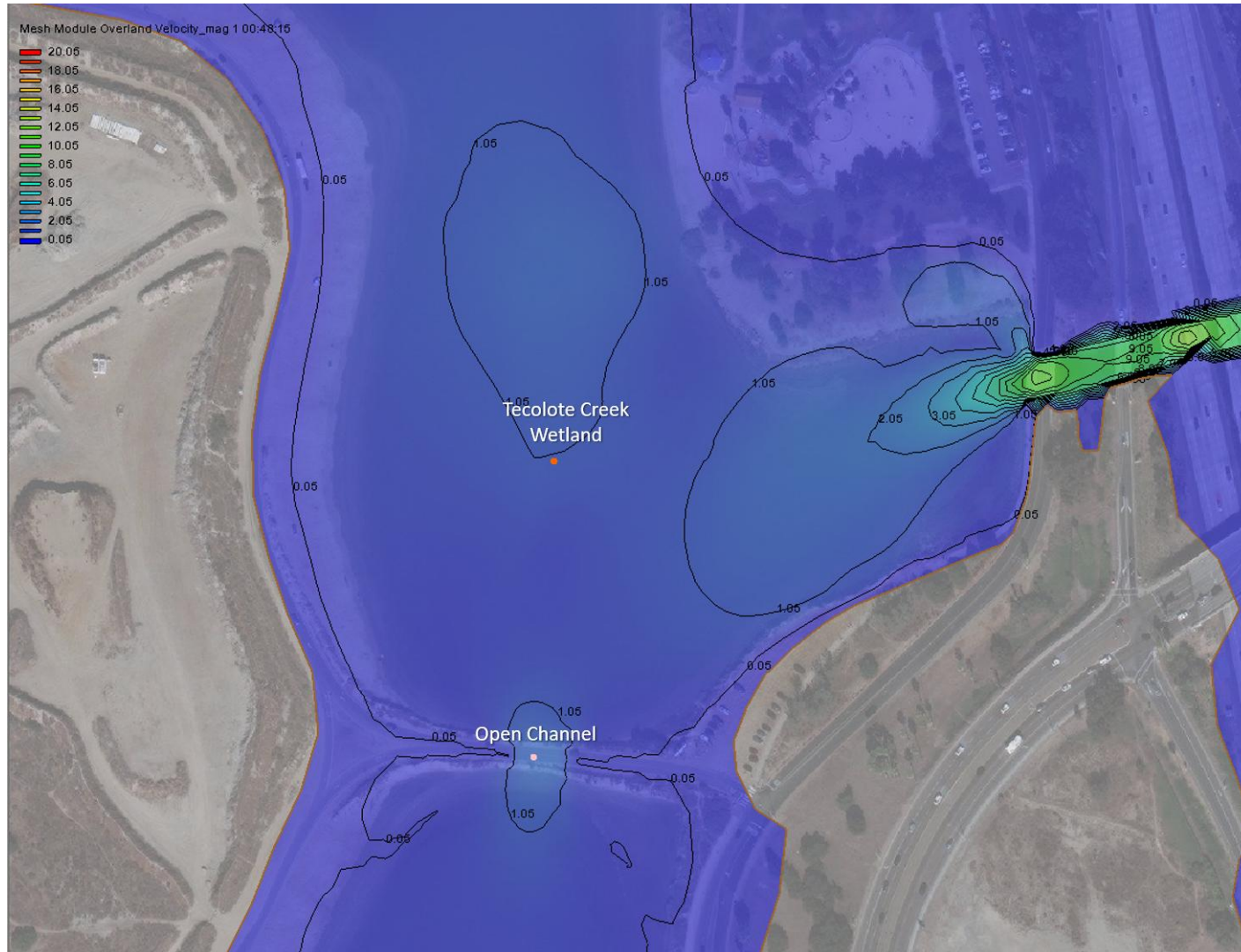


Figure 4-7. Depth Averaged Peak Current Velocities at Proposed Wetland: Storm Flood Hydraulic Scenario 2

Table 4-6, Figure 4-8, and Figure 4-9 summarize hydraulics at the Tecolote Creek Wetland and Fiesta Island Causeway locations (see Figure 4-5) for each of the modeled hydraulic scenarios. As discussed above, storm flow velocities rapidly dissipate downstream of the mouth of Tecolote Creek reaching a maximum of approximately 2.2 ft/s (Hydraulic Scenario 1) in the central area of the proposed wetland. At the causeway, constriction of the flow results in higher current velocities reaching a maximum of up to approximately 5 ft/s under Hydraulic Scenario 1. The values presented in Table 4-6 below are extracted from numerical model results at the extraction points shown in Figure 4-7.

Regarding water levels, the solid blue curves in Figure 4-8 and Figure 4-9 indicate that storm water elevations remain approximately the same or lower than tidal elevations (dashed blue curves) throughout the course of the storm for both hydraulic scenarios. Thus, water surface elevations at the site are controlled more by tides than stormflows.

Table 4-6. Predicted Extreme Storm Flood Hydraulics at the Proposed Wetland and Fiesta Island Causeway

Station	Hydraulic Scenario 1		Hydraulic Scenario 2	
	Peak Current Velocity (ft/s)	Peak Water Level	Peak Current Velocity (ft/s)	Peak Water Level
Tecolote Creek Wetland	2.2	Below tidal elevation	1.0	Below tidal elevation
Fiesta Island Causeway	5.1		1.9	

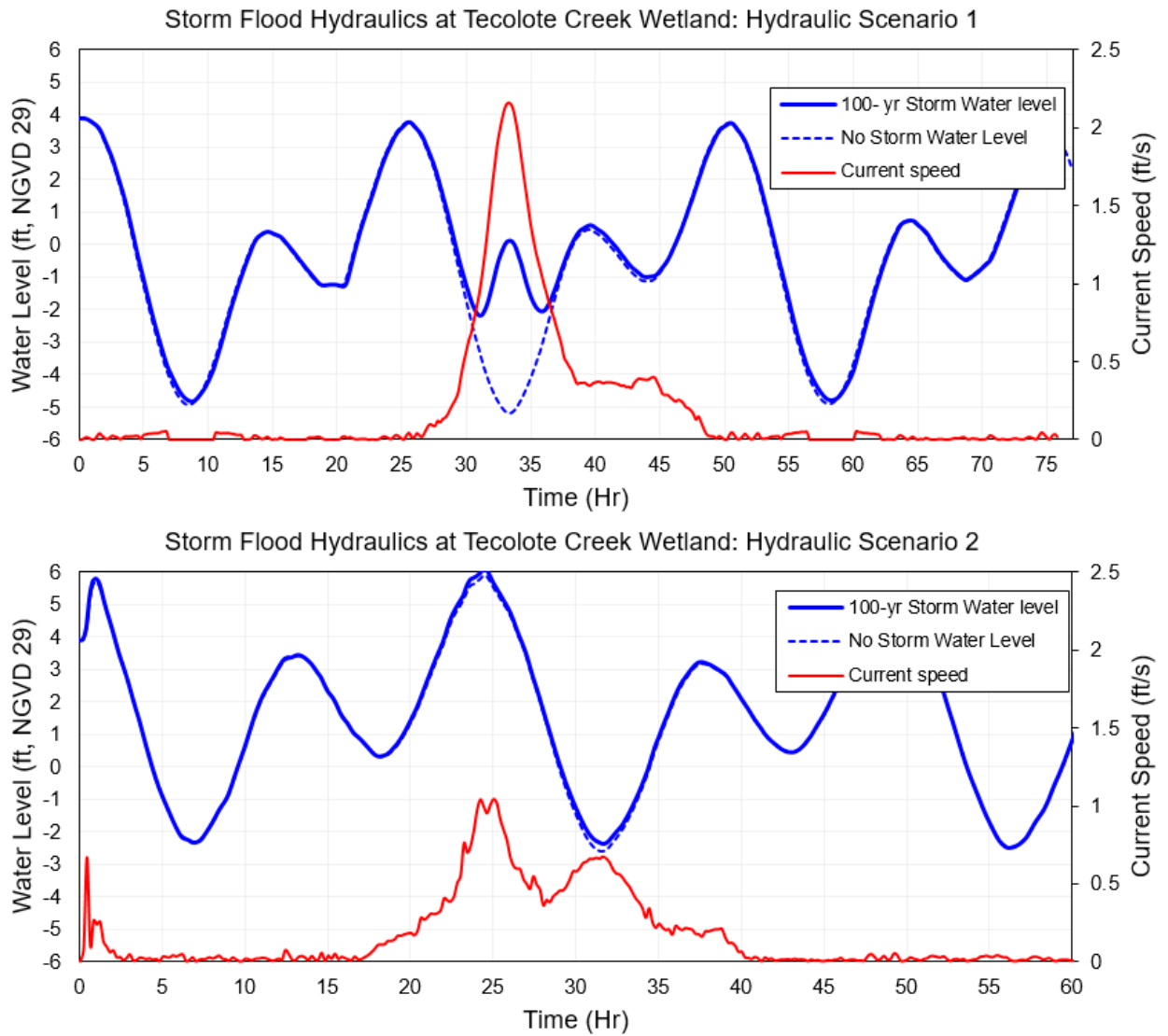


Figure 4-8. Predicted Storm Flood Hydraulics at Tecolote Creek Wetland

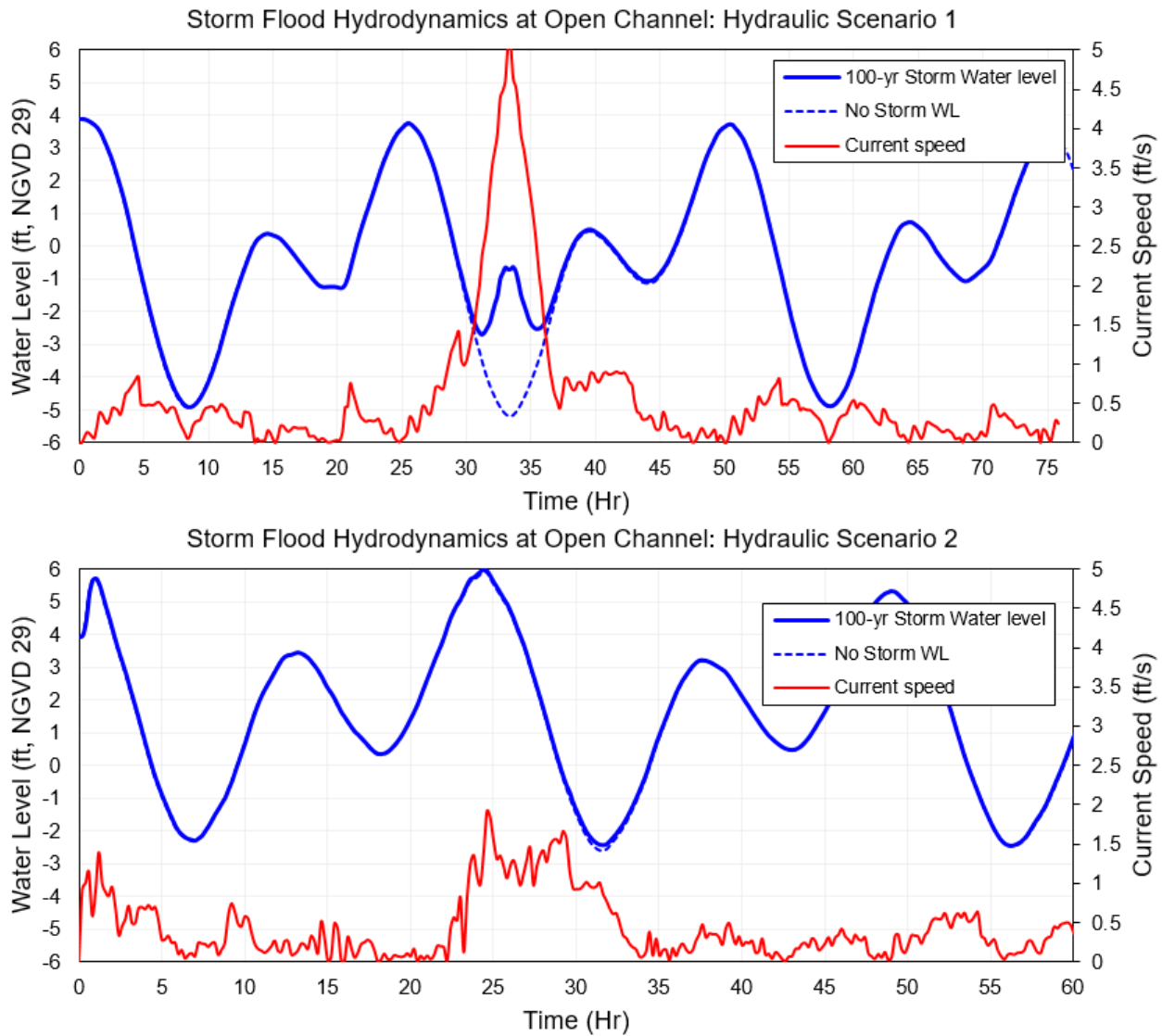


Figure 4-9. Predicted Storm Flood Hydraulics at the Fiesta Island Causeway

4.1.4 Fencing

Perimeter fencing is proposed for this Project to restrict access and allow the site’s vegetative community time to develop and mature post-construction. The fencing will reduce the risk of damage to the salt marsh caused by either foot traffic, animals, or unauthorized vehicular traffic. A 6-foot-high chain-link fence is assumed for this Project, although other exclusion fence types may be explored. Gates will be included to allow authorized access for monitoring and maintenance, and tours if desired.

4.2 Preliminary Drawings

A preliminary set of drawings of the Tecolote Creek Wetland Restoration & Fiesta Island Causeway can be found in Appendix B. Drawings are currently in draft phase and are not for construction. These drawings include the project components and design criteria stated in Section 4.1.

4.3 Preliminary Opinion of Probable Construction Cost

To determine a cost estimate for this preliminary design, unit costs were derived from the City of San Diego Unit Price List and similar project cost estimates. The cost estimate for construction of the preliminary design is categorized by line item, as shown in Table 4-7.

Table 4-7. Preliminary Opinion of Probable Construction Cost

Item	Unit	Quantity Total	Unit Price	Cost
1. Mobilization of Equipment	LS	1	\$50,000	\$50,000
2. Earthwork and Stockpiling	CY	169,220	\$25	\$4,230,500
3. Irrigation and Planting, Plus 1 Year of Plant Establishment	AC	5	\$118,000	\$590,000
4. One Bridge (or Large Culvert)	SF	6,000	\$1,000	\$6,000,000
5. Perimeter Fence (6-Foot Chain link)	LF	3,393	\$20	\$67,860
6. Swing Gates (West and East Perimeters)	EA	2	\$1,000	\$2,000
7. Relocate Water and Sewer Lines	LS	2	500,000	\$1,000,000
8. Rock Apron Near E. Mission Bay Dr. Bridge	CY	620	160	99,200
9. Demobilization	LS	1	\$50,000	\$50,000
10. Field Office	LS	1	\$10,000	\$10,000
<i>Subtotal Construction Cost</i>	NA	NA	NA	<i>\$12,099,560</i>
<i>Contingency (30% of Total Construction Cost)</i>				<i>\$3,629,868</i>
Total Construction Cost				\$15,729,428

The total preliminary opinion of probable cost of the Tecolote Creek Wetland Restoration preliminary design is shown in Table 4-8 below. The planning and design cost estimate is based on 40% of the total construction costs. Additionally, the environmental permitting cost is based on 5% of the total construction costs.

Table 4-8. Preliminary Opinion of Probable Cost

Item	Cost
Total Construction Cost	\$15,729,428
Planning and Design (40% of Construction Cost)	\$6,291,771
Environmental Permitting (5% of Construction Cost)	\$786,471

The construction cost estimate assumes the following conditions apply:

1. 169,220 cubic yards of surplus soils can be obtained from the stockpile on North Fiesta Island. The surplus soils are available from the North Fiesta Island Wetland Restoration project.
2. Construction is done in the dry with typical earthmoving equipment such as loaders, excavators, and off-road trucks.

4.4 Preliminary Project Schedule

The wetland project can theoretically be constructed within a total timeframe of approximately 180 calendar days, or 6 months assuming 22 working days per month. Unforeseen complications could extend that duration, but this is a reference point as a duration for planning. Construction is assumed to be accomplished using conventional equipment using the surplus soil staged at North Fiesta Island. Material could also be obtained from other sites in the vicinity if the North Fiesta Island Wetland Restoration project is not yet constructed. The wetland project can be completed at any time of year without prohibitive bird nesting restrictions but could also be scheduled to avoid the breeding season if desired, or to occur concurrently with the North Fiesta Island Wetland Restoration project to improve efficiency and cost-effectiveness. A bridge would require a longer duration than 6 months to construct and is assumed as pre-cast concrete that can be hauled onto the site and assembled. If a bridge is not desired, then a large culvert can be installed as an alternative during the last month of the Project. The last act will be to breach the opening to the channel that connects the wetland to south Mission Bay (south of the causeway). The preliminary project construction schedule can be found in Appendix C.

Assuming that construction can start immediately after Labor Day with mobilization of equipment onto the site, earthwork can proceed and be completed within 180 calendar days assuming a production rate of the earthmoving equipment of 2,500 cy per day. The schedule shows a duration of 3 months for earthwork, with overlapping of the end of earthwork by installation of irrigation. Once irrigation installation is partially complete, planting can be initiated to overlap with the remaining irrigation installation. Both planting and irrigation require one month each, with two weeks overlap.

Depending on whether the contractor works a 5- or 6-day work week, the number of months available to complete the work is approximately 6 months. This duration accounts for no work during all of the major holidays (Thanksgiving, Christmas, and New Year's Day). The remaining time available will need to be used to complete the bridge or culvert, and installation of irrigation and planting.

