# PALO ALTO HORIZONTAL LEVEE PILOT PROJECT

## South Reach—Preliminary Design Report

Prepared for
City of Palo Alto
San Francisco Estuary Partnership

December 2020

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City of Palo Alto
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# EXECUTIVE SUMMARY

This Preliminary Design Report (PDR) documents the vision (30% project definition) for the Palo Alto Horizontal Levee Pilot Project (PAHLPP). The PAHLPP proposes construction of a 450-linear-foot horizontal levee and irrigated ecotone at a site along the southwestern edge of Harbor Marsh (South Reach), adjacent to the City of Palo Alto's (City's) Regional Water Quality Control Plant and Byxbee Park. The PAHLPP provides a unique habitat to San Francisco Bay (Bay) that is a benefit to species as well as sea-level-rise resilience, while also enhancing wastewater polishing to improve water quality, and improving public access and education opportunities. The projected implementation timeline includes design development and permitting/CEQA in 2021 with construction currently projected for 2023.

This PDR is an update to a previous December 2019 PDR that detailed a preliminary design for an alternate site adjacent to the City of Palo Alto Airport (Central Reach). Because of land use compatibility conflicts on airport land, the Central Reach site was abandoned, and the City selected the South Reach as the new preferred alternative for the PAHLPP. This PDR discusses issues with and potential approaches to securing permits and completing the required environmental documentation for the South Reach location. A preliminary cost estimate is also included.

A grant from the U.S. Environmental Protection Agency's Climate Ready Estuaries Program and the California State Coastal Conservancy funded development of this work, which was managed by the San Francisco Estuary Partnership in collaboration with the City of Palo Alto. In addition to the project's key goals of habitat enhancement, sea-level-rise adaptation, and wastewater polishing, the PAHLPP would include post-construction data collection. This information can be incorporated into future designs of larger flood control levee improvement projects and can supplement regional data gaps to encourage broader implementation of horizontal levees.

The PAHLPP would enhance the ecological function of the adjacent Harbor Marsh by converting ruderal, poor-quality upland habitat to freshwater marsh and transitional brackish ecotone slopes. An *ecotone* is defined as a gradient between two contrasting plant communities. In Palo Alto, the ecotone would provide a transition between upland plant communities along the horizontal levee core into freshwater marsh, and ultimately into existing salt marsh within the Harbor Marsh. The transitional ecotone is anticipated to provide critical habitat for special-status species including Ridgway's rail and salt marsh harvest mouse that inhabit the adjacent Harbor Marsh. In addition, the densely vegetated, broad, flat ecotone slopes would reduce wind-wave erosion, potentially allowing for a lower levee crest (compared to a traditional levee) while providing similar levels of flood protection. Horizontal levees can therefore be considered green infrastructure alternatives to traditional riprap improvements used for preventing shoreline erosion. In addition, horizontal levees have been identified in the 2015 Baylands Goals update as an important feature of future Bay habitats to help tidal marshes be more resilient to sea level rise.

The PAHLPP site shares the same alignment with two alternative alignments for the proposed Strategy to Advance Flood Protection, Ecosystems, and Recreation along San Francisco Bay (SAFER Bay) flood control levee (Reach 10) and is within Economic Impact Area Number 1 of the South San Francisco Bay Shoreline Study project (Shoreline Study), which is being conducted for a potential future flood control levee by the U.S. Army Corps of Engineers (USACE). Final alignments for these projects have yet to be determined, and this report discusses various options for construction sequencing and integration plans. The PAHLPP would be designed and permitted as a stand-alone project offset from Embarcadero Road; the future, parallel SAFER Bay/Shoreline Study flood protection levee would be a separate project that would connect to the PAHLPP in subsequent years.

As a conservative approach, the City decided to move forward with the proposed PDR with the assumptions necessary to accommodate future flood control levee construction. The PDR assumes that the PAHLPP would be constructed first (on what would be the outboard side of the future flood control levee), would reserve space for the future flood control levee, and would include a small berm (on the inboard side of the horizontal levee) that would provide support in the interim.

The future flood control levee is assumed to be built after the PAHLPP under a separate project and would provide protection for up to 3 feet of sea level rise consistent with the guidelines from SAFER Bay, the Ocean Protection Council, and USACE (SFCJPA 2019). The PAHLPP berm would support the horizontal levee treatment zone's infrastructure and maintain a corridor for integration into the future regional flood control levee. This proposed berm crest would exceed the elevation of the existing trail berm by 1.5 to 2.5 feet and would be approximately 18 inches higher than Embarcadero Road in this project reach. The horizontal levee would be designed for wave attenuation, and associated infrastructure would be located to minimize conflicts with a future flood protection levee that integrates into the project berm.

Highly treated (tertiary) wastewater effluent from a new, dedicated pipeline and control system would be distributed to the upslope portion of the horizontal levee, from which it would seep downslope to the adjacent Harbor Marsh and would support critical transitional ecotone habitat. The treated wastewater would be further polished in a subsurface seepage zone that has proven to be highly efficient in denitrification and removal of contaminants of emerging concern, including trace pharmaceuticals (Cecchetti et al. 2020).

Native seeds and plant plugs would be planted to provide a diverse plant palette that would evolve over time to adapt to the unique and heterogeneous habitat niches formed by the variable topography, hydrology, and salinity of the site. The native plant community dominated by freshwater and brackish wetland and riparian species is anticipated to create organic peat soils at relatively high rates because of the optimal hydrology and nutrient inputs to the native plant assemblages. The hydrologic regime and plant colonization would be actively monitored, maintained, and adaptively managed over the establishment period. When the system reaches maturity as the plants become fully established and the hydrologic regime is fine-tuned, it is expected to function passively, with only periodic adjustments and maintenance by City staff.

In December 2019, during development of the project's environmental compliance and permitting strategy, the project team presented the project in concept (based on the Central Reach 30% project definition) to the multi–regulatory agency Bay Restoration Regulatory Integration Team (BRRIT). The team obtained useful feedback and recommendations that have been considered in development of the project for the new South Reach. The South Reach project concept (30% design) was then presented to the BRRIT in November 2020. The project's environmental compliance and permitting strategy is presented in an attached Permitting Strategy memorandum, which has been updated to reflect the feedback received from the BRRIT in 2020. The BRRIT comments will also be addressed in the upcoming 60% design and permitting phase.

As part of this environmental compliance and permit strategy development process, a number of potential challenges were identified at the Central Reach and need to be addressed at the new South Reach as well:

- Potentially lengthy and costly permitting and California Environmental Quality Act (CEQA) processes.
- Potentially costly compensatory mitigation requirements.
- Possibly adverse effects on listed biological species.
- Design of the relocated trail and public access amenities to address public interests and wildlife concerns.
- Design implications of potential project integration with other local flood control efforts.
- Potential Federal Aviation Administration permitting challenges associated with the nearby operational airport.

A number of recommendations have been made to resolve the key issues identified, address stated concerns, and streamline permitting and environmental compliance. These recommendations include continuing the ongoing engagement of project stakeholders, which include members of the public, permitting and wildlife agencies, CEQA responsible agencies, and City Airport and Planning staff.

In preparation for the next design phase, several initial studies need to take place, such as special-status species surveys, an aquatic resources delineation, vegetation surveys, and cultural resource surveys. A geotechnical report is needed, including borings, analyses of slope stability, seepage, and settlement, as well as recommendations for levee design. In addition, a survey of existing topography should be conducted and a tide gauge be set up to measure the site's tide range.

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# PALO ALTO HORIZONTAL LEVEE PILOT PROJECT

## South Reach Preliminary Design Report

## 1. Introduction

This Preliminary Design Report (PDR) documents the vision and preliminary design (30% project definition) for a pilot horizontal levee adjacent to the City of Palo Alto's (City's) Regional Water Quality Control Plant (RWQCP) along the edge of Harbor Marsh. This PDR presents a preliminary design concept for the South Reach site along the south branch of Embarcadero Road, adjacent to Byxbee Park (**Figure 1**). This new site is located south of the Central Reach (along Embarcadero Road adjacent to the Palo Alto Airport) that was considered and documented in a previous report (ESA 2019).

The design approach for the new South Reach location adapts the concepts developed for the Central Reach to the existing topography, upland extents, and constraints at the South Reach site. This report also discusses issues and potential approaches to securing permits and completing required environmental documentation in addition to providing preliminary cost estimates. A grant from the U.S. Environmental Protection Agency's Climate Ready Estuaries Program and the California State Coastal Conservancy (Coastal Conservancy) funded development of this work, which was managed by the San Francisco Estuary Partnership in collaboration with the City of Palo Alto.

A *horizontal levee* is a flood control levee with a gently sloping berm along the San Francisco Bay (Bay) shoreline that provides key transitional habitat between tidal wetlands and terrestrial uplands. Its target vegetation consists of grassy wet meadow, freshwater/brackish marsh, and riparian scrub. This type of habitat has been decimated by development along the shoreline, which separates the uplands that surrounded historic tidal marshes from the remnant marshes that currently occupy the Bay's margins; therefore, it is a high restoration priority for resource agencies (SFEI 2015). The horizontal levee includes habitat for endangered species found only along the Bay shoreline, such as the salt marsh harvest mouse and Ridgway's rail, by providing refugia during high water and connectivity between marshes. At the same time, regulators identified the introduction of a new source of freshwater to the Bay as a concern for marsh conversion to freshwater or brackish species, specifically with respect to the potential for effects on the endangered Ridgway's rail (addressed later in this report).

Historically, natural transition zones would be fed by freshwater seeps from the surrounding watershed. Most areas that supported the historic transition zones around the Bay's tidal marshes have been developed or converted to agricultural uses. Modern storm drainage systems intercept runoff and efficiently convey it downstream, further disconnecting marsh transition zones from shallow freshwater inputs. To replicate the historic freshwater seep, the slope's vegetation can be irrigated with highly treated (tertiary) wastewater effluent. As the effluent percolates through the vegetation and soil, nutrients and pollutants are removed, thereby improving the effluent's water quality before discharge to the Bay.

The gentle slopes of horizontal levees also provide accommodation space for tidal wetlands to adapt to sea level rise by shifting landward. These contribute to flood management by attenuating waves, potentially allowing the construction of future flood control levees with crest elevations up to 2 feet lower than conventional levees. The Urban Levee Design Criteria developed by the California Department of Water Resources indicate that the Minimum Top of Levee shall be either the Design Water Surface Elevation plus 3 feet of freeboard or the Design Water Surface Elevation plus wind setup and wave run-up (DWR 2012). Thus, incorporation of a broad, flat transitional slope fronting the future flood protection levee can noticeably reduce the required Minimum Top of Levee by significantly reducing wind setup and wave run-up.

In addition, a horizontal levee provides erosion protection on the front side of coastal levees, limiting the need for rock riprap or other hard protection on the levee face. By encouraging sediment deposition and biomass creation, the vegetation supported on the gentle slope can build the ground surface elevation, contributing sea-level-rise resilience to both the habitat and flood management functions.

The desirability for horizontal levees from the ecological viewpoint has been understood for some time (SFEI 1999), but these features have not been included in many restoration projects to date. Utilizing treated wastewater effluent on horizontal levees and realizing the role of horizontal levees in increasing resilience to sea level rise are more recent concepts. The constructed Oro Loma Horizontal Levee Demonstration Project in San Lorenzo, California, consists of both approaches and generates insightful data from ongoing research and monitoring. The Oro Loma project is a closed system used in part to evaluate the effectiveness of the horizontal levee for removal of nutrients and contaminants of emerging concern, in particular pharmaceuticals, from treated wastewater. In addition, the project demonstrated the added benefit of treatment wastewater as irrigation to support establishment of habitat. The project has no hydrologic connection to the Bay; levee discharge is captured and routed back to the Oro Loma Sanitary District's wastewater treatment plant. The Palo Alto Horizontal Levee Pilot Project (PAHLPP) seeks to incorporate experience garnered from the Oro Loma Horizontal Levee Demonstration Project and extend the research to a horizontal levee open to Bay interactions.

Previous work (ESA 2018a, 2018b) evaluated and developed conceptual designs for alternative locations to implement the horizontal levee concept within the Palo Alto Baylands. The funding for the conceptual design effort was provided through the Oro Loma Horizontal Levee Demonstration Project, funded by a California Department of Water Resources Integrated Regional Water Management grant. The previously preferred alternative at the Central Reach was selected by the City and other stakeholders to progress through preliminary design for the pilot system because of its large upland area and connection to the goals and objectives of the Palo

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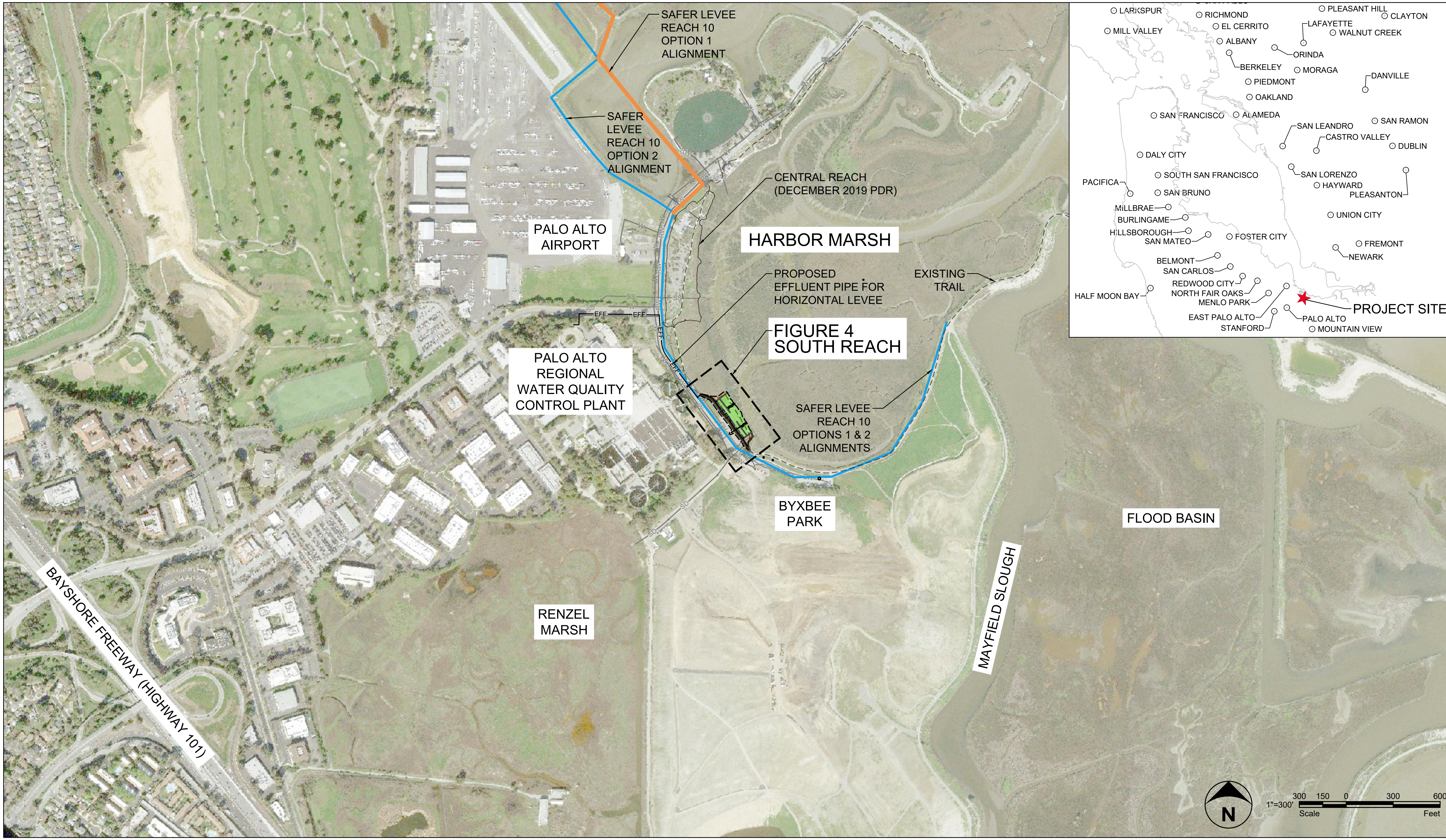


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**FIGURE 1**

SITE LOCATION MAP

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Alto Baylands Comprehensive Conservation Plan (BCCP). However, because of land use compatibility conflicts on airport land, that site was abandoned, and the South Reach with the project located north-adjacent to Byxbee Park was selected by the City as the new preferred alternative for the PAHLPP. To arrive at this site selection, the City considered numerous locations and design approaches as detailed in Section 2, *Site Selection*. The funding for revision of the preliminary design for the new site was provided by a Coastal Conservancy Proposition 1 grant.

## 1.1 Objectives and Key Concerns

Horizontal levees provide multiple ecological and environmental benefits. Depending on a project's priorities, the design approach can focus on enhancing one or more potential benefits. The City of Palo Alto has identified the following project objectives for the horizontal levee, in order of priority:

- Improve habitat along the perimeter of Harbor Marsh for native species. Restore rare and historic broad ecotone that supports a variety of transitional plant assemblages including riparian scrub, wet meadow, freshwater marsh, and narrow band of brackish alkali-bulrush wetland within the adjacent salt marsh.
- Adapt to sea level rise by providing a transitional slope that will support freshwater plants, which in turn build organic soils, all of which is aimed at keeping pace with sea level rise. With rising water levels, saltmarsh will gradually migrate up the slope, providing transgression space for up to three feet of sea level rise.
- Reduce flood risk by integrating a horizontal levee on the outboard side of a traditional flood control levee providing wind-wave attenuation and vegetative erosion protection for the flood control levee core.
- Provide polishing treatment to discharged treated wastewater.
- Maintain public access to the existing trail system while providing opportunities for compatible low-impact recreation, increased social infrastructure, and educational opportunities on sea level rise. Ensure perspectives of marginalized communities are incorporated into social infrastructure and educational components.
- Be on the leading edge of integrating habitat enhancement with sea-level-rise adaptation and novel wastewater treatment approaches around the San Francisco Bay. Collect data and information that could support broader implementation of horizontal levees as components in larger flood control levee improvement projects within Palo Alto and beyond.

The following key concerns expressed by the City and project team members have been used to guide the Preliminary Design development:

- Minimize operational complexity and maintenance required by City staff.
- Avoid substantial land use compatibility conflicts and increasing risks for wildlife aircraft strikes.
- Select a site that shares an alignment with future levee improvement projects, if possible, to efficiently use public resources to provide flood protection and habitat enhancement.

- Limit the amount of salt marsh that is converted to brackish marsh to an amount deemed beneficial for ecosystem health and minimize impacts on existing wetlands and other sensitive habitats.

## 1.2 Project Location

The project site (Figure 1) is located along Embarcadero Road adjacent to the RWQCP and Byxbee Park in Palo Alto, California; this stretch of Embarcadero Road is known to locals as Harbor Road. The project site is bounded on the north by the marsh where it reaches Embarcadero Road, to the west by Embarcadero Road, and to the south by the Byxbee Park parking lot entrance. The project location is adjacent to the existing Harbor Marsh, an approximately 90-acre tidal saltmarsh that has established within the former Palo Alto Yacht Harbor.

The 450-linear-foot (LF) project would include approximately 295 LF of horizontal levee irrigated with treated wastewater to create a transitional freshwater wetland slope with upland/transitional plantings in adjacent areas supported with more limited irrigation. The horizontal levee site shares the same alignment with two alternatives for the proposed Strategy to Advance Flood Protection, Ecosystems, and Recreation along San Francisco Bay (SAFER Bay) levee and the Coastal Conservancy and U.S. Army Corps of Engineers (USACE) South San Francisco Bay Shoreline Study project (Shoreline Study). The PAHLPP is intended to ultimately be integrated into the future SAFER Bay/Shoreline Study levee. The horizontal levee would be constructed outboard of the proposed future flood control levee corridor and connected to the tidal marsh. When the system reaches maturity as the plants become fully established and the hydrologic regime is fine-tuned, it is expected to function passively with only periodic monitoring, adjustments and maintenance by City staff.

## 1.3 Project Background

Much of the Palo Alto shoreline, while highly developed and altered, continues to sustain tidal marsh along the San Francisco Bay and in particular at the former yacht harbor where the project is proposed to be built. Harbor Marsh and the Baylands Nature Preserve are backed by low levees and a closed landfill. Directly behind these levees are significant City of Palo Alto infrastructure, including the City's RWQCP, airport, the Palo Alto Flood Basin, roads and light commercial development. Potential flooding of City infrastructure, buildings, and other development west of U.S. Highway 101 are limited by the existing levees. The existing levees are not engineered to meet Federal Emergency Management Agency (FEMA) accreditation standards, and in many locations do not provide 100-year flood protection. To improve these levees, the City has partnered with nearby cities and county flood agencies as a member of the San Francisquito Creek Joint Powers Authority (SFCJPA). The SFCJPA plans, designs, and implements capital projects to protect the cities of East Palo Alto, Menlo Park, and Palo Alto from San Francisco Bay coastal flooding. The SFCJPA and their consulting team evaluated alternatives to protect Palo Alto against extreme tides with sea level rise under the SAFER Bay project. The public draft of the SAFER Bay Feasibility Report was released in June 2019 and includes levee improvements that can accommodate an additional 3 feet of sea level rise and explores integration with horizontal levees (HDR 2019).

The City of Palo Alto is also participating in the Shoreline Study, a Congressionally authorized study being conducted by USACE, Santa Clara Valley Water District (Valley Water), and the Coastal Conservancy to identify and recommend flood risk management and ecosystem restoration projects along South San Francisco Bay for federal funding. The next phase of the Shoreline Study is just beginning and will leverage the SAFER Bay Feasibility Report and consider the feasibility of options to manage flood risk along the Palo Alto shoreline with more defined guidelines. One of the goals for the Shoreline Study is to incorporate natural infrastructure, such as horizontal levees, to provide increased flood protection that can evolve in the future, restore Bay habitats, and public access.

The City is in the process of updating the BCCP, which provides guidance for managing City-owned open space property along the Bay shoreline. The project site is part of the inner harbor southwest shoreline, which is identified in the BCCP as in need of restoration because of current habitat degradation and the existence of invasive species. The BCCP also identified horizontal levees as a potential implementation strategy to meet Natural Resources Management Goal 5 to incorporate climate change and sea level rise into long-term management and policies. The BCCP's Natural Resources Management Goal 5.3 specifically encourages a "pilot study of a horizontal levee" amongst other sea-level-rise adaptation strategies.

In 2019, the City presented a preliminary 30% design of the PAHLPP at the Central Reach location (on Palo Alto Airport property immediately adjacent to the airport) to the Bay Restoration Regulatory Integration Team (BRRIT). Feedback from the BRRIT, received in 2019 for the Central Reach site, is discussed in Section 3.7, *Regulatory Permit Strategy,* and Appendix D. Following development of the preliminary designs for the Central Reach, the City decided to consider and compare different sites and project approach options to resolve permitting and associated land use compatibility issues that were uncovered at the time. This project site analysis review is presented in Section 2, *Site Selection*. The City determined that Option 3 for a Horizontal Levee at Byxbee Park (South Reach) is the preferred site and design approach for the Pilot Project to progress to a revised preliminary 30% design. The South Reach Project includes a pilot horizontal levee in Harbor Marsh with an interim, inboard berm at the north end of Byxbee Park across Embarcadero Road from the RWQCP. In November 2020, the City presented a revised 30% design of the South Reach Project and location to the BRRIT, and the resulting feedback is also discussed in Section 3.7, *Regulatory Permit Strategy,* and Appendix D.

The City owns and operates the RWQCP to treat and dispose of wastewater from the City and surrounding communities. In 2019, the plant received approximately 18 million gallons per day (mgd) of average dry weather inflow, provided tertiary treatment, and routed its effluent to recycled water uses (approximately 0.6 mgd), Renzel Marsh (approximately 1 mgd), and the Bay (the remaining 16.4 mgd) (City of Palo Alto 2020a).

Effluent from the RWQCP currently meets water quality criteria from its National Pollutant Discharge Elimination System (NPDES) permits (City of Palo Alto 2020b) that are issued by the San Francisco Bay Regional Water Quality Control Board. The treatment facility is a permitted shallow-water discharger, and it is expected that the proposed discharge location at the horizontal levee would be added to the existing permit. The effluent supply that would be beneficially reused and discharged at the PAHLPP would be from the same connection point source that currently serves the Renzel Marsh. The City, along with other Bay Area wastewater treatment operators, is assessing the capacity of the plant's current treatment process to meet more restrictive criteria for nutrients, particularly nitrogen, that may be implemented with a future permit renewal. To meet future nitrogen criteria, the City is planning to upgrade the existing treatment process (Carollo 2012). However, the South Reach horizontal levee may be completed ahead of implementation of any planned nutrient removal upgrades. A horizontal levee can provide additional nitrogen removal capacity while also reducing concentrations of contaminants of emerging concern, including trace pharmaceuticals (Sedlak 2018), for effluent that does not receive nutrient removal treatment.

## 1.4 Project Vision

The PAHLPP would be the first installation of the full horizontal levee concept that receives treated wastewater, provides polishing treatment in a subsurface gravel seepage layer, and discharges via shallow surface/subsurface seepage to the Bay. Information and data collected from this pilot system can be fed into designs for broader implementation of horizontal levees throughout the Bay Area. The following vision for the horizontal levee is drawn from personal communication and a memorandum included as Appendix A produced by Dr. Peter Baye (2019) as well as other proponents of the concept.

The horizontal levee's ecological function would be to create an *ecotone transition*, defined as a gradient between two contrasting plant communities. The horizontal levee slope, saturated with the highly treated wastewater effluent, would support a heterogeneous freshwater wetland habitat mosaic that includes marsh, wet meadow, and riparian scrub. At the base of the horizontal levee, the existing salt marsh provides a contrasting plant community. The intrusion of the freshwater into the saline soil environment would likely form a distinct brackish marsh zone (within the salt marsh), which is a rare and valuable habitat in the San Francisco Bay. The brackish marsh is typically dominated by alkali-bulrush, but can also include gumplant.