5 Other Considerations as Appropriate

5.1 Feasibility Analysis of Constructability

This section presents information about construction such as the approach, equipment needs, and access. Each subject is discussed below.

5.1.1 Construction Approach

Construction is anticipated to mostly occur in the dry using conventional earthmoving equipment. This Project consists of placing 169,200 cubic yards of material into the proposed wetland footprint at the existing location of the Tecolote Creek mouth and east Mission Bay. The material can be delivered in the dry by truck and placed by earthmovers. This scenario assumes that the material is provided from the North Fiesta Island Wetland Restoration project site. If the material does not come from North Fiesta Island, then it is assumed that all material is delivered by truck from elsewhere in the vicinity. This construction scenario assumes that the site would be filled from the edges toward the middle of the site. A turbidity boom would be placed along the western boundary of the Tecolote Creek Wetland site to protect east Mission Bay from turbidity associated with the filling.

Dry construction consists of hauling material by truck from the stockpile at North Fiesta Island, which could have an excess of approximately 315,000 cubic yards of material after restoration. The first item of construction is installation of a turbidity boom along the western project boundary. Also, an internal construction road network could be installed to serve as access for trucks to deliver material into the interior of the site. Finally, an excavator could be located within the interior of the site to move the material around to gradually fill the site as material is delivered by truck. The excavator would be able to create the grades required on the grading plans. More than one excavator may be needed to maintain the pace of material delivery. This quantity may require 90 calendar days if the work is done efficiently, with truck delivery reaching a pace of 2,500 cubic yards per day.

Nesting restrictions are not imposed on the Tecolote Creek mouth project site but may be imposed at the material source stockpile location at North Fiesta Island. Although there are restrictions from February 15 to September 15 each year for the California Least Tern nesting area at the north end of the Island, the distance from the stockpile to the nesting site is larger than the required buffer of 500 feet. However, the truck haul route could come within 500 feet of the nesting area and potentially disturb nesting. If needed, installation of a temporary truck access road could be investigated that avoids the north end of the Island and reduces impacts from hauling on nesting activities.

One other factor of construction is the approach to connecting the waters of Mission Bay south and north of the Fiesta Island Causeway. A bridge structure would be constructed by drilling cast-in-drilled-hole piles for the substructure, constructing abutments and bent caps, placing pre-cast concrete girders, and then casting the deck and barriers. This could all be accomplished one section at a time, allowing one lane of the causeway

to remain open to traffic with flaggers, if desired. Once the bridge is finished, the channel could be constructed. If culverts are chosen as the preferred method of creating a channel under the causeway, this would be constructed by excavation and placement, and could also be accomplished allowing one lane of the causeway to remain open to traffic with flaggers.

The connection can be either an open channel that would require a bridge at the public roadway or a very large culvert. The disadvantage of a culvert is that it may be hydraulically less efficient than an open channel and could restrict tidal flows if it were not large enough to function as an open channel. A culvert may also pose a public safety threat to people unless well marked, cordoned off, and/or screened over the opening. Use of a bridge would require more time to complete the structure, and it is also more expensive than culverts. A possible compromise is a pre-cast bridge structure that can be transported to the site and set in place over the channel.

5.1.2 Equipment Needs

The causeway component of the Project will be installed using excavators to remove the portion of the causeway needed for the culvert or bridge. The culvert can be placed on a bedding layer of rock and backfilled with earth material. A bridge would be installed as a pre-cast structure delivered to the site and set in place; alternatively, it could be designed as a full span concrete structure poured in place.

The suite of equipment needed to perform construction of the wetland in the dry condition with delivery of material from the stockpile on the Island is estimated to be:

- Excavators (4);
- Off-road trucks with a capacity of 16 to 18 cubic yards each (12);
- Front-end loaders (5); and
- Bulldozers (5).

The suite of equipment needed to perform construction of the bridge/culvert is estimated to include a crane, drill rig, concrete pump, excavator and/or dredging equipment, dump truck.

If material is placed in wet conditions, such as the lower elevations of restoration site, amphibious excavators may be a useful component of the equipment suite.

5.1.3 Equipment Access

Land-based construction equipment would access the wetland site from East Mission Bay Drive, and access to and from the Fiesta Island via the causeway.

5.1.4 Maintenance and Monitoring Requirements

Operations and maintenance will be required for the wetland. The most intensive actions may include:

- Trash removal;
- Weed removal from transitional habitat areas;
- Channel and culvert maintenance;
- Perimeter fence repair; and
- SLR adaptive management.

Maintenance should occur regularly to ensure the habitat functions at the highest level possible for the site.

If a culvert is used at the causeway, inspection and maintenance of the culvert should be conducted periodically to ensure proper functioning. Inspection and maintenance frequency will vary with site conditions, such as floating debris, which can plug the opening, marine fouling organisms (mussel growth), and vandalism. Inspections are recommended every year, with periodic cleaning (if necessary) to maintain smooth operation. Inspections should verify the condition of the openings and of the wetland water levels to confirm unimpeded connections. Debris removal should also be included.

If a marine fouling community develops inside the culvert pipe, the fouling may have to be periodically removed. Cleaning of the culvert could be conducted with a hand scraper or power washer to remove bio-fouling and accumulated sediment only if they interfere with conveyance of water through the pipes.

Note that when a wetland is initially restored, nutrients are sometimes mobilized on a grand scale and a bio-fouling community may quickly develop inside culverts. Continued flushing of the wetland system reduces the nutrient load and thereby also reduces the nutrient dependent marine fouling community.

A pre- and post-construction monitoring program may be required by the CCC to quantify changes to the site over time. The monitoring plan should be integrated into existing work at the Mission Bay Wetlands by local universities, and potentially coordinated with the regional monitoring program devised by the Science Advisory Panel for the Southern California Wetlands Recovery Project. Monitoring should occur for the lifetime of the Project and include tidal elevations at several points in each marsh, water quality, and habitat condition and distribution.

Issues with compromised habitat conditions or hydrology would need to be addressed through adaptive SLR management. Adaptive management may include minor grading, planting, culvert modifications, and periodic thin-layer sediment augmentation to maintain appropriate tidal/land elevation relationships that support the target marsh habitat diversity.

5.2 Risk Assessment

Various risks are prevalent when undertaking a wetland restoration design process. This section explores the variety of risks to help shed light on the potential future challenges that may be encountered. By documenting

the risks, and developing an understanding of common challenges, future pitfalls may be avoided or minimized to achieve the best possible outcome. The multiple potential risks are summarized below.

A Risk Assessment Table containing the information from the risk assessment is provided in Appendix D.

The Risk Assessment Table was prepared based on three criteria: (1) probability of each risk occurring, (2) the potential impacts to cost, and (3) the potential impacts to time until project completion. Each risk was given a value of either very low, low, moderate, or high for each of the three risk assessment criteria. Additionally, a strategy and response action for each risk was determined.

5.2.1 Land Ownership

Tecolote Creek Wetland and Fiesta Island Causeway are located within Mission Bay Park, in San Diego, CA. It is owned and maintained by the City of San Diego. As such, there are no known land ownership conflicts that may present risk to this project.

5.2.2 Utilities

A review of existing utilities was performed utilizing data from SanGIS, made available by the City of San Diego Public Utilities Department and SANDAG. The SanGIS utility data inventory is focused on public water and stormwater lines and does not contain gas, electric, telecommunication and other data. Within and adjacent to the Project area, the existing utilities are depicted in Figure 5-1 and listed below:

- Sewer Main;
- Sewer Manholes;
- Water Main;
- Water Hydrant;
- Tecolote Creek Channel; and
- Tecolote Creek Outlet.



Figure 5-1. SanGIS Utilities – Tecolote Creek

The utilities located in the causeway will require consideration during design and construction. Early coordination with utility owners, as well as potholing services, will be useful to confirm the horizontal and vertical location of utilities and reduce the risk of schedule and cost delays.

Prior to construction, the contractor will be required to take due precautionary measures to protect any existing utilities or structures located at the work site. It is the contractor’s responsibility to contact the owners of sewer, gas and electric, water, and sewer outfall utilities or structures prior to any excavation for verification and location of utilities and notification of commencement of work.

5.2.3 Existing Soil Data

Soils in the area of Tecolote Creek and Fiesta Island have been investigated through past geologic investigations. Compromised, or contaminated soils have not been identified on the site. Additionally, proposed land uses are compatible with the following known geologic hazards: possible consolidation under additional fill or structural loads, active faults, high potential for liquefaction, coastal flooding, and potentially corrosive soils (The Bodhi Group 2018).

Cone penetration testing was performed at two relevant locations in the Project area. Results identified geologic stratification as follows: Artificial Fill at the surface, underlain by Holocene bay mud, underlain by Holocene older alluvium, underlain by a Pleistocene old paralic deposit of well-consolidated sedimentary rock (The Bodhi Group 2018). Soil behavior at south Fiesta Island and the Tecolote Creek parking lot are shown in Figure 5-2, but the current extent of soil investigations on-site is insufficient to fully describe the material on-site. Therefore, further geotechnical investigations are required to progress to final permitting and design.

The upland areas of Tecolote Shores, Fiesta Island, and other nearby Mission Bay Park uplands are identified as Artificial Fill which was dredged and hydraulically placed materials from Mission Bay. Artificial Fill thickness ranges from 5 to 20 feet, is composed of loose to medium dense sand, and may be subject to settlement under building or additional fill loads. Such soils throughout Mission Bay, including the Project area were identified to have “high potential for liquefaction due to high groundwater...and hydraulic fills” (The Bodhi Group 2018). Therefore, further geotechnical investigations on settlement sensitive projects are recommended; this would include the Fiesta Island Causeway.

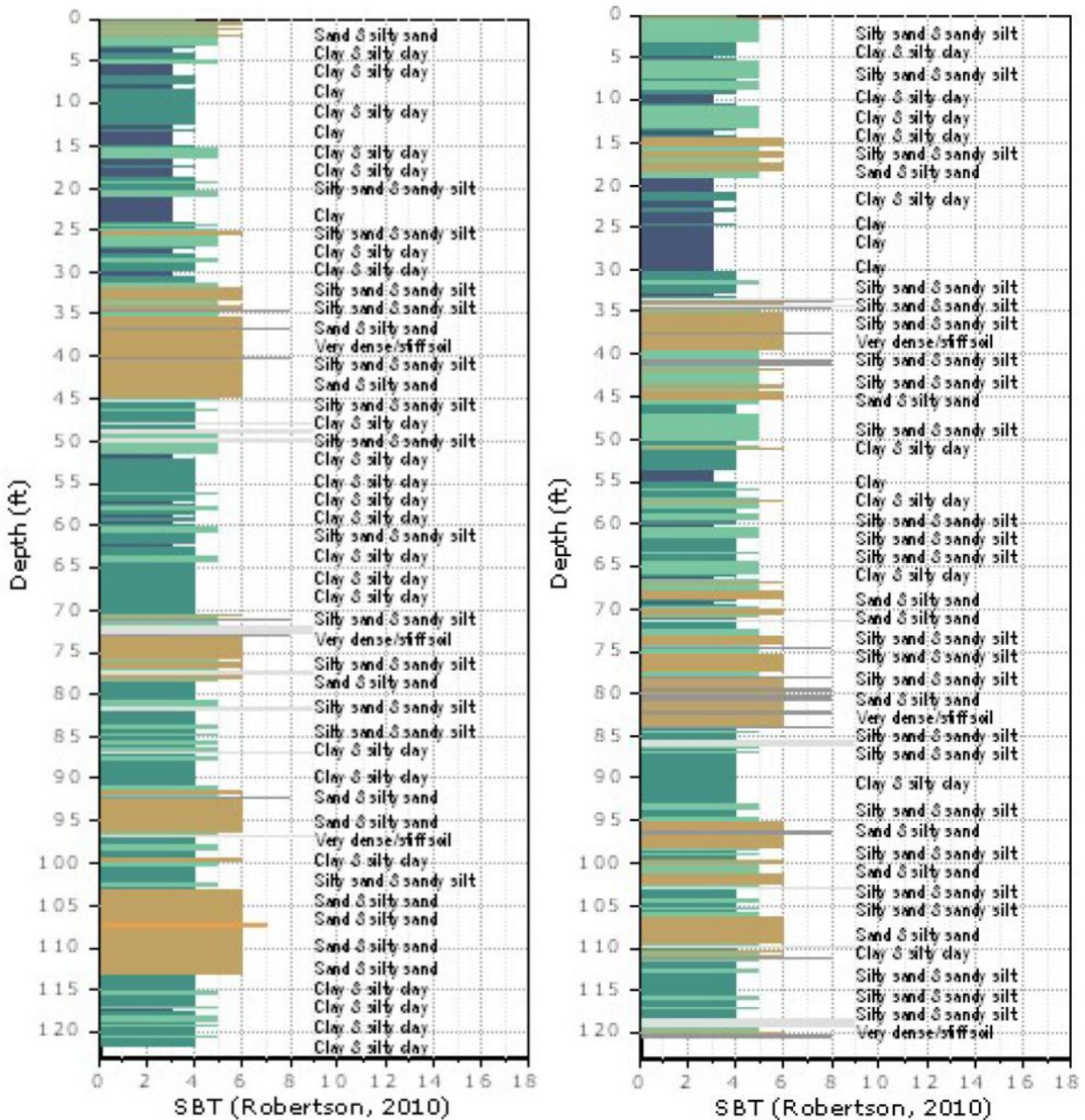


Figure 5-2. Soil Behavior Type – Left: South Fiesta Island, Right: Tecolote Creek Parking Lot

5.2.4 Proximity to Neighbors

The Tecolote Creek Wetland Restoration & Fiesta Island Causeway project site is located within East Mission Bay. The Project is surrounded by Fiesta Island on the west, the open water and Tecolote Shores Park to the north, East Mission Bay Drive and Interstate-5 to the east, and Fiesta Island Road and open waters to the south.

Construction activities have the potential to impact neighbors in a multitude of ways, including, but not limited to noise impacts and traffic impacts. Noise impacts have the potential to disrupt visitor, commercial, and

residential activity throughout Mission Bay Park. This includes Fiesta Island, East Mission Bay Drive near the Tecolote Creek Wetland, and Mission Bay waters, which are actively used for recreation. Commercial impacts could be felt by, for example, visitor supporting businesses, including the nearby Hilton San Diego Resort & Spa. Residential impacts could extend to the nearby Bay Park community and others.

Traffic impacts have the greatest potential to disrupt visitor use of Fiesta Island and along East Mission Bay Drive near Tecolote Creek Wetland. Fiesta Island Road is a two-lane, two-way access road to Fiesta Island, adjacent to East Mission Bay Drive, Sea World Drive, and Interstate-5. Construction activities may limit public access to Fiesta Island during certain periods of construction. Construction staging will be located as closely as permissible to the Tecolote Creek mouth and Fiesta Island Causeway. Land-based construction will impose traffic directly on Fiesta Island Road, and East Mission Bay Drive, and less directly on Sea World Drive and Interstate-5. Construction of Fiesta Island Causeway will be especially impactful with limited access by one-way traffic for most of the construction, and potentially prohibiting access to Fiesta Island for select periods of construction. Therefore, a temporary bridge is proposed for installation during causeway modification to allow for continued use of the causeway while the new bridge or culvert is installed.

Noise and traffic regulations may be necessary to restrict daily work hours and weekend work. Construction timing of the Project may be scheduled to reduce impacts to visitor use. Peak visitor use spans approximately from Memorial Day (May) through Labor Day (September). The Project is anticipated to occur from post-Labor Day to July, with the bridge continuing through January of the following year.

Long-term impacts to nearby neighbors are anticipated to be minor. Such impacts could include: reduced open water acreage for boaters, increased risk of personal watercraft passing through the new Fiesta Island Causeway, and increased populations of wildlife, especially avian species.

5.2.5 Environmental Windows

Environmental constraints of endangered bird nesting seasons do not pertain to this project site because birds do not nest on-site. However, if earth material is sourced from North Fiesta Island then there is a possible constraint from bird nesting at that location.

5.2.6 Water Quality Concerns

The Tecolote Creek Wetland Restoration & Fiesta Island Causeway project is designed with the primary goal of complying with the Mission Bay Master Plan water quality improvements initiative. The first Mission Bay Master Plan (City of San Diego 2002) key recommendation is:

It is broadly recognized that the Park's economic and recreational future depends on the quality of the Bay's water. In response to fluctuating quality of the Bay waters, this Plan proposes a comprehensive set of measures involving state-of-the-art biological, mechanical, public education and recreation management programs. Biological measures include the establishment of salt-water marshes that can naturally filter pollutants as they enter the Bay through the creeks that drain the Bay's watershed...

A past Water Quality Control Study (Tetra Tech 1983) identified that the water quality problem largely stems from two issues:

- *A nearly continuous input of pollutants from various point and nonpoint sources within the increasingly urbanized drainage areas inland from the bay.*
- *Flushing and circulation conditions which are generally inadequate to transport pollutants out of the Bay. As a result, pollutants can build up to undesirable levels.*

The Project proposes to create and protect a wide range of natural recreation and habitat. The habitats proposed for wetland restoration include subtidal, mudflat, low marsh, mid marsh, high marsh, transitional, and upland habitat. Tecolote Creek storm flows will exit into the newly restored wetlands, allowing for the capture of suspended sediment and contaminants, as well as the filtration of upland stormwater. Therefore, wetland habitat will serve to improve water quality. Additionally, the reach of tidal circulation is improved by the creation of a connection through Fiesta Island Causeway, decreasing residence times of water at the mouth of Tecolote Creek (M&N 2019). Lastly, runoff from upland areas of the surrounding Fiesta Island, Tecolote Shores, and Fiesta Island Causeway will partially be directed into the wetland to improve the capturing of suspended sediment and infiltration of runoff.

5.2.7 Competing Interests

City Charter Section 55.2 proposes that the Mission Bay Park Improvements project include efforts to restore wetlands, wildlife habitat, and other environmental assets; preserve beneficial uses of the Improvement Zone by maintaining navigable water and eliminating navigational hazards; restore embankments and erosion control features; and to improve the conditions of the Improvement Zone for the benefit and enjoyment of residents and visitors.

The Tecolote Creek Wetland Restoration & Fiesta Island Causeway project makes up one portion of the wider Mission Bay Park Improvements. As such, the Project is focused on certain aspects of the larger City Charter Section 55.2; the Project is designed to restore wetlands, improve water quality, improve wildlife habitat, as well as improve natural recreation for the benefit of residents and visitors.

5.2.8 Sensitive Habitat

Existing habitat maps of the Project site show a small variety of vegetation, including: Beach, Southern Coastal Salt Marsh, Open Water, Disturbed Habitat, and Developed Lands (see Figure 5-3). Of these habitats, Southern Coastal Salt Marsh is the only type considered sensitive habitat and encompasses 1.61 acres within the Project area. Mitigation ratios for disturbed sensitive habitat are determined through discussion with resource agencies. For salt marsh habitat, ratios are typically in the area of 4:1 for restoration of in-kind habitat. Due to the habitat creation goals of the Project, a total of approximately 16.2 acres of wetland habitat are proposed in the area, and therefore, no permanent habitat impacts are anticipated.

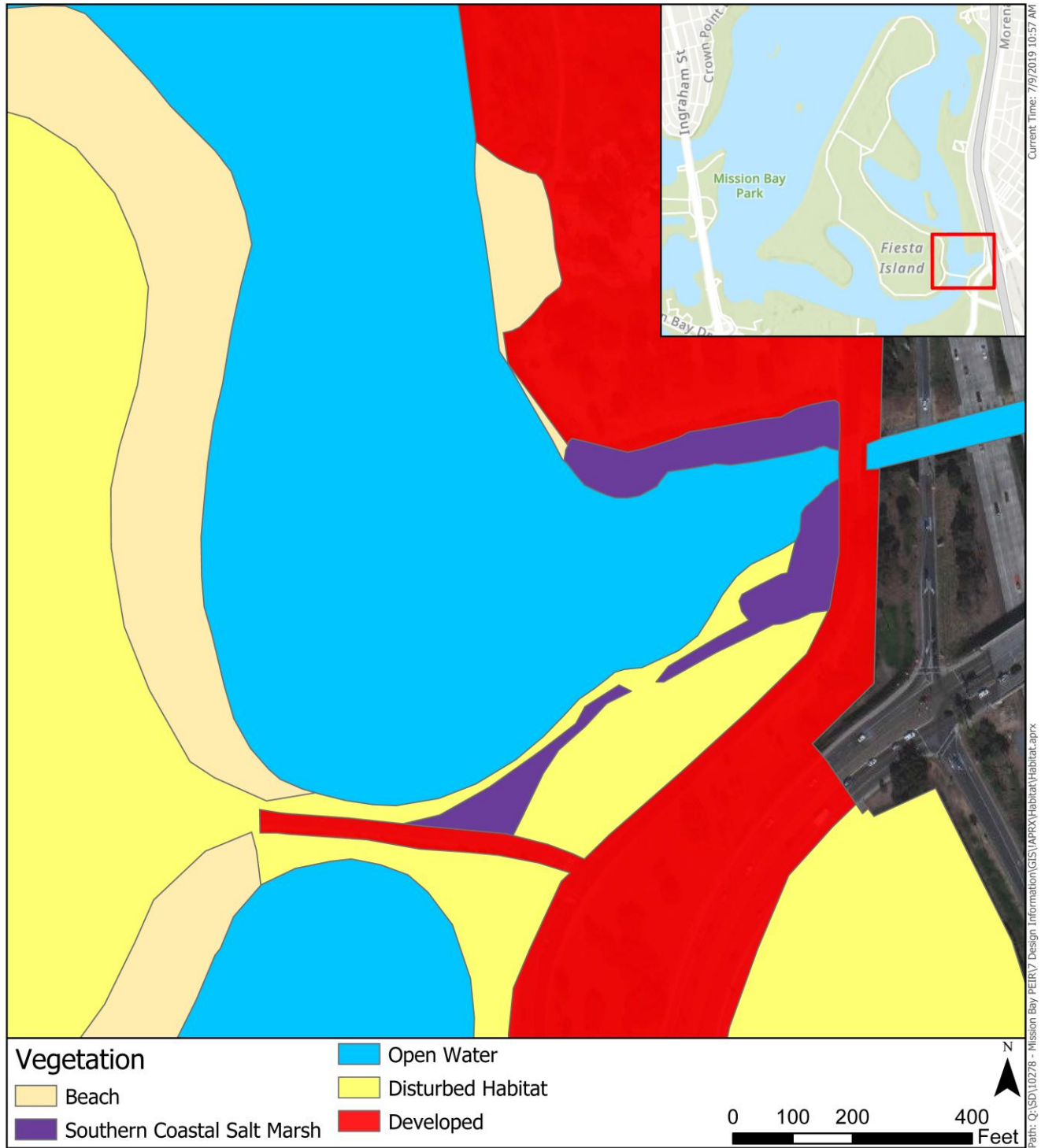


Figure 5-3. Vegetation Distribution - Tecolote Creek Project Area

5.2.9 Sea Level Rise

Salt marsh restoration and tidal culvert construction at Tecolote Creek must be developed considering SLR, which is the local rate of SLR relative to the land. SLR primarily affects this Project with its impact on wetland habitat distribution and functions. As sea levels increase above 3.6 feet, the wetland habitat becomes submerged, which decreases habitat diversity at the site. Additionally, the function and effectiveness of the proposed tidal culvert at Fiesta Island causeway will gradually change as sea level rises. These impacts are addressed below.

Tecolote Creek Wetlands

As directed by the City, this report analyzes the risk SLR poses to the site through the Year 2100. Two SLR projections (3.6 feet and 7.0 feet) were selected for Year 2100 that represent major thresholds for the Project. They are both specified in the 2018 Sea Level Rise Guidance document by the State of California (OPC, 2018). The projection of 3.6 feet represents the low risk aversion scenario for 2100 in San Diego, while the 7 foot scenario represents the medium-high risk aversion for 2100. These thresholds represent the 33% probability and 0.5% probability scenarios, respectively, and are driven by coastal flooding that is expected to increase (progress inland) with a 100-year storm event in conjunction with SLR. There is a low probability that SLR could exceed 7.0 feet by the end of the century, but the range of scenarios presented here capture important impact thresholds for Tecolote Creek Mouth regardless of when they occur. As shown in Figure 5-4 and Figure 5-5 below, future habitat distribution compared to the original habitat design is significantly affected by SLR. Future impacts from a SLR increase of 3.6 feet and 7 feet are summarized below.

- **3.6 feet (110 cm) SLR:** most of the Project would be subject to tidal inundation during high tides after restoration. Under this scenario the restored salt marsh habitat will likely transform with less high and mid and low marsh, and more mudflat, with subtidal habitat. Without raising the elevation of the site by filling or implementing adaptation measures, the site would predominantly become mudflat with tidal channels. The exception is the base of the dune habitat area that becomes vegetated marsh. The dune features are projected to become transitional wetland and upland habitat.
- **7.0 feet (213 cm) SLR:** under this SLR scenario, the wetlands would nearly all become subtidal and mudflat habitat area, with some limited perimeter salt marsh on earthen slopes. Without raising the elevation of the site by filling or implementing adaptation measures, the site would effectively become mudflat with tidal channels. The exception is the along the toe of slope of the dune features that become vegetated marsh. The dune features are projected to become transitional wetland and upland habitat.

Table 5-1 below shows the changes (in acres) to habitat areas with each SLR scenario for the proposed habitat of the Project.

Table 5-1. Change to Habitat Areas in Acres with 3.6 and 7.0 Feet of SLR

Proposed Habitats	Designed Acreage	Habitat with 3.6 ft SLR	Habitat with 7.0 ft SLR
Subtidal	3.52	5.32	13.95
Mudflat	2.48	14.99	8.34
Low marsh	3.35	0.30	0.19
Mid marsh	6.83	0.92	0.38
High marsh	3.70	0.25	0.20
Transitional	0.61	0.43	0.48
Upland	1.14	1.14	1.14
Developed/Upland	1.11	1.93	1.04
Beach/Dunes	2.98	0.44	0.00
Coastal Salt Marsh	0.43	0.43	0.43
TOTAL AREA	26.15	26.15	26.15

When SLR causes significant habitat changes in the marsh, the site can be adapted by:

- Revising the site design to provide higher ground now and less area at lower wetland elevations. This may result in less marsh in the near-term but more in the long-term. This option is worth considering but is also limited on what can be accomplished with a relatively small site such as Tecolote Creek Wetland.
- Reconfiguring and/or raising the marsh plains above future high internal marsh water levels through thin layer sediment additions (i.e., the pilot project at Seal Beach Naval Weapons Station in 2016). This will allow for mudflat and vegetated marsh habitat to persist. This is the preferred option.
- Creating a muted salt marsh system by controlling the tide range. This can be accomplished by introducing tide gates, which allow flexibility in the management operation as water levels rise; the tide gates may need to be replaced over time to provide modified tide levels. This approach may not be optimal due to the dependence on structures for project success.

While it is possible that these adaptation strategies may need to be implemented in the near-term at some time between 2050 and 2100, they may also need to be repeated multiple times in the long-term after 2100 as sea level rises in the future. Adaptation measures such as the ones listed above will be necessary if the vision is to provide vegetated marsh habitat at Tecolote Creek Wetlands into perpetuity.

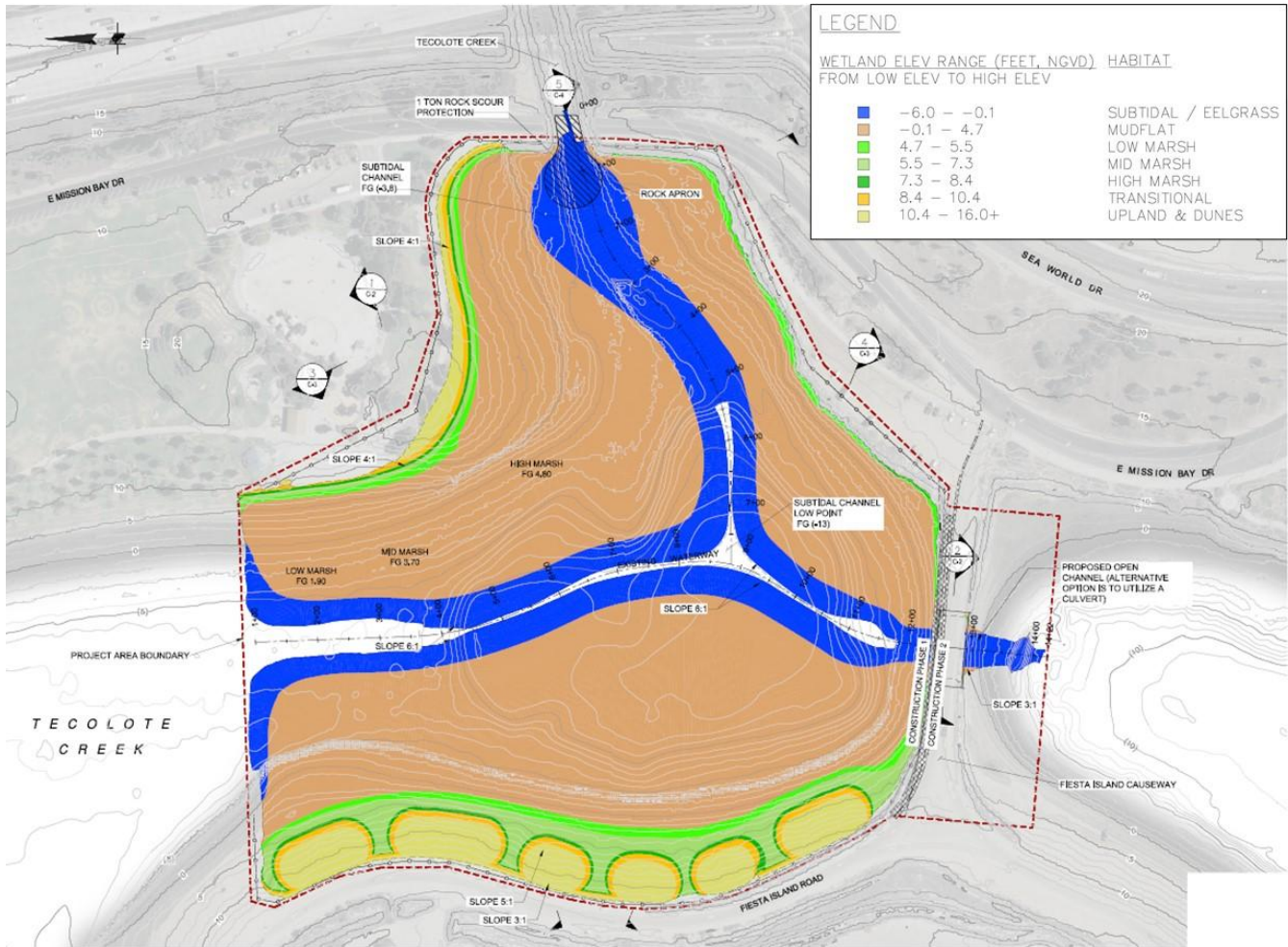


Figure 5-4. Predicted Habitat Distribution with a SLR Increase of 3.6 Feet

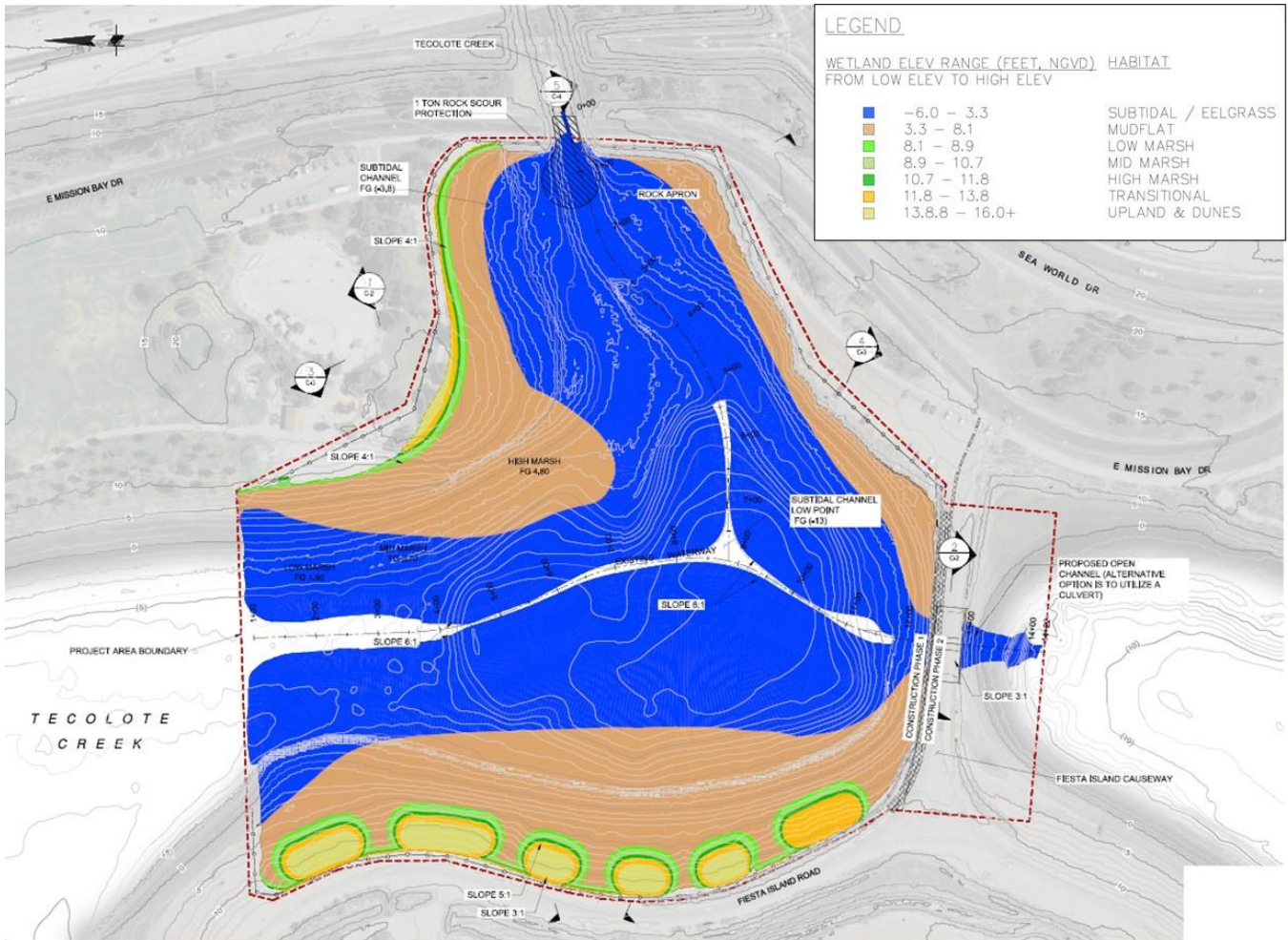


Figure 5-5. Predicted Habitat Distribution with a SLR Increase of 7.0 Feet

5.2.10 Permitting

As a result of the need to receive approval from multiple resource permitting agencies, the possibility of project delays during approval could occur which would result in an increased project schedule or require new mitigations. See Section 5.4.