The freshwater contribution to the horizontal levee slope mimics the hydrology often seen where hill slopes meet tidal marsh and create the salinity gradient and ecotone. The habitat benefits of the alkali-bulrush wetland include enhanced high-tide cover for local populations of salt marsh harvest mouse and Ridgway's rail during extreme high tides. Existing gumplant patches provide similar extreme high-tide refugia and would likely benefit from the broader brackish seepage zone created by the horizontal levee, particularly during drought conditions when gumplant is susceptible to dry-weather and summer-induced hypersalinity die-back.

However, freshwater discharge into the existing salt marsh could exceed the beneficial habitat objective of enhanced brackish-salt marsh zonation and cross the salinity threshold, resulting in a type conversion of larger areas of salt marsh to brackish marsh. Semi-enclosed tidal basins with salt marshes, like Harbor Marsh, can experience increased residence time and reduced mixing of freshwater discharges with tidal flows. This could amplify the influence of the freshwater contribution to the salinity gradient within the salt marsh making adaptive management an important aspect of operations and maintenance (O&M). The project should aim at gradually increasing freshwater discharge during the startup phase until brackish marsh conditions are observed. While salinity modeling suggests that the off-site conversion is not likely to occur, when progressive salt marsh conversion to brackish marsh is detected at early stages, inputs of freshwater could be controlled. This marsh conversion monitoring should be a part of any future O&M discussions and included as an integral part of how decisions are made with regard to the amount and timing of changes to freshwater instructions. See the salinity modeling results in Section 3.6, *Hydrologic Considerations,* and Appendix G.

The existing salt marsh between the horizontal levee and the adjacent tidal channel varies in width between 20 and 75 feet. The preliminary target for brackish marsh conversion is approximately a 20- to 30-foot band along the toe of the horizontal levee, and it is anticipated that much of the narrow band of salt marsh between the horizontal levee and the adjacent tidal channel would convert to brackish conditions. A conversion area greater than the 20- to 30-foot-wide band and/or conversion of areas opposite the adjacent channel would trigger management activities (i.e., reduced freshwater discharge rates) to limit the size of the brackish marsh.

# 2. Site Selection

During the preliminary design process for the originally preferred project location at the Central Reach of Harbor Marsh, a potential land use compatibility issue came to light regarding federal Aviation Administration (FAA) guidance on the proximity of wetlands habitats to public airports. Although the FAA guidance related to creation of wetlands habitat applies to all lands within a certain distance of an operational airport, within which all of the Palo Alto Baylands—and therefore all of the alternative sites—are located, this issue was expected to be particularly challenging for the originally preferred project site (Central Reach), due its location on City Airport property. Therefore, the City wanted to consider alternative sites that could better adhere to FAA guidance to address comments/concerns from the Palo Alto Airport.

Subsequently, the City identified a number of potential sites for the pilot project. The project locations and approaches considered are described in Appendix I, and considered  locations are shown in **Figure 2**.

Based on the review of the options considered, Option 3–South Reach Horizontal Levee was selected by the City to progress. This preference stands as compared to Option 2–South Reach Horizontal and Flood Control Levee, unless there emerges a geotechnical requirement. Therefore, the 30%-complete plan set and cost estimate are currently based on progressing Option 3 at the South Reach.

However, it is possible that as the project design develops, the City could opt for Option 2 including construction of at least the lower portion of the flood control levee pending the detailed geotechnical investigation, analyses and recommendations. These options are presented in more detail in Section 4.9, *Integration with Flood Control Levee Improvements,* where several options for integration with the future SAFER Bay/Shoreline Study levee are discussed.

# 3. Preliminary Design Considerations

## 3.1 Existing Site Description

The Harbor Marsh tidal salt marsh is in relatively early successional stages between low cordgrass marsh to middle zone pickleweed-cordgrass, following harbor siltation and abandonment in the 1960s–1970s. The salt marsh was extensively infested with hybrid non-native smooth cordgrass (*Spartina alterniflora* x *foliosa*), which was treated and mostly controlled during the last decade, though some backcross hybrid colonies appear to persist and required re-treatment in recent years. Channel bed mudflats at least intermittently support thick cyanobacterial and algal mats, indicating high nutrient availability and relatively low wind-wave disturbance or sediment accretion during the summer. At the head of the embayed salt marsh, farthest from the tidal inlet (south end, near the South Reach Embarcadero Road project area), a number of relatively large alkali-bulrush colonies exist within the salt marsh matrix of cordgrass and pickleweed. Alkali-bulrush stands also occur in sparser, shorter vegetation mixed with pickleweed and saltgrass in the high salt marsh ecotone. The existing ecotone, therefore, is primed to respond almost instantaneously to form a robust brackish marsh zone upon connection to the freshwater seepage discharge from the constructed horizontal levee (Baye 2019).

The vegetation of the existing terrestrial-tidal marsh ecotone is predominantly non-native vegetation with poor high-tide cover for salt marsh wildlife during extreme marsh submergence events. Some significant stands of native perennial grasses such as saltgrass (*Distichlis spicata*) and creeping or alkali wildrye (*Elymus triticoides*) are also present despite summer desiccation of soils. These species can and should be salvaged, propagated, and incorporated as either successional plantings or "final" vegetation on less waterlogged (mounded, better drained) segments within the constructed horizontal levee slope. Dominant terrestrial weeds extending from adjacent lowlands to the terrestrial ecotone of the marsh include saltwort (*Salsola soda*), iceplant (*Carpobrotus edulis*), fennel (*Foeniculum vulgare*), and many non-native annual grasses (*Bromus, Hordeum, Avena* spp.), plus the perennial Russian wheatgrass (*Elymus ponticum*). Some native upland shrubs, including the weedy but valuable habitat of coyote-brush (*Baccharis pilularis*), are also widespread (Baye 2019).

The native plant species diversity and terrestrial wildlife habitat of the constructed horizontal levee slope is expected to significantly exceed those of the existing ruderal grassland and scrub. Along the steeper flood control levee core, the native species diversity and habitat quality should also at least match or exceed those of the existing ruderal lowland bay fill areas. However, regulatory policies regarding vegetation on levee slopes requires complete exclusion of scrub (cover, food, nesting habitat) which can be mitigated to some extent by maximizing the quality of native grassland habitat on the levee, and enhancing upland and wetland scrub habitat where it does not conflict with levee maintenance standards (Baye 2019).

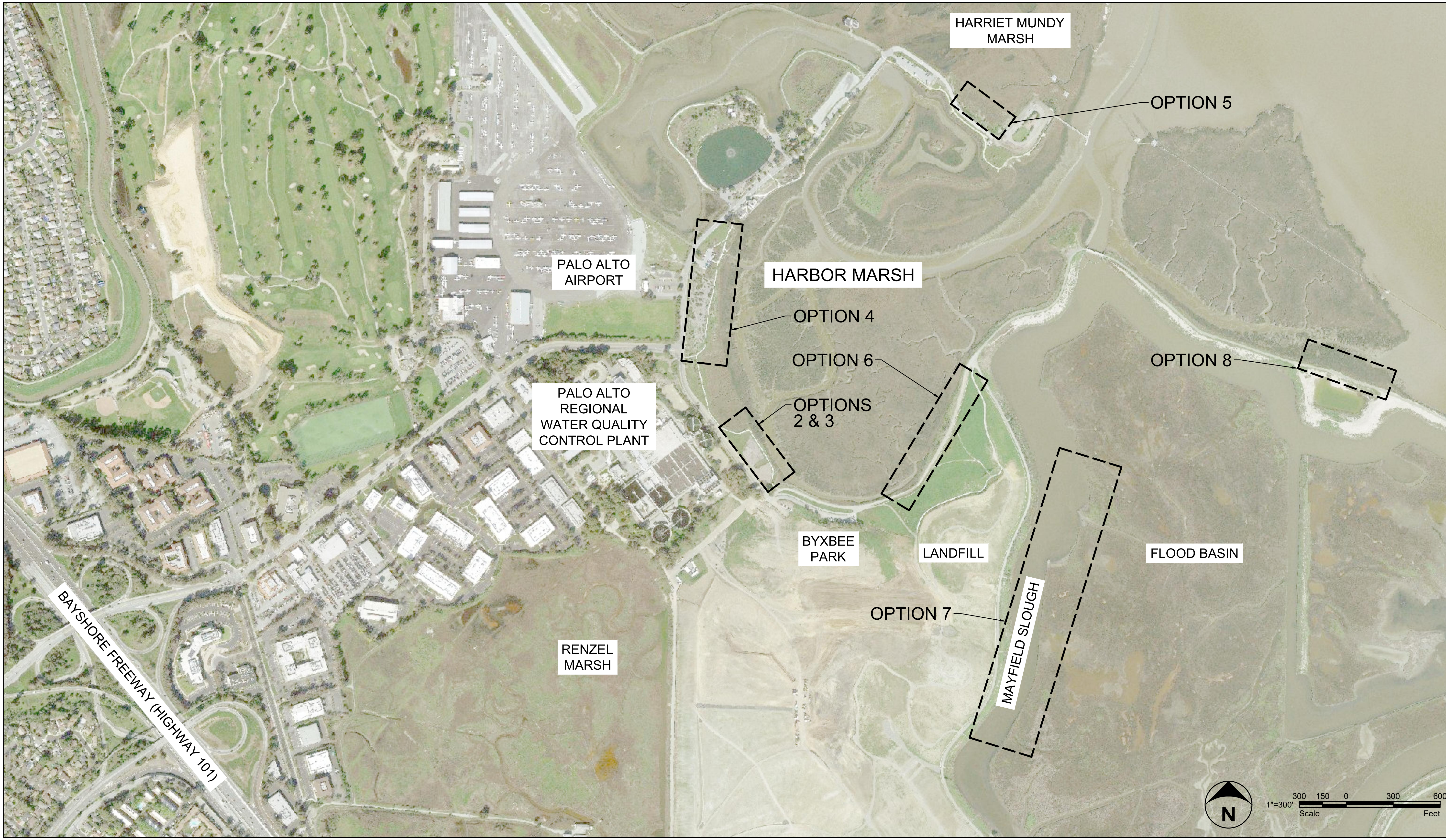


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**FIGURE 2**

PROJECT OPTIONS LOCATION MAP

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## 3.2 Project Datums

The vertical datum used by the project is North American Vertical Datum of 1988 (NAVD 88) and all elevations stated in this report reference this datum.

The closest reliable tide measurements are from the tide station at Coyote Creek (NOAA, ID 9414575). The station is located approximately 4.2 miles northwest of the site. Tidal datums from the tide gauge are shown in **Table 1**. There was a tide station located at the yacht harbor (9414525 PALO ALTO YACHT HARBOR) which was operational only in 1984. It is recommended that a tide gauge be set up to measure the tide range and surveys of existing vegetation at the site be performed to refine this table for final design. The San Francisco Bay Tidal Datums and Extreme Tides Study (AECOM 2016) provides another estimate of mean high water and mean higher high water to base marsh plain elevation, as well as estimates of extreme water levels (1-year through 500-year).

**TABLE 1**
**OBSERVED WATER LEVELS AT COYOTE CREEK IN FREMONT, CALIFORNIA, AND SAN FRANCISCO BAY EXTREME TIDES STUDY**

| Tidal Datum | | Coyote Creek (ft, MLLW) | Coyote Creek (ft, NAVD 88) | San Francisco Bay Extreme Tide Study |
|---|---|---|---|---|
| 100-Year Water Level | | | | 11.11 |
| 50-Year Water Level | | | | 10.58 |
| Highest Observed (12/03/1983) | | 12.27 | 10.92 | |
| Highest Astronomical Tide (11/23/1995) | HAT | 11.68 | 10.33 | |
| Highest Annual Water Level (1-Year) | HAWL | | | 8.63 |
| Mean Higher High Water | MHHW | 8.85 | 7.5 | 7.36 |
| Mean High Water | MHW | 8.26 | 6.91 | 6.75 |
| Mean Tide Level | MTL | 4.72 | 3.37 | |
| Mean Sea Level | MSL | 4.87 | 3.52 | |
| Diurnal Tide Level | DTL | 4.43 | 3.08 | |
| Mean Low Water | MLW | 1.18 | -0.17 | |
| North American Vertical Datum | NAVD[1] | 1.35 | 0.0 | |
| Mean Lower Low Water | MLLW | 0.0 | -1.35 | |
| Lowest Astronomical Tide (01/18/1984) | LAT | -2.02 | -3.37 | |
| Lowest Observed (02/17/1984) | | -1.93 | -3.28 | |

NOTES:

ft = feet; MLLW = mean lower low water; NAVD 88 = North American Vertical Datum of 1988

1. Conversion from MLLW to NAVD 88 from USACE 2015, Appendix D.

SOURCE: AECOM, 2016.

## 3.3 Existing Topography and Utilities

The existing topography within the project footprint at the South Reach gently undulates between elevations (EL) 8.0 and 11.5 feet (NAVD 88, typical). The project site is bounded to the west by Embarcadero Road (approximately EL 11.5 feet) and to the east by an existing low berm that extends up to EL 10.5 to 11.5 feet along the edge of Harbor Marsh (which starts at approximately EL 7.5 feet). The low berm along the eastern boundary of the site provides limited flood protection to the site; however, it does not meet FEMA flood protection standards and would be overtopped during a 10- to 50-year tidal flood, depending on wind direction and wave run-up.

The City provided drawings of public utilities within and adjacent to Embarcadero Road. Within Embarcadero Road, there is a water main centered in the western, southbound travel lane as well as a storm drain to the west between the road edge and sidewalk. Along the east side of the road, there is a run of power poles with overhead electrical, cable, and phone lines. The joint pole and overhead alignment is approximately 12 feet from the road edge near the southern end of the project and 20 feet from the road edge near the northern end. Two known pipes and one unconfirmed gas line cross Embarcadero Road toward the proposed berm and horizontal levee footprint with additional information provided in Section 4, *Preliminary Design Elements*.

The storm drain culvert is an 18-inch reinforced concrete pipe that extends from the western storm drain main and daylights approximately 35 feet east of the road along with a second shorter reach of pipe through the existing berm along the eastern boundary of the site. In addition, this storm drain discharges into a shallow swale that may support wetlands habitat.

The second pipeline is the Renzel Marsh connection 18-inch HDPE pipeline that crosses the existing trail in the southern end of the project footprint. The pipeline connects to the intake structure at a tidal channel within the main portion of Harbor Marsh and crosses Embarcadero Road to route Bay water to the Renzel Marsh tidal lagoon. The intake structure is outside of the project footprint; however, the pipe lies under the proposed grading transition to existing grade at the southern end of the proposed project.

The unconfirmed gas line crosses Embarcadero Road from west to east and then sharply turns south along the eastern edge of the road before another sharp turn to the south of the project footprint toward Harbor Marsh. This gas line is not within the project footprint, and it is not clear whether it is present or still active. Lastly, there is an existing hydrant assembly formerly served by chlorinated final effluent from the RWQCP (also referred to as W4 internally) that has been abandoned. The final effluent line is unconfirmed, and the hydrant and vault would be removed as long as such removal would not threaten the stability of the Renzel Marsh intake structure.

## 3.4 Soils and Geotechnical Investigations

The information presented in this report references past geotechnical work in the vicinity of the site and professional judgement for the conditions that are likely at this site (HDR 2020a). Specifically referenced is work conducted by HDR for the SAFER Bay project, which includes a proposed levee that would share the same alignment as the horizontal levee (Appendix B). Future design phases of this project will include a site-specific geotechnical investigation. The investigation includes fieldwork (soil borings and cone penetrometer tests) that will be planned accordingly with respect to environmental requirements. Ridgway's rail restrictions limits project activities within a 750-foot buffer from nesting habitat from February 1 through August 31. Agencies also have a year-round requirement of a 50- to 100-foot buffer around salt marsh areas as potential salt marsh harvest mouse habitat. The potential locations where borings could be drilled are along/northeast of the shoulder of Embarcadero Road and/or in the gravel area near the intersection of Embarcadero Road and the Byxbee Park driveway. These areas appear to be drill rig accessible year round.

The subsurface conditions encountered in the explorations conducted for the SAFER Bay project indicate that areas in the vicinity of the site consist of fill overlying Young Bay Mud which in turn, overlies alluvial deposits. The fill encountered is variable in composition but generally consisted of medium dense clayey sand and relatively soft sandy silt, and extended to depths of about 9–12 feet. Beneath the fill, Young Bay Mud consisting of soft to medium stiff fat clay was encountered to depths of about 21–23 feet. Beneath the Young Bay Mud, alluvial deposits generally consisting of interlayered stiff to very stiff lean clay with varying amounts of sand and silt, and loose to dense clayey sand and sand with clay and gravel, were encountered to the maximum depth explored of about 60 feet.

## 3.5 Endangered Species

Adding a horizontal levee component to the proposed levee improvements for flood control (such as those proposed by the SAFER Bay project) along the Bay Road section of the project footprint would be a valuable addition to the Harbor Marsh that would provide potential escape cover for both the salt marsh harvest mouse (*Reithrodontomys raviventris*) and the Ridgway's rail (*Rallus obsoletus obsoletus*). Direct impacts on the existing tidal marshes would be minimal, with minor cut and fill along the outboard edges of the transition zones. There is a small existing transition zone along the existing berm at the edges of the marsh, but it is only a few feet (generally less than 5 LF) wide.

As described in Appendix A, existing vegetation is a mixture of mostly non-native species, but nonetheless it provides some existing cover. The location of the proposed levee and transition zone, inboard and upland from the existing marsh, would expand the available escape cover for both species. There would be indirect effects of the discharge through seepage on the existing edge of the tidal salt marsh. Brackish marsh dominated by a band of alkali-bulrush *(Bolboschoenus maritimus)* would occur both on the side slope of the horizontal levee and extend into the existing tidal salt marsh, effectively converting that portion of salt marsh to brackish marsh. There would be tradeoffs with that conversion, mostly positive (see below discussion).

ESA has prepared a Ridgway's Rail Resources Memorandum (Appendix H) specifically to review potential effects of the PAHLPP on the endangered Ridgway's rail. This analysis was prompted by early input from the regulatory agencies (BRRIT 2019). This report includes the results of ESA's protocol surveys conducted in January 2020, as well as an analysis of Ridgway's rail surveys conducted by others at Harbor Marsh and Hooks Island from 2008 to 2020 (Appendix H).

ESA takes a conservative approach by assuming that despite minimal changes in modeled salinity (see Section 3.6, *Hydrologic Considerations*), habitat conversion from salt marsh to brackish marsh would occur with the addition of freshwater at the project site. However, it still concludes that brackish marsh vegetation does not necessarily preclude healthy Ridgway's rail populations, and therefore the project is not anticipated to have negative adverse effects on the rails. However, some monitoring elements are recommended to verify these conclusions and to inform project operations-related freshwater inflows into the system if needed. Through monitoring and adaptive management, that the freshwater inputs are anticipated to be managed to limit the extent of brackish marsh conversion within the Harbor Marsh.

The salt marsh harvest mouse is known to inhabit brackish marshes as well as salt marshes in the South San Francisco Bay, and brackish marshes are expected to become increasingly important as saline marshes become more isolated and reduced in size. Generally, salt marsh harvest mouse populations are denser in South Bay salt marshes than in brackish marshes; however, in the harbor, the salt marshes provide little cover during extreme high-tide events. At those times a band of alkali bulrush could be extremely valuable by providing high-tide refugia. As the marsh matures, the bulrush would also create an understory of thatch that would further enhance refugia and provide cover for salt marsh harvest mice during dispersal and foraging. King tides in this location have in the past inundated the entire Harbor Marsh, completely covering all the pickleweed and eliminating most refugia areas, subjecting wildlife to an abrupt interface with the built environment and increased exposure to predators. The horizontal levee would provide for refugia, where now there is none, and some conversion of salt marsh to brackish marsh may also prove beneficial to the salt marsh harvest mouse.

As described in Appendix A, there is a concern that too much discharge could change a broader portion of the Harbor Marsh from salt to brackish marsh, but the measures to monitor and adaptively manage the freshwater inputs seem well suited to prevent such changes beyond the short term. These issues should illustrate to concerned parties the positive long-term benefits of the project to the salt marsh harvest mouse and Ridgway's rail. Further development of take avoidance measures should focus on barrier fencing and hand removal of vegetation in the existing transition zone and in the minor cut and fill marsh areas below mean higher high water (MHHW). These avoidance and minimization measures are typically developed in the California Environmental Quality Act (CEQA) and regulatory permitting stages of a project, and have been included in the BRRIT feedback to date (Appendix D). In addition, an O&M plan will be developed as discussed in Section 4.10, *Operations and Maintenance*.

## 3.6 Hydrologic Considerations

The PAHLPP would be the first project of its kind to have a surface-seepage discharge of polished wastewater to the Bay to support transitional ecotone habitat that would purposefully trigger vegetation and habitat change in adjacent tidal marsh. Observing analogous natural systems around the Bay, including China Camp State Park, Alviso Slough, and Petaluma Marsh that include shallow groundwater seepage at the toe of hills adjacent to tidal marsh, has helped develop an understanding of how the alkali-bulrush marsh forms from adjacent freshwater inputs. A conceptual understanding of tidal marsh hydrology and vegetation interactions along terrestrial edges where significant seasonal groundwater discharges occur also reveals the drivers of habitat transitions. However, the complex interaction of freshwater discharge rates/durations with tidal mixing and soil substrate permeability are difficult to predict and/or model. The flexibility of the water delivery system and attentive monitoring during the establishment phase would help to fine-tune the hydrologic regime.

The effective soil pore water salinity is the key driver of habitat suitability for different marsh communities (salt marsh, brackish marsh, freshwater marsh). Hydrologic processes and soil conditions that contribute to pore water salinity include intermittent wet season freshwater surface flows, persistent dry season shallow groundwater contributions to the tidal marsh, and persistent shallow groundwater contributions to freshwater wetlands. The pore water salinity during active growing season is influenced by springtime fresh groundwater, whose discharge lags behind winter rains. As the year progresses, increased evapotranspiration and the lack of rain typically results in the highest annual salinity during late summer. Of these processes, the persistent dry season freshwater seeps into tidal marsh have the greatest impact on the development of brackish marsh conditions. The water distribution system would be seasonally programmable to mimic natural seasonal variations in flow and to account for annual variations in rainfall if needed.

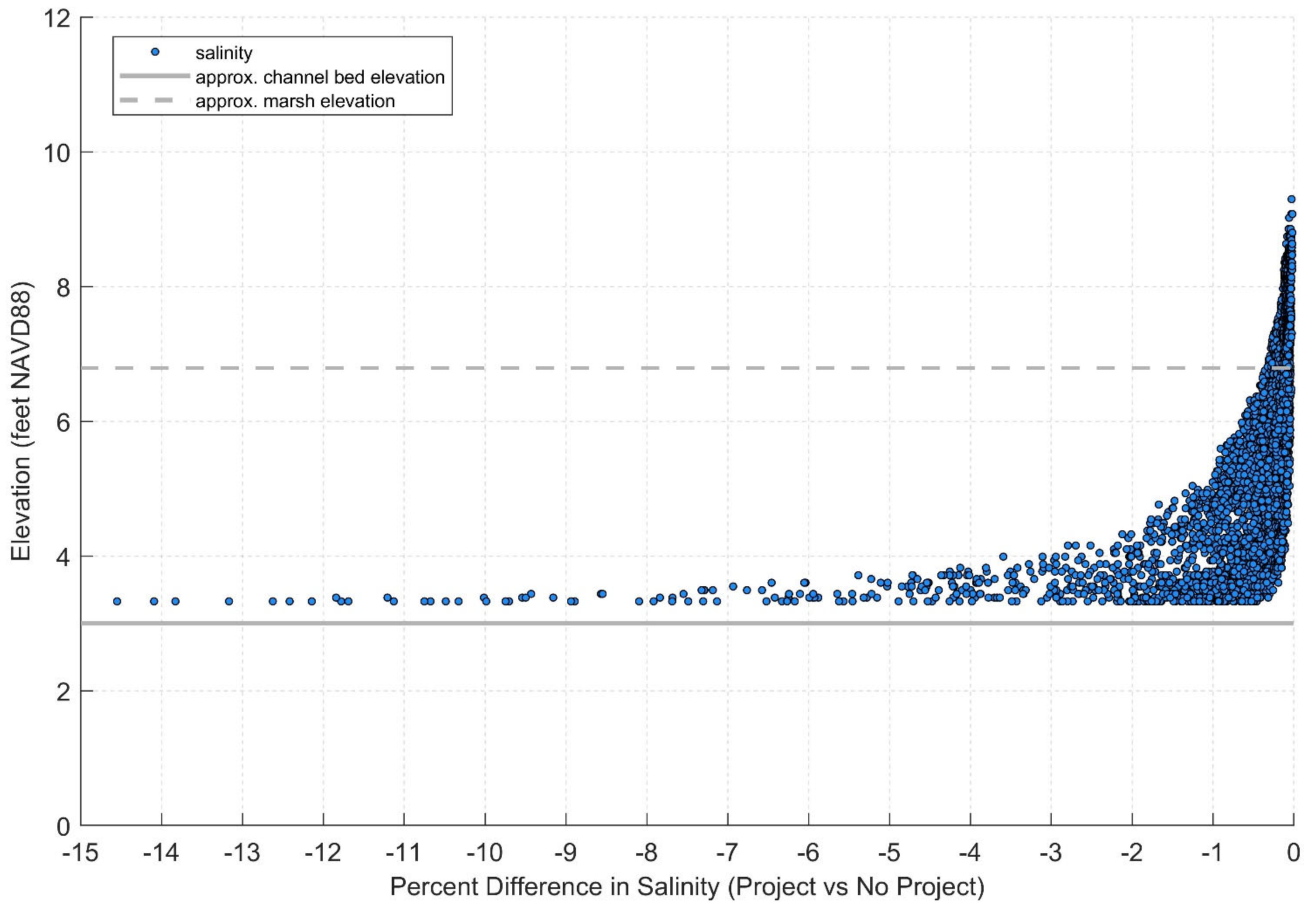
As described above, the project anticipates that much of the 20- to 50-foot band of salt marsh between the horizontal levee and the adjacent tidal channel would convert to brackish conditions. The project also seeks to avoid unintended impacts on salt marsh beyond this band. To assess the potential effect of the project on the adjacent tidal channel and marsh beyond the band at the horizontal levee's toe, a surface water salinity model was developed for the site. The model was developed using a mass-balance approach, considering the seasonal groundwater seepage supply rate into the tidal channel, and also resolving the tidal flows into and out of the channel driven by conditions in the Bay. The model applies tidal boundary conditions interpolated between NOAA tide stations at Coyote Creek (#9414575) and Redwood City (#9414523), and applies seasonal Bay salinity boundary conditions derived from U.S. Geological Survey monitoring (Schraga et al. 2018). The model predicts water levels at the site by relating the inflow and outflow terms at each time step to a stage-storage relationship for the tidal channel and adjacent marshes derived from a LiDAR topographic/bathymetric digital elevation model developed for the region by the U.S. Geological Survey. The model simulates a full year (January to December 2019), and is used to predict the time-varying water level (controlled by the tides), and the time-varying salinity (as a function of combined Bay-sourced tidal exchange and horizontal levee-source seepage).