5.3 Project Conflict Coordination and Evaluation

Design and construction of the Tecolote Creek Wetland Restoration & Fiesta Island Causeway project should coordinate with the following major development projects at Fiesta Island and nearby within Mission Bay Park:

- Fiesta Island Deferred Maintenance
- Fiesta Island Bike/Pedestrian Paths and Bridges

- Wetland Restoration
 - North Fiesta Island Wetland Restoration
 - Cudahy Creek Cove Wetland Restoration
 - Rose Creek Wetland Restoration
 - Restoration of Shoreline – De Anza Point Restoration

In addition, coordination will need to occur with adjacent recreational uses for future restoration. These include the playground, recreational uses, fire rings near proposed dunes, etc. All projects under this program need to assess the potential limitations on usable recreation areas, available parking, beaches, swimming locations, and possibly other uses. Newly restored wetland areas will be off-limits to water contact use and navigation to minimize disturbance from the public and ensure the success of the restoration.

5.3.1 Fiesta Island Deferred Maintenance

As a part of the Mission Bay Park PEIR, a deferred maintenance program is in progress to prepare a maintenance plan and preliminary drawings of identified maintenance, repair, or rehabilitation of play areas, restroom buildings, shoreline restoration, seawall, and parking lot areas. Within this Project, Fiesta Island may include proposals for facility maintenance, which could conflict with or compliment the Fiesta Island Causeway project.

This project is currently in progress, and no Fiesta Island maintenance is currently proposed. Therefore, project conflict coordination and evaluation are to be determined.

5.3.2 Fiesta Island Bike/Pedestrian Paths and Bridges

As a part of the Mission Bay Park PEIR, a Bike/Pedestrian Paths and Bridges study is in progress to prepare a report and preliminary drawings for bike and pedestrian paths and bridges throughout Mission Bay Park. Within this project, Fiesta Island is proposed to be improved with bike and pedestrian paths and bridges, which could conflict with or complement the Fiesta Island Causeway project.

The City is currently reviewing draft concepts of this project. Project conflict and coordination and evaluation are to be determined.

5.3.3 Wetland Restoration

As a part of the Mission Bay Park PEIR, multiple wetland restoration projects are proposed throughout the Bay. Wetland restoration is proposed at North Fiesta Island, Cudahy Creek Cove, Rose Creek, and De Anza Point.

Construction timing of all wetland restoration projects in Mission Bay is currently undefined. There is a potential for construction of such projects to be complementary to one another. Beneficial reuse of excavated

dredge material could be distributed across sites in place of import material to maintain sediment on-site and reduce construction costs across several restoration projects. For example, in the case of this Project; surplus excavated or dredged material from North Fiesta Island Wetland could be beneficially reused to supply fill to Tecolote Creek Wetland. Additionally, mobilization and demobilization costs increase construction costs; phasing of construction of wetland restoration projects could capitalize on the availability and proximity of construction equipment, materials, and crew. Wetland restoration projects could potentially be grouped under one construction contract, allowing the contractor to plan efficient use of construction equipment, materials, and crew.

5.4 Environmental Considerations and Permits

Environmental permits required to construct the Tecolote Creek Wetland & Fiesta Island Causeway are summarized in, but not limited to

Table 5-2. As a part of the Mission Bay Improvements Plan, the City is seeking to streamline state and federal resource agency approval for all future projects (San Diego, 1994). This work includes but is not limited to preparation and submission of applications for regulatory permits to the USACE, pursuant to Section 404 of the federal Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act; California Regional Water Quality Control Board (RWQCB), pursuant to Section 401 of the federal CWA; and California Department of Fish and Wildlife (CDFW), pursuant to the California Fish and Game Code (Section 1600). Additionally, permitting support and strategy for CCC pursuant to the California Coastal Act and Coastal Zone Management Act is in progress as it is included within the scope of work for this project.

Pursuit of USACE Section 404 CWA programmatic permit is anticipated to be applied for as a Regional General Permit (RGP) to authorize the implementation of multiple projects within Mission Bay. An RGP can authorize a category or categories of activities, such as the Mission Bay Park Improvements, in a specific geographical region for activities that are similar in nature and cause only minimal individual and cumulative environmental impacts.

In pursuit of a U.S. Fish and Wildlife Service (USFWS) Programmatic Biological Opinion, a Biological Assessment (BA), which is a modified version of a Biological Technical Report (BTR), is required in accordance with Section 7 of the Endangered Species Act (ESA). The BA is focused on project impacts on and restoration benefits for California least tern, western snowy plover, and other federally listed species, including marine species, which have the potential to occur within the Project area.

In pursuit of a RWQCB programmatic 401 Water Quality Certification, an application will be required as well as RWQCB issued General Waste Discharge Requirements (WDRs) for authorization of Mission Bay Park Improvements.

Resource agency-imposed restrictions play a strong role in construction costs and duration. During discussions with resource agencies, permit restrictions will be negotiated, including but not limited to:

- Hours of Operations
- Noise Control
- Light Control
- Dust Control
- Fueling
- Site Access
- Storage and Staging
- Impacts to Habitat and Sensitive Species

Regarding the above topics, the City should strive for the following in order to maintain flexibility of construction methods:

- 6-day work weeks

- Hours of operation from 7 AM to 6 PM with occasional night work, as necessary
- Fueling and equipment maintenance permitted on-site
- Land-based and water-based site access
- Wide environmental window
 - The timing of construction in sensitive areas may also be affected by the patterns of nesting and breeding birds. Typically, the nesting season window is mid-February through early-September, which coincides with a large portion of the dry season. Note that existing marsh habitat is present at the Tecolote Creek mouth, but nesting is not documented at the site so restrictions may not be imposed.
 - Optimally, the environmental window can either be eliminated or relaxed, and the Project can be constructed without breaks or unnecessary haste.
- Flexible construction access and staging areas
 - Multiple construction access and staging areas allow various approaches to be conceived by contractors to increase competition during bidding.
 - Staging areas within or close in proximity to the construction area reduces construction duration and cost.

Table 5-2. Environmental Permit Requirements

Agency	Permit
Federal	
U.S. Army Corps of Engineers (USACE)	<ul style="list-style-type: none"> • Permit under Section 404 of the Clean Water Act, 33 USC Section 1344 • Section 10 of the River and Harbors Act of 1899, 33 USC Section 403 • Issue Record of Decision (ROD) • Fish and Wildlife Coordination Act, 16 USC Sections 661-666
National Marine Fisheries Service (NMFS)	<ul style="list-style-type: none"> • Magnuson-Stevens Fishery Conservation and Management Act, as amended 1996 (Public Law 104-267)
State Historic Preservation Officer/Tribal Historic Preservation Office	<ul style="list-style-type: none"> • National Historic Preservation Act of 1966 (NHPA), Section 106 Consultation with SHPO/THPO (36 CFR Part 800)
U.S. Fish and Wildlife Service (USFW)	<ul style="list-style-type: none"> • Endangered Species Act, 16 USC Sections 1531-1544 Section 7 Consultation with the federal lead agency (i.e., USACE) • Programmatic Biological Opinion
State	
California Coastal Commission (CCC)	<ul style="list-style-type: none"> • Coastal Development Permit • Consistency Certification, Section 30600(a) of the California Coastal Act, or Waiver of Federal Consistency Provisions
California Department of Fish and Wildlife (CDFW)	<ul style="list-style-type: none"> • Streambed Alteration Agreement, Section 1602 of the California Fish and Game Code • California Endangered Species Act Section 2081 Incidental Take Permit
Regional Water Quality Control Board (RWQCB)	<ul style="list-style-type: none"> • Water Quality Certification under Section 401 of the Clean Water Act
Regional/Local	
<p>San Diego Air Pollution Control District (APCD)</p> <p>Discretionary Site Development Permit from the City Development Services Department.</p>	<ul style="list-style-type: none"> • Authority to Construct/Permit to Operate for any dredge • • • Local agency permission to Construct the wetland project

5.5 City Professional Standards and Mission Bay Masterplan Consistency

Concept development, design, and permitting of Tecolote Creek Wetland Restoration & Fiesta Island Causeway must comply with City standards and the Mission Bay Park Masterplan (City of San Diego 2002). An inventory of relevant standards, potential conflicts, and potential resolutions to such conflicts, is provided in Table 5-3.

Table 5-3. Inventory of Relevant Standards

Source	Standards and Recommendations	Compliance/ Potential Conflict	Implementation/ Solution
Mission Bay Park Master Plan	Pg. 4 – It is broadly recognized that the Park’s economic and recreational future depends on the quality of the Bay’s water. In response to fluctuating quality of the Bay waters, this Plan proposes a comprehensive set of measures involving state-of-the-art biological, mechanical, public education, and recreation management programs.	Tecolote Creek Wetland Restoration & Fiesta Island Causeway preliminary design is developed with the general goal of improving or maintaining water quality.	Improvements - Wetland Habitat - Tidal Channel through Fiesta Island causeway
	Pg. 6 – The turf and beach areas along the Park’s shorelines support the most intensive public recreational activity in Mission Bay. These areas draw users from throughout the San Diego region. With the County’s population on the rise, the capacity of the park to accommodate this activity must be commensurately increased.	Tecolote Creek Wetland Restoration & Fiesta Island Causeway preliminary design is developed with the general goal of improving or maintaining public recreational activity.	Improvements - Natural Recreation

Source	Standards and Recommendations	Compliance/ Potential Conflict	Implementation/ Solution
	Pg. 10 – The rise of environmental awareness in recent decades has been paralleled by an increase in the desire for more natural recreation venues. The telephone survey conducted as part of the Master Plan Update revealed that a majority of San Diego residents would like to experience parts of Mission Bay in a more natural condition.	Tecolote Creek Wetland Restoration & Fiesta Island Causeway preliminary design is developed with the general goal of improving or maintaining the natural condition of Mission Bay.	Improvements - Subtidal Habitat - Mudflat Habitat - Low Marsh Habitat - Mid Marsh Habitat - High Marsh Habitat - Transitional Habitat - Upland Habitat
	Pg. 10 – In response to an extraordinary level of public demand for preservation and enhancement of natural resources, this Plan includes a number of proposals aimed at improving the Park's wildlife habitats.	Tecolote Creek Wetland Restoration & Fiesta Island Causeway preliminary design is developed with the general goal of improving or maintaining the natural condition of Mission Bay.	Improvements - Subtidal Habitat - Mudflat Habitat - Low Marsh Habitat - Mid Marsh Habitat - High Marsh Habitat - Transitional Habitat - Upland Habitat

Source	Standards and Recommendations	Compliance/ Potential Conflict	Implementation/ Solution
	<p>Pg. 82 – Mission Bay Park should be planned, designed, and managed for long-term environmental health. The highest water quality; sustained biodiversity; ongoing education and research; and the reduction of traffic noise, and air pollution should all be priorities. The Park’s natural resources should be conserved and enhanced not only to reflect environmental values, but also for aesthetic and recreation benefits.</p>	<p>Tecolote Creek Wetland Restoration & Fiesta Island Causeway preliminary design is developed with the goal of improving environmental conditions for Mission Bay Park.</p>	<p>Improvements</p> <ul style="list-style-type: none"> - Water Quality - Subtidal Habitat - Mudflat Habitat - Low Marsh Habitat - Mid Marsh Habitat - High Marsh Habitat - Transitional Habitat - Upland Habitat - Natural Recreation
	<p>Pg. 90, Recommendation 63 – Although as yet unquantified, a substantial amount of pollutants may be entering the Park through...Tecolote Creek...measures that could curb the flow of pollutants into the Bay should be pursued, where proven feasible: Sediment traps or basins adjacent to the creek outfalls, or at suitable upstream locations, that can be adequately maintained.</p>	<p>Tecolote Creek Wetland Restoration preliminary design incorporates a sediment trap at the Tecolote Creek mouth.</p>	<p>Improvements</p> <ul style="list-style-type: none"> - Tecolote Creek sediment trap as evidenced by the large subtidal area in the central portion of the project.

Source	Standards and Recommendations	Compliance/ Potential Conflict	Implementation/ Solution
	Pg. 90, Recommendation 66 – ...the creation of wet-lands in the Park should be pursued as part of a comprehensive program to improve the quality of the Bay waters.	Tecolote Creek Wetland Restoration & Fiesta Island Causeway preliminary design is developed with the general goal of improving or maintaining water quality.	Improvements - Wetland Habitat
	Pg. 91, Recommendation 68 – Given their potential treatment value, new wetland areas should be placed where they can optimally perform a pollution filtration function: the outfalls of Rose and Tecolote Creeks, and other significant storm sewer outfalls, which is where the “first-flush” of pollutants would most likely enter the Bay. Accordingly, the following wetland areas are proposed...Tecolote Creek outfall: 12+/- acres...The configuration and ultimate area of these wetland areas should be derived from balancing mitigation, water quality, flood control, aquatic recreation, and safety values and needs. The wetland mitigation value should not be compromised by their design as water quality improvement facilities but be balanced to optimize both objectives.	Tecolote Creek Wetland Restoration & Fiesta Island Causeway preliminary design is developed with the general goal of improving or maintaining water quality.	Improvements - Wetland Habitat

Source	Standards and Recommendations	Compliance/ Potential Conflict	Implementation/ Solution
	<p>Pg. 94 Recommendation 69 – Philip Williams & Associates, Ltd., hydrologic specialists, have provided a preliminary evaluation of the feasibility of creating a marsh at the Rose Creek outfall...Key recommendations include:</p> <ul style="list-style-type: none"> - Maintaining and extending the flood control channel through the marsh. - Diverting a portion or all of the “first-flush” into the marsh by secondary channels or pipes, from a point upstream from the creek’s outfall. - Building levees around the marsh, with operable gates, to achieve the required retention treatment time (20 hours, ideally). The gates could be inflatable “bladder dams” that are activated only during flood events; the remainder of the time the dams could be deflated, permitting rowers and canoeists into the marsh channels. The levees could be designed as upland habitat areas, adding value to the ecology of the marsh. <p>Similar considerations apply to the proposed Tecolote Creek marsh.</p>	<p>The current preliminary Project design does maintain and extend the flood control channel through the marsh. No “first-flush” diversion or “bladder dams” are incorporated into the design.</p>	<p>The preliminary Project design is anticipated to achieve project goals of improving water quality and natural habitat and recreation without the need to include “first-flush” diversion and “bladder dam” flood control. This allows the Project to avoid expensive initial and maintenance costs for such engineered features, maintains a more natural project aesthetic, and promotes the resiliency of the wetlands without human interference.</p>

Source	Standards and Recommendations	Compliance/ Potential Conflict	Implementation/ Solution
2018 City CADD Standards	The City uses Bentley MicroStation as its basic CADD graphics engine, for engineering design and drawing production, if approved by the City, Design Consultants may use other industry standard CADD systems, such as AutoCAD, to produce hard copy or PDF files which can be transmitted appropriately to the Project Managers as submittals. However, for compatibility reasons, all electronic CADD file submittals must be created in MicroStation or approved CADD system using City specified seed files that will be uploaded into the City's CADD file management system and shall conform to the requirements set forth in these standards (https://www.sandiego.gov/publicworks/edocref/drawings).	Submit final electronic CADD files in MicroStation.	No conflict.
City Stormwater Guidelines	Project plans to comply with The City of San Diego Storm Water Standards and the MS4 Permit.	Project plans to comply with City standards.	No conflict.

5.6 ADA and Title 24

The Americans with Disabilities Act (ADA) of 1990 is a civil rights law prohibiting discrimination against individuals with disabilities. With respect to Tecolote Creek Wetland Restoration & Fiesta Island Causeway, ADA requirements pertain to the proposed Fiesta Island causeway. However, civil roadway design is beyond the scope of this Project. Therefore, there are no public use components of the project and ADA requirements are not applicable.

Title 24 is a California Building Standards Code establishing requirements for “energy conservation, green design, construction and maintenance, fire and life safety, and accessibility” of a building’s “structural, mechanical, electrical, and plumbing systems.” No buildings are proposed as a part of the Tecolote Creek Wetland Restoration & Fiesta Island Causeway and, therefore, Title 24 requirements are not applicable.

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A. Hydrology Support Documents

1.1 Hydraulics

This section describes the background, methodology, and results of the hydraulic analysis performed in support of the Mission Bay Park Improvement Plan and Tecolote Creek Wetland.

1.1.1 Methodology

Hydraulic analyses were performed to determine hydraulic characteristics throughout the proposed design, including water surface elevations and channel velocities, for both the 100-year storm event and the 10-year storm event. The U.S. Army Corps of Engineers' Hydrologic Engineering Center's River Analysis System (HEC-RAS) v. 4.1.0 was used to model the hydraulic characteristics of Tecolote Creek, as well as to assess the hydraulic impact of the proposed wetlands. HEC-RAS is designed to perform one-dimensional hydraulic calculations for steady or gradually varied flow in natural and constructed channels. The HEC-RAS Workmaps showing the project area are included in Attachment 1. The following sections of this report will describe the Effective, Duplicative Effective, Corrected Effective, Existing Condition and Proposed Condition Models analyzed in this report.

Effective, Duplicate Effective, and Corrected Effective Hydraulic Models Methodologies

RICK prepared a request for data to FEMA in order to obtain the effective hydraulic model files associated with the project area shown on the FIRM 06073C1614G dated May 16, 2012. The request for data was sent on February 19, 2019 and fulfilled on March 7, 2019. RICK received the Effective Model, in PDF format showing HEC-2 input and output files, for Tecolote Creek from approximately the West Morena Blvd. crossing to north of the Balboa Avenue crossing. The Effective Model for Tecolote Creek FIS Run was executed on August 13, 1979. Based on the date that the Effective Model was run, the Effective Model appears to be referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29). A copy of the Effective Model can be found in Attachment 2.

The FEMA effective model was received in the form of a PDF scan of the HEC-2 model for Tecolote Creek. The Effective Model HEC-2 input data were translated into digital files from approximately 350 feet east of the East Morena Boulevard Bridge crossing to the West Morena Boulevard crossing. The data was then executed in HEC-2 software to create the Duplicate Effective Model, which served as the basis for the subsequent hydraulic modeling. A copy of the Duplicate Effective Model is provided in Attachment 3.

A Corrected Effective HEC-RAS Model was prepared by importing the Duplicative Effective HEC-2 Model using the Import HEC-2 Data feature within the HEC-RAS software. Updates were made to existing bridges and culverts within the HEC-RAS program to account for the differing model requirements between HEC-2 and the HEC-RAS program. For the Corrected Effective HEC-RAS Model, bridge/culvert locations were imported with an upstream distance of zero, which is not allowed in the HEC-RAS software. The distance between the upstream cross section was adjusted from zero to one foot and the bridge width column was reduced by two feet to allow for a positive distance both upstream and downstream of cross sections adjacent to the bridge/culvert. The Corrected Effective Model downstream low chord for the bridge at East Morena Drive (cross section 1740) was adjusted 351.3 feet to allow for an opening on the downstream side of the bridge. The Weeks Avenue name was changed to West Morena Boulevard in 1973. Therefore, the Weeks Avenue bridge identified in the FEMA effective hydraulic model was changed to the name of West Morena Boulevard for the Corrected Effective, Existing Conditions and Proposed Conditions Hydraulic Models.

A copy of the Corrected Effective Model is provided in Attachment 4.

Existing Conditions Hydraulic Model Methodologies

The Existing Condition HEC-RAS Model was prepared by utilizing the updated topography within the study area. As part of the project, topographic aerial imagery and survey data were collected by Photo Geodetic Corporation in April

2019. The horizontal basis of coordinates for this survey is referenced to the California Coordinate System of 1983 (CCS83) Zone 6, North American Datum of 1983 (NAD83), and elevations are referenced to the NGVD 29. Data from the surveys were compiled into computer aided drafting and design (CADD) files.

For areas outside of the wetland project focus area (e.g., Tecolote Creek Channel), 2014 Light Detection and Ranging (LiDAR) data obtained from the U.S. Geological Survey (USGS) were utilized. It should be noted that the topographic data was in reference to the North American Vertical datum of 1988 (NAVD 88). A conversion between the NAVD 88 and NGVD 29 was performed by subtracting 2.1 feet from the obtained USGS (NAVD 88) topography, ensuring all analyses have been referenced to the NGVD 29 datum.

The HEC-RAS cross section locations were chosen based on the Corrected Effective cross section locations. Additional HEC-RAS cross-section locations were added in the existing condition analysis downstream of the Corrected Effective Model in the area of proposed improvements. The river station naming for the existing and added cross sections was based on the Corrected Effective Model with 2000 added to the stationing. For example, the Corrected Effective station of 750 would be 2750 in the Existing Condition Model. The geometries, flow data, and bridge data for Cross Sections 4065 through 2830 in the Corrected Effective Model were used to tie into the Existing Condition Model.

Since the creek outlets into Mission Bay and is subject to tidal influence, different models were created with varying downstream water surface elevations (WSE) to account for the different tide levels.

The downstream boundary conditions for the Existing and Proposed Conditions Model were estimated based on the water surface elevations (WSE) from the 2016 San Diego Regional Standard Drawings (Sheet M-12, Datums) include the following:

- 100-year peak flow rate with the downstream WSE at 4.91 feet (in reference to the Highest Tide Datum)
- 100-year peak flow rate with downstream WSE at 0 feet (in reference to the Mean Sea Level Datum)
- 100-year peak flow rate with the downstream WSE at -2.88 feet (in reference to the Mean Lower Low Water Datum)

A hard copy of the HEC-RAS hydraulic analysis associated with the Existing Condition Model with a downstream WSE of 4.91 is included in Attachment 5.

Proposed Conditions Hydraulic Model Methodologies

The Existing Conditions HEC-RAS analysis was modified to reflect the Proposed Condition Model. The proposed channel and wetland improvements begin downstream of the I-5 Freeway at Section 2100. A summary of results of the water surface elevations for the Existing Conditions and Proposed Conditions Models is provided in Table 1. A hard copy of the HEC-RAS hydraulic analysis associated with the Proposed Condition Model is included in Attachment 6. The Proposed Condition HEC-RAS Workmap is included in Attachment 1.

1.1.2 Results

Various model scenarios were evaluated to estimate the hydraulic performance of the channel and proposed wetland area to guide the design process. The proposed project has been hydraulically analyzed, and the results indicate that the proposed wetland will have less than 0.2 feet of rise in water surface elevations of Tecolote Creek in comparison to the existing conditions. More specifically, the modeling results indicate that a few cross sections in the immediate vicinity of the project area will have increases of 0.18 feet or less. In many cross sections, the project will result in lower water surface elevations in the project area.

Tecolote Creek is mapped by the Federal Emergency Management Agency (FEMA) as a Special Flood Hazard Area (SFHA) Zone AE without a designated floodway. The sections of the *San Diego Municipal Code, Chapter 14*, dated December 2019, containing guidance pertinent to the proposed project development includes the following:

City of San Diego Municipal Code 143.0146 (a) (2): Proposed development in a Special Flood Hazard Area shall not adversely affect the flood carrying capacity of areas where base flood elevations have been determined but the floodway has not been designated. “Adversely affect” as used in this section means that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point.

The proposed wetland improvements will not increase the water surface elevation of the base flood more than one foot at any point in accordance with City requirement related to SFHA Zone AE mapped areas without a designated floodway.

Table 1. Comparison of Existing Conditions and Proposed Conditions Hydraulic Models

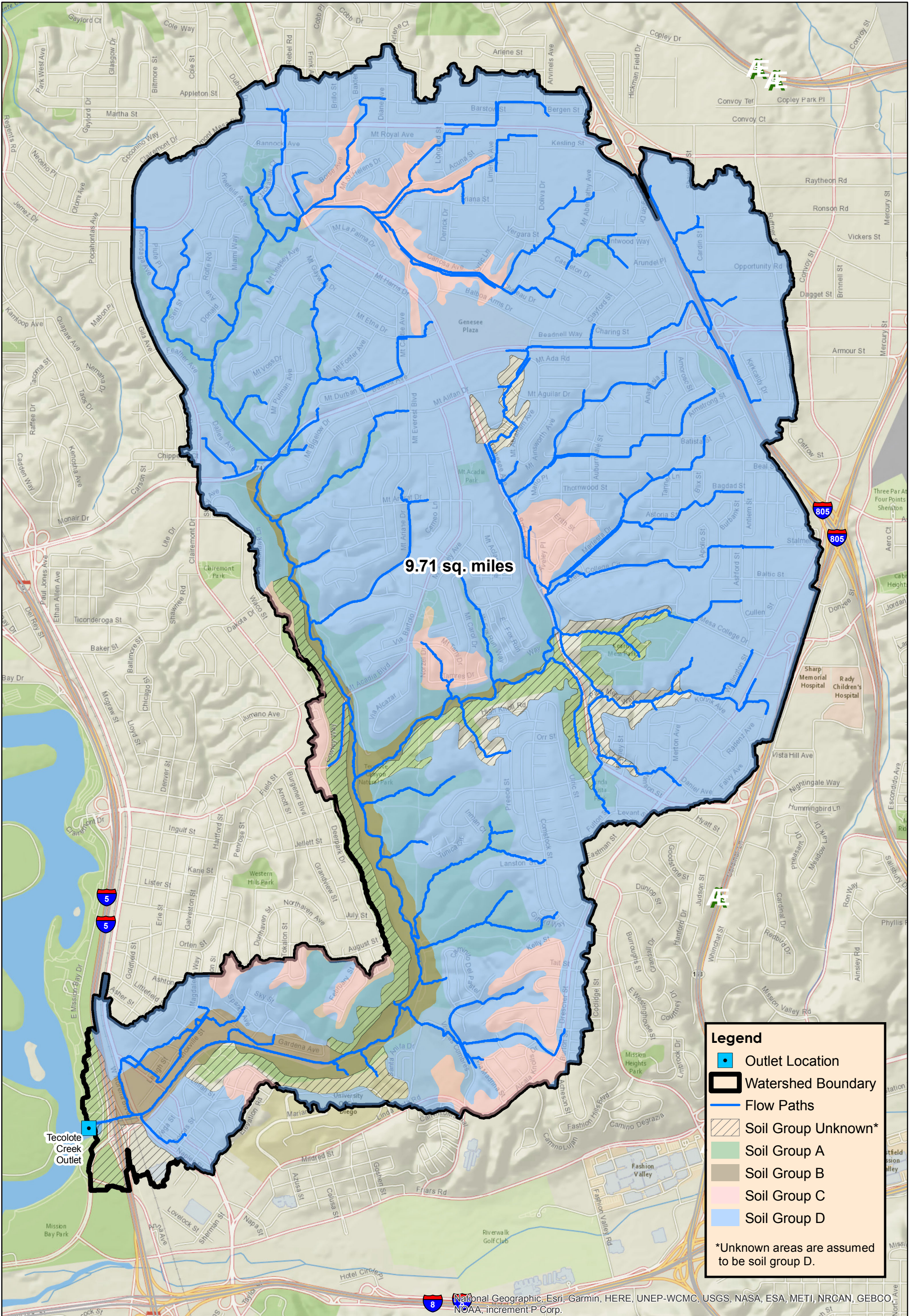
HEC Ras Cross Section	Existing Conditions HEC-RAS WSE (ft) ¹	Proposed Conditions HEC- RAS WSE (ft) ¹	Difference (ft) ²
4065	21.01	21.06	0.05
3785	21.02	21.07	0.05
3750	21.36	21.42	0.06
Bridge # 2 - East Morena Blvd.	-	-	-
3730	17.24	17.24	0
3640	17.32	17.32	0
3300	17.97	17.97	0
2940	18.41	18.41	0
2900	17.69	17.69	0
Bridge # 1 - West Morena Blvd.	-	-	-
2830	11.02	11.02	0
2750	9.93	9.93	0
2610	9.73	9.73	0
2600	10.56	10.56	0
2500	9.17	9.17	0
2400	8.59	8.59	0
2300	7.79	7.8	0.01
2200	7.16	7.16	0
2100	4.6	4.61	0.01
2000	4.61	4.73	0.12
1922.975	4.99	5.09	0.10
1800	4.87	5.05	0.18
1700	4.88	5.03	0.15

HEC Ras Cross Section	Existing Conditions HEC-RAS WSE (ft) ¹	Proposed Conditions HEC- RAS WSE (ft) ¹	Difference (ft) ²
1600	4.91	5.01	0.10
1424.49	4.93	5.04	0.11
1150	4.94	5.03	0.09
900	4.93	4.82	-0.11
700	4.91	4.90	-0.01
500	4.91	4.91	0
400	4.91	4.91	0

Notes:

¹ Elevations are referenced to NGVD 29.

² Difference is Proposed Conditions WSE minus Existing Conditions WSE

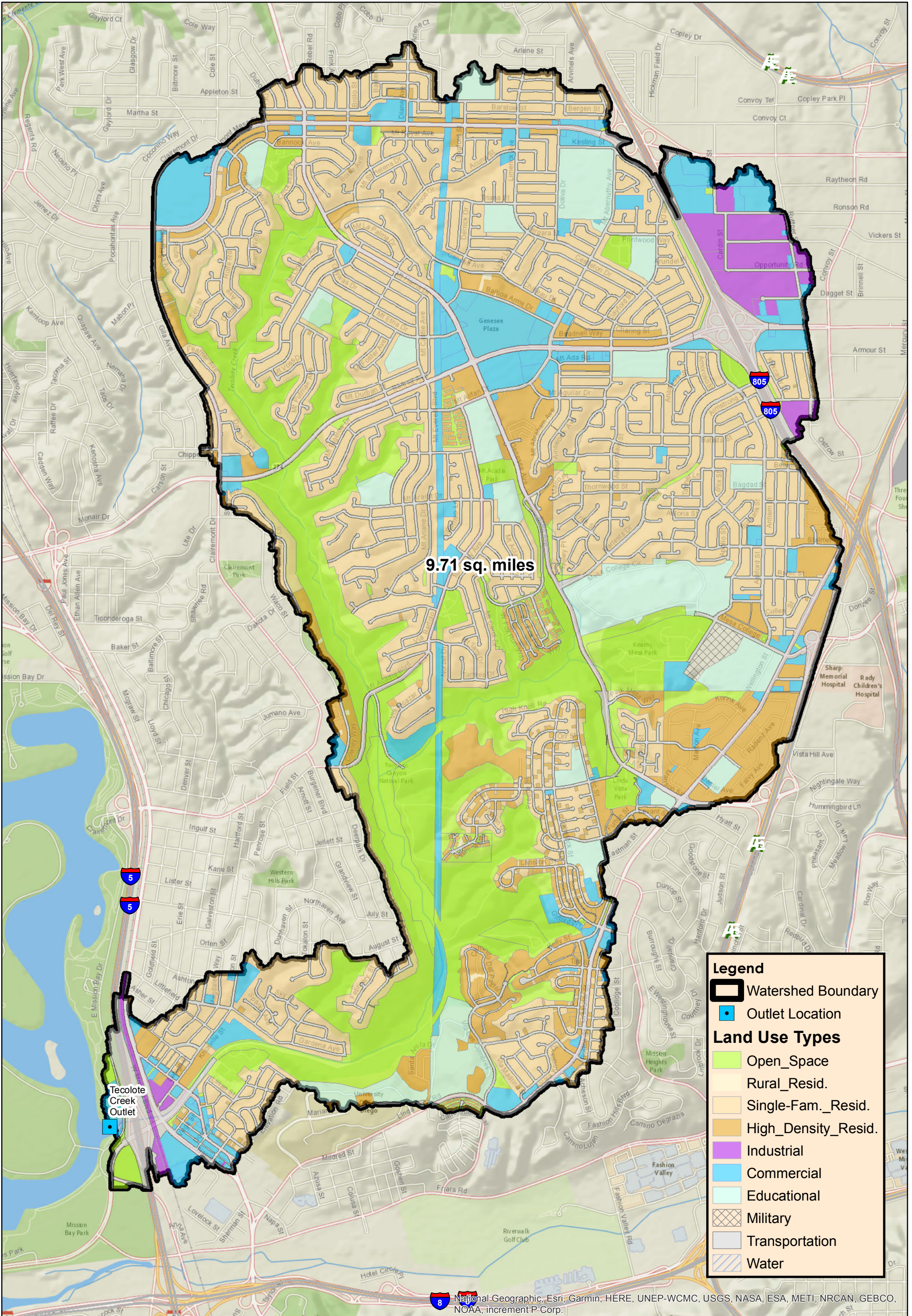


Legend

- Outlet Location
- Watershed Boundary
- Flow Paths
- Soil Group Unknown*
- Soil Group A
- Soil Group B
- Soil Group C
- Soil Group D

*Unknown areas are assumed to be soil group D.

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9.71 sq. miles

Tecelote Creek Outlet

Legend

- Watershed Boundary
- Outlet Location

Land Use Types

- Open_Space
- Rural_Resid.
- Single-Fam._Resid.
- High_Density_Resid.
- Industrial
- Commercial
- Educational
- Military
- Transportation
- Water

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T:\18097_MissionBayPEIR\GIS\18097_Hydrology_Exhibits_Tecelote_Creek_landuse.mxd

TABLE 8: SUMMARY OF PEAK DISCHARGES

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cubic feet per second)			
		10% Annual- Chance	2% Annual- Chance	1% Annual- Chance	0.2% Annual- Chance
Above Confluence with Descanso Creek	25.2	2,900	11,000	15,100	27,200
Switzer Creek					
At Harbor Drive	4.3	830	2,200	2,600	5,000
Upstream of Russ Boulevard	3.5	675	1,540	1,870	3,220
Above Confluence with Florida Drive Branch	1.0	185	420	510	880
Tecolote Creek					
At Interstate Highway 5	9.29	2,100	3,800	4,900	9,300
Downstream of Confluence with Unnamed Tributary	7.28	2,000	3,700	4,700	8,900
Upstream of Confluence with Unnamed Tributary	4.04	1,100	1,900	2,400	4,500
Downstream of Balboa Avenue	2.54	750	1,300	1,600 ⁸	2,600 ⁸
Upstream of Balboa Avenue	2.54	750	1,300	1,700	3,100
Downstream of Genesee Avenue	1.64	640	1,100	1,400 ⁹	2,100 ⁹
Upstream of Genesee Avenue	1.64	640	1,100	1,500	3,000

⁸ Decrease Due to Culvert Restriction at Balboa Avenue

⁹ Decrease Due to Culvert Restriction at Genesee Avenue

Tecolote Creek Drainage Area Land Use Summary

Composite CN Value

89.6

Area (ac)

6,216.0

Area (mi2)

9.71

Row Labels	Sum of Area_ac	Max of CN
Commercial-B	32.2	90
Commercial-C	37.0	91
Commercial-D	445.6	92
Educational-B	1.2	90
Educational-C	8.2	91
Educational-D	426.0	92
High_Density_Resid.-B	8.4	82
High_Density_Resid.-C	61.1	88
High_Density_Resid.-D	572.8	90
Industrial-B	8.2	90
Industrial-D	119.3	92
Military-D	18.6	92
Open_Space-B	172.1	82
Open_Space-C	15.5	88
Open_Space-D	1,040.6	91
Rural_Resid.-B	0.0	78
Rural_Resid.-C	1.3	84
Rural_Resid.-D	6.2	87
Single-Fam._Resid.-B	28.8	79
Single-Fam._Resid.-C	216.2	85
Single-Fam._Resid.-D	1,836.2	87.5
Transportation-B	28.9	90
Transportation-C	87.1	91
Transportation-D	1,043.0	92
Water-D	1.4	99
Grand Total	6,216.0	99