Modeling results predict only a small change in surface water salinity would occur as a result of the project. If instantaneous mixing of tidal and groundwater contributions is assumed through the modeled volume, the effect of the project is negligible during high tides (MHW and above). This is because at these high water levels, the contribution of groundwater seepage is a very small fraction of the total water volume (both in the channel and above the marsh plain) at the site. During lower tides, when flows are contained within the tidal channel, the model predicts decreases in salinity with the project of up to 5 parts per thousand. The assumption of instantaneous mixing may not be wholly appropriate for looking at ecological interactions because it reduces the local effect of freshwater, which may be higher locally. To test sensitivity to this assumption, conditions with the project (which assume no mixing, i.e., that freshwater accumulates in a separate layer at the surface) were also assessed. For this case, the unmixed surface freshwater layer is predicted to have a maximum thickness of less than one-tenth of 1 inch, again indicating a low likelihood of the project having a significant influence on surface water salinity conditions.

It should be noted that the model is not intended to be sufficient to predict salinity (both surface and groundwater/pore water) and the resulting vegetation changes; rather, it is intended to predict the potential change in salinity attributable to the additional discharge added to the horizontal levee. Thus, although some other factors (e.g., springs or other subsurface flows) may be causing some brackish marsh vegetation in the marsh, the project's addition of an annual maximum of 0.06 cubic feet per second (cfs) distributed along the 400-foot project site is not enough to significantly affect the area outside of the marsh band along the toe of the horizontal levee. A comparison between the water level and percent change in salinity (as shown in **Figure 3**) indicates that salinity decreases attributable to the PAHLPP discharge only exceed 3% when the water level is 1 foot or less in the tidal channel (well below the vegetated marshplain). Refer to the Salinity Modeling Results in Appendix G for additional results figures.

## 3.7 Regulatory Permit Strategy

Based on the proposed project's location in and adjacent to the waters of the San Francisco Bay, as well as the presence of regulated biological and cultural resources within the project vicinity, the project is expected to require a number of local, state, and federal regulatory permits and/or approvals, as well as demonstration of compliance with CEQA. Based on the South Reach site's 30% project definition as documented herein, the project team developed an environmental compliance and permitting strategy to outline this process moving forward. The project team also presented the project at the South Reach site, in concept, to the multi-regulatory-agency Bay Restoration Regulatory Integration Team (BRRIT) in November 2020, and obtained useful feedback and recommendations firsthand (Appendix D). This feedback builds upon that first received by the project team in December 2019, upon presenting the original Central Reach project (adjacent to the Palo Alto Airport, and located on City Airport property) to the BRRIT; feedback from both BRRIT project presentations has been incorporated herein. Furthermore, a prior suggested permitting strategy to advance a pilot project was to select an alternative site, preferably not located on City Airport property and potentially farther from the Palo Alto Airport itself, but still within the Palo Alto Baylands, to resolve potential issues such as site ownership, land use compatibility, and potential restrictions posed by FAA/airport guidelines. This strategy was implemented, resulting in the selection of the South Reach site. A Permitting Strategy memorandum—which includes the list of permits expected to be required, anticipated permitting challenges, and suggested strategies—is provided as a standalone document in Appendix D. Key findings are briefly summarized herein.




Refer to Appendix G Figures G-2 (top panel), G-4 (bottom panel) and G-5.



**Figure 3**
Water Level vs Percent Change in Salinity

As a multi-functional restoration project developed in line with a number of regional goals and planning documents, the project—in concept—has received explicit support from a number of regulatory entities and interest groups around the Bay Area (including support for the concept in the 2015 Baylands Goals Update), and is expected to continue to do so as the need for multi-objective habitat restoration and sea-level-rise adaptation grows. However, even restoration projects tend to face some regulatory and/or environmental compliance challenges. The following key project challenges related to permitting have been identified to date:

- The likely requirement for a USACE Individual Permit (instead of a more streamlined Nationwide Permit), a State Lands Commission Lease or Lease Amendment, requirements for studies and plans such as an Alternatives Analysis and Adaptive Management and Monitoring Plan (AMMP), all of which would require more time and costs associated with complex permitting.
- The possible requirement for costly avoidance and minimization measures (to be implemented before, during, and for many years after construction), costly compensatory mitigation (e.g., the purchase of mitigation credits, or the preservation, enhancement, restoration or creation of habitats, or the conservation of lands) to offset permanent losses or "type conversions" of certain habitats (such as regulated wetlands or sensitive species habitat) as a result of project implementation.
- Developing a public access solution(s) that achieves a balance between the various and sometimes competing goals of a multi-benefit project, and that meets agency requirements
- Project effects on sensitive (e.g., FESA- and/or CESA-listed) species as a result of construction activities, and the potential costs and constraints of including feasible yet effective measures to adequately avoid, minimize, and monitor these effects (e.g., how to successfully avoid sensitive species breeding windows while at the same time accomplishing earthmoving activities during the dry season).
- Potential challenges associated with obtaining an early RWQCP-wide NPDES permit (or permit modification) to include the PAHLPP's regular discharges of treated water from the ecotone slope directly to the waters of the Bay, because the PAHLPP is the first of its kind to propose this form of polishing treatment and discharge; depending on agency comfort levels surrounding the novel aspects of the PAHLPP, costly studies may be required in association with the NPDES permit.
- Potential conflicts between project goals and Federal Aviation Administration (FAA) guidance (as applicable to the nearby Palo Alto Airport and surrounding lands), which may or may not be resolvable and therefore may require changes to the project's design, construction methods, and/or timelines.
- Identifying the appropriate CEQA analysis approach, to adequately address stakeholder concerns and potentially significant effects, and meet the requirements of CEQA responsible agencies; the time and costs associated with preparation of an EIR or Focused EIR, if selected.

The following strategies are suggested to attempt to resolve key issues and/or streamline permitting:

- Actively engage in strategic conversations and coordination with the Palo Alto Airport staff and leadership, to identify potential opportunities and/or constraints, and to make decisions within the context of the broader regional framework and in light of FAA guidance. This may include employing certain strategies raised in FAA Circular AC No 150/5200-33B to reduce or eliminate issues related to wildlife hazards.

- Leverage lessons learned from the Oro Loma Demonstration Project and utilize relevant expertise from the scientific community (including scientists such as Jeremy Lowe for design elements, Peter Baye for ecological needs, and David Sedlak for water treatment) to increase agency comfort levels with this novel project type.

- Conduct robust coordination with regulatory and resource agencies throughout project refinement, to develop appropriate and feasible avoidance and minimization measures for inclusion in the project description, to seek support from a CEQA-responsible agency (such as the San Francisco Bay Regional Water Quality Control Board or the California Department of Fish and Wildlife) for an appropriate CEQA pathway, to best-fit the project to existing streamlined permitting mechanisms to the extent possible, and to take advantage of newly developed or currently developing regulatory and policy changes. *Note: the City of Palo Alto has incorporated feedback from the 2019 and 2020 BRRIT into proejct designs and strategies to date.*

- Engage with the City of Palo Alto's Planning group (as the CEQA lead agency), to identify potentially appropriate CEQA approaches, based on known potentially significant issues (such as potential for construction-related "take" of sensitive species or their habitats) and in light of agency and stakeholder feedback to date.

- Conduct robust outreach to stakeholders to attempt to adequately resolve their concerns and address key issues. This includes the issue of public access. *Note: the City of Palo Alto presented the new South Reach location during a local Sea Level Rise Adaptation Webinar on September 9, 2020; additional stakeholder outreach is planned in the next project phase.*

- Continue to rally support for the project from agencies, the scientific community, and/or local government representatives, in anticipation of leveraging that support during likely permitting "hang-ups" and in pursuit of project funding for future phase(s) including for the long-term. *The City of Palo Alto has met with USACE, is coordinating with Valley Water and the Coastal Conservancy, and has engaged with various scientific professionals to further project support and the scientific concepts involved.*

A more detailed exploration of the above issues and strategies, as well as the list of permits expected to be required, is contained within Permitting Strategy memorandum (Appendix D). Permitting and CEQA compliance approaches should be given considerable attention during the next phase of project development, as these processes have the potential to take considerable time and require considerable funding, and lack of public, municipal, or agency support could render the project infeasible.

# 4. Preliminary Design Elements

For the City of Palo Alto, the primary project objective is to enhance ecological habitat within and adjacent to Harbor Marsh. The horizontal levee itself would have a variety of freshwater wetland, wet meadow, and riparian/upland scrub ecotypes. As the freshwater inputs enter the marsh plain, a brackish water ecotone is expected to form within the salt marsh immediately adjacent to the horizontal levee. The purpose of the project design is to foster the ecological complexity envisioned by providing a simple yet robust hydraulic control system and other monitoring and adaptive management practices to respond to project needs.

## 4.1 Grading Plan

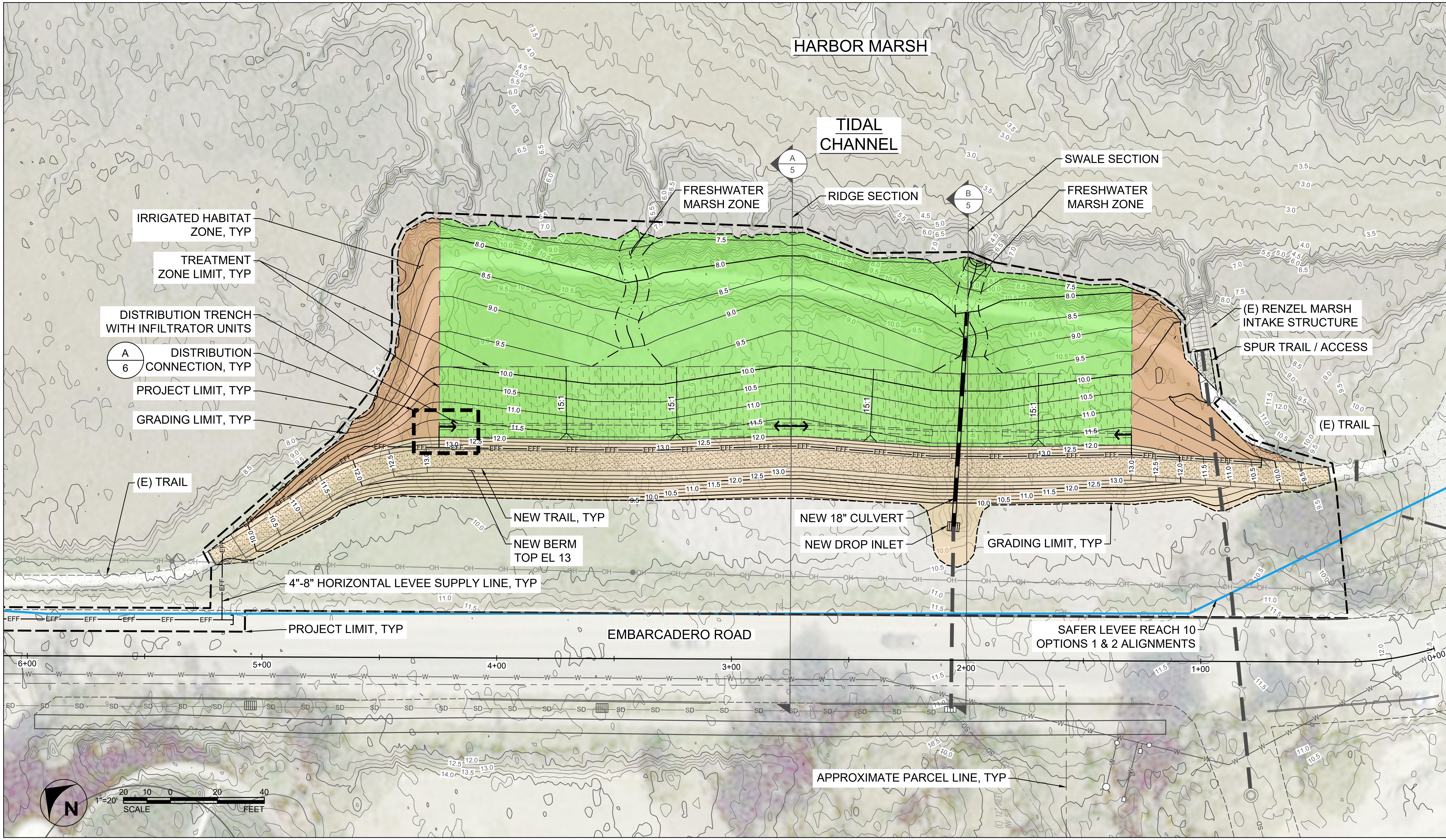
The horizontal levee's grading plan reflects a mildly undulating hill slope (see **Figure 4**). Essentially, broad watersheds would be created with the grading that would direct a higher portion of the water to the swales with the ridges that would generally be modestly drier environments. This varied hydrology is expected to contribute to the zonation of ecotypes.

The horizontal levee would be divided into three primary areas: (1) an engineered berm to support the horizontal levee slope, (2) a treatment zone designed to support polishing of treated wastewater via subsurface seepage through a drainage layer while supporting native transitional habitats, and (3) a downslope habitat zone designed to support a variety of ecotypes where polished wastewater would seep toward the adjacent Harbor Marsh as shallow surface/subsurface flow. The horizontal levee is designed to be a freshwater transition zone to the tidal marsh.

The horizontal levee berm is intended to support the horizontal levee while replacing the flood protection and trail function of the berm along the eastern edge of the project site. This proposed berm would extend up to EL 13 feet (NAVD 88) and exceed the elevation of the existing trail berm by 1.5 to 2.5 feet. This berm would be designed and constructed with requirements similar to a flood control levee (materials specifications, subgrade preparation, moisture conditioning and compaction) with the intent that this berm can be integrated into a future SAFER Bay/Shoreline Study levee. As currently proposed, this berm is offset from Embarcadero road to provide space for the larger future flood control levee. Depending on the ultimate approach, the future levee could either tie directly into this berm—raising it by building out towards Embarcadero Road while raising the grades to the ultimate design grade, or remove a portion of the berm to construct a contiguous levee core using a portion of the existing berm as a stability berm for the future levee. At this stage, it is assumed that the existing trail would be relocated onto the new horizontal levee berm and that the trail would be raised to the top of the new flood control levee following construction of the future levee improvement project.

The treatment zone has a 15:1 (H:V) longitudinal slope that drops 2 vertical feet, from elevations 11.5 to 12 feet down to elevations 9.5 to 10 feet, respectively. The treatment zone represents an evolution from the design incorporated at Oro Loma Sanitary District including a steeper treatment zone (15:1 vs. 30:1 at Oro Loma) and deeper subsurface treatment layer (1 foot thick versus 0.5 foot thick at Oro Loma) to increase hydraulic capacity of the treatment zone. The goal is to allow for flows to remain in the subsurface within the treatment zone which provide significantly greater treatment efficiencies, while narrowing the width of the treatment area to reduce project costs and construction complexity. In addition, the elevation of the treatment zone is intended to keep this zone above the typical high tides to limit saline influences in the near term following implementation.

Below the treatment zone, the habitat zone would continue the varying topography characterized by ridges and swales down to meet the adjacent tidal marsh plain. The ridges would generally be flatter at higher elevations (approximately 20:1 to 30:1) and gradually steepening to about 10:1 at

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NOTES

1. AERIAL ORTHOIMAGERY FROM NORTHROP GRUMMAN (2015), AS DOWNLOADED FROM USGS EARTH EXPLORER DATABASE. IMAGERY WAS COLLECTED BY NORTHROP GRUMMAN BETWEEN FEBRUARY 20 TO FEBRUARY 24, 2015.
2. ALL ELEVATIONS ARE ON NORTH AMERICAN VERTICAL DATUM 1988 (NAVD88).

ESA

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**FIGURE 4**

SOUTH REACH PLAN VIEW

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the interface with the Harbor Marsh. The swales would direct flow into a swale that would capture and convey seepage flows to the adjacent marsh. These swales would generally be steeper (15:1 to 20:1) at higher elevations just below the treatment zone gradually flattening to approximately 30:1 as they approach the adjacent tidal marsh.

To accommodate existing utilities, the project would connect to the upstream existing storm drain pipe at the daylight end near the road, remove the existing culvert that crosses the existing trail to the channel, and extend the proposed culvert to outfall into the tidal channel. The existing swale would be regraded and filled as part of the horizontal levee grading, and the outfall would be moved farther downstream to discharge into a new swale within the horizontal levee. Special design consideration would need to be made for replacing this culvert during this project potentially including cambering the pipe to accommodate future levee settlement.

### 4.1.1 Sea-Level-Rise Considerations

The tidal datums presented above were used to set key elevations for the proposed South Reach horizontal levee. One of the horizontal levee’s primary functions is to provide a broad, flat slope that would be converted to salt marsh as sea level rises. The habitat zone rises from elevation 7.5+/- to 12 feet at an average slope of 6.2% to 4.8%, including the treatment zone, which would support salt marsh habitat with up to 4 to 4.5 feet of sea level rise.

The adjacent and integrated future flood control levee would also be designed to account for sea level rise. The SAFER Bay feasibility study included planning for up to 3 feet of sea level rise consistent with their project guidelines as well as guidance from the Ocean Protection Council (OPC) and the U.S. Army Corps of Engineers (USACE) (SFCJPA 2019). California state guidance (OPC 2018) recommends 3 feet of sea level rise for medium-high risk aversion decision making by 2070. In addition, USACE projects 3 feet of sea level rise to occur in a similar time period, between 2075 to 2095 (USACE 2011). Although long-term polishing treatment is not a high priority of this project, the treatment layer is set approximately two to two-and-a-half feet above the marshplain and will function for up to that amount of sea level rise to address initial stakeholder feedback. Situating the outlet elevation of the treatment zone 2 to 2.5 feet above MHHW ensures that the full treatment zone would be above tidal influence for several decades based on current estimates of sea level rise. In addition, to drive flow through the treatment layer, freshwater input would have a driving head 1–2 feet above the outlet elevation, helping to drive freshwater flows towards the habitat slope and adjacent tidal marsh. As sea level approaches the treatment zone, management approaches can be considered such as timing increased discharge to the horizontal levee to maintain a positive freshwater hydraulic gradient during high tides, and/or relying on drainage during lower tides. When high tides reach the lower portion of the treatment zone, the freshwater layer above the saline layer would still function as designed, and ongoing freshwater inputs would displace saline water during lower tides. The treatment effectiveness of the treatment layer under brackish or saline conditions is currently unknown; however, research is planned at Oro Loma Sanitary District to evaluate such conditions.

## 4.2 Treatment Area

The treatment area would extend across approximately 295 LF of the total 450-LF project reach. The 295-LF treatment area would support the full functions of the horizontal levee including polishing of treated wastewater and seepage flows to support native transitional ecotone plantings. As the levee transitions to meet existing grades on either end of the project, the existing upland corridor is too narrow to support the full horizontal levee functions and dimensions (including a treatment zone). In these areas, the remaining 155 LF of the project reach would support an ecotone slope with native plantings and more limited surface irrigation to support a transitional ecotone vegetation assemblage.

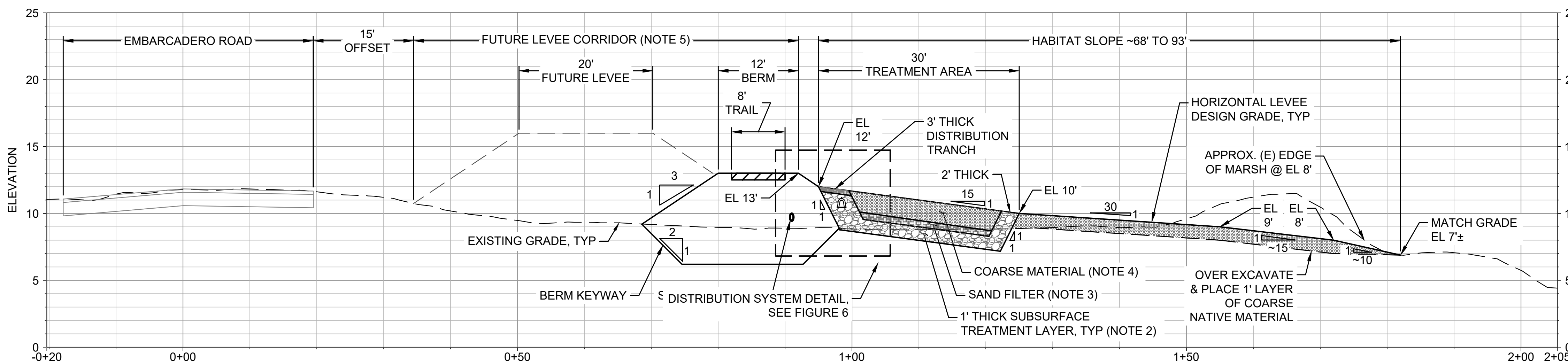
The subsurface treatment zone, shown in **Figure 5**, would be supplied by a distribution system that includes a buried hollow chamber specifically designed for distributing wastewater to a subsurface treatment zone similar to those used in leach fields (see **Figure 6**). The treatment zone slope length in the direction of flow is approximately 30 feet long and the subsurface gravel layer is a 1-foot-thick layer of uniformly graded, high permeability drain rock mixed with composted wood chips with a thicker layer at the inlet and outlet. The gravel treatment layer daylights on the slope between elevation 9.5 and 10 feet, delivering shallow surface/subsurface seepage flow to the habitat slope.

The grading and layout of the treatment zone including the longitudinal slope and a subtle cross slope between ridges and swales will be refined during future design development by a developing surface water–groundwater hydraulic model. Key model inputs, including saturated hydraulic conductivity, will be informed by monitoring results from the Oro Loma Horizontal Levee Demonstration Project. The goal of the modeling will be to determine an appropriate cross slope for treatment zone to provide a relatively even distribution of flows across the horizontal levee.

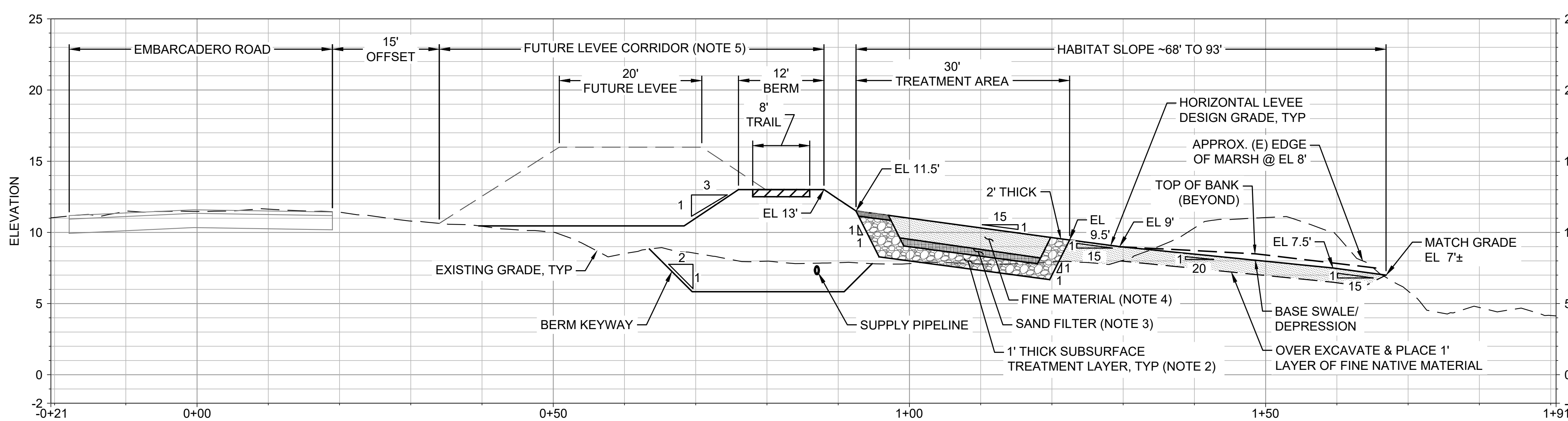
As described in Section 1.3, *Project Background,* the RWQCP is already permitted for a shallow water discharge to the Bay, and the City's primary goal is to support a heterogeneous mosaic of native transitional plant communities. Thus, the horizontal levee is not expected to be required to meet any higher levels of treatment than is already permitted; but it would provide an additional level of polishing treatment than currently exists. Future design phases will include seeking guidance from the San Francisco Bay Regional Water Quality Control Board on criteria for the level of treatment required and sampling/analyses requirements to monitor discharge from the horizontal levee to the Bay.

The treatment zone would include a layered approach to support a high-permeability treatment layer and a finer surface soil layer to support native plantings. The treatment zone is anticipated to include (from the base to surface):

1. *Subgrade*—Compacted Bay mud subgrade to provide a relatively impervious base.
2. *Treatment layer*—Approximately 1-foot-thick layer consisting of a blend of drain rock and composted wood chips to provide an initial source of labile carbon to help support biological treatment.
3. *Separation layer*—Separation fabric to limit migration of fines into the drainage layer.




A TYPICAL SECTION - RIDGES/HIGH & WIDE
PROFILE
SCALE: 1" = 10' H
1" = 5' V




B TYPICAL SECTION - SWALES & DEPRESSIONS
PROFILE
SCALE: 1" = 10' H
1" = 5' V

## NOTES

1. SEGREGATE FINE AND COARSE MATERIAL ENCOUNTERED DURING EXCAVATION OF SITE TO SUBGRADE. DURING FILL OPERATIONS, PLACE COARSE MATERIAL ON THE RIDGES AND FINE MATERIALS IN THE SWALES.
2. SUBSURFACE TREATMENT LAYER COMPRISED OF A BLEND OF DRAIN ROCK AND COMPOSTED WOOD CHIPS.
3. SAND FILTER COMPRISED OF A BLEND OF SAND AND WOOD CHIPS.
4. COARSE AND FINE MATERIAL INCLUDES A BLEND OF NATIVE MATERIAL WITH COMPOSTED WOOD FINES.
5. FUTURE FLOOD CONTROL LEVEE MAY OR MAY NOT BE CONSTRUCTED, BUT THIS LAYOUT PLANS FOR ITS POTENTIAL SPACE SHOULD IT BE CONSTRUCTED.
6. ALL ELEVATIONS ARE ON NORTH AMERICAN VERTICAL DATUM 1988 (NAVD88).

SCALE 10 5 0 10 20 FEET



PALO ALTO HORIZONTAL LEVEE D181306.01

**FIGURE 5**
SOUTH REACH CROSS SECTIONS

ESA

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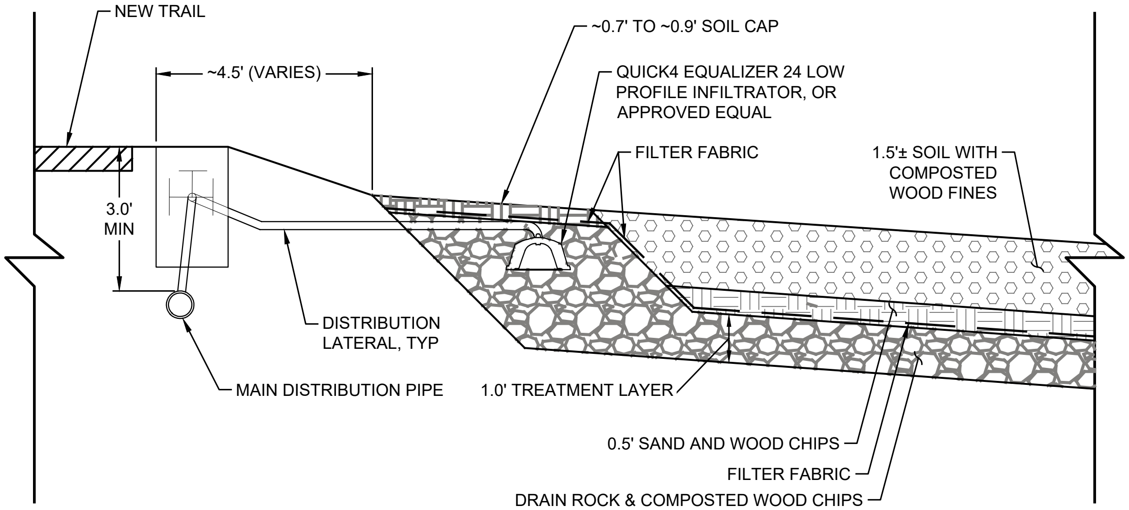


A / - DISTRIBUTION CONNECTION AND TREATMENT ZONE MATERIAL

SECTION SCALE: 1" = 4'




**FIGURE 6**
DISTRIBUTION DETAIL

*Sand filter layer*—Approximately 0.5-foot-thick layer of imported sand blended with composted wood chips.

*Soil layer*—Approximately 1.5 feet of surface soils excavated from on-site and blended with composted wood fines to provide labile carbon to support biologic treatment.

Over time as the native plant community establishes, the root mass from the plants is anticipated to gradually replace the composted wood chips and fines as a source of carbon to support the biologic sub-surface treatment processes.

## 4.3 Vegetation Considerations/Plant List

Dominant vegetation of the tidal-terrestrial ecotone varies from grassland or wet meadow to riparian scrub where seasonal or perennial wetland hydrology occurs along natural seeps. A comprehensive species list and propagation and transplanting specifications including patterns, rates, timing, and methods will be developed in an integrated revegetation and weed management plan during the final design phase. The following are initial considerations and preliminary plant list for the PAHLPP.

The most widespread and dominant elements of seasonally wet tidal marsh ecotone grasslands include riparian alkali grassland species such as creeping wildryes (*Elymus triticoides, E. x gouldii*), saltgrass (*Distichlis spicata*), Baltic rush (*Juncus arcticus*), and rhizomatous, creeping sedges with tolerance to alkali or oligohaline salinity (*Carex barbarae, C. praegracilis*).

Additional species well adapted to alkali soils include many creeping forbs. Many Aster family forbs like western ragweed (*Ambrosia psilostachya*), western goldenrod (*Euthamia occidentalis*), marsh asters (*Symphyotrichum chilense, S. lentum*), as well as less common species like the robust California sunflower (*Helianthus californicus*). Most of the native terrestrial ecotone forbs that depend on summer desiccation of alkali soil (arid seasonal wetlands) to compete with dominant grass-like plants (*Iva, Heliotropium, Cressa, Frankenia*) would be excluded by competition from vegetation supported by perennial freshwater seepage, and would be replaced by wet meadow and freshwater marsh species such as common spikerush (*Eleocharis macrostachya*), threesquare bulrush (*Schoenoplectus americanus*), and smartweeds (*Persicaria punctata, Persicaria* spp.).

Strongly waterlogged swales with perennial seepage in tidal marsh ecotones support freshwater/oligohaline marsh plants such as Typha spp. (*T. latifolia, T. domingensis*), and tules (*Schoenoplectus acutus*, less often *S. californicus*), sometimes with a ground layer of sedges, club-rushes (*Isolepis cernua*), or saltgrass from adjacent brackish marsh zones. The composition of the wetland grassland ecotone varies with the degree of summer soil moisture (physiological desiccation stress or waterlogging stress). These assemblages are generally formed under conditions of low to moderate nutrient availability. Elevated nutrient availability from wastewater that is not thoroughly denitrified is likely to reduce diversity to a few dominant species with high relative growth rates and large size, especially in strongly waterlogged soils (conducive to dominance by large cattails and tules). Thus, the intended high species diversity of the vegetation design of the transitional slope relies on subsurface flows with high efficiency of denitrification, as demonstrated at the Oro Loma Horizontal Levee Demonstration Project. At the Oro Loma site, bird surveys were conducted in 2017 to identify species attracted to created habitats (Appendix F).

Riparian scrub vegetation integrating with tidal marsh ecotones include widespread riparian species, including California rose (*Rosa californica*) and black elder (*Sambucus nigra*). Willows (especially *Salix lasiolepis*) are important habitat-forming riparian scrub species that locally dominate freshwater seeps, and spread clonally in substrates with buried or near-surface saturated coarse sediments. Due to the inherently large size and spread of willows, they cannot be interspersed with other scrub or wet meadow or marsh vegetation, and must be segregated (as in natural conditions) as discrete groves.

### 4.3.1 Active and Passive Revegetation

Both active and passive revegetation strategies are used on restoration sites for different purposes. Passive revegetation refers to the natural colonization of disturbed ground by seeds distributed by wind, water, and animals. Active revegetation refers to the deliberate spreading of seed and installation of container material and cuttings.

Typically, tidal wetland restoration projects working at or below the MHHW elevation rely primarily on passive revegetation because of the relative difficulty of installing plugs of salt marsh plants, the great effectiveness of natural distribution of wetland species by tidal influx, and the lack of weed species that can take hold in the saline environment. Above MHHW, active revegetation is encouraged because the lack of tidal influence limits the ability of natural recruitment and the substrate is typically easier to maneuver within for planting.

Active revegetation is very common in freshwater marsh and upland restoration projects because weed establishment is a serious concern and is difficult to manage and the techniques for planting and establishment are well understood. Fast growing planted grasses and forbs colonize the landscape, minimizing the opportunity for weeds to establish while container plants fill in the site. Installing an assemblage of plants allows natural colonization patterns to emerge where certain species are better adapted to variations in site conditions.

Important elements to help planning for active revegetation include (1) developing the final plant list and quantities with sufficient time to allow nursery propagation, (2) securing a location to establish a nursery near the site that has the space, water, and soil available to propagate plants for transplant, and (3) propagating extra plants to account for field mortality and replanting.

One particular potential project partner, Save the Bay, operates a nursery along the Duck Pond north of Embarcadero Road. Save the Bay implemented the revegetation efforts for the Oro Loma horizontal levee and they lead similar efforts for restoration projects around San Francisco Bay. Save the Bay could become an important project partner to coordinate revegetation efforts for the PAHLPP.

## 4.4 Hydrologic Design Criteria

The hydrologic design criteria are focused on meeting the project objectives which include creating and enhancing freshwater marsh, wet meadow, riparian scrub, and brackish marsh habitats. Maintaining a high polishing treatment efficiency is an important project goal to help support the primary habitat objectives by limiting nutrient input to maintain a high diversity of native plant species. Maximizing wastewater throughput is explicitly not a project goal.

Because the creation of brackish alkali-bulrush wetland requires a delicate hydrologic and salinity balance, the project proposes to take a cautious approach regarding hydraulic application rates to the horizontal levee.

Relatively low flow rates would sustain the wetland plants in the horizontal levee largely by capillary action wicking water up from the treatment zone, which would act as a water reservoir. As long as the flow rate exceeds the evapotranspiration and groundwater seepage losses, treated wastewater would continue to daylight at the bottom of the treatment zone. This bare minimum flow rate, for the levee length/area considered in this report, is on the order of 800 to 3,900 gallons per day (gpd) during the winter and summer, respectively, to meet the average monthly evapotranspiration rates. Presence of groundwater and retained moisture in the substrate could allow for lower flow rates to the horizontal levee.

To achieve the desired ecological function, the flow rate discharged to the horizontal levee should attempt to mimic the annual hydrologic fluctuations in analogous systems around the Bay. In these systems, pulses of surface water are discharged in the winter and a long-tail of shallow groundwater is discharged in the spring and summer, tapering off in the late summer and fall. Freshwater seeps where hillslopes meet tidal marshes at the fringe of the Bay are fed by runoff from the surrounding hillslopes, and thus require far more than incidental rainfall to support the hydrology found in freshwater seeps. The target discharge rates will continue to be refined in future design phases, but order-of-magnitude values for the dry/wet season are 7,400–59,600 gpd. The maximum flow rate that the horizontal levee can convey through the subsurface treatment zone, for the scenario presented in this preliminary design, is approximately 73,750 gpd assuming that the system matches the hydraulic conductivity measured at Oro Loma. A flow regime management plan will be developed for the startup phase and would be adaptively managed during actual operations. Flow rates are anticipated to gradually increase during the rainy season, reaching a maximum in the winter and gradually taper off beginning in the late spring/early summer through late summer/fall. In addition, during the rainy season, alternating "wet" days with three to four "dry" days between each wet day are anticipated to better mimic surface runoff that flows from surrounding hillslopes into tidal marshes. The "dry" days would maintain the shallow seepage flows, while "wet" would increase flow rates to allow for saturation of the sub-surface layer and increased surface seepage flows to the lower habitat zone. Depending on the month, "wet" days would have up to three to four times the flow rates delivered on the "dry" days.

The supply pipe to the horizontal levee would be sized to deliver the maximum anticipated delivery rate for the full horizontal levee buildout scenario along Harbor Marsh. This design flow rate and pipe sizing would be developed further during a future design phase. However, for planning purposes, the full buildout would have a maximum daily flow rate of up to 226,000 gpd. The actual flow rates delivered to the horizontal levee (both seasonally and annually) would be adjusted to support a narrow band of brackish marsh habitat at the toe of the horizontal levee while limiting conversion of the adjacent saltmarsh within the larger Harbor Marsh to brackish marsh. Thus, flow rates would be adaptively managed through monitoring of the habitat including potential conversion of salt marsh to brackish marsh.

# 4.5 Hydraulics

The project's hydraulic components include connecting to the RWQCP's treated effluent line, supplying the treated water to the horizontal levee, and the discharging the flow through the treatment zone. One of the City's priorities is for the system to be as simple as possible, with few moving parts or electronics that are overly complicated or that require a high level of maintenance.

## 4.5.1 Connection to the Regional Water Quality Control Plant

After reviewing the options with the City, the preferred approach is to connect directly to the 12-inch pipe that supplies treated effluent to Renzel Marsh, which would eliminate the need for a separate pump for the horizontal levee. The connection would be located where the pipe exits the effluent junction box on the north side of the chlorine contact tank within the RWQCP's property (HDR 2020b; Appendix C).

This existing 12-inch pipe conveys a constant flow of approximately 1 mgd to Renzel Marsh (with future pump upgrades planned with capacity to pump 3 mgd), with an estimated pressure of 25 psi at the point of connection. A 4- to 8-inch pipe would be teed off and connected with a series of appurtenances including an isolation valve, check valve, flow meter, and a flow control valve. These facilities would be located above ground at the effluent junction box.

## 4.5.2 Flow Control

The water supply system would operate in an on/off mode at a set flow rate, which would be adjustable. Based on the flow requirement for a given day, the system's operating duration would change to provide the total daily flow demand.

The flow durations for each day would be programmable. The level of control input would be based on initial field monitoring by an ecologist, but ultimately the system would automatically operate based on daily flow demands without daily user input. It is anticipated that an ecologist would monitor (and gradually increase) the shallow surface discharge from the horizontal levee slope to the existing tidal marsh over the first three to five years of operation to fine tune the discharge flow rate to the horizontal levee. Monitoring is anticipated on a monthly basis, and would directly feed into monthly adjustments (if needed) of treated water supplied to the horizontal levee. The purpose of the monitoring is to understand the relationship between flow rate discharged to the horizontal levee, evapotranspiration and other losses, and subsequent patterns of shallow overland flow downslope of the treatment layer throughout the year. The ecologist would be looking to ensure that the freshwater wetland plants receive adequate water supply to thrive and to monitor the emergence of alkali bulrush at the ecotone transition where the horizontal levee slope meets existing salt marsh. The seasonal water supply cycle would be programmed into the programmable logic controller (PLC), and adjusted based on the results of the monthly and annual monitoring. Ongoing monitoring of the emergence of alkali bulrush (occurring approximately quarterly) would inform adjustments to the PLC over time. As relationships between water inputs, precipitation, and evapotranspiration become better understood over time, the PLC would be adjusted to better mimic natural hydrologic cycles while discharging flows that do not cause a potentially adverse conversion of large areas of salt marsh.

To control the rate of flow to the horizontal levee, the flow meter and flow control valve inputs and outputs would terminate to a remote input/output panel (RIO panel), which would be provided near the effluent junction box at the RWQCP. The RIO panel would communicate with the hypochlorite PLC using ethernet protocol via a CAT 6 connection. An ethernet communication card would be required to connect to the new RIO. Power to the RIO panel, flow control valve, and flow meter would be obtained from a panel board located at the ultraviolet disinfection system motor control center.

### 4.5.3 Inlet Distribution Structure

After the force main to the horizontal levee travels off the RWQCP site, the main would be routed along the horizontal levee berm adjacent to the treatment zone to eliminate the need for (1) a pipe penetration through the horizontal levee berm, and (2) special construction considerations for settlement of the berm. Depending on the construction approach for the SAFER Bay/Shoreline Study flood protection levee, this distribution line may need to be reconstructed when this larger levee is constructed while the portion of the distribution line that crosses the larger SAFER Bay/Shoreline Study levee would need to be replaced.

Figure 4 shows four flow control zones across the approximately 295-foot-long treatment zone. The purpose of the separate flow control zones is to distribute and balance the flow across the full width of the treatment zone. The horizontal levee distribution line would tee off the force main with the force main headed south along Embarcadero Road to route treated effluent to the South Reach site and with the northern tee capped for future expansion. The distribution line would be polyvinyl chloride (PVC) piping (approximately 4-inch). The flows would be manually balanced via analog flow meters and ball valves or mud valves into each flow control zone separately from the programmable valve at the treatment plant. The system would operate at a set flow rate with a valve that opens & closes discussed above in Section 4.5.2 Flow Control. Once the system is balanced at a set flow rate, only periodic monitoring and manual rebalancing should be required. As operation is developed further, levee conditions should be monitored on a monthly to quarterly basis to ensure that the flow balance is maintained over the longer term.

Treated wastewater would be discharged into a trench that contains a hollow subsurface distribution chamber that runs the length of the flow control zone. The chamber would be surrounded by gravel and capped with soil and seeded.

### 4.5.4 Flow Through Horizontal Levee Slope

The hydraulic conductivity of the subsurface gravel layer limits the maximum flow rate through the treatment layer. Experience at the Oro Loma Horizontal Levee Demonstration Project has shown that high treatment efficiencies occur even when the treatment layer is flowing at a rate that maintains flows in the subsurface (i.e., preventing overland flow that short circuits the subsurface treatment zone). In the case of the PAHLPP, the project objective is not to maximize the flow rate through the treatment system, but rather improve ecological function of the marsh which includes limiting the potential conversion of salt marsh to brackish alkali-bulrush habitat below the treatment zone.

As such, the treatment zone is designed with a 1-foot-thick gravel subsurface treatment layer sat at a 15:1 slope. This design thickness doubles the capacity provided at Oro Loma, and the design slope further doubles the potential maximum flow capacity resulting in treatment approach with up to four times the capacity that was implemented at Oro Loma. The intent of expanding the capacity is to allow for the maximum expected “wet” day flow rates to be maintained in the subsurface, which in turn allows for higher treatment efficiencies of nitrogen and contaminants of emerging concern.

## 4.6 Soils

Soil characteristics have an important role in soil moisture levels and the types of plants that would colonize different areas. Coarser soils drain better and retain less moisture than fine-grained soils. The project design incorporates coarser soil material on the ridges and finer soil material placed in the swales. The project would rely on native soil encountered during excavation to be segregated for on-site placement and screening or import of large volumes of specific soil materials for the freshwater transition zone would not be required.

During the geotechnical investigation, soils data would be collected via soil borings and cone penetrometer tests. This information would be utilized to ascertain the soil characteristics within the project footprint including soil type and organic content, by location and depth. Soils would be classified into two to three broad categories and integrated into a soils management approach that would place soils in specific topographic forms such as the ridges, swales, and transition areas.

If soils at the project site are similar to those encountered in the geotechnical investigations previously performed in the project vicinity, fill soils ranging from clayey sand to sandy silt excavated from the site can be utilized to construct the horizontal levee slope. For the adjacent horizontal levee berm, it appears that the existing fills on-site could be acceptable for construction of the berm. However, imported material that meets guidance for levee construction is anticipated to be required for berm construction, either to augment on-site soils or to fully construct the berm to levee standards.

## 4.7 Geotechnical Criteria

The feasibility-level geotechnical design for the SAFER Bay project found that the future flood control levee would cause settlement over time, primarily because of the consolidation of the underlying Young Bay Mud. At the feasibility level, the SAFER Bay project identified a target crest elevation of 16 feet (NAVD 88). However, the SAFER Bay project did not perform a detailed wind-wave analysis and assumed a relatively steep 3:1 outboard slope that would not effectively dissipate wind waves. By contrast, the proposed South Reach project would incorporate very flat 15:1 to 30:1 slopes extending above the current 100-year water level which would significantly reduce wave run-up and could result in a target design crest up to 1 foot lower than what would be required with a steeper Bayfront face. To achieve the target crest elevation of

16 feet, the feasibility study also indicated that the flood control levee should be overbuilt by up to 1.5 feet, raising the crest up to elevation 17.5 feet. However, it is not clear whether that level of overbuild would be required at the South Reach location, because this location already has several feet of fill overlying (and consolidating) the underlying young bay mud as compared to the nearby reach that was analyzed in the feasibility study where the levee would be constructed in an area of the existing marsh that is not surcharged by fill.

For the South Reach project, the City is currently proposing to construct a low berm with a 12-foot-wide top width at EL 13 feet (NAVD 88) to support a new trail and the horizontal levee treatment zone. This low berm would replace the flood protection function of the existing trail berm along the Harbor Marsh. To support the adjacent treatment areas, the berm construction (e.g., materials, subgrade preparation, compaction) should be per geotechnical recommendations developed for levee fill following USACE guidance on stability and seepage. Construction of the berm to meet geotechnical recommendations for levee fill should allow the berm to be readily incorporated into the future SAFER Bay/Shoreline Study flood protection levee.

This new berm would be offset from Embarcadero Road to provide a corridor for construction of the future flood control levee. The offset includes a 15-foot-wide corridor from Embarcadero Road to limit impacts on the existing road and associated subsurface utilities plus an approximate 56-foot-wide corridor for the future flood control levee along the western edge of the horizontal levee (the project berm is within this reserved corridor). The 15-foot offset from the road is based on the assumption that the future flood control levee would be constructed adjacent to the road rather than under it per the Feasibility study. The corridor for the future levee includes sufficient space to build out a flood control levee to at least EL 16 feet with a 20-foot top width, assuming that the horizontal levee would significantly reduce wind-wave run-up. In advanced design levels, the project may evolve such that the berm should be constructed as a core for the future levee (fully complying with USACE specifications with the intent to remain). The corridor allows the new berm to be incorporated into the new flood control levee as a stability berm that could provide a vegetation free zone between the horizontal levee and new flood control levee core.

The reserved corridor also allows for the buildout condition of the future flood control levee at EL 16 feet. However, depending on the results of the wind-wave analysis and geotechnical explorations and analyses, the levee crest may need to be incrementally higher than EL 16 feet to accommodate a combination of overburden for settlement and/or additional freeboard. Surcharging (stockpiling material on the levee footprint ahead of construction to achieve settlement before construction of the levee) could be considered to limit the need for overburden which could be a preferred option given the potential for differential settlement and varying subgrade strength that could be created by the project's interim berm. This is discussed in more detail in Section 4.9, *Integration with Flood Control Levee Improvements*.

Penetrations of the levee by pipes are discouraged because they can lead to preferential flow paths for water through the levee, and ultimately, levee failure. Special design considerations would need to be made for the extension of the existing storm drain culvert through the horizontal levee and berm to its new outfall location. The storm drain extension pipe may require cambering the pipe (to accommodate future levee settlement), as well as special bedding and backfill requirements to meet USACE guidance for penetrations through levees. The new supply pipeline to the horizontal levee would be routed in the proposed berm along the horizontal levee. This line would need to be routed up and over the future flood control levee when that project is implemented, although it would still be buried (or located in a shallow, traffic-rated vault to facilitate crossing of the levee.

### 4.7.1 Levee/Berm Fill Material

The proposed berm along the horizontal levee should be constructed of low to medium plasticity cohesive soil that exhibits low shrink and swell potential, and provides resistance to external and internal erosion. On-site fill materials include clayey sand and sandy silts which may not be suitable for use in the future flood control levee. Specific levee fill requirements will be developed during the design development phase of the PAHLPP, and the intent is that the horizontal levee berm can be easily integrated into the SAFER Bay/Shoreline Study levee when that project is constructed in the future. It is anticipated that imported fill would be required to balance earthwork quantities associated with the project, and this imported material can be utilized for construction of the berm either blended with on-site materials or exclusively if needed to meet the requirements for levee fill.

### 4.7.2 Construction Sequencing and Piping

The anticipated long-term levee settlement (up to 1.5 feet) may occur following construction of the SAFER Bay/Shoreline Study levee (assumed to be approximately 10 feet above existing grade), whether the levee is constructed in one or two stages. For the South Reach project, the City is proposing to construct a berm (approximately 4 feet above existing grade), which is likely to result in up to 0.5 feet of settlement. The majority of the settlement is expected to occur within the first year after fill placement. If constructed in two stages, the length of time to get to the equilibrium levee height would be longer. This is potentially an important factor in decision making because the water supply pipeline for the horizontal levee would need to cross the future flood control levee and would experience settlement along with the levee, which could affect the pipes' integrity.

For the South Reach project, the supply pipeline is assumed to be installed along the outboard side of the horizontal levee berm. When the larger flood control levee is constructed in the future, the connection to the supply pipeline that crosses the levee footprint would need to be reconstructed. There are several approaches to mitigating the effects of settlement on the new supply pipes. The project could use flexible joints or elbow joints between pipeline sections and at pipeline connections to structures such as vaults to better accommodate the anticipated settlements. The pipes could be installed at a slight upward arc to account for the increased settlement beneath the levee centerline, which would result in the final pipe being closer to level. Lastly, the project could construct the levee to full height a year prior to pipeline installation to allow the levee to complete most of the settlement prior to installing the pipes.

New gravity pipelines crossing through the levee would need to be constructed with special considerations to prevent the bedding layer from becoming a conduit for seepage through the levee. The storm drain line that would cross the horizontal levee berm and the future flood control levee would need to address requirements for backfill to limit seepage through the pipe backfill. There are several approaches to using relatively impervious backfill material such as low-density cellular backfill material or controlled low-strength material.