Lag Time Calculations

Drainage Area	9.71 Sq. Miles
Length of longest watercourse	7.644 miles
Lc, length of longest watercourse measured upstream to point	3.822 miles
elevation of most remote point on	381 feet
elevation at outlet	0 feet
Overall Slope	49.84 feet/mile
M	0.38
Average Manning's N for Watercou	0.03

Lag 1.235142 Hours

Time to Peak 1.064692 Hours

$$\text{Lag} = 2.4 \bar{n} \left(\frac{L \times L_c}{s^{0.5}} \right)^m$$

where:

- L = Length to longest watercourse (miles)
- Lc = Length along longest watercourse, measured upstream to a point opposite the watershed centroid (miles)
- s = Overall slope of drainage area between the headwaters and the collection point (feet per mile)
- m = Constant determined by regional flood reconstitution studies (0.38 for San Diego County)
- \bar{n} = Average of the Manning's n values of the watercourse and its tributaries

Time Step	30 min	15 min
Lag =	1.235 Hrs	1.235 Hrs
Time to Peak	1.065 Hrs	1.065 Hrs
NRCS Lag (TI)	0.815 Hrs	0.940 Hrs

Drainage Design Manual Method HEC-1

TC_24HR. OUT

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1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
*   JUN 1998
*   VERSION 4.1
*
* RUN DATE 30JUL19 TIME 16:38:42
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* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
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X X XXXXXXX XXXXX X
X X X X X XX
X X X X X X
XXXXXXX XXXX X XXXXX X
X X X X X X
X X X X X X
X X XXXXXXX XXXXX XXX
    
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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE. THE DEFINITION OF -AMSK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION. NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE, SINGLE EVENT DAMAGE CALCULATION, DSS: WRITE STAGE FREQUENCY, DSS: READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE: GREEN AND AMPT INFILTRATION KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

HEC-1 INPUT PAGE 1

```

1
LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
*DIAGRAM
ID 100-YEAR, 24-HR STORM EVENT
*** FREE ***
2 IT 30 0 0 100
3 IO 1 2
4 KKTECOLOTE_CK
5 IN 30
6 PB 4.0
7 PI 0 .009 .007 .009 .009 .011 .009 .011 .012 .013
8 PI .014 .016 .017 .02 .023 .03 .045 .067 .088 .096
9 PI .082 .041 .027 .023 .021 .02 .019 .017 .016 .018
10 PI .01 .016 .015 .014 .015 .012 .013 .01 .01 .009
11 PI .01 .011 .01 .009 .009 .009 .01 .009
12 BA 9.71
13 LS 0 93.0
14 UD 0.815
15 ZZ
    
```

```

1
SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT LINE (V) ROUTING (--->) DIVERSION OR PUMP FLOW
NO. (.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW
4 TECOLOTE
    
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
*   JUN 1998
*   VERSION 4.1
*
* RUN DATE 30JUL19 TIME 16:38:42
*
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* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*
*****
    
```

100-YEAR, 24-HR STORM EVENT

```

3 10 OUTPUT CONTROL VARIABLES
      IPRNT 1 PRINT CONTROL
      IPLOT 2 PLOT CONTROL
      QSCAL 0 HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA
   NMIN 30 MINUTES IN COMPUTATION INTERVAL
   IDATE 1 0 STARTING DATE
   ITIME 0000 STARTING TIME
   NO 100 NUMBER OF HYDROGRAPH ORDINATES
   NDDATE 3 0 ENDING DATE
   NDTIME 0130 ENDING TIME
   ICENT 19 CENTURY MARK
    
```

TC_24HR. OUT

COMPUTATION INTERVAL .50 HOURS
TOTAL TIME BASE 49.50 HOURS

ENGLISH UNITS
DRAINAGE AREA SQUARE MILES
PRECIPITATION DEPTH INCHES
LENGTH, ELEVATION FEET
FLOW CUBIC FEET PER SECOND
STORAGE VOLUME ACRE- FEET
SURFACE AREA ACRES
TEMPERATURE DEGREES FAHRENHEIT

*** **

*
4 KK * TECOLOTE * _CK
*

5 IN TIME DATA FOR INPUT TIME SERIES
JXMIN 30 TIME INTERVAL IN MINUTES
JXDATE 1 0 STARTING DATE
JXTIME 0 STARTING TIME

SUBBASIN RUNOFF DATA

12 BA SUBBASIN CHARACTERISTICS
TAREA 9.71 SUBBASIN AREA

PRECIPITATION DATA

6 PB STORM 4.00 BASIN TOTAL PRECIPITATION

7 PI INCREMENTAL PRECIPITATION PATTERN
.00 .01 .01 .01 .01 .01 .01 .01 .01 .01
.01 .02 .02 .02 .02 .03 .04 .07 .09 .10
.08 .04 .03 .02 .02 .02 .02 .02 .02 .02
.01 .02 .01 .01 .01 .01 .01 .01 .01 .01
.01 .01 .01 .01 .01 .01 .01 .01 .01 .01

13 LS SCS LOSS RATE
STRTL .15 INITIAL ABSTRACTION
CRVNR 93.00 CURVE NUMBER
RTIMP .00 PERCENT IMPERVIOUS AREA

14 UD SCS DIMENSIONLESS UNIT GRAPH
TLAG .81 LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

UNIT HYDROGRAPH
10 END-OF-PERIOD ORDINATES
1865. 4400. 3416. 1520. 721. 333. 156. 72. 37. 14.

HYDROGRAPH AT STATION TECOLOTE

DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	*	DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
1		0000	1	.00	.00	.00	0.	*	2		0100	51	.00	.00	.00	387.
1		0030	2	.00	.00	.00	0.	*	2		0130	52	.00	.00	.00	226.
1		0100	3	.04	.04	.00	0.	*	2		0200	53	.00	.00	.00	103.
1		0130	4	.03	.03	.00	0.	*	2		0230	54	.00	.00	.00	48.
1		0200	5	.04	.04	.00	0.	*	2		0300	55	.00	.00	.00	22.
1		0230	6	.04	.04	.00	0.	*	2		0330	56	.00	.00	.00	10.
1		0300	7	.04	.04	.00	2.	*	2		0400	57	.00	.00	.00	4.
1		0330	8	.04	.03	.00	13.	*	2		0430	58	.00	.00	.00	2.
1		0400	9	.04	.04	.01	38.	*	2		0500	59	.00	.00	.00	0.
1		0430	10	.05	.03	.01	79.	*	2		0530	60	.00	.00	.00	0.
1		0500	11	.05	.03	.02	130.	*	2		0600	61	.00	.00	.00	0.
1		0530	12	.06	.03	.02	187.	*	2		0630	62	.00	.00	.00	0.
1		0600	13	.06	.03	.03	253.	*	2		0700	63	.00	.00	.00	0.
1		0630	14	.07	.03	.04	328.	*	2		0730	64	.00	.00	.00	0.
1		0700	15	.08	.03	.05	414.	*	2		0800	65	.00	.00	.00	0.
1		0730	16	.09	.03	.06	523.	*	2		0830	66	.00	.00	.00	0.
1		0800	17	.12	.04	.08	676.	*	2		0900	67	.00	.00	.00	0.
1		0830	18	.18	.04	.14	946.	*	2		0930	68	.00	.00	.00	0.
1		0900	19	.27	.05	.22	1441.	*	2		1000	69	.00	.00	.00	0.
1		0930	20	.35	.05	.30	2192.	*	2		1030	70	.00	.00	.00	0.
1		1000	21	.38	.04	.35	3035.	*	2		1100	71	.00	.00	.00	0.
1		1030	22	.33	.02	.30	3609.	*	2		1130	72	.00	.00	.00	0.
1		1100	23	.16	.01	.15	3496.	*	2		1200	73	.00	.00	.00	0.
1		1130	24	.11	.01	.10	2756.	*	2		1230	74	.00	.00	.00	0.
1		1200	25	.09	.00	.09	1998.	*	2		1300	75	.00	.00	.00	0.
1		1230	26	.08	.00	.08	1518.	*	2		1330	76	.00	.00	.00	0.

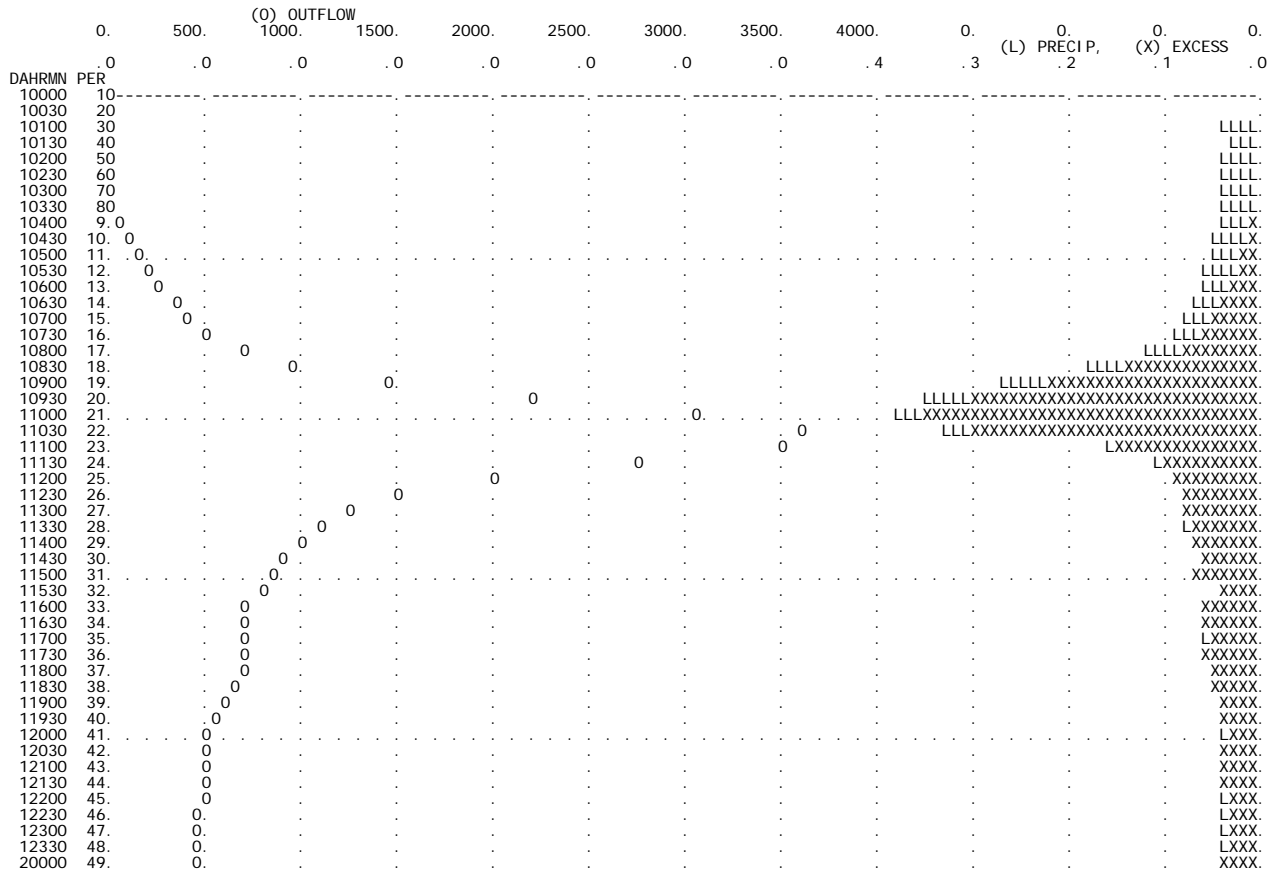
TC_24HR. OUT														
1	1300	27	.08	.00	.08	1244.	*	2	1400	77	.00	.00	.00	0.
1	1330	28	.08	.00	.07	1087.	*	2	1430	78	.00	.00	.00	0.
1	1400	29	.07	.00	.07	981.	*	2	1500	79	.00	.00	.00	0.
1	1430	30	.06	.00	.06	893.	*	2	1530	80	.00	.00	.00	0.
1	1500	31	.07	.00	.07	843.	*	2	1600	81	.00	.00	.00	0.
1	1530	32	.04	.00	.04	786.	*	2	1630	82	.00	.00	.00	0.
1	1600	33	.06	.00	.06	706.	*	2	1700	83	.00	.00	.00	0.
1	1630	34	.06	.00	.06	701.	*	2	1730	84	.00	.00	.00	0.
1	1700	35	.06	.00	.05	713.	*	2	1800	85	.00	.00	.00	0.
1	1730	36	.06	.00	.06	705.	*	2	1830	86	.00	.00	.00	0.
1	1800	37	.05	.00	.05	689.	*	2	1900	87	.00	.00	.00	0.
1	1830	38	.05	.00	.05	654.	*	2	1930	88	.00	.00	.00	0.
1	1900	39	.04	.00	.04	613.	*	2	2000	89	.00	.00	.00	0.
1	1930	40	.04	.00	.04	560.	*	2	2030	90	.00	.00	.00	0.
1	2000	41	.04	.00	.03	512.	*	2	2100	91	.00	.00	.00	0.
1	2030	42	.04	.00	.04	484.	*	2	2130	92	.00	.00	.00	0.
1	2100	43	.04	.00	.04	487.	*	2	2200	93	.00	.00	.00	0.
1	2130	44	.04	.00	.04	500.	*	2	2230	94	.00	.00	.00	0.
1	2200	45	.04	.00	.03	491.	*	2	2300	95	.00	.00	.00	0.
1	2230	46	.04	.00	.03	467.	*	2	2330	96	.00	.00	.00	0.
1	2300	47	.04	.00	.03	451.	*	3	0000	97	.00	.00	.00	0.
1	2330	48	.04	.00	.03	444.	*	3	0030	98	.00	.00	.00	0.
2	0000	49	.04	.00	.04	449.	*	3	0100	99	.00	.00	.00	0.
2	0030	50	.04	.00	.04	457.	*	3	0130	100	.00	.00	.00	0.

TOTAL RAINFALL = 4.00, TOTAL LOSS = .78, TOTAL EXCESS = 3.22

PEAK FLOW (CFS)	TIME (HR)	6-HR (CFS)	MAXIMUM (INCHES) (AC-FT)	AVERAGE FLOW 24-HR	72-HR	49.50-HR
3609.	10.50	2023.	1.937	840.	408.	408.
		1003.	1003.	3.218	3.220	3.220
				1667.	1667.	1667.

CUMULATIVE AREA = 9.71 SQ MI

1 STATION TECOLOTE



Modified HEC-1 to match to FIS hydrograph

TC_24HR_mod. OUT

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1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
*   JUN 1998
*   VERSION 4.1
*
* RUN DATE 30JUL19 TIME 19:05:41
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* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*
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X X XXXXXXX XXXXX X
X X X X X XX
X X X X X X
XXXXXXX XXXX X XXXXX X
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X X XXXXXXX XXXXX XXX
    
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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE. THE DEFINITION OF -AMSK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE, SINGLE EVENT DAMAGE CALCULATION, DSS: WRITE STAGE FREQUENCY, DSS: READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE: GREEN AND AMPT INFILTRATION KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
*DIAGRAM
ID 100-YEAR, 24-HR STORM EVENT
*** FREE ***
2 IT 30 0 0 100
3 IO 1 2
4 KKTECOLOTE CK_Modified_Increased Precipitation so that Qpeak is equalvant to F
5 IN 30
6 PB 5.2
7 PI 0 .009 .007 .009 .009 .011 .009 .011 .012 .013
8 PI .014 .016 .017 .02 .023 .03 .045 .067 .088 .096
9 PI .082 .041 .027 .023 .021 .02 .019 .017 .016 .018
10 PI .01 .016 .015 .014 .015 .012 .013 .01 .01 .009
11 PI .01 .011 .01 .009 .009 .009 .009 .01 .009
12 BA 9.71
13 LS 0 93.0
14 UD 0.815
15 ZZ
    
```

```

1 SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT LINE (V) ROUTING (--->) DIVERSION OR PUMP FLOW
NO. (.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW
4 TECOLOTE
    
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
*   JUN 1998
*   VERSION 4.1
*
* RUN DATE 30JUL19 TIME 19:05:41
*
*****
    
```

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* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*
*****
    
```

100-YEAR, 24-HR STORM EVENT

```

3 IO OUTPUT CONTROL VARIABLES
I PRNT 1 PRINT CONTROL
I PLOT 2 PLOT CONTROL
Q SCAL 0. HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA
NMIN 30 MINUTES IN COMPUTATION INTERVAL
I DATE 1 0 STARTING DATE
I TIME 0000 STARTING TIME
NO 100 NUMBER OF HYDROGRAPH ORDINATES
NDDATE 3 0 ENDING DATE
NDTIME 0130 ENDING TIME
ICENT 19 CENTURY MARK
    
```

COMPUTATION INTERVAL .50 HOURS
 TOTAL TIME BASE 49.50 HOURS

ENGLISH UNITS
 DRAINAGE AREA SQUARE MILES
 PRECIPITATION DEPTH INCHES
 LENGTH, ELEVATION FEET
 FLOW CUBIC FEET PER SECOND
 STORAGE VOLUME ACRES- FEET
 SURFACE AREA ACRES
 TEMPERATURE DEGREES FAHRENHEIT

*** **

 *
 4 KK * TECOLOTE * _CK_Modified_Increased Precipitation so that Qpeak is equivalent to F
 *

5 IN TIME DATA FOR INPUT TIME SERIES
 JXMIN 30 TIME INTERVAL IN MINUTES
 JXDATE 1 0 STARTING DATE
 JXTIME 0 STARTING TIME

SUBBASIN RUNOFF DATA

12 BA SUBBASIN CHARACTERISTICS
 TAREA 9.71 SUBBASIN AREA

PRECIPITATION DATA

6 PB STORM 5.20 BASIN TOTAL PRECIPITATION

7 PI INCREMENTAL PRECIPITATION PATTERN
 .00 .01 .01 .01 .01 .01 .01 .01 .01 .01
 .01 .02 .02 .02 .02 .03 .04 .07 .09 .10
 .08 .04 .03 .02 .02 .02 .02 .02 .02 .02
 .01 .02 .01 .01 .01 .01 .01 .01 .01 .01
 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01

13 LS SCS LOSS RATE
 STRL .15 INITIAL ABSTRACTION
 CRVNR 93.00 CURVE NUMBER
 RTIMP .00 PERCENT IMPERVIOUS AREA

14 UD SCS DIMENSIONLESS UNIT GRAPH
 TLAG .81 LAG

WARNING *** TIME INTERVAL IS GREATER THAN .29*LAG

UNIT HYDROGRAPH
 10 END-OF-PERIOD ORDINATES
 1865. 4400. 3416. 1520. 721. 333. 156. 72. 37. 14.