## 4.8 Public Access

Balancing public access with wildlife habitat is an important objective of this project. Currently, the Marsh Front Trail parallels the salt marsh within the proposed PAHLPP footprint. The existing trail alignment through the project area is between 10 and 20 feet from existing salt marsh habitat. This preliminary design would relocate this trail farther from Harbor Marsh and salt marsh habitat than the existing trail, while providing a similar function. The realigned trail would be between 70 and 100 feet from the salt marsh atop the berm inboard of the horizontal levee. Potential adverse impacts on wildlife may be minimized or avoided by optimizing design elements (e.g., siting, buffers) as well as implementing trail management options (e.g., trail closures during extreme tides or breeding season, pet restrictions).

A project objective is to provide habitat-compatible public access and low-impact recreation opportunities that are consistent with Palo Alto’s Comprehensive Plan Policy N-3.8, 4.B, and 4.D and BCCP Public Access and Facilities Goal 1 to provide opportunities for recreation/access via a habitat compatible trail network to enable wildlife observations and ensure that future generations develop an appreciation for wildlife, other wildlife compatible recreational activities, and connections to the greater Palo Alto area. This has also been expressed as a key concern from early feedback garnered from environmental stakeholders.

Considerations will need to be made in subsequent design phases for public access trails along the berm alignment with respect to the location, preferred widths, and surfacing materials. The preliminary design shows the trail relocated at the top of the horizontal levee berm. This location provides the most separation between the public and the enhanced habitat while maintaining a visual connection to Harbor Marsh with a vantage point above wetland vegetation. The future flood protection levee would further distance the trail from the salt marsh when the project berm is integrated into the future levee. The assumed trail alignment at that time is atop the future flood protection levee. Therefore, the project understanding is that the trail on the berm is an interim condition, though one that is expected to be in place for the several years ahead of implementation of a flood protection levee project. Advantages of this change to the trail includes an elevated vantage point for trail users as well as enhanced interpretative opportunities on the project itself as well as sea-level-rise adaptation. An alternative trail alignment for the project would be on the inboard side of the berm along existing grade; however, the approximate 4-foot-high berm would then be between the trail and Harbor Marsh.

The proposed vegetation palette is much denser than the current ruderal vegetation and would be more effective than existing vegetation at deterring visitors and pets from entering the salt marsh. Special-status species are expected to use the highest portion of the horizontal levee slope during extreme storm surges, coinciding with inclement weather, a time period that typically has low recreational usage.

The Bay side trail edge would be approximately 5 feet from the inboard edge of the horizontal levee. The current trail location reflects incorporation of early outreach and feedback from environmental advocates. In the previous layout for the Central Reach alternative, the edge of the trail was approximately 15 feet from the top of the horizontal levee slope.

The project design needs to consider appropriate methods to keep the public and pets from entering the horizontal levee. Potential improvements to guide this separation include gathering points on the trail at either end of the horizontal levee as well as educational and informative signage about the horizontal levee and its components and features. Other projects have incorporated fencing to help control the public and pets from accessing sensitive habitat areas. Further discussions are needed with regulators on creative barriers that would be acceptable to maintain public safety as well as abide by the City's Baylands design standards and aesthetic preferences and the San Francisco Bay Conservation and Development Commission (BCDC) criteria.

Future phases of the project development will include outreach to agencies and the public to receive input on trail design considerations and strike the suitable balance between public access, improved social infrastructure, minimal disturbance to wildlife from trail use, and flood control design restrictions. Input and direction from the BRRIT is welcomed on how to effectively time, approach, and accomplish public engagement as well as agency guidance and review for the trail.

## 4.9 Integration with Flood Control Levee Improvements

The SAFER Bay levee is currently in the planning phase, and both alternative Reach 10 alignments parallel Embarcadero Road opposite the RWQCP and align with the proposed South Reach horizontal levee (SFCJPA, 2019). The proposed horizontal levee/irrigated transitional ecotone slope is approximately 450 LF within the approximately 1.8-mile-long Reach 10 levee. The proposed PAHLPP would be constructed on the outboard face of the SAFER Bay levee if built along these alignments. The City is continuing to evaluate options for food risk management along the Palo Alto shoreline as part of USACE, Valley Water, and the Coastal Conservancy's Shoreline Study. One of the goals for the Shoreline Study is to incorporate natural infrastructure to provide increased flood protection that can evolve in the future, restore Bay habitats, and public access. Once analyzed, information will be shared with the City of Palo Alto to better inform future decisions on levee improvements.

The City met with USACE in June 2020 to discuss potential sites and approaches for the proposed horizontal levee—see Section 2, *Site Selection*. USACE proposed Option 1–No Project and Option 2–South Reach with Flood Control and Horizontal Levee for the City to consider. In addition, the City also discussed Option 3–South Reach with Horizontal Levee with USACE. Feedback from that meeting was incorporated and discussed by the City during the site selection described in Section 2. The City will continue to coordinate closely with USACE and the Shoreline Study.

One of the goals for the Shoreline Study is to incorporate natural infrastructure to increase flood protection and restore Bay habitats. This goal is in line with the City's goal for the PAHLPP and Option 3–South Reach with Horizontal Levee. However, the PAHLPP differs from the Shoreline Study at this time in that flood protection would not yet be increased, given the smaller berm proposed along the inboard side of the horizontal levee. As the PAHLPP design progresses, technical aspects may require a larger berm and/or different specification requirements to be considered. In that case, there are several potential paths for the PAHLPP to move forward collaboratively with the future flood control levee improvement project. The benefits of working together include the potential to enter into a cost-sharing arrangement and share technical resources for the design and construction of the project. Two possible options for integrating the South Reach Phase 1A project with the future SAFER Bay/Shoreline Study levee are summarized below.

**Option A**: Construct the 450 LF of the flood control levee to approximately EL 12–13 feet along with the horizontal levee. This option would require the flood control levee improvement project to raise the levee to the design elevation during subsequent Reach 10 segment construction. This option is similar to the currently proposed South Reach Phase 1A project, with the exception that the proposed horizontal levee berm would be constructed with a wider footprint to allow the subgrade to evenly consolidate below the future flood control levee footprint.

Similar to the previously analyzed Central Reach project, USACE and SFCJPA would need to obtain a second round of permits for raising the levee that could be complicated by potential wildlife impacts created by introduction of the horizontal levee. However, the currently proposed alignments for the SAFER Bay/Shoreline Study levees both traverse existing tidal marsh habitat just north of the proposed horizontal levee reach, so the larger flood protection levee project would already be dealing with challenging permitting conditions related to work within existing habitat, and any work raising an existing berm to full levee height would be comparably less complex for permitting. Alternatively, the full-height SAFER Bay levee could be permitted as part of this project and constructed in accordance with the SFCJPA’s schedule. Depending on SFJPA’s schedule and permit durations, this may or may not be feasible. This concern is addressed further in Section 3.7, *Regulatory Permit Strategy*.

This option would enable the project to receive a federal share to build out the flood control levee core to full height.

**Option B**: Construct the 450 LF of a low berm to approximately EL 13 feet along with the horizontal levee. This is the currently proposed pilot. It is possible that the geotechnical investigations and analyses that will be performed during the subsequent design development phase could identify potential geotechnical issues associated with implementation of the proposed smaller berm that could create uneven soil strength properties underlying the footprint of the future flood control levee that could complicate construction. Following completion of the geotechnical investigations and analyses, the City will reexamine the preferred option, and could revise the preferred approach to address any potential issues.

## 4.10 Operations and Maintenance

O&M activities would vary from the initial start-up phase and typical operations once the site is established. Personnel from different City agencies and/or contractors would be responsible for various O&M activities. In addition, separate work will be done, likely by a consultant (possibly with assistance from graduate students), to monitor and report on the system performance to meet CEQA and permit requirements. The requirements are unknown at this time, but will be informed by a monitoring and adaptive management plan prepared to support the permitting process.

The initial start-up phase would include programming the PLC for water delivery, manually adjusting the discharge valves at the horizontal levee to balance flow, and plant maintenance. Over the first three to five years of operation, it is anticipated that the flow program will be adjusted to match plant requirements on a monthly/seasonal and annual basis. Section 4.7.2, *Construction Sequencing and Piping,* describes the flow control system in more detail.

Ongoing O&M activities include adjustment to flow program, monitoring the system for leaks and blockages, vegetation management to control spread of invasive, non-natives, and levee/trail inspections and maintenance (similar to current trail maintenance activities).

# 5. Engineer's Estimates

Our team assembled a Class 3 cost estimate to assist with budget planning. The estimate is expected to be -20% to +30% of actual project costs. Quantities are based on the 30%-complete design plan set developed in AutoCAD Civil 3D. Actual quantities could change in accordance with design refinement and/or changes in design such as project location and project elements. Construction cost estimates are an opinion of probable construction costs, and the designers have no control over the actual costs at the time of construction. The actual cost of construction may be affected by the availability of construction equipment and crews and fluctuation of supply prices at the time the work is bid. The engineers make no warranty, expressed or implied, as to the accuracy of such opinions as compared to bids or actual costs.

Unit prices were developed using costs from the SAFER Bay Project Public Draft Feasibility Report (HDR 2019), similar projects, the online Caltrans Contract Cost Database, and RS Means. Cost are presented in 2020 dollars. However, construction-related costs (construction, construction monitoring, and construction management) are escalated at rate of 3% per annum for 5 years (16%), assuming construction would take place through 2025. A 30% contingency is included in the final cost.

Soft costs for design, permitting, and CEQA were originally developed during the project proposal bid phase. Cost ranges have been added to account for some of the uncertainties that came to light during the preliminary design phase such as potential relocation of the project, the level of environmental documentation required, and the novelty of the project from a design and permitting perspective. An estimate of 15% of total construction costs is used for Construction Monitoring and Administration for the project owner. Additionally, a placeholder of $200,000 has been added to cover onsite biological monitoring to address permit requirements that have yet to be developed to protect endangered SMHM and Ridgway's Rail, and other sensitive resources at the project site. As the project develops, the cost estimates for various project elements will be updated periodically. The project cost estimate is summarized in **Table 2** and presented in detail in Appendix E, *Preliminary Design Cost Estimate*.

The future O&M budget was not evaluated on a cost-basis and will be evaluated in subsequent design phases.

**TABLE 2**
**SUMMARY OF PROJECT COSTS INCLUDING DESIGN, PERMITTING, ENVIRONMENTAL COMPLIANCE, AND CONSTRUCTION**

| | |
|---|---|
| Construction Cost Estimate | $1,230,000 |
| Final Design | $575,000 to $675,000 |
| Permitting | $240,000 |
| CEQA (IS/MND or Focused EIR) | $90,000 to $200,000 |
| Construction Monitoring | $200,000 |
| Construction Management | $184,000 |
| Grand Total | $2,519,000 to $2,729,000 |

NOTES:
CEQA = California Environmental Quality Act; EIR = environmental impact report; IS/MND = initial study/mitigated negative declaration
SOURCE: Data compiled by Environmental Science Associates in 2020

## 5.1 Earthwork Quantities

Earthwork quantities were developed applying a typical cross section multiplied by the length that the cross section is applied. The quantities for berm fill placement are based on the volume required to construct the top of berm to the design grade (EL 13, except at the transitional grading at each end) and include a 3-foot-deep keyway backfilled with berm fill. Cut quantities were obtained by calculating cut required to achieve subgrade for the berm keyway, the treatment zone for horizontal levee, and over-excavation of the habitat slope. Additional cut volumes were obtained by subtracting the finished grade surface from existing grade for the habitat slope.

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# Appendix A
Ecological Considerations
Memorandum

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# MEMORANDUM

To: Scott Stoller, Mark Lindley, Eve Pier-Kieli, ESA
Date: August 22, 2019

**SUBJECT: Palo Alto RWQCP Horizontal Levee Pilot Project – Ecological Design and Assessment (final memorandum)**

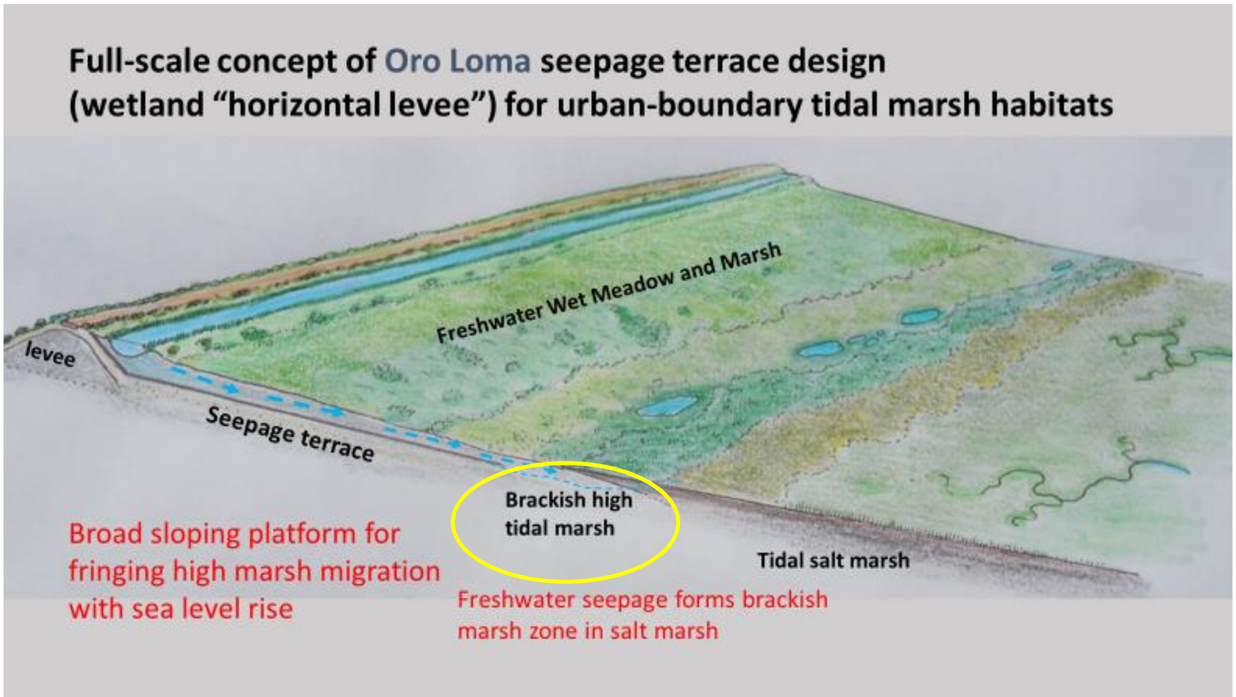
Scott, Mark, Eve:
This memorandum integrates and supplements our email and phone conference discussions of the Palo Alto Harbor Marsh "horizontal levee" tidal-terrestrial ecotone design. It includes revisions and corrections on the draft memo of July 23, 2019.

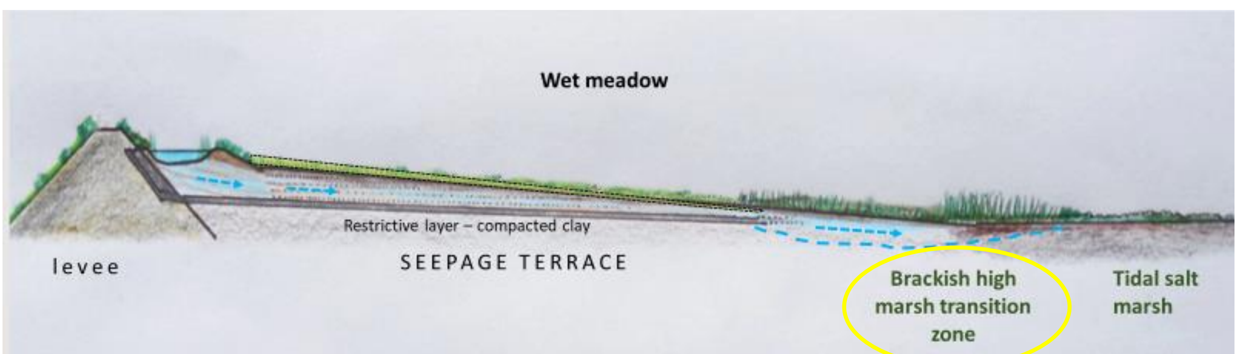
## 1.0 Geographic & Ecological context of the Palo Alto Ecotone Levee Project

**1.1**. **Novel brackish ecotone between estuarine salt marsh and engineered terrestrial wastewater slope wetlands**. The Palo Alto "horizontal levee" project conceptual design (Engelage 2018; ESA 2018) is the first application of the Oro Loma Sanitary District (OLSD) horizontal levee prototype to an actual tidal marsh setting for which it was essentially designed to function. The analysis and evaluation of the OLSD project focused exclusively on internal water quality and hydraulic operations and functions, and vegetation performance. There were no tidal marsh ecological interactions (vegetation, wildlife, including endangered species), tidal-terrestrial groundwater interactions, or storm wave runup interactions to design, monitor or assess. The Palo Alto project raises all of these missing tidal marsh-terrestrial interactions for design, assessment, and monitoring.

The Palo Alto project is the first actual "ecotone" design for an essentially freshwater slope wetland. The OLSD project was an ecotone in name only, because it did not intergrade with a contrasting vegetation or community type, or produce a novel intermediate zone between them. Ecotones are defined as gradients between two contrasting plant communities. The nominal "ecotone slope" in the OLSD project and in the Palo Alto project also is essentially a heterogeneous freshwater slope wetland (marsh, wet meadow, and riparian scrub mosaic) rather than an ecotone. The true ecotone in the Palo Alto project, which is one of the topics of emphasis in this memorandum, is the distinct brackish marsh zone (vegetation gradient along a salinity gradient generated by the treated wastewater seepage) between the tidal salt marsh and the freshwater wetland slope. Thus, the intrusion of the fresh-brackish salinity gradient and groundwater slope from the terrestrial edge to the tidal marsh is the hydrologic driver of the ecotone, most of which is occurs the tidal marsh itself, not in the freshwater wetland slope.

1.2. **Salt marsh zonation versus conversion to brackish marsh**. The original concept for the seepage slope of the wetland "horizontal levee" was predicated on the localized conversion of a narrow zone of salt marsh to brackish marsh, typically dominated by alkali-bulrush in San Francisco Bay.




The Palo Alto Harbor Marsh is a semi-enclosed tidal basin with a matrix of tidal salt marsh and mudflats, and a mosaic of large alkali-bulrush (brackish marsh indicator species) patches in 2017, even after a severe historic drought. This suggests that the salt marsh is normally near the salinity threshold between salt marsh and the upper salinity range of brackish marsh vegetation. This is evident in the combination of two distinctive local tidal marsh features: dense cyanobacterial and algal mats on the upper mudflats and channel banks (typical of eutrophic or hypereutrophic estuaries), and multiple large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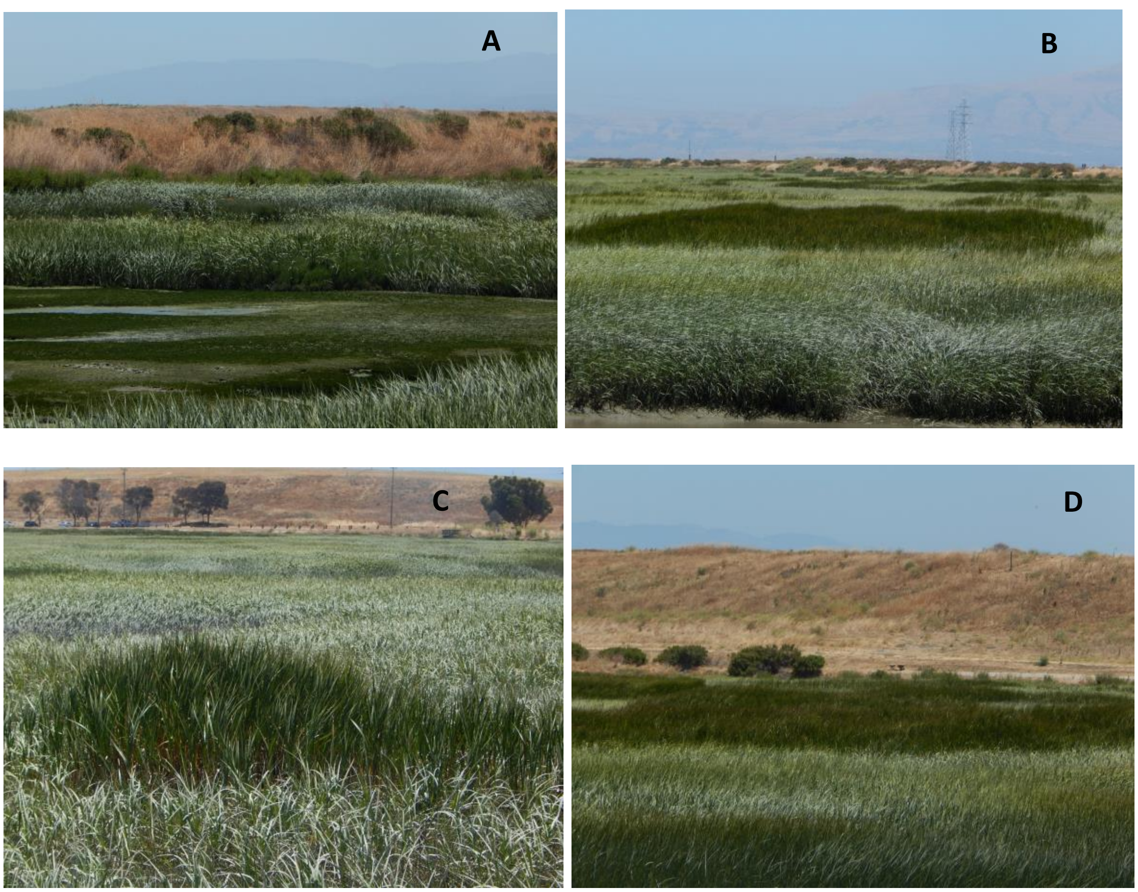
patches of alkali-bulrush in a matrix of cordgrass and pickleweed in the absence of a point source discharge of freshwater (stream or ditch culvert) following a multi-year extreme drought.

Local indicators of pre-existing elevated residence time of freshwater discharges and nutrients (eutrophic, borderline brackish-salt marsh salinity range) in Palo Alto Harbor Marsh: (a) dense cyanobacterial and algal mats on mudflats; (b-d) extensive single-dominant colonies of alkali-bulrush (*Bolboschoenus maritimus*) in the head (south end) of the marsh near Bxybee Park and Embarcadero Road, farthest from the tidal inlet (harbor entrance). July 2017.

Semi-enclosed tidal basins with salt marshes generally increase the residence time and mixing of freshwater discharges and brackish influence in salt marsh vegetation. For qualitative geographic context of the spectrum of tidal marsh sensitivity to freshwater influence and development of brackish tidal marsh zones or mosaics, tidal marsh settings can include:

- open bay fringing marsh with well-drained tidal creeks (most dispersive, least responsive to salinity dilution effects of freshwater discharges, like most of East Bay);

- semi-enclosed tidal basin marshes (neck or inlet flaring into a basin or lagoon, like Harbor Marsh; conducive to local brackish marsh gradients), and

- narrow sloughs with upstream freshwater discharges, bordering narrow fringing tidal marsh (most sensitive to longitudinal brackish-salt marsh gradients like Alviso Slough)

The main point is that Harbor Marsh's artificial shape and size (set by historic levee and fill configurations) inherently establish a semi-enclosed tidal basin conducive to relatively longer residence times and amplification of freshwater dilution influence on tidal salt-brackish marsh threshold salinity range (Section 2.0).

1.3. **Ecological objectives for freshwater seep influence on tidal salt marsh at Palo Alto Harbor Marsh**. The primary ecological objective for the freshwater seepage slope influence on the existing tidal salt marsh is to enhance zonal species diversity and vegetation structure of the landward tidal marsh platform by forming a brackish marsh zone in the salt marsh. Brackish marsh is not intended or expected to form on the freshwater seepage slope itself, which is likely to flush out physiologically significant soil salt concentrations during the growing season.

The habitat benefits of increased development of a persistent, narrow, tall alkali-bulrush brackish marsh zone include enhanced high tide cover for local populations of special-status wildlife species (SMHM, CRR), during extreme high tides. In addition, the broader brackish seepage zone of influence (bordering and also near but away from the alkali bulrush zone) should reduce drought impact on gumplant patches (subject to drought dieback, reduced cover due to summer marsh soil hypersalinity) that also provide high tide refuge cover locally. The brackish alkali-bulrush marsh zone should also significantly increase wave damping at the tidal marsh edge because of the tall, dense canopy characteristic of alkali bulrush marsh, relative to salt marsh vegetation. \

1.4. **Excessive freshwater discharge on salt marsh**. Excessive freshwater discharge into a semi-enclosed basin may exceed the beneficial habitat objective of enhanced brackish-salt marsh zonation in the landward ecotone, and cross the salinity threshold for type conversion of whole salt marsh to brackish marsh. This would be a highly significant adverse impact that can and must be avoided to prevent adverse habitat modification to endangered wildlife species. The regulatory precedent for this impact is widespread brackish marsh conversion by high volume discharges of urban wastewater tidal sloughs near Alviso since the 1980s. The ecological limitation on the capacity for tidal salt marsh to receive subsurface or surface freshwater discharges must be based on the ability to cut back or divert freshwater discharges (either to evapotranspiration "sinks" or other discharge points) when progressive salt marsh conversion to brackish marsh is detected at early stages. This issue is discussed in practical detail in Section 3.0.

## 2.0. Reference marshes for zonal salt-brackish tidal marsh

Examples of freshwater influence from terrestrial subsurface and surface drainage forming brackish middle-high marsh zones dominated by alkali bulrush at the landward edge of salt marshes. The Palo Alto bayshore, like the other urbanized San Mateo and Santa Clara County bayshores, have lost all remnants of the original riparian, lowland alkali grassland ecotones, which were described by W.S. Cooper (1926) based on interviews with local residents during early agricultural conversions there in the 1850s-1860s. A reconstructed distribution of broad vegetation and terrestrial habitat types bordering South Bay salt marshes (Alameda, Santa Clara counties) was prepared by San Francisco Estuary Institute (Beller *et al*. 2013) based on diverse historical documentary evidence of physical geography.

Broad similarities exist in plant species composition of remnant or regenerated (self-assembled, not actively restored) tidal marsh-terrestrial ecotones in Suisun Marsh, San Pablo Bay, and the few that remain in San Francisco Bay. Selected examples are cited here as living models comparable with many aspects of the salt marsh border vegetation types described by Cooper (1926) in relation to soils and hydrology. These are not speculative or arbitrary "plant palettes" (environmental horticulture), but variable natural assemblages of plant species that recur in tidal marsh-terrestrial ecotones. They have important distinctive functional relationships with sea level rise adaptation, erosion buffering, wildlife habitat structure, and resilience to climate change. These historical and remnant modern reference systems provide the basis for the species assemblages recommended for the terrestrial wetland ecotone slope. A comprehensive species list and with propagation and transplanting/sowing specifications (patterns, rates, timing, methods) should be developed in an integrated revegetation and weed management plan.

Dominant vegetation of the tidal-terrestrial ecotone varies from grassland or wet meadow to riparian scrub where seasonal or perennial wetland hydrology occurs along natural seeps, alluvial fans and plains, and stream deltas. These landscape features are prevalent along most of the San Francisco Estuary, except where steep hillslopes or bluffs directly contact tidal marsh edges, and actual uplands form an abrupt (non-ecotone) edge. The most widespread and abundant to dominant elements of seasonally wet tidal marsh ecotone grasslands include riparian alkali grassland species such as creeping wildryes (*Elymus triticoides*, *E.* ×*gouldii*), saltgrass (*Distichlis spicata*), Baltic rush (*Juncus arcticus*), and rhizomatous, creeping sedges with tolerance to alkali or oligohaline salinity (*Carex barbarae, C. praegracilis*).

Many creeping forbs with relatively high tolerance to alkali soils are components of this ecotone assemblage, including many Aster family forbs like western ragweed (*Ambrosia psilostachya*), western goldenrod (*Euthamia occidentalis*), marsh asters (*Symphyotrichum chilense, S. lentum*), as well as less common species like the robust California sunflower (*Helianthus californicus*). Most of the native terrestrial ecotone forbs that depend on summer desiccation of alkali soil (arid seasonal wetlands) to compete with dominant grass-like plants (*Iva, Heliotropium, Cressa, Frankenia* spp.) would be excluded by competition from vegetation supported by perennial freshwater seepage, and would be replaced by wet meadow and freshwater marsh species such as common spikerush (*Eleocharis macrostachya*), threesquare bulrush (*Schoenoplectus americanus*), and smartweeds (*Persicaria punctata, Persicaria* spp.).

Strongly waterlogged swales with perennial seepage in tidal marsh ecotones support freshwater/oligohaline marsh plants such as Typha spp. (*T. latifolia, T. domingensis*), and tules (*Schoenoplectus acutus*, less often *S. californicus*), sometimes with a ground layer of sedges, club-rushes (*Isolepis cernua*), or saltgrass from adjacent brackish marsh zones. The composition of the wetland grassland ecotone varies with the degree of summer soil moisture (physiological desiccation stress or waterlogging stress). These assemblages are generally formed under conditions of low to moderate nutrient availability. Elevated nutrient availability from wastewater that is not thoroughly denitrified is likely to reduce diversity to a few dominant species with high relative growth rates and large size, especially in strongly waterlogged soils (conducive to dominance by large cattails and tules). Thus, the intended high species diversity of the vegetation design of the wetland slope relies on subsurface flows with high efficiency of denitrification, as demonstrated at Oro Loma. Surface flows of wastewater that bypass active denitrification layers of the substrate during the growing season would be incompatible with the design and function of wet meadow and marsh on the slope.

Riparian scrub vegetation intergrading with tidal marsh ecotones include widespread riparian species, including California rose (*Rosa californica*), and black elder (*Sambucus nigra*). Willows (especially *Salix lasiolepis*) are important habitat-forming riparian scrub species that locally dominate freshwater seeps, and spread clonally in substrates with buried or near-surface saturated coarse sediments. Willows, because of their inherently large size and spread, cannot be interspersed with other scrub or wet meadow or marsh vegetation, and must be segregated (as in natural conditions) as discrete groves or (“sausals”).

The basis for these plant assemblages in riparian-tidal marsh ecotones is provided by historical accounts (SFEI 2013, Cooper 1927), few South Bay remnant vegetation stands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(Coyote Hills slope wetlands at salt pond margins/historical tidal marsh; upper Newark Slough hillslope toe/tidal marsh vegetation), and widespread remnant stands throughout the remainder of the San Francisco Estuary (Rush Ranch in Suisun Marsh, China Camp State Park, San Pablo Bay; Whitcraft et al. 2012, Baye 2012), and my unpublished tidal marsh edge surveys of Point Pinole and Point Molate (Richmond), Petaluma Marsh, Sonoma-Napa Marshes, and Suisun Marsh. Selected examples are presented below to show the overall zonal structure, patterning, and composition of the diverse natural fresh-brackish-salt marsh ecotones.

A small, seasonal freshwater stream delta discharges on to the fully tidal marsh plain at the south end of China Camp Marsh, where it forms a zonal ecotone on a salinity gradient between freshwater riparian woodland (willow grove), fresh-brackish marsh (tule), brackish marsh (alkali-bulrush), brackish-salt marsh (gumplant, saltgrass, sea arrow-grass), and high salinity salt marsh (pickleweed, dodder). May 22, 2017.


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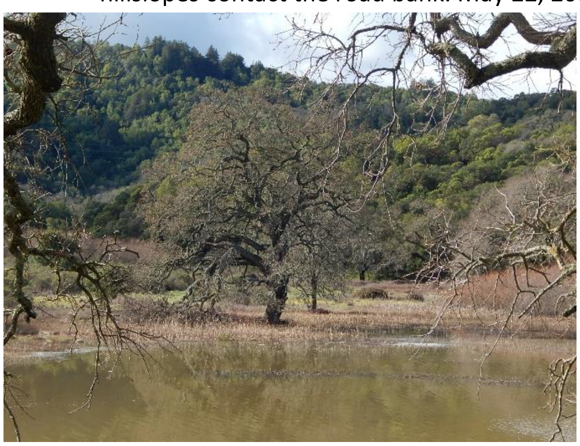
China Camp hillslope and gulch groundwater patterning of narrow alkali-bulrush marsh patches (circled) is evident only in wet years, where narrow stands of alkali bulrush emerge at the edge of the tidal marsh across from small gulches that drain by subsurface seepage through road embankment, without culverts. Brackish marsh patches are typically absent where steeper hillslopes contact the road bank. May 22, 2017.



Winter high tide flooding of freshwater wetlands at China Camp, Back Ranch Meadow Marsh, does not result in conversion of freshwater marsh to brackish marsh below the highest tide line. Dormant vegetation is relatively resistant to salinity injury, and residual soil salinity is mostly dissipated by freshwater runoff and shallow groundwater seepage by the start of the growing season. Similar patterns and processes would be expected at the toe of the freshwater wetland slope below the high tide line.

Alman Marsh, near the Petaluma Marina, is bordered by artificial terrestrial and dredge sediment fans, similar to natural alluvial fans, which support seasonal wetlands and lowland grasslands naturally recolonized by some native dominant wet meadow species, such as creeping (alkali) wildrye, *Elymus triticoides*. June 2008 (left), and 2017 (right).

Alman Marsh, Petaluma, fluctuates between salt marsh vegetation (pickleweed-dominated) during droughts, and brackish marsh vegetation (alkali-bulrush) following years of high rainfall and brackish marsh salinity in summer, influenced by Adobe Creek outflows. Perennial pepperweed invades brackish marsh where disturbances occur or where alkali-bulrush canopies are insufficiently dense. June 1, 2017.

**3.0 Conceptual model for hydrology, soils, and vegetation.** Palo Alto is the first "horizontal levee" project positioned to trigger vegetation and habitat changes in adjacent tidal marsh, driven by freshwater seepage. The anticipated changes in adjacent salt marsh vegetation composition and structure are predicted in part by a set of analogous reference systems (Section 2.0), and in part by a conceptual model of tidal marsh hydrology and vegetation interactions at terrestrial edges where significant seasonal groundwater discharges occur (this section).

3.1. **Salinity range and vegetation types**. Broad classification of San Francisco Bay area tidal wetland vegetation by the salinity range of adjacent tidal channels flooding them provides a practical guide for discussion of interactions between the key features of tidal marsh and terrestrial ecotone slopes. The effective physiological control of wetland plant growth, however, is the actual soil porewater salinity in the root zone during the active growing season, which is influenced by springtime lags (residence time of porewater of lower salinity spring tides in late winter) as well as evaporative concentration of soil salts in summer.

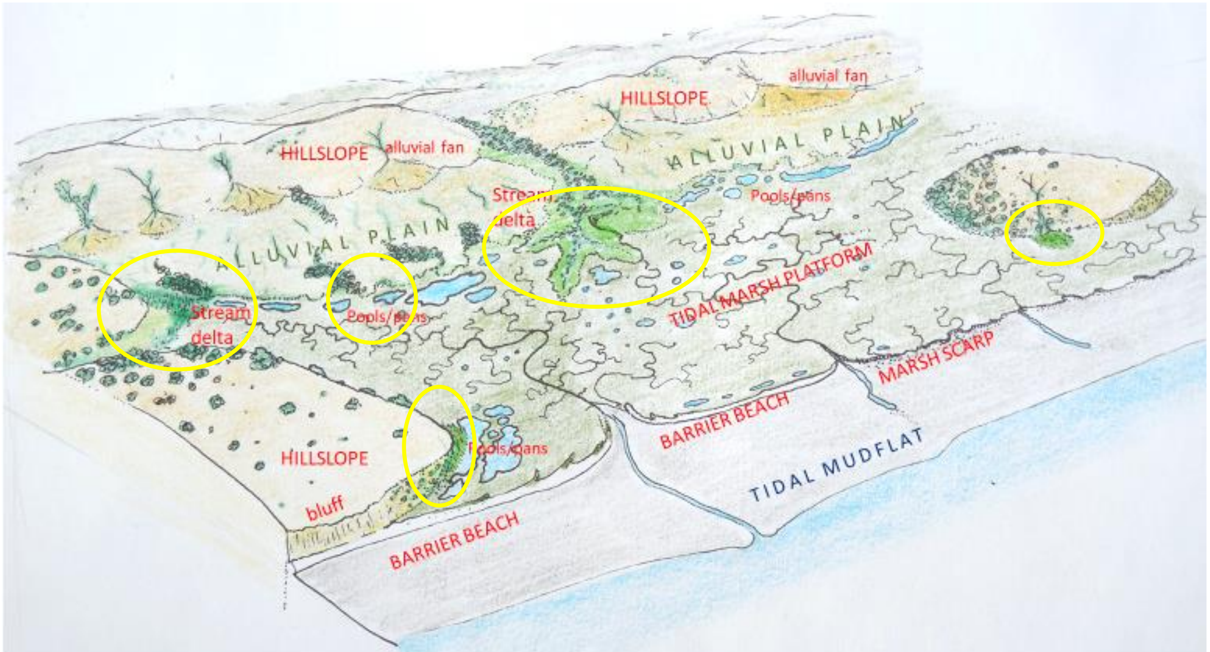
| Salinity range | Vegetation | Indicator or dominant species |
|---|---|---|
| *Polyhaline* (18.0-30.0 ppt) | Salt marsh | *Sarcocornia pacifica* (Pacific pickleweed)<br>*Spartina foliosa* (California cordgrass) |
| *Mesohaline* (5.0-18.0 ppt) | Brackish marsh | *Bolboschoenus maritimus* (alkali-bulrush) |
| *Oligohaline* (0.5-5.0 ppt | Fresh-brackish marsh | *Schoenoplectus californicus, S. acutus* (tules)<br>*Typha* spp. (cattails) |
| *Freshwater* (< 0.5 ppt) | Freshwater marsh | *[Fresh-brackish marsh species plus many more highly salt-sensitive species]* |

Note that salt marsh species can grow more vigorously at lower (brackish) salinity in the absence of strong competition from dominant brackish marsh plants in brackish salinity range; they do not require high salt concentrations to establish or grow. Fresh-brackish marsh plants can also persist (salt-inhibited) in brackish salinity range for portions of the late growing season, but grow primarily in oligohaline salinity range.

3.2. **Landscape and hydrology drivers of brackish and salt marsh zonation**. The development of zoned freshwater, fresh-brackish, brackish, and salt marsh vegetation depends on processes inherent in landscape position (geomorphic and drainage features) and sediment texture (porosity, hydraulic conductivity) of the terrestrial soil profile, including buried sediment layers of coarser (flood deposits) or finer (low energy, backwater deposits) sediments. Landscape features that strongly express zoned wetland vegetation at tidal marsh borders in California include the following features that inform wetland ecotone levee design:

- **Alluvial fans or plains** spreading over, or drowned by, tidal marsh (San Pablo Bay examples: Back Ranch Meadow and Miwok Meadow marshes, China Camp State Park; Turtleback Hill, China Camp State Park)
- **Stream delta lobes or levee crevasse splays** spreading over, or drowned by, tidal marsh (examples: Lagunitas Creek, Tomales Bay; Los Osos and Churro Creeks, Morro Bay)
- **Hillslope valleys, springs or seeps** intercepted by modern or historic tidal marshes (examples: Coyote Hills, Newark; Point Molate and Point Pinole, Richmond)

Simplified illustrations of these tidal marsh-terrestrial landscape patterns, in an idealized San Francisco Bay (East Bay or south Peninsula) composite pre-agricultural setting, are shown below. Ecotone models for horizontal levees are associated with stream valleys, deltas, alluvial fans and plains, and hillslope seeps/springs at tidal marsh borders.




Key natural hydrologic processes and salinity gradients associated with these terrestrial-tidal marsh ecotones are summarized below. They correspond with hydrology objectives and criteria (Section 4.0) for the wetland ecotone levee design.

- **Intermittent wet season freshwater surface flows** (winter-spring runoff, unstable shallow channels) typically flush out soil salts in the tidal marsh root zone near the landward tidal marsh edge, reducing winter-spring salinity to fresh or fresh-brackish (oligohaline) range in a gradient below the high tide line, in both alluvial (terrestrial) and estuarine soils. This seasonal dilution of marsh soil salinity is gradually reversed by high salinity (polyhaline) spring high tides in June and July, but supports a lag in brackish soil salinity range persisting during spring in (otherwise) salt marsh vegetation.

- **Chronic dry season subsurface flows (seeps) into the tidal marsh plain (below MHHW)** typically reduce spring-summer soil porewater salinity in the tidal marsh root zone to oligohaline (fresh-brackish) or brackish (mesohaline, mixohaline) range at a variable distance from the terrestrial edge, depending on the duration and rate of subsurface discharges. The timing of this dilution during the growing season is essential to the effect on vegetation; dormant (winter) marsh vegetation is relatively unresponsive to low salinity pulses or gradients. This persistent seepage gradient establishes a distinct brackish marsh zone (ecotone) at the landward edge of tidal salt marsh, below freshwater wetlands. (Extreme high freshwater seepage rates may potentially cause intrusion of fresh-brackish marsh and brackish marsh zones far into the salt marsh plain, but this does not occur in low flow summer stream deltas in tidal salt marshes; this impact usually occurs only in levee-confined tidal sloughs with high volume dry season wastewater discharges.)

- **Chronic dry season subsurface flows in the spring-intertidal (above MHHW) terrestrial wetland gradient** during the spring-summer growing season maintain oligohaline soil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salinity range, and mostly freshwater (non-halophyte) wetland vegetation, even where perigee spring high tides briefly flood soils.

The resulting brackish vegetation gradient in the ecotone between tidal salt marsh and freshwater riparian vegetation (grassland, scrub, woodland) may be gradual or dynamic (fluctuating interannually), or relatively abrupt and persistent among years, depending on (a) the salinity range of the salt marsh, and (b) the strength and variability of the freshwater discharges during the growing season. Three or four distinct marsh vegetation zones of variable widths may be distinguished, relevant to Palo Alto project design, monitoring, objectives, and adaptive management:

- **Terrestrial freshwater wetlands**. Purely freshwater to at most oligohaline plant assemblages on terrestrial soils and slopes near the high tide line and above, due to net seepage removal of soil salts deposited during spring high tides. Common vegetation types: sedge-rush meadow, willow scrub, mixed riparian scrub (rose, blackberry, marsh baccharis)

- **Brackish marsh zone**. A fresh-brackish to brackish zone (oligohaline to mesohaline) with elevated groundwater near surface in the landward tidal marsh plain, near the contact between nearly flat tidal marsh plain and terrestrial seepage slope. Dominant vegetation types: alkali-bulrush, hardstem tule, cattail dominated stands (depending on salinity range during the growing season); halophytes by definition are never dominant in this zone.

- **Salt-brackish marsh ecotone**. A brackish-saline diffusion zone (polyhaline to mesohaline) with primarily tidal groundwater hydrology (spring/neap), depending on variations in ambient bay salinity and summer temperatures (evapotranspiration). Common vegetation types: peripheral (diffuse, patchy) alkali-bulrush stands, gumplant, pickleweed, saltgrass, fleshy Jaumea.

- **Salt marsh (zone or plain)** – polyhaline to hyperhaline marsh dominated exclusively by halophytes, excluding brackish marsh plant species: common vegetation types are pickleweed, cordgrass, with gumplant, saltgrass, and alkali heath mostly restricted to channel banks/natural levees in young San Francisco Bay salt marsh.

3.3 **Relative extent of brackish-salt marsh zonation: optimal patterning and adverse type conversion risk**. The spread and maximum extent of the brackish and salt-brackish marsh ecotone zones are critically important design features for ecotone levees. Alkali bulrush in mesohaline landward marsh zones provides taller, more dense and persistent flood refuge cover for wildlife during extreme winter high tides than native California cordgrass or Pacific pickleweed, and often exceeds the canopy height and density of gumplant. Alkali bulrush back-marsh zones are effectively refuges for endangered marsh wildlife (salt marsh harvest mouse, California Ridgway's rail) when they occur in short dispersal distance of their home ranges. In addition, the salt-brackish marsh ecotone vegetation is likely to sustain tall gumplant canopies as well during severe multi-year droughts, when salt marsh hypersalinity often causes extensive dieback of gumplant.

In contrast, where freshwater discharge rates during the growing season are excessive, and extensively lower salt marsh soil salinity to the brackish range, otherwise limited and beneficial brackish marsh zones can spread over whole salt marshes, and convert them to brackish tidal marsh. The threshold for seasonal timing, duration, and extent of salt marsh salinity dilution that shifts the dominant vegetation canopy from pickleweed or cordgrass to alkali-bulrush is therefore critically important for long-term operation and management of engineered fresh(waste) water ecotone levees. This marsh type conversion is an adverse habitat modification for Ridgeway's rails, and is presumably also for salt marsh harvest mice in south San Francisco Bay (though the northern subspecies of SMHM reportedly maintains persistent high populations in periodically flooded tall brackish marsh vegetation canopies).

In summary, a relatively small, local freshwater seepage influence that supports a narrow brackish marsh (alkali bulrush canopy) zone is a beneficial modification of salt marsh vegetation; but extensive, diffuse freshwater influence that drives past the threshold for extensive brackish marsh conversion is presumably and potentially significant adverse impact in South San Francisco Bay.

3.4. **Sensitivity of salt marsh to brackish tidal marsh conversion and lag effects (hysteresis)**. The sensitivity of salt marshes to brackish marsh conversion by local freshwater discharges depends in part on the size and shape of the embayment in which it occurs (Section 1.1), and variability of ambient estuarine salinity. The closer ambient marsh salinity is to the salt-brackish threshold (18 ppt) during the summer, the more sensitive the salt marsh near local freshwater discharges would be to brackish type conversion. This threshold is not an instantaneous or short-term salinity criterion, however; salt-brackish marsh phases may exhibit significant lags because of persistent high viability "bud banks" (corms and rhizomes) of dormant alkali-bulrush during high salinity (polyhaline to euhaline years inhibitory to above-ground growth of alkali-bulrush). Below-ground populations of alkali-bulrush are maintained by perennial corms that may remain dormant but highly viable for several years or more. This allows visible above-ground vegetation gradients (canopy structure, composition) to fluctuate much more than persistent below-ground populations. Therefore, vulnerability to brackish marsh conversion may persist even after above-ground vegetation indicators have converted back to salt marsh after an episode of brackish marsh type conversion. Monitoring and assessment of brackish marsh conversion and recovery must anticipate this pattern and process.

**4.0. Harbor Marsh baseline: recent tidal marsh and adjacent upland conditions** (based on July 2017 site visits).

The predicted response of the pre-project tidal marsh and terrestrial habitats of the site to the introduction of perennial seepage flows from the constructed wetland slope can be estimated from existing conditions, based on July 2017 (early post-drought) observations. The Harbor Marsh tidal salt marsh is in relatively early successional stages between low cordgrass marsh to middle zone pickleweed-cordgrass, following harbor siltation and abandonment in the 1960's-70s. The salt marsh was extensively infested with hybrid non-native smooth cordgrass (*Spartina* *alterniflora* x *foliosa*), which was treated and mostly controlled during the last decade, though some backcross hybrid colonies appear to persist and require re-treatment as of 2017. Channel bed mudflats at least intermittently support thick cyanobacterial and algal mats, indicating high nutrient availability and relatively low wind-wave disturbance or sediment accretion during the summer. At the head of the embayed salt marsh, farthest from the tidal inlet (south end, near Embarcadero Road project area), alkali-bulrush colonies are frequent and large within the salt marsh matrix of cordgrass and pickleweed. Alkali-bulrush stands also occur in sparser, shorter vegetation mixed with pickleweed and saltgrass in the high salt marsh ecotone. The existing ecotone, therefore, is primed to respond almost instantaneously to form a robust brackish marsh zone upon connection to the freshwater seepage discharge from the constructed wetland levee.

The vegetation of the existing terrestrial tidal marsh ecotone is predominantly non-native vegetation with poor high tide cover for salt marsh wildlife during extreme marsh submergence events.  Some significant stands of native perennial grasses saltgrass (*Distichlis spicata*) and creeping or alkali wildrye (*Elymus triticoides*) are also present despite summer desiccation of soils. These species can and should be salvaged, propagated, and incorporated as either successional plantings or "final" vegetation on less waterlogged (mounded, better drained) segments within the constructed wetland slope. Dominant terrestrial weeds extending from adjacent lowlands to the terrestrial ecotone of the marsh include saltwort (Salsola soda), iceplant (*Carpobrotus edulis*), fennel (*Foeniculum vulgare*) and many non-native annual grasses (*Bromus, Hordeum, Avena* spp.), plus the perennial Russian wheatgrass (*Elymus ponticum*). Some native upland shrubs, including the weedy but valuable habitat of coyote-brush (*Baccharis pilularis*) are also widespread.

The native plant species diversity and terrestrial wildlife habitat of the constructed wetland slope is expected to significantly exceed those of the existing ruderal grassland and scrub. The native species diversity and habitat of the flood control levee component of the project should also at least match or exceed those of the existing ruderal lowland bay fill areas, but the levee engineering requirement for complete exclusion of scrub (cover, food, nesting habitat) will require compensation by maximizing the quality of native grassland habitat on the levee, and enhancing upland and wetland scrub habitat where it does not conflict with levee maintenance standards.


The landward edge of the salt marsh at the project site (bordering Embarcadero Road) already supports ecologically significant, sparse but extensive pre-existing short colonies of alkali-bulrush. These colonies would rapidly form an expanded, dense, tall brackish marsh ecotone after contact with a freshwater seepage gradient from the constructed wetland levee. No planting is needed to establish the brackish ecotone vegetation.

Native grass species locally dominate patches of the existing terrestrial ecotone: saltgrass (*Distichlis spicata*) and creeping or alkali wildrye (*Elymus triticoides*), which should be salvaged, propagated, and incorporated in the project design.

Most existing tidal marsh-terrestrial ecotones at the project site and vicinity are dominated by either invasive non-native species (including large stands of saltwort, *Salsola soda*, and iceplant, *Carpobrotus edulis*), and provide very limited (short, sparse) high tide cover for salt marsh wildlife during marsh submergence events.

 

Most terrestrial lowland ("upland") areas in the project footprint are artificial bay fill substrates (including drained bay mud) and support predominantly non-native weedy vegetation, including annual grasses (bromes, oats, barleys), fennel, and saltwort (*Salsola soda*).

## 5.0 Ecological Design Objectives

### 5.1. Proposed ecological objectives and criteria for tidal marsh adjacent to the constructed wetland slope, modified adjacent salt marsh ecotone, and constructed wetland slope.

5.1.1. ***Brackish marsh and salt marsh zones*** *(contiguous tidal marsh plain below slope)*

- <u>Objectives</u>: dense, tall, alkali-bulrush (*Bolboschoenus maritimus*) continuous stand between 3-6 m wide, not exceeding 8 m wide, in the existing tidal marsh plain. Mean canopy (culm) height not less than 1.2 m above ground surface in winter. This zone should be discrete and not coalesce with significantly enlarged pre-existing alkali-bulrush colonies in the salt marsh. The adjacent marsh plain should remain dominated by over a minimum of approximately 60% salt marsh (pickleweed, cordgrass vegetation) in any consecutive 3-year period. Total cover: 100% (continued from existing conditions).
- <u>Target (expected time to reach objectives)</u>: 5 years.
- <u>Key ecological functions</u>: dense, tall shoots persist standing above ground dover winter and provide both storm wave dissipation during highest tides, and high tide cover for marsh wildlife. Dense below-ground root and rhizome mesh impart high soil shear strength and erosion resistance. The above-ground functions do not occur during years of high salinity (drought), which inhibits growth or enforces dormancy.