HYDROGRAPH AT STATION TECOLOTE

DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q	*	DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
1	0000	1	.00	.00	.00	0.	*	2	0100	51	.00	.00	.00	.00	509.	
1	0030	2	.00	.00	.00	0.	*	2	0130	52	.00	.00	.00	.00	296.	
1	0100	3	.05	.05	.00	0.	*	2	0200	53	.00	.00	.00	.00	135.	
1	0130	4	.04	.04	.00	0.	*	2	0230	54	.00	.00	.00	.00	63.	
1	0200	5	.05	.05	.00	0.	*	2	0300	55	.00	.00	.00	.00	29.	
1	0230	6	.05	.05	.00	2.	*	2	0330	56	.00	.00	.00	.00	13.	
1	0300	7	.06	.05	.01	18.	*	2	0400	57	.00	.00	.00	.00	6.	
1	0330	8	.05	.04	.01	56.	*	2	0430	58	.00	.00	.00	.00	2.	
1	0400	9	.06	.04	.02	109.	*	2	0500	59	.00	.00	.00	.00	1.	
1	0430	10	.06	.04	.02	175.	*	2	0530	60	.00	.00	.00	.00	0.	
1	0500	11	.07	.04	.03	253.	*	2	0600	61	.00	.00	.00	.00	0.	
1	0530	12	.07	.03	.04	336.	*	2	0630	62	.00	.00	.00	.00	0.	
1	0600	13	.08	.03	.05	429.	*	2	0700	63	.00	.00	.00	.00	0.	
1	0630	14	.09	.03	.06	533.	*	2	0730	64	.00	.00	.00	.00	0.	
1	0700	15	.10	.03	.07	651.	*	2	0800	65	.00	.00	.00	.00	0.	
1	0730	16	.12	.03	.09	799.	*	2	0830	66	.00	.00	.00	.00	0.	
1	0800	17	.16	.03	.12	1008.	*	2	0900	67	.00	.00	.00	.00	0.	
1	0830	18	.23	.04	.19	1378.	*	2	0930	68	.00	.00	.00	.00	0.	
1	0900	19	.35	.04	.30	2052.	*	2	1000	69	.00	.00	.00	.00	0.	
1	0930	20	.46	.04	.42	3059.	*	2	1030	70	.00	.00	.00	.00	0.	
1	1000	21	.50	.03	.47	4167.	*	2	1100	71	.00	.00	.00	.00	0.	
1	1030	22	.43	.02	.41	4897.	*	2	1130	72	.00	.00	.00	.00	0.	
1	1100	23	.21	.01	.20	4708.	*	2	1200	73	.00	.00	.00	.00	0.	
1	1130	24	.14	.01	.14	3694.	*	2	1230	74	.00	.00	.00	.00	0.	
1	1200	25	.12	.00	.12	2669.	*	2	1300	75	.00	.00	.00	.00	0.	
1	1230	26	.11	.00	.11	2022.	*	2	1330	76	.00	.00	.00	.00	0.	

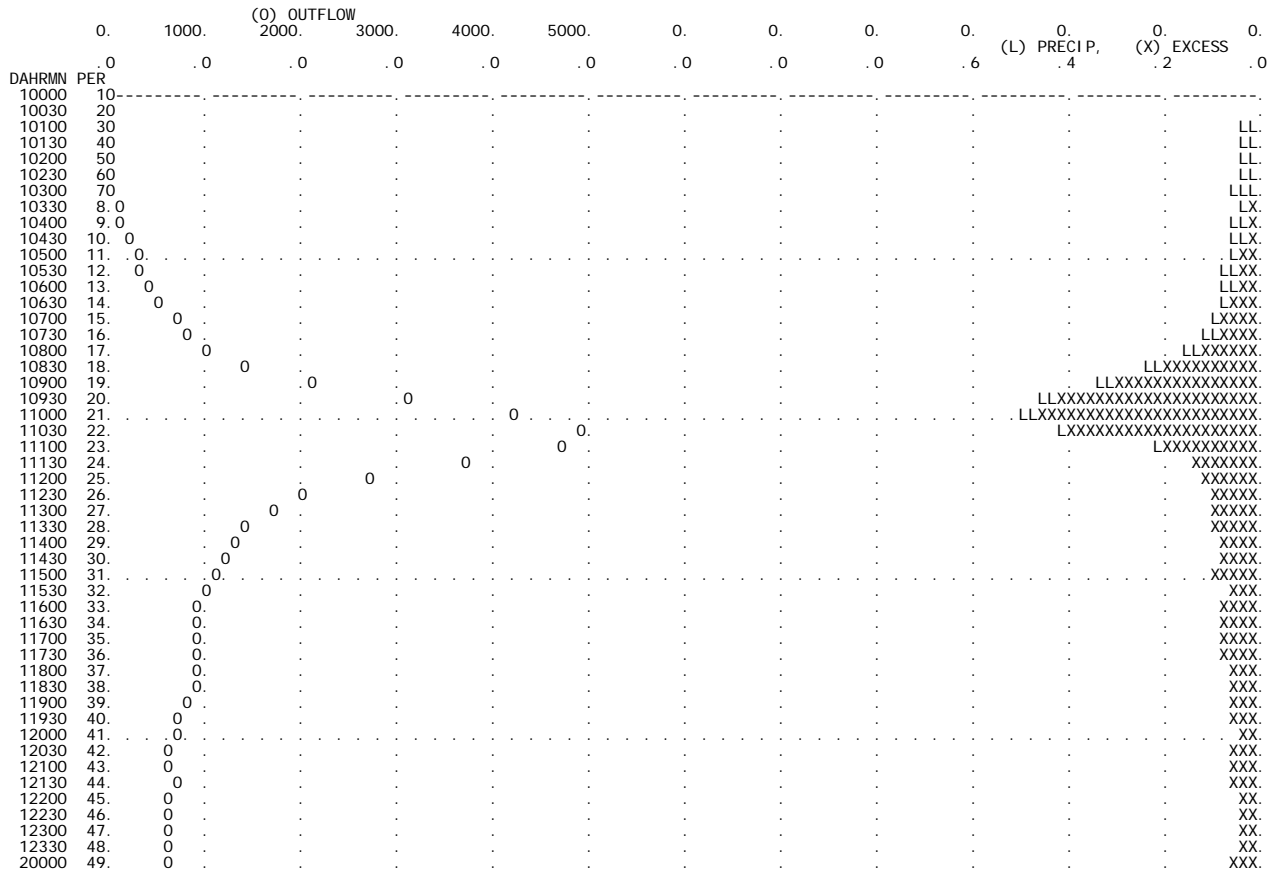
TC_24HR_mod. OUT														
1	1300	27	.10	.00	.10	1652.	*	2	1400	77	.00	.00	.00	0.
1	1330	28	.10	.00	.10	1441.	*	2	1430	78	.00	.00	.00	0.
1	1400	29	.09	.00	.09	1299.	*	2	1500	79	.00	.00	.00	0.
1	1430	30	.08	.00	.08	1181.	*	2	1530	80	.00	.00	.00	0.
1	1500	31	.09	.00	.09	1114.	*	2	1600	81	.00	.00	.00	0.
1	1530	32	.05	.00	.05	1038.	*	2	1630	82	.00	.00	.00	0.
1	1600	33	.08	.00	.08	932.	*	2	1700	83	.00	.00	.00	0.
1	1630	34	.08	.00	.08	925.	*	2	1730	84	.00	.00	.00	0.
1	1700	35	.07	.00	.07	940.	*	2	1800	85	.00	.00	.00	0.
1	1730	36	.08	.00	.08	929.	*	2	1830	86	.00	.00	.00	0.
1	1800	37	.06	.00	.06	908.	*	2	1900	87	.00	.00	.00	0.
1	1830	38	.07	.00	.07	861.	*	2	1930	88	.00	.00	.00	0.
1	1900	39	.05	.00	.05	808.	*	2	2000	89	.00	.00	.00	0.
1	1930	40	.05	.00	.05	737.	*	2	2030	90	.00	.00	.00	0.
1	2000	41	.05	.00	.05	674.	*	2	2100	91	.00	.00	.00	0.
1	2030	42	.05	.00	.05	637.	*	2	2130	92	.00	.00	.00	0.
1	2100	43	.06	.00	.06	640.	*	2	2200	93	.00	.00	.00	0.
1	2130	44	.05	.00	.05	658.	*	2	2230	94	.00	.00	.00	0.
1	2200	45	.05	.00	.05	645.	*	2	2300	95	.00	.00	.00	0.
1	2230	46	.05	.00	.05	614.	*	2	2330	96	.00	.00	.00	0.
1	2300	47	.05	.00	.05	593.	*	3	0000	97	.00	.00	.00	0.
1	2330	48	.05	.00	.05	584.	*	3	0030	98	.00	.00	.00	0.
2	0000	49	.05	.00	.05	589.	*	3	0100	99	.00	.00	.00	0.
2	0030	50	.05	.00	.05	600.	*	3	0130	100	.00	.00	.00	0.

TOTAL RAINFALL = 5.20, TOTAL LOSS = .81, TOTAL EXCESS = 4.39

PEAK FLOW (CFS)	TIME (HR)	6-HR (CFS)	MAXIMUM 24-HR (INCHES) (AC-FT)	AVERAGE FLOW 72-HR	49.50-HR
4897.	10.50	2745.	1146.	556.	556.
		2.628	4.391	4.394	4.394
		1361.	2274.	2276.	2276.

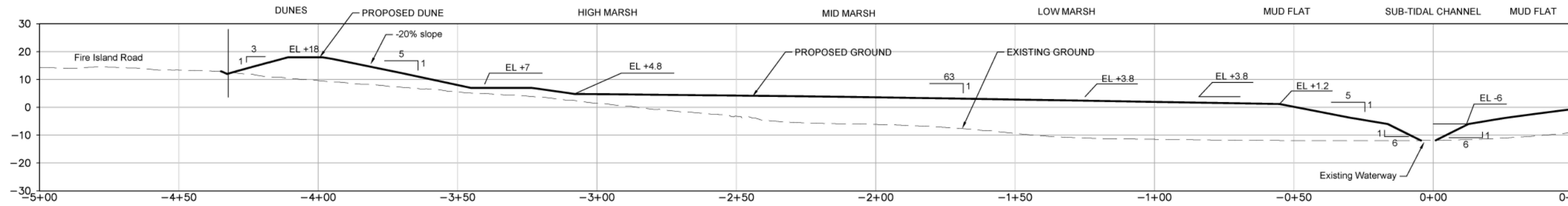
CUMULATIVE AREA = 9.71 SQ MI

1 STATION TECOLOTE

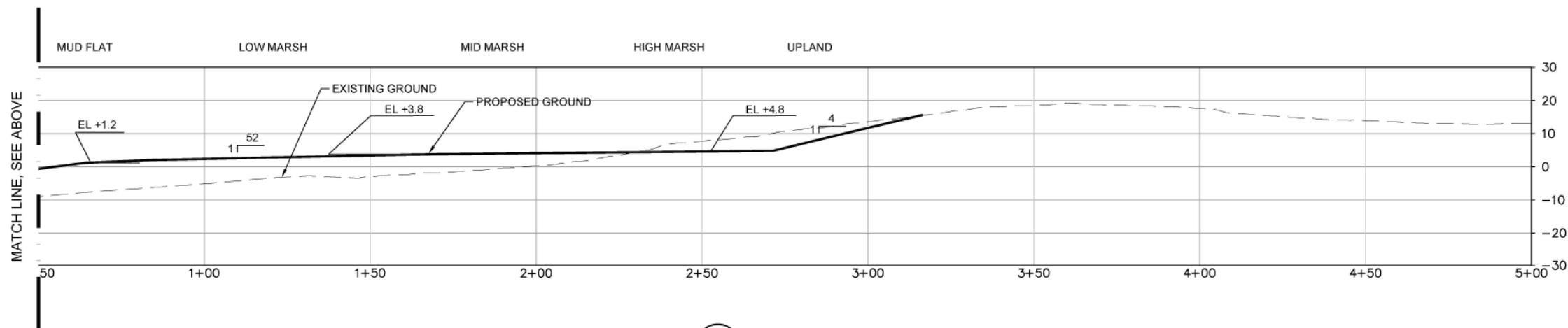


B. Preliminary Drawings

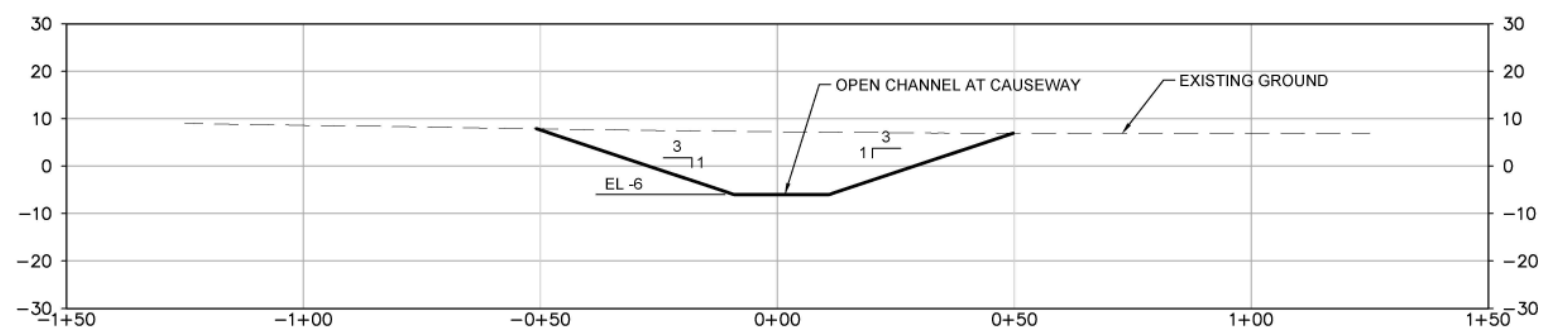




1 SECTION
C-1 SCALE: 1"=20' H, 1"=20' V



1 SECTION
C-1 SCALE: 1"=20' H, 1"=20' V



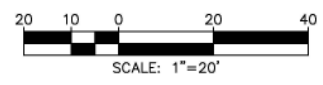
2 SECTION
C-1 SCALE: 1"=20' H, 1"=20' V

NOTES

- 1. ALL ELEVATIONS ARE IN REFERENCE TO NGVD 29 VERTICAL DATUM.