5.1.2. ***Wet meadow slope***

- <u>Objectives</u>: native graminoid (grass-like; sedge, rush, grass) vegetation dominant on slightly convex slope surfaces, associated with perennial forbs with relatively high species richness and diversity (over 5 native species co-dominant or sub-dominant in stands over 10 m diameter with minimum 10 species present). Wet meadows should not exhibit significant net increases of invasive non-native species over any three consecutive years, above 2% cumulative cover in any 5 m diameter patches. Total vegetation cover within type 99% (including standing litter). Approximate project % cover: not less than 40%; no upper limit.

- Target: 5 years.
- Key ecological functions: the dense sward of rhizomatous grass-like vegetation establishes an erosion-resistant sod, maintains high primary productivity, and accumulates soil organic matter as well as peat-like surface accretion. Strong ongoing resistance to weed invasion at maturity due to accumulated thick shoot litter mat and dense sod/root mat. The physiologically connected rhizome mat also enables the seaward end of the sward to tolerate brief episodes of seawater flooding by translocating fresh water to shoots. Below-ground production (roots, rhizomes) provides labile carbon sources for microbial activity driving biogeochemical processes essential to water quality improvements.

5.1.3. ***Freshwater slope marsh***

- Objectives: native emergent freshwater marsh forbs and graminoids in shallow swales or depressions on the wetland slope, with perennial saturation at the surface, dominated with moderate plant species richness and diversity (over 3 species co-dominant or sub-dominant in stands over 5 m diameter, minimum 5 species present). Invasion by reed (*Phragmites australis*) is prohibited (0% cover tolerance, 0 colonies; any colonization triggers rapid removal). Approximate project % cover; no less than 10%, not to exceed 50%.
- Target: 5 years.
- Key ecological functions: the dense sward of rhizomatous grass-like vegetation establishes a relatively erosion-resistant sod, maintains highest primary productivity, and also accumulates soil organic matter as well as peat-like surface accretion. Strong resistance to weed invasion due to thick litter mat and dense sod/root mat. The canopy provides nesting and foraging habitat for riparian birds. The physiologically connected rhizome mat also enables the seaward end of the sward to tolerate brief episodes of seawater flooding by translocating fresh water to shoots. Below-ground production (roots, rhizomes) provides labile carbon sources for microbial activity driving biogeochemical processes essential to water quality improvements. Root and rhizome channels (piping) incrementally improve hydraulic conductivity of clayey bay mud.

5.1.4. ***Freshwater riparian scrub***

- Objectives: native scrub patches, discrete local distribution. *Two types*: willow scrub/woodland, mixed riparian scrub. Willow patches should be few and large (1-3 total, located at the end of the wetland slopes; patch size diameter approximately 30 (to 40) ft, 10% cover willow canopy, with some sedge ground layer (circa 20%). Mixed riparian scrub patches should range 3-5 m diameter, located near the wetland slope toe (tidal marsh edge) or trail edge. Planting density (vegetative transplants; pre-rooted stakes or bare-root dormant whole plants) within patches: willows, 1-3/10 $m^2$; other scrub species, 1-2/ $m^2$.
- Target: 5 years
- Key ecological functions: Highly productive habitat with complex canopies provides rich foraging habitat for riparian birds and mammals, habitat for diverse invertebrate communities, and high evapotranspiration. Functions and resilience depend on freshwater seepage year-round for resistance to injury or mortality from episodic seawater flooding

and sea level rise. Below-ground production (roots, rhizomes) provides labile carbon sources for microbial activity driving biogeochemical processes essential to water quality improvements.

5.1.5. ***Interim (early succession, < 5 yr) criteria for constructed wetland slope***.

- Objectives: Post-construction wetland slopes should be planted with vegetative propagules of native perennial plants at high density (mean range 1-3/$m^2$) and sown with native annual "cover crop" at high density (aggregate all species, mean density exceeding 500 seed/$m^2$). First year cover annual cover crop may include saltgrass, and should exceed 90% by May. Clonal perennial cumulative cover at the end of the first growing season should not be less than 10% by end September. Successional non-native annual plant cover up to 30% by May should be tolerated. The perennial wet meadow and marsh cover crop should be composed of a majority of *Epilobium ciliatum, Hemizonia congesta, Centromadia pungens, Persicaria punctata,* and *Juncus bufonius*. Total native perennial cover by the end of the second growing season should exceed 30% in any 5 m diameter patch. Perennial non-native invasive plant colonies (including *Lepidium latifolium, Phalaris aquatica, Dittrichia graveolens, Phragmites australis*) should not exceed 1 m diameter or produce viable seed before removal (in the same growing season as detection) during the interim period.
- Target: over 90% native perennial cover by year 5.
- Key ecological functions: Pre-emption of rapid colonization, establishment, and dominance of widespread invasive weed seedlings; managed competition based on sequence (priority) of high seedling numbers of highly competitive, natural pioneer annual forbs with life-history and seasonal development similar to target weeds. Rapid surface soil stabilization by fall-winter root networks and above-ground foliar cover. Abundant pollinator foraging habitat. Facilitation of native perennial graminoid and forb establishment, or minimize competition with native perennials relative to impacts of weed invasion.

5.1.6. **General vegetation performance rejection criteria**. Any consecutive years of significant net decline in cover of native perennial vegetation, or large contiguous patches of mass dieback (mortality below and above-ground) indicate failure of progress, and should trigger immediate corrective measures based on expert evidence-based assessment of declines. Any rapid invasion or consecutive years of net spread by non-native invasive species (including project edges, outside managed target areas) indicate a need for rapid implementation of control measures (same growing season, prior to seed maturation).

**5.2. Proposed ecological objectives and criteria for flood control levee and trail.**

**5.2.1. Trail edges** should be dominated by native creeping sod-forming perennial grasses and forbs to provide ongoing suppression of disturbance-tracking annual nuisance weeds (e.g., *Centaurea solstitialis, Dittrichia*), in clay loam substrate. Trail edge plant assemblage must include *Elymus triticoides* as dominant, with *Ambrosia psilostachya, Iva axillaris, Cressa truxillensis, Frankenia salina,* and *Distichlis spicata* associated. Trail berm slope below the edge should be dominated by *Elymus triticoides,* interspersed with managed (brush-cut periodically to a height of less than 1.5 m) patches of mixed native riparian and upland scrub (*Baccharis pilularis, Rosa californica, Sambucus nigra, Heteromeles arbutifolia*)

**5.2. Levee slopes** should be capped with clay loam substrate to a depth of 1.5 ft to support dominant native perennial grassland to stabilize slopes and provide continuous wildlife cover (*Elymus triticoides),* diversified with associated perennial alkali grassland forbs and grasses (*Iva axillaris, Cressa truxillensis, Frankenia salina, Chlorogalum pomeridianum*) and annual forbs (*Centromadia pungens, Madia sativa, Hemizonia congesta, Amsinckia intermedia*). Annual native forbs should be sown as a cover crop on newly constructed levee slopes at an aggregate density of 500 seed/ $m^2$), with first-year cover criterion of 90% by June.

**5.3. Planting and propagation overview**

The specification for revegetation methods and materials should be developed for detailed implementation in a stand-alone revegetation plan. An overview of methods and materials is provided here for project planning.

Planting stock needs to be field-collected from the nearest natural (spontaneous) source populations in adjacent watersheds or bayshores. A two-year lead time should be planned for propagation of sufficient quantities of seed stock and perennial rootstock. Nursery-grown container stock is not recommended as the primary planting stock for rhizomatous perennial species. Optimal unit cost for production and transplant vigor would be provided by <u>bulk translocation of dormant rootstock</u> (rhizome fragments basal shoot crowns with attached roots, rhizomes) <u>shallowly planted manually or graded into the top 15 cm of substrate while dormant</u> in fall (dry soil), gently compacted (sheepsfoot roller) immediately prior to the first predicted major rainfall events of fall or early winter. Bulk propagation of perennial and annual species in either raised beds or open field plots, allowing lateral spread of rhizomes and unconfined root spread, is strongly recommended to achieve low cost/unit, high vigor transplant units and very large quantities of seed needed. Spring planting is not recommended; planting during the dormant late fall to early winter period is strongly recommended. Late winter or spring planting increases risks of transplant mortality, and significantly increases risk of non-native species invasion (competitive advantage of pre-emption or colonization sequence effects)

**5.4. Grading, topography and substrate specifications matching vegetation types.** Low-relief topographic variation should be incorporated in the grading plan for the wetland slope, providing small but ecologically significant variations in soil waterlogging, drainage, and near-surface sediment texture.

- <u>Low relief (scale: 10-20 cm) swales or troughs aligned with the slope</u>, and <u>closed, undrained depressions</u>, would be conducive to hydrology and soil conditions supporting freshwater marsh vegetation.
- <u>Gentle convex surfaces</u> (positive drainage), with slightly increased silt or fine sand content of loam (not to exceed 10% fine sand), would be conducive to persistent local dominance by wet meadow.
- <u>Local small-scale coarser sandy loam with shallow groundwater in depressions</u> would be suitable for local willow groves (*Salix* spp.) at the project margins.

- Sandy loams with convex surface topography above shallow groundwater (avoiding persistent surface saturation) would also be suitable for designated areas of mixed riparian scrub.

**5.5. Trail and public access considerations for wildlife and weed management.**
Public trails are vectors for weed dispersal and colonization because people and bicycles carry weed seeds, and trampling disturbance creates weed seedling colonization opportunities. Public trails for recreation and viewing would be most compatible if set back as far as possible from sensitive wetland habitats. Locating the trail at the top of the levee would provide the optimal, maximum buffer zone and set-back distances for wildlife habitat. Maximum set-back distance would also maximize weed dispersal distances from target habitats, especially during early succession on the constructed wetland slope. Aligning the public trail at the levee crest would also provide maximum elevation for scenic vistas, and minimal conflict with vegetation canopy height for views.

**5.6**. **Mosquito control considerations for wildlife and marsh impact minimization.** The gravel subsurface flow design (based on Oro Loma hydraulic conductivity designs for denitrification and seepage flow rate management) provides some "upwelling" potential for slow-flowing surface springs on the wetland slope, under dense vegetation with abundant organic matter. This provides a high risk for localized floodwater mosquito production habitats. Mosquito production would also be increased if groundwater emergence includes elevated levels of biologically available nitrogen, if denitrification removal is insufficient during low temperature periods or episodes of overland wastewater flow. The site and vicinity are sensitive receptors (residential, commercial, and recreational uses on or adjacent to the site) for mosquito nuisances. Mosquito control would likely require vehicular access (ATV) to the constructed wetland slope, and possibly vegetation management (mowing for access of BT applications). These would be incompatible ongoing impacts for wildlife habitat objectives, and the disturbances would likely increase risks of non-native invasive weed spread. Alternative design solutions to avoid these potential conflicts or impacts may include:

- Locating the proposed gravel upwelling zone as close as possible to the maintenance vehicle access path along the levee crest, where vegetation is maintained low height for views, and potential production sites are in reach of vehicle equipment.
- Modifying the denitrification zone to an analog of efficient compact denitrification walls with minimal 6 hr retention times (meta-analysis: Addy *et al.* 2016, J. Environ. Qual. 45:873–881), and locating the "bioreactor" discharge at the top of the wetland slope, either immediately below or above the trail.

**5.7. Wave energy dissipation by the alkali bulrush (brackish marsh) zone of the ecotone**.
The dissipation of estuarine storm wave energy by tidal marsh vegetation friction is influenced primarily by the height, density, and flexibility of partially submerged marsh vegetation, and the width of the vegetation. Alkali bulrush stands, especially those growing in the lower end of the mesohaline salinity range, are generally taller and more dense than native cordgrass, and are significantly taller and denser than all other salt marsh vegetation types. The width, density, and height of the alkali bulrush zone generated by the wetland

levee seepage should be factored into (reduced) wave runup estimates for the flood control levee crest elevation, and levee dimensions. In addition, monitoring wave decay through the bayward edge of the alkali bulrush zone, compared with wave decay through adjacent salt marsh vegetation types with similar incident wave energy, should be considered for monitoring and research. The vegetation of the terrestrial wetland slope itself is unlikely to undergo any wave interactions after alkali bulrush zone develops in the tidal marsh, because the alkali bulrush zone is likely to intercept and damp all storm wave action within the basin.

### 5.8. Levee and seepage slope area ratio: landscape-level habitat considerations

The SAFER levee shown in Figure 3 (ESA concept design memo, Phase I plan view) and Figures 4-5 (cross-sections) is large relative to the wetland slope habitat created; about a quarter of the cross-section in wider segments, and about 1:1 or less in the narrower southern sections. This may be a concern for resource agencies and wetland advocates with policies favoring sea level rise resilience of marshes, given that flood control levees and ramps for high tidal marsh migration compete for accommodation space. It is likely a substantial issue for project evaluation and public support.

Given the engineering constraints for flood control levees, this apparent competition for ecological and flood control space could be mitigated by maximizing the wildlife and native plant habitat support provided by the flood control levee, and minimizing public access trail conflicts with wildlife. Possible measures to achieve this may include:

- Minimal adjustment of the public access trail and platform as close as possible to the levee crest, farthest back from the upper wetland seepage slope.
- Incorporation of a trail border vegetation design for weed management, scenic views and vegetative restriction of access including:
    - Sod-forming, creeping perennial grass and sedge vegetation belt bordering the trail edge to restrict annual weed growth (dense sod), compatible with mowing and irrigation, but incompatible with herbicide use, as described above at 5.2.1.
    - Low native riparian scrub borders below the perennial creeping grass and sedge belt, restricting passage of dogs and people downslope without fences that impede terrestrial wildlife movements, also compatible with irrigation and periodic brush-cutting to a height of 3-4 ft: *Rosa californica* (30-50%), *Sambucus nigra*, *Rubus ursinus*, *Baccharis pilularis*, *Baccharis glutinosa*.

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# Appendix B
## Geotechnical Memorandum

ESA

# Memorandum

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|---|---|
| Date: | Friday, September 18, 2020 |
| Project: | Palo Alto Horizontal Levee |
| To: | Liane Ware, PE and Mark Lindley, PE; Environmental Science Associates (ESA) |
| From: | Edwin Woo, PE, GE; HDR; reviewed by Victor Crosariol, PE; HDR |
| Subject: | Conceptual Level Geotechnical Considerations and Recommendations |

This memorandum presents conceptual level geotechnical considerations and recommendations for the Palo Alto Horizontal Levee (PAHL) project. The proposed PAHL site is located across the southern end of Embarcadero Road from the Palo Alto Regional Water Quality Control Plant (RWQCP) in an area along the bay shoreline that is referred to as Harbor Marsh. As currently envisioned, the San Francisquito Creek Joint Powers Authority (SFCJPA) will be designing and constructing a flood control levee between Embarcadero Road and the PAHL as part of the SAFER Bay project. The SAFER Bay levee is currently in the feasibility design phase.

Based on a conceptual design developed by ESA, the PAHL will consist of a gently sloping area with slope inclinations on the order of 15:1 (horizontal to vertical) in the treatment zone and 30:1 in the habitat zone, along the bay shoreline to provide transitional habitat between tidal wetlands and terrestrial uplands. The horizontal levee will include a gravel treatment zone to enable the polishing treatment of wastewater from the RWQCP prior to discharge to the bay. The gravel treatment zone will be fed with wastewater through a series of eight, 3- to 4-inch diameter pipelines that will cross beneath the future SAFER Bay levee. A figure prepared by ESA showing this conceptual design is attached.

# Subsurface Conditions

HDR reviewed previous geotechnical studies performed in the immediate vicinity of the proposed PAHL to obtain information on subsurface conditions to serve as a basis for developing preliminary geotechnical considerations and recommendations for the PAHL. The previous studies reviewed include the following:

- A draft feasibility level geotechnical study by HDR for the SAFER Bay project (HDR, 2016);

- A draft geotechnical investigation report by McMillen Jacobs Associates (MJA) for a proposed outfall leading from the RWQCP to an unnamed slough north of the PAHL area (MJA, 2017).

The HDR SAFER Bay geotechnical study included one test boring (B-07) and one cone penetrometer test (C-09) performed along Embarcadero Road in the vicinity of the proposed PAHL. The subsurface conditions encountered in these explorations consisted of fill overlying Young Bay Mud which in turn, overlies alluvial deposits that extended to the maximum depth explored of about 60 feet. The fill encountered is variable in composition but generally consisted of medium dense clayey sand and relatively soft sandy silt, and extended to depths of about 9 to 12 feet. Beneath the fill, Young Bay Mud was encountered to depths of about 21 to 23 feet. The Young Bay Mud generally consists of soft to medium stiff fat clay. Beneath the Young Bay Mud, alluvial deposits generally consisting of interlayered stiff to very stiff lean clay with varying amounts of sand and silt, and loose to dense clayey sand and sand with clay and gravel, were encountered to the maximum depth explored of about 60 feet. The subsurface conditions encountered in the MJA explorations are generally consistent with those encountered in the HDR explorations.

Water judged to be perched water was encountered in Boring B-07 at a depth of about 2.5 feet, corresponding to Elevation 8.5 feet (North American Vertical Datum, NAVD) at the time of drilling. The boring may not have been left open for a sufficient amount of time to establish equilibrium groundwater conditions. Given the proximity of the bay, it is anticipated that groundwater levels at the site are likely to be tidally influenced and near high water levels. ESA reported in a previous project memorandum (ESA, 2018) mean higher high water (MHHW) and mean high water (MHW) levels along the Embarcadero Road shoreline at Elevation 7.5 and 6.9 feet, respectively.

# Geotechnical Considerations and Recommendations

The following presents conceptual level geotechnical considerations and recommendations for the proposed PAHL project.

## SAFER Bay Levee Configuration

As part of the geotechnical study for the feasibility phase of the SAFER Bay project, HDR had performed geotechnical stability and seepage analysis for a levee along this same portion of Embarcadero Road, across from the RWQCP. The configuration of the levee that was analyzed had a target final crest height of Elevation 16 feet (North American Vertical Datum, NAVD), crest width of 20 feet, and 3:1 (H:V) side slopes. This geometry is similar to the SAFER Bay levee that is being considered by ESA for the PAHL, with the main exception that the ESA PAHL concept also includes a 12-foot wide trail atop a berm at Elevation 13 feet along the bayside slope of the future levee (see attached ESA figure). Thus, it is HDR's judgment that these previous analyses can provide a basis for developing conceptual level geotechnical considerations and recommendations for the proposed PAHL project.

The loading from the future SAFER Bay levee will cause settlement over time, primarily due to the consolidation of the underlying Young Bay Mud. Based on our previous settlement analysis, HDR judges that this portion of the SAFER Bay levee should be overbuilt by about 1.5 feet, or to Elevation 17.5 feet, to achieve a target crest elevation of 16 feet. Based on our previous settlement analysis, HDR judges that this levee can be constructed to its final target crest height of Elevation 17.5 feet in a single stage of construction while maintaining the required factor of safety against end-of-construction instability (the critical case). However, the SAFER Bay project can elect to construct this levee in more than one stage. To accommodate the anticipated overbuild height and intermediate terrace for the pedestrian trail, a wider levee footprint than the standard levee template geometry should be provided. For conceptual planning purposes, we recommend that a minimum 75-foot wide zone be provided for the proposed levee and trail, measured from the landside levee toe to the edge of the gravel treatment zone. This width is about 10 feet more than what is available for the levee corridor, as shown on the attached figure from the ESA. To provide the width needed for the future SAFER Bay levee, it may be necessary to incorporate the berm into the levee, and relocate the trail atop the levee.

## Considerations for Levee Fill Composition

The SAFER Bay levee should be constructed of low to medium plasticity cohesive soil that exhibits low shrink and swell potential, and provides resistance to external and internal erosion. Specific levee fill requirements will be developed during the design phase of the SAFER Bay project. Alternatively, if this portion of the SAFER Bay levee is constructed as part of the PAHL project, levee fill requirements can be developed during the design phase of this project. It is anticipated that imported fill will be required to meet these fill material requirements and to provide the quantity of fill needed.

## Construction Sequencing Considerations

As noted above, loading from the future SAFER Bay levee will cause settlement over time, primarily due to the consolidation of the underlying Young Bay Mud. The pipelines that will cross beneath the levee to feed wastewater from the RWQCP to the gravel treatment area will also experience settlement due to this loading. If the levee were to be constructed in a single stage to its final target height of Elevation 17.5 feet, HDR estimates the resulting magnitude of total settlement to be on the order of 1 to 1½ feet beneath the centerline of the levee, with less settlement toward the toes of the levee. HDR estimates that the large majority of this settlement would occur within the first year after levee construction, with less settlement occurring at a slower rate in subsequent years. If the levee were to be constructed in stages, settlement would occur after each stage of loading. For example, if the levee were to be constructed to the elevation of the proposed trail in the first stage of loading, the portion of the total settlement that corresponds to this load would occur, with the large majority of it occurring within the first year following construction. If the levee were then constructed to its final target height at a later time, it would initiate additional settlement. Similar to the response to the first stage of loading, the large majority of settlement that corresponds to this second stage of loading would occur within the first year after loading.

From a geotechnical perspective, we judge that constructing the levee in a single stage or in two stages would be acceptable. As currently envisioned, the fill for the new trail overlaps or abuts the gravel treatment zone. If the levee were to be constructed in two stages, we judge that the first stage of construction should place fill to at least the level of the trail. Because of anticipated settlement, for conceptual planning purposes, the full width of the levee should be constructed to at least Elevation 14 feet, to achieve a target elevation of 13 feet for the trail. Because of the close proximity of the levee to the gravel treatment zone, we recommend that at least the first stage of the levee be constructed at the same time as the gravel treatment zone and horizontal levee. Constructing these overlapping/abutting elements concurrently should help reduce negative impacts of construction and settlement.

Because consolidation settlement occurs over time after the soil is loaded, likely the only way to significantly reduce settlement of the pipelines would be to construct the levee to its final target height well in advance (one year or more) of installing the pipelines. This may not be considered practical or desirable as it would require that large portions of the levee be excavated at a later time to install the pipelines, then reconstructed. The other approach would be to install the pipelines prior to levee construction and plan for the anticipated settlements in their design. Pipeline design considerations are discussed in the following section.

## Pipeline Design Considerations

### New Pipelines

The following design measures should be considered for the new pipelines that will discharge wastewater into the gravel treatment zone.

- Install the pipelines at an elevation that is 1 to 1½ feet higher than their final target elevation so that they are closer to their desired elevation after the levee-induced consolidation settlement has occurred.
- The largest magnitude of settlement is expected to be beneath the centerline of the levee, with less settlement toward the levee toes. Consideration can be given to installing the pipelines with a slight upward arc so that they will be closer to level following the levee-induced settlement.
- Use flexible joints or elbow joints between pipeline sections and at pipeline connections to structures such as vaults, to better accommodate the anticipated settlements.

It is generally not recommended that pipelines be located beneath or within 10 feet of the toes of levees, as pipelines and conventionally backfilled pipeline trenches can serve as pathways that increase the potential for seepage, internal erosion, and other related consequences that can impact the integrity of the levee. However, in this situation, rerouting these pipelines does not appear to be feasible. Therefore, measures will need to be undertaken to protect the levee and pipelines. These measures include using a relatively impervious backfill around the pipes instead of conventional pervious soil backfill material. Impervious backfill materials that can be considered include low density cellular backfill material or controlled low strength material (CLSM). Low density cellular backfill is lighter than CLSM and would not add new net load to initiate additional consolidation settlement. However, since the large majority of the new load will be from the future SAFER Bay levee, this benefit may be negligible. These considerations can be developed more fully during the design phase.

### Other Considerations

Consideration was given to routing new pipelines over the top of, rather than underneath, the levee. We judge that this is not a desirable option for the following reasons:

- Local stakeholders and other interested parties generally do not favor exposed "unnatural" elements such as pipelines;
- Security and safety concerns of exposed elements;

- The pipelines hinder access to vehicles and pedestrians during both normal usage and during critical times such as periods of flood fighting; and
- As the levee settlement is primarily due to consolidation of the underlying soft Young Bay Mud, which effects the entire levee, routing pipelines over the top, as opposed to underneath the levee, would not reduce the magnitudes of settlement they experience.

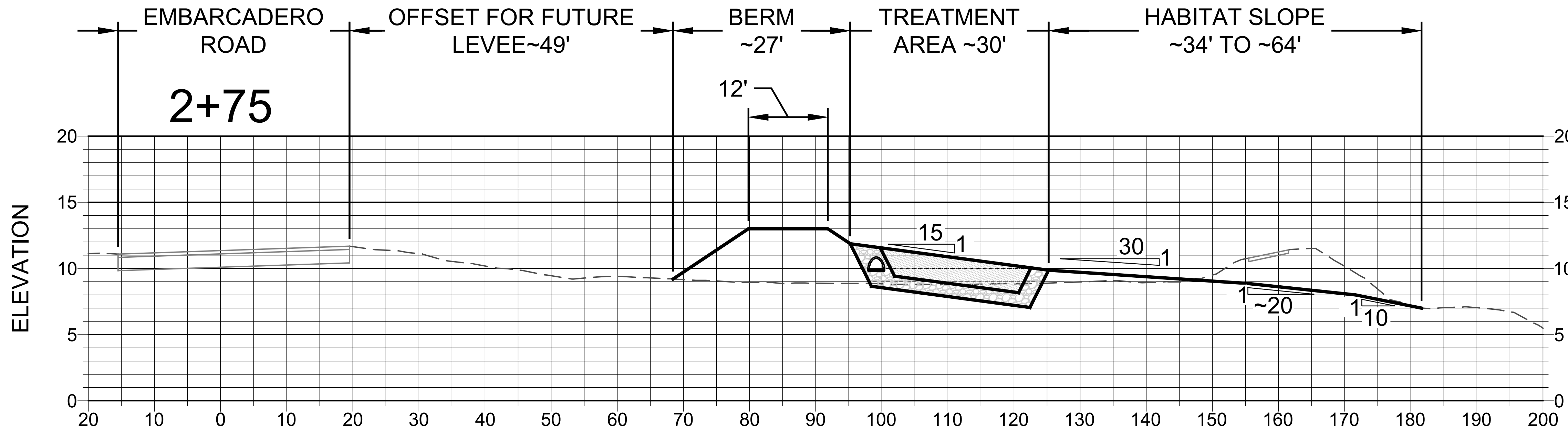
Wastewater will be discharged into the gravel treatment zone, which will then seep into the horizontal levee, on a near-continuous basis. During the design phase, consideration should be given to the material size and gradation of the fill materials used, so that appropriate levels of seepage and filtration can occur, while limiting the potential for internal erosion and maintaining the integrity of the SAFER Bay levee and PAHL.

# References

Environmental Science Associates, memorandum with subject “Horizontal Levee Conceptual Designs for Palo Alto Regional Water Quality Control Plant,” dated September 13, 2018.

HDR, “Geotechnical Report for the Feasibility Phase, SAFER Bay Project, Task Order No. 2,” draft dated July 2016.

McMillen Jacobs Associates, “Geotechnical Engineering Investigation Report, City of Palo Alto: Regional Water Quality Control Plant, New Outfall No. 1 Project,” draft dated June 29, 2017.




A
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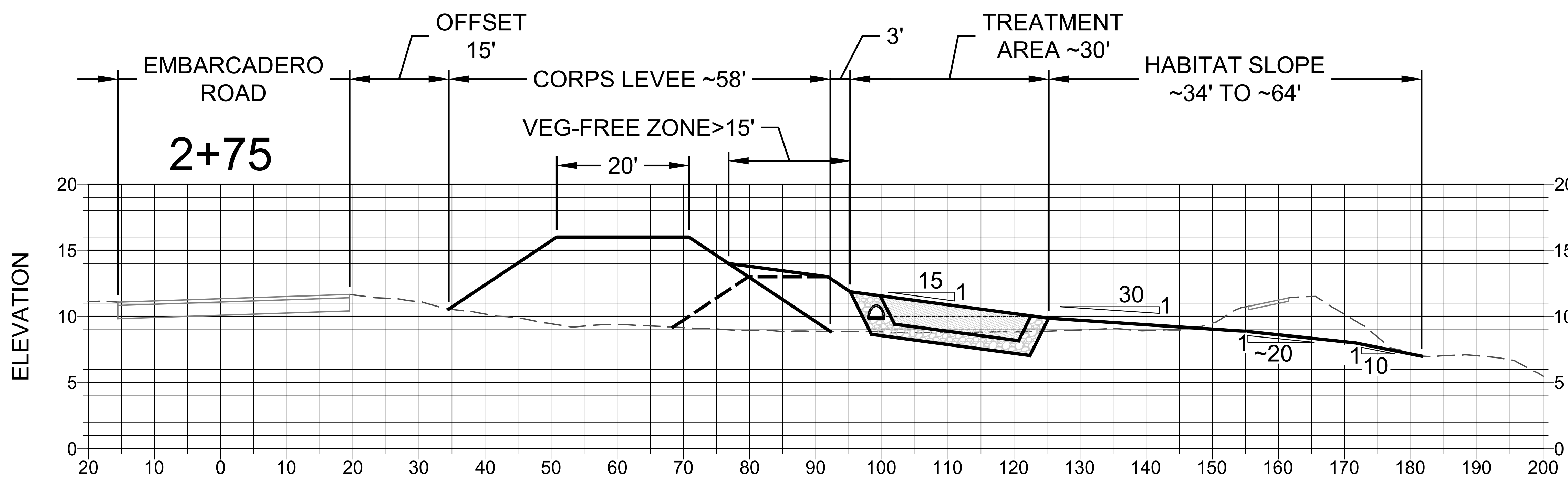
## HORIZONTAL LEVEE - PHASE 1

TYPICAL SECTION - CITY OF PALO ALTO

SCALE: 1" = 20' H
1" = 10' V




B
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## HORIZONTAL LEVEE - BUILD-OUT

TYPICAL SECTION WITH CORPS LEVEE

SCALE: 1" = 20' H
1" = 10' V

5
3
3
5
11
10
9
10
11
10
11
11
8
10
9
10
5+00
4+00
3+00
2+00
1+00
0+00
A&B
TYP
N
40
20
0
40
80
1"=40'
SCALE
FEET

# Appendix C
## Piping Memorandum

# Memo

| | |
|---|---|
| Date: | Tuesday, October 20, 2020 |
| Project: | City of Palo Alto Horizontal Levee |
| To: | Mark Lindley, ESA |
| From: | Tom Hoffman, HDR |
| Subject: | Horizontal Levee MEP Conceptual Description |

The horizontal levee piping will connect to the existing 12" HDPE pipe to the freshwater pond near where it exits the effluent junction box on the north side of the chlorine contact tank on the City of Palo Alto RWQCP site. This existing 12" pipe conveys a constant flow of approximately 3 mgd to the freshwater pond. The anticipated pressure available is approximately 25 psi at the connection location and has an expected cover depth of 3'-6".

The proposed forcemain to the horizontal levee is anticipated to be a 6-inch PVC pipe based on the current flow demands. This pipe will include an isolation valve, check valve, flow meter, and a flow control valve (Cla-Val model 40-01, 100-01 or similar). These items are proposed to be located above grade near the effluent junction box on the WWTP site. The system will operate in ON/OFF mode at a set flow rate, which will be adjustable. Based on the flow demands for a given day, the system operating duration will change to provide the total day flow demand. Table 1 shows the preliminary flow demands provided to HDR. Table 2 below provides the anticipate flow rates and operational hours per day at maximum and minimum day demands.

**Table 1. Preliminary Flow Demands.**

| Flow Condition | Project Phase | Value | Units |
|---|---|---|---|
| Minimum Day | Pilot | 9,300 | gpd |
| Maximum Day | Pilot | 77,100 | gpd |
| Minimum Day | Buildout | 56,100 | gpd |
| Maximum Day | Buildout | 293,800 | gpd |

**Table 2. Preliminary Flow Set Points at Phase 1 and Buildout.**

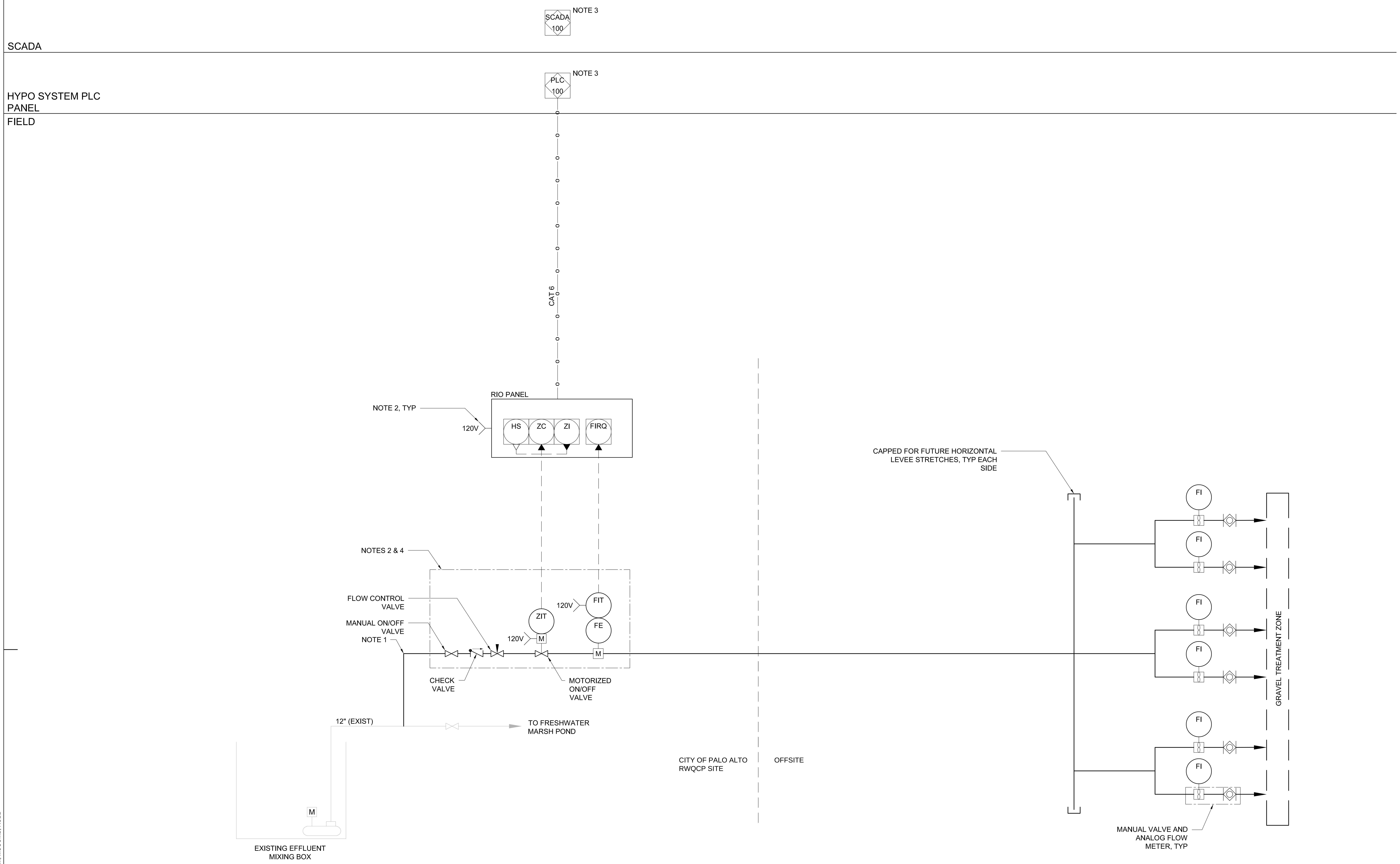
| Phase 1 - Flow Set Point | Project Phase | Value | Units |
|---|---|---|---|
| Set flow rate | Pilot | 100 | gpm |
| Time on @ min demand / day | Pilot | 1.56 | hrs |
| Time on @ max demand /day | Pilot | 12.9 | hrs |
| **Buildout - Flow Set point** | **Project Phase** | **Value** | **Units** |
| Set flow rate | Buildout | 220 | gpm |
| Time on @ min demand / day | Buildout | 4.3 | hrs |
| Time on @ max demand /day | Buildout | 22.3 | hrs |

The flow durations for each day will be programmable. The level of control input will be based on ESA/ecologist input during the subsequent design phases, but the system could be set up to operate based on daily flow demands without daily user input. The flowmeter and flow control valve inputs and outputs (I/O) will terminate to a remote input/output panel (RIO panel), which will be provided near the effluent junction box. The RIO panel will communicate with the hypochlorite PLC using ethernet protocol via a CAT 6 connection. An ethernet communication card will be required to connect to the new RIO.

Power to the RIO panel, flow control valve, and flowmeter will be obtained from a panelboard located at the UV system motor control center and is estimated to be about 20 amps.

After the main to the horizontal levee travels off the WWTP site, the main will tee off to the levee distribution system. The distribution system will be PVC piping to each levee zone. The flows will be manually balanced via analog flow meters and valves into each levee zone. The system will operate at a set flow rate. Once the system is balanced at a set flow rate, no additional manual balancing will be required. However, annual or quarterly review of levee conditions should be monitored to ensure that the flow balance is maintained over the longer term.

Figure P01 provides a preliminary process and instrumentation diagram for the Horizontal levee feed system.




## HORIZONTAL LEVEE

## NOTES:

1. PIPE SIZE TO HORIZONTAL LEVEE TO BE BETWEEN 4" AND 8". FINAL SIZING TO BE DETERMINED DURING DETAILED DESIGN.
2. 120V POWER TO COME FROM 120V PANELBOARD LOCATED NEAR THE UV SYSTEM MCC.
3. DATA CONNECTION FOR REMOTE I/O PANEL TO COME FROM THE CHLORINE SYSTEM PLC PANEL. FLOWMETER AND VALVE TO BE CONTROLLED AND MONITORED BY SCADA.
4. PIPE HEADER AND RIO PANEL TO BE LOCATED NEAR EXISTING EFFLUENT BOX ON THE WWTP SITE.

C:\Users\rmccomb\Desktop\Palo Alto\P&ID.dwg
10/20/2020 10:46 AM, MCCOMB, ROBB

| ISSUE | DATE | DESCRIPTION |
|---|---|---|

| | |
|---|---|
| PROJECT MANAGER | L. MESBAH |
| DESIGNED BY | T. HOFFMAN |
| DESIGNED BY | |
| CHECKED BY | |
| DRAWN BY | R. McCOMB |
| DATE | OCTOBER 2020 |
| PROJECT NUMBER | X |

**City of Palo Alto**
**Water Treatment Plant**
**HORIZONTAL LEVEE PROJECT**

**PROCESS AND INSTRUMENTATION DIAGRAM**

**HORIZONTAL LEVEE FEED**

0 1" 2"

| | |
|---|---|
| FILENAME | P&ID.dwg |
| SCALE | NONE |
| SHEET | P01 |

HDR

| | | | | | Calc. No. | 2 |
|---|---|---|---|---|---|---|
| **Computation** | | | | | | |
| ***Project:*** | Palo Alto - Horizontal Levee Phase 1 | | | | ***Computed:*** | TH |
| ***Subject:*** | Conceptual Design Level - MEP Estimate | | | | ***Date:*** | 10/10/2020 |
| ***Task:*** | Engineers Opinion of Probable Construction Costs | | | | ***Reviewed*** | LM |
| | | | | | ***Date:*** | 10/10/2020 |
| **DESCRIPTION** | | | **QUANTITY** | **UNITS** | **UNIT COST** | **TOTAL COST** |
| | | | | | | |
| **DIVISION 1 - GENERAL REQUIREMENTS** | | | | | | |
| | Mobilization | | 1 | LS | 2.00% | $4,600 |
| | Demobilization | | 1 | LS | 1.00% | $2,300 |
| | Bonds, Insurance, etc. | | 1 | LS | 2.00% | $4,600 |
| | Schedules and Updates | | 1 | LS | 2.00% | $4,600 |
| | Temporary Facilities/Fencing/Offices | | 1 | LS | 4.00% | $9,200 |
| | As-Built Documents | | 1 | LS | 1.50% | $3,500 |
| | Facilities Start-up, & Testing | | 1 | LS | 2.00% | $4,600 |
| | Permitting | | 1 | LS | 3.00% | $6,900 |
| | | **DIVISION SUBTOTAL** | | | | **$40,300** |
| **DIVISION 2 - SITE WORK** | | | | | | |
| | Pavement Cutting, Demo, and Patching | | 4,400 | SF | $9 | $39,600 |
| | Pipe Connection to Existing | | 1 | LS | $1,500 | $1,500 |
| | | **DIVISION SUBTOTAL** | | | | **$41,100** |
| **DIVISION 3 - CONCRETE** | | | | | | |
| | Miscellaneous Concrete | | 1 | LS | $2,500 | $2,500 |
| | | **DIVISION SUBTOTAL** | | | | **$2,500** |
| **DIVISION 5 - MISCELLANEOUS METALS** | | | | | | |
| | Miscellaneous metals | | 1 | LS | $5,000 | $5,000 |
| | | **DIVISION SUBTOTAL** | | | | **$5,000** |
| **DIVISION 9 - FINISHES** | | | | | | |
| | Protective Coatings | | 1 | LS | $5,000 | $5,000 |
| | | **DIVISION SUBTOTAL** | | | | **$5,000** |
| **DIVISION 15 - MECHANICAL** | | | | | | |
| | 8" PVC, C900 Main, 3-ft cover | | 1,245 | LF | $80 | $99,600 |
| | 8" DIP, Main, above grade | | 20 | LF | $200 | $4,000 |
| | 4" PVC C900, Distribution Header, 3-ft cover | | 350 | LF | $50 | $17,500 |
| | Distribution Connection, including analog FM and Valve | | 8 | EA | $2,000 | $16,000 |
| | Flow Control Valve | | 1 | EA | $15,000 | $15,000 |
| | 8" Flow Meter | | 1 | EA | $15,000 | $15,000 |
| | 8" Check Valve | | 1 | EA | $2,500 | $2,500 |
| | 8" Butterfly Valve | | 1 | EA | $2,000 | $2,000 |
| | Pipe Supports | | 1 | LS | $2,500 | $2,500 |
| | | **DIVISION SUBTOTAL** | | | | **$174,100** |
| **DIVISION 16 - ELECTRICAL AND INSTRUMENTATION** | | | | | | |
| | Electrical | | 15% | % | $35,000 | $35,000 |
| | Instrumentation and Controls | | 5% | % | $12,000 | $12,000 |
| | | **DIVISION SUBTOTAL** | | | | **$47,000** |
| | | | | | **ONSITE CONSTRUCTION (LESS DIV 1, DIV 16) SUBTOTAL** | **$227,700** |
| | | | | | **ADDITIVE FOR DIV 1 AND DIV 16** | **$87,300** |
| | | | | | **ESTIMATION CONTINGENCY (30%)** | **$94,500** |
| | | | | **TOTAL** | | **$409,500** |

# Appendix D
Permitting Strategy Memorandum

ESA 50 YEARS 1969-2019

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San Francisco, CA 94108
415.896.5900 phone
415.896.0332 fax

esassoc.com

# Memorandum

| | |
|---|---|
| date | December 18, 2020 |
| to | City of Palo Alto and the San Francisco Estuary Partnership |
| cc | Mark Lindley, Christie Beeman, and Marisa Landicho (ESA) |
| from | Priya Finnemore (ESA) |
| subject | Palo Alto Horizontal Levee Pilot Project - Permitting Strategy |

## Introduction

This Permitting Strategy Memorandum (memo) presents the anticipated environmental permits or approvals required for the Palo Alto Horizontal Levee Pilot Project (PAHLPP, or Project), as well as summarizing anticipated challenges and suggested strategies. The San Francisco Estuary Partnership (SFEP), in partnership with the City of Palo Alto (City), proposes the pilot construction of a horizontal levee, which will enhance the ecological function of the adjacent Harbor Marsh by converting ruderal upland areas to freshwater marsh and transitional brackish ecotone slopes. This memo is an update to an earlier December 2019 memo prepared for an alternate site adjacent to the City of Palo Alto Airport, formerly referred to as the 'Embarcadero Road' site (Central Reach). The newly-selected site is located adjacent to the Palo Alto Regional Water Quality Control Plant (RWQCP) and Byxbee Park, along the southwestern edge of Harbor Marsh (South Reach, or Project site) in the City of Palo Alto, California, as depicted in **Figure 1** and further detailed below. The Project has applied for a Proposition 1 grant to further Project design and implementation. If successful in obtaining a grant and timely permits, the Project would aim to be constructed in 2023.

Due to the proposed Project's location in and adjacent to the waters of the San Francisco Bay, as well as the presence of regulated biological and cultural resources within the Project vicinity, the Project is expected to require a number of local, state, and federal regulatory permits and/or approvals. **Table 1** outlines the anticipated permits or approvals required, including the regulatory agency responsible for the permit or approval, permit trigger(s), key notes about permit acquisitions, and the approximate acquisition/approval timelines expected. A "typical" environmental compliance (CEQA + Permitting) process and timeframe for a project involving in-water work in the San Francisco Bay area is presented in **Figure 2**.

A discussion of the anticipated permitting challenges and some suggested strategies for increasing permitting success follows.

# Project Understanding and Background

## Project Objectives

Horizontal levees provide multiple ecological and environmental benefits. Depending on a project's priorities, the design approach can focus on enhancing one or more potential benefits. The City of Palo Alto has identified the following project objectives for the horizontal levee, in order of priority:

- Improve habitat along the perimeter of Harbor Marsh for native species. Restore rare and historic broad ecotone that supports a variety of transitional plant assemblages including riparian scrub, wet meadow, freshwater marsh, and narrow band of brackish alkali-bulrush wetland within the adjacent salt marsh.
- Adapt to sea level rise by providing a transitional slope that will support freshwater plants, which in turn build organic soils, all of which is aimed at keeping pace with sea level rise. With rising water levels, saltmarsh will gradually migrate up the slope, providing transgression space for up to three feet of sea level rise.
- Reduce flood risk by integrating a horizontal levee on the outboard side of a traditional flood control levee providing wind-wave attenuation and vegetative erosion protection for the flood control levee core.
- Provide polishing treatment to discharged treated wastewater.
- Maintain public access to the existing trail system while providing opportunities for compatible low-impact recreation, increased social infrastructure, and educational opportunities on sea level rise. Ensure perspectives of marginalized communities are incorporated into social infrastructure and educational components.
- Be on the leading edge of integrating habitat enhancement with sea–level-rise adaptation and novel wastewater treatment approaches around the San Francisco Bay. Collect data and information that could support broader implementation of horizontal levees as components in larger flood control levee improvement projects within Palo Alto and beyond.

The following key concerns expressed by the City and project team members have been used to guide the Preliminary Design development:

- Minimize operational complexity and maintenance required by City staff.
- Avoid substantial land use compatibility conflicts and increasing risks for wildlife aircraft strikes.
- Select a site that shares an alignment with future levee improvement projects, if possible, to efficiently use public resources to provide flood protection and habitat enhancement.
- Limit the amount of salt marsh that is converted to brackish marsh to an amount deemed beneficial for ecosystem health and minimize impacts to existing wetlands and other sensitive habitats.

## Proposed Activities

The proposed Project site is referred to as the 'South Reach' site and is situated immediately across Embarcadero Road from the City of Palo Alto's Regional Water Quality Control Plant (RWQCP). The project site is adjacent to Harbor Marsh and contains the following elements: an existing trail atop an existing berm, a storm drain culvert from Embarcadero Road that discharges into a shallow partially vegetated swale (inboard of the existing berm/trail), a second storm drain culvert in the same alignment that crosses the existing berm/trail and discharges into the tidal channel, a water intake structure and pipeline (the Renzel Marsh connection), an existing but abandoned hydrant and vault assembly, a small outboard strip of terrestrial-tidal marsh ecotone habitat, and upland/ruderal vegetation that is largely non-native and poor habitat quality. However, the Project site and the general vicinity of the Harbor Marsh are known to support sensitive species including the California Ridgway's Rail [formerly California clapper rail] and the salt marsh harvest mouse.

The proposed project would connect to an existing effluent discharge pipe at the RWQCP and route a new supply pipeline to the horizontal levee including controls both at the treatment plant and at the horizontal levee. The project site would be cleared and excavated to a design subgrade for construction of horizontal levee and treatment and habitat zone improvements as well as adjacent berm improvements per geotechnical recommendations developed for levee fill following United States Army Corps of Engineers (USACE) guidance on stability and seepage. Imported materials to be placed on the site include material for the berm as well as gravels, sands, and wood chips for the treatment layer. Highly treated wastewater would be directed to a subsurface distribution chamber connected to a gravel treatment layer. Polished wastewater would seep onto the surface of the ecotone habitat slope at the terminus of the treatment zone and migrate to the adjacent salt marsh via shallow surface/subsurface flow.

An assemblage of native seeds and plugs would be planted to provide a diverse plant palette that would evolve over time to adapt to the unique and heterogeneous habitat niches formed by variable topography, hydrology, and salinity of the site. The hydrologic regime and plant colonization would be actively monitored, maintained, and adaptively managed over the establishment period. When the system reaches maturity as the plants become fully established and the hydrologic regime is fine-tuned, it is expected for it to function passively with only periodic adjustments and maintenance by City staff.

The proposed Project site (South Reach) was selected after completing the preliminary design (30%) process for the originally-preferred project location at the Central Reach (formerly referred to as the 'Embarcadero Road' site), which is immediately adjacent to the City of Palo Alto Airport and located on airport property. During that site's investigation, a potential land use compatibility issue came to light regarding Federal Aviation Administration (FAA) guidance on the proximity of wetlands habitats to public airports. Therefore, the City considered a number of alternative sites and project options that could better adhere to FAA guidance and coordinate with the future levee improvement projects (e.g., SAFER Bay and Shoreline Study) (ESA, 2020).

Based on this evaluation of alternatives, the City has selected the South Reach site location, and the 'Option 3' horizontal levee design (an approach to proceed with constructing the ecotone slope component as well as a small berm adjacent to the inboard side of the levee, without construction of a flood protection levee) (ESA, 2020), for the pilot project. Note: As the PAHLPP design progresses, technical aspects may require a larger berm and/or different specification requirements to be considered. In that case, there are several potential paths for the PAHLPP to move forward collaboratively with the future flood control levee improvement project, including options for integrating the South Reach pilot project with the future SAFER Bay/Shoreline Study levee. These integration opportunities are further addressed in the PDR prepared for the project (ESA, 2020).

The proposed Project includes the following main elements:

- Construction of a horizontal levee with an effluent discharge treatment zone and habitat slope
- Construction of a berm on the land side of the horizontal levee
- Water distribution infrastructure from the RWQCP through the berm to the horizontal levee slope
- Restoration seeding and planting

- Construction of a realigned segment of the Marsh Front Trail atop the project berm, that may include gravel/paving, signage, lighting, gathering spaces, and trash receptacles
- Construction of drainage infrastructure
- Long-term operations and maintenance (O&M) and adaptive management

The proposed project would require temporary work and/or permanent fill placement in jurisdictional waterbodies for the following elements:

- Constructing/modifying a flood protection and horizontal levee, which will enable sediment/organic peat soil accretion over time (to keep pace with some level of Sea Level Rise)
- Creating microtopography that enables the development and/or persistence of aquatic habitats adjacent and connected to the existing Harbor Marsh