LEGEND

- EXISTING GROUND
- PROPOSED GROUND



PRELIMINARY
NOT FOR CONSTRUCTION

C-2

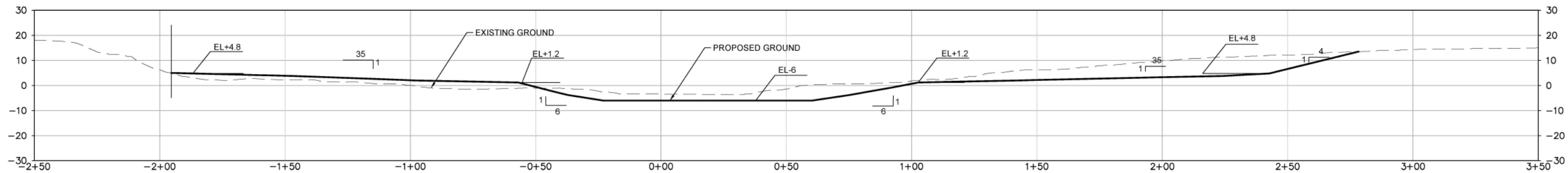
**MISSION BAY PROGRAM EIR
TECOLOTE CREEK
WETLANDS RESTORATION
TECOLOTE CREEK - SECTIONS**

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET OF 5 SHEETS

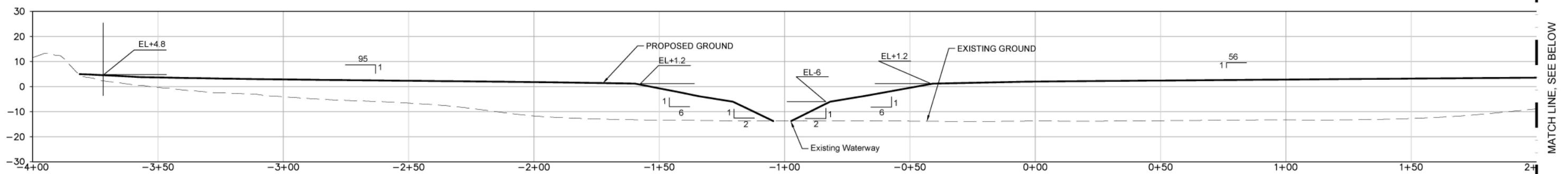
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FOR CITY ENGINEER		DATE		PROJECT MANAGER	
PRINT NAME		RCE#		CHECKED BY:	
DESCRIPTION	BY	APPROVED	DATE	FILMED	PROJECT ENGINEER
ORIGINAL	REC				226-1701
					CCS27 COORDINATE
					1866-6261
					CCS83 COORDINATE
CONTRACTOR				DATE STARTED	
INSPECTOR				DATE COMPLETED	
					XXXXX-02-D

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PLOTTER: Thursday, March 25, 2021 - 10:07am USER: chrumpion

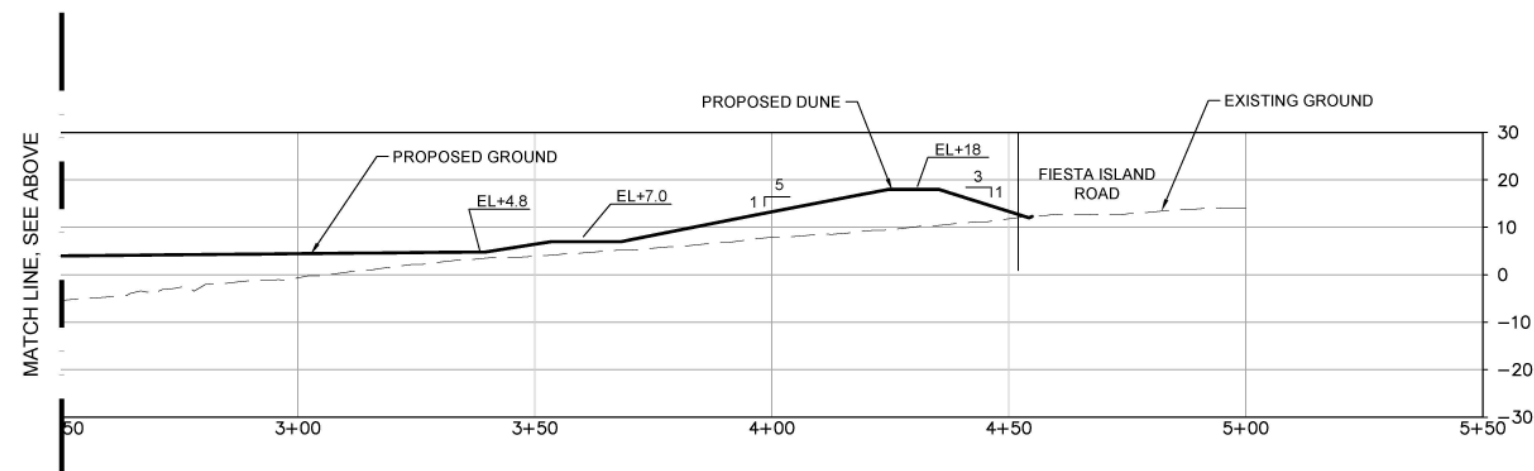
TECOLOTE CREEK



3 SECTION
C-1 SCALE: 1"=20' H, 1"=20' V



4 SECTION
C-1 SCALE: 1"=20' H, 1"=20' V



4 SECTION
C-1 SCALE: 1"=20' H, 1"=20' V

NOTES

- ALL ELEVATIONS ARE IN REFERENCE TO NGVD 29 VERTICAL DATUM.

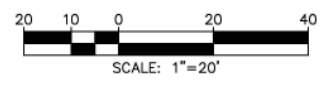
LEGEND

- EXISTING GROUND
- PROPOSED GROUND

C-3

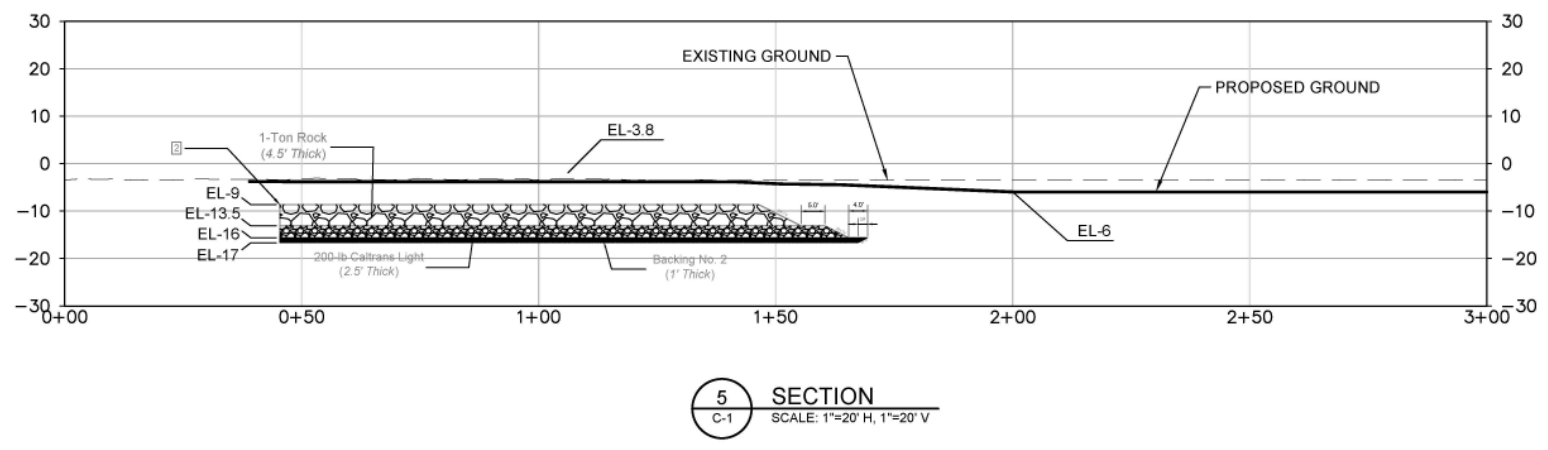
**MISSION BAY PROGRAM EIR
TECOLOTE CREEK
WETLANDS RESTORATION
TECOLOTE CREEK - SECTIONS**

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET OF 5 SHEETS



PRELIMINARY
NOT FOR CONSTRUCTION

APPROVED:		DATE		SUBMITTED BY:	
FOR CITY ENGINEER				PROJECT MANAGER	
PRINT NAME		RCE#		CHECKED BY:	
DESCRIPTION	BY	APPROVED	DATE	FILMED	PROJECT ENGINEER
ORIGINAL	REC				226-1701
					CCS27 COORDINATE
					1866-6261
					CCS83 COORDINATE
CONTRACTOR				DATE STARTED	
INSPECTOR				DATE COMPLETED	
					XXXXX-02-D



5 SECTION
C-1 SCALE: 1"=20' H, 1"=20' V

NOTES

1. ALL ELEVATIONS ARE IN REFERENCE TO NGVD 29 VERTICAL DATUM
2. TIE INTO EXISTING RIPRAP

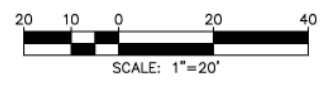
LEGEND

- EXISTING GROUND
- PROPOSED GROUND
- Top Layer: 1-Ton Rock
- Middle Layer: 200-lb Caltrans Light
- Bottom Layer: Backing No. 2

C-4

MISSION BAY PROGRAM EIR
TECOLOTE CREEK
WETLANDS RESTORATION
TECOLOTE CREEK — SECTIONS

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET OF 5 SHEETS



PRELIMINARY
NOT FOR CONSTRUCTION

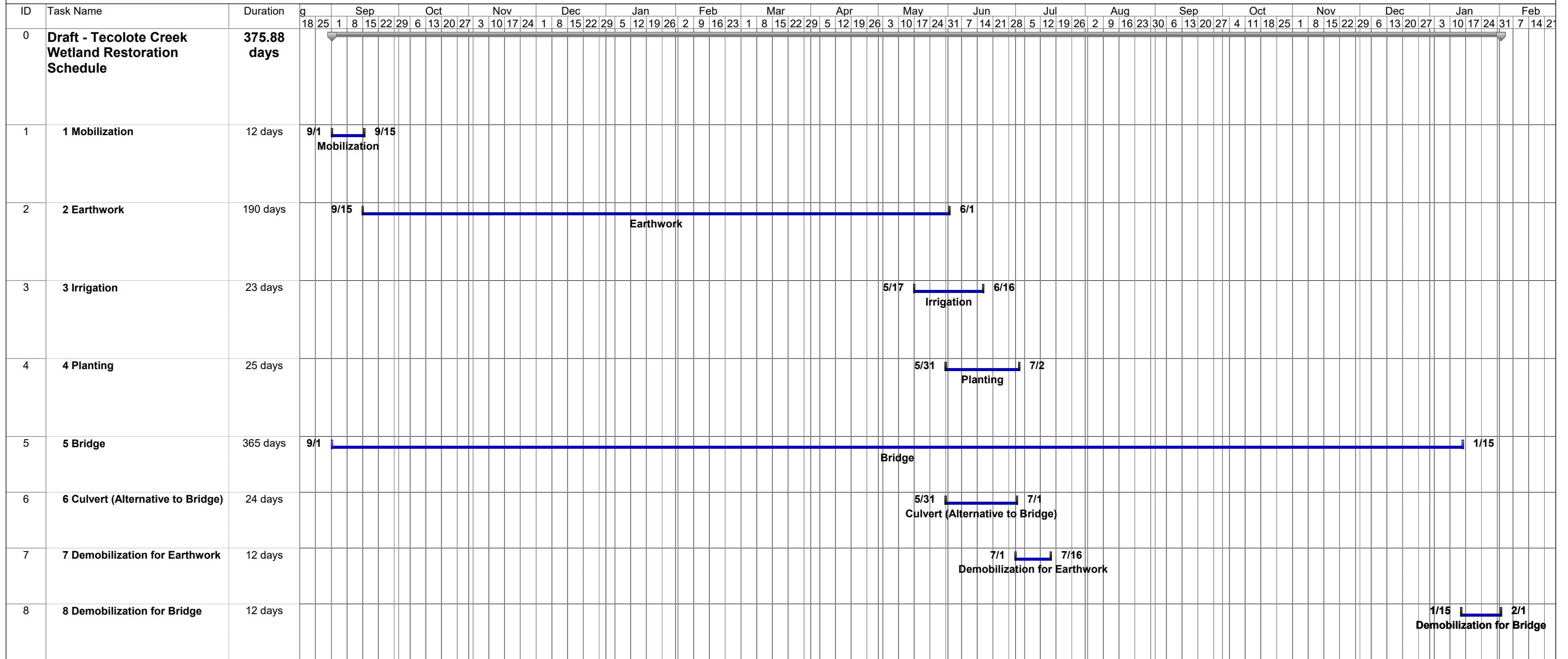
APPROVED:		DATE		SUBMITTED BY:	
FOR CITY ENGINEER				PROJECT MANAGER	
PRINT NAME		RCE#		CHECKED BY:	
DESCRIPTION	BY	APPROVED	DATE	FILMED	PROJECT ENGINEER
ORIGINAL	REC				226-1701
					CCS27 COORDINATE
					1866-6261
					CCS83 COORDINATE
CONTRACTOR		DATE STARTED		XXXXX-02-D	
INSPECTOR		DATE COMPLETED			

FILE NAME: C:\SA\10278 - Mission Bay PERY Design\CADD\CADD_Active\SheetSet (Mission Bay Program EIR-Wetlands)\C-4 - TECOLOTE CREEK - Sections.dwg
PLOTTER: Thursday, March 25, 2021 - 10:07am USER: drempton

TECOLOTE CREEK

C. Tecolote Creek Wetland Restoration & Fiesta Island Causeway Schedule

Tecolote Creek Wetland Restoration Schedule



Project: Draft - Tecolote Creek Wetland Restoration
Date: Thu 7/25/19

Task
 Summary
 Project Summary
 Critical
 Manual Task

D. Risk Assessment Table

RISK ASSESSMENT TABLE			Project Name:	Tecolote Creek Wetland Restoration & Fiesta Island Causeway				
ID #	Category	Title	Risk Statement	Risk Assessment			Risk Response	
				Probability	Cost Impact	Time Impact	Strategy	Response Actions
1	PM	Land Ownership	As a result of this project being in a public park owned and maintained by the City of San Diego, there are no land ownership conflicts that may present risk to the project.	Very Low	Low	Moderate	None	There are no known land ownership conflicts.
2	PM	Utilities	There are two known utilities in the causeway that will require consideration during design and construction. Encountering unforeseen utilities could cause schedule delays and increased costs.	Low	Moderate	Moderate	Mitigate	The design team will coordinate with utility owners early in the design phase to verify utility locations. The contractor is required to notify utility owners for verification and location of utilities.
3	Construction	Existing Soil Data	Past geologic investigation did not identify compromised or contaminated soils. The soils have been identified to have high potential for liquefaction due to high groundwater and hydraulic fills. Further geotechnical investigations will be required. Soils subject to liquefaction would likely increase bridge construction costs.	Moderate	Moderate	Low	Mitigate	Geotechnical investigations on bridge projects and settlement-sensitive projects are recommended. Further geotechnical investigations are required to progress to final design.
4	Construction	Proximity to Neighbors	As a result of construction activities that may have noise and traffic impacts, mitigation could be required, resulting in an extended project schedule.	Moderate	Moderate	Moderate	Mitigate	The contractor may be required to use time windows that reduce the noise and traffic impacts to the surrounding park and bay areas.
5	Environmental	Environmental Windows	Environmental constraints of endangered bird nesting seasons do not pertain to this project site because birds do not nest on-site.	Very Low	Low	Very low	None	There are no known environmental constraints.
6	Environmental	Water Quality Concerns	As a result of this project being located near continuous input of pollutants from various sources within the increasingly urbanized areas, pollutants can build up to undesirable levels.	Very Low	Low	Very low	None	Tecolote Creek storm flows will exit into the newly restored wetlands, allowing for the capture of suspended sediment and contaminants, as well as the filtration of upland stormwater. Therefore, wetland habitat will serve to improve water quality.
7	Environmental	Sensitive Historic Resources	As a result of earthwork activities, impacts to archeological or paleontological resources may occur which would lead to potential delays during construction.	Low	Moderate	Moderate	Mitigate	The team will work directly with the resource agencies to ensure timely response times and the efficient transfer of information.
8	Environmental	Sensitive Habitat	As a result of earthwork activities, impacts to rare plant species may occur requiring mitigation or avoidance.	Low	Moderate	Low	Mitigate	All efforts will be taken to minimize or avoid impacts to any rare plant species found on site.
9	Environmental	Sensitive Habitat	As a result of earthwork activities, impacts to rare or endangered wildlife may occur requiring avoidance or mitigation.	Low	Low	Low	Mitigate	All efforts will be taken to minimize or avoid impacts to any rare or endangered wildlife species found on site.
10	Environmental	Sea Level Rise	SLR primarily affects this project with its impact on wetland habitat distribution and functions. As sea levels increase, the wetland habitat becomes submerged, which decreases habitat diversity at the site.	High	Moderate	Low	Mitigate	The site can be adapted to SLR by reconfiguring and/or raising marsh plains by adding thin layers of sediment, or creating a muted salt marsh system by controlling the tide range.
11	PM	Permitting	As a result of the need to receive approval from multiple permitting agencies, the possibility of unanticipated mitigation requirements or project delays during approval could occur, which would result in increased project schedule and/or cost.	Moderate	Low	High	Mitigate	During the approval process, the team will work directly with the permitting agencies to ensure timely response times and the efficient transfer of information.

E. Project Goals and Objectives Table

PROJECT GOALS AND OBJECTIVES TABLE		Project Name:	Tecolote Creek Wetland Restoration					J-18097-A
			Overall Goals (Qualitative Outcome)					
ID #	Potential Benefits	Description/ Qualitative Outcome	Water Quality	Aquatic Resources	Fish and Wildlife Species	Environmental Enhancement	Recreation	Quantitative Outcome
1	Habitat creation	<ul style="list-style-type: none"> The creation of low marsh, mid-marsh, high marsh, transitional habitat and dunes will increase the biodiversity of the site The wetland will draw birds to area and create an opportunity for bird watching Interface between the wetland and the open water has been designed to allow low flows and high flows from Tecolote Creek 	X	X	X	X	X	<ul style="list-style-type: none"> Creation of 20.5 acres of salt marsh Creation of 5 acres of dune habitat The creation of areas for bird watching will add recreational visitors to the area
2	Storm water runoff / water quality improvement	<ul style="list-style-type: none"> Low flows and storm water runoff will inundate the salt marsh area, which will filter waters from the watershed Improved water quality will improve public safety and recreational use Improved tidal circulation at the causeway will potentially improve the water quality in East Mission Bay 	X	X	X	X	X	<ul style="list-style-type: none"> Improved water quality will increase the aquatic recreational experience
3	Flood control	<ul style="list-style-type: none"> The existing waterway and channel at Tecolote Creek has been designed to adequately convey runoff from the watershed Storm flows will be conveyed underneath the causeway through an open channel or culvert 		X		X		<ul style="list-style-type: none"> The channel and opening underneath the causeway have been designed to convey the 100-year storm event.
4	Reduced maintenance	<ul style="list-style-type: none"> Sediment delivered from the watershed will be deposited within the wetlands and circulated by tidal flows 		X	X	X		<ul style="list-style-type: none"> If the City installs a culvert underneath the causeway, periodic maintenance of the culvert may be required to remove marine growth and biofouling. An open channel underneath the causeway will require little to no maintenance compared to a culvert.
5	Resilience linked to future climate change and sea level rise	<ul style="list-style-type: none"> Salt marsh restoration at Tecolote Creek has been developed considering Sea Level Rise (SLR) by elevating marsh concepts to allow for some SLR while remaining as salt marsh. 		X	X	X		<ul style="list-style-type: none"> SLR adaptation strategies may need to be implemented in the future. The estimate based on current data is that SLR adaptation measures may be required at times between 2050 and 2100 (2.0 to 4.8 feet of SLR, respectively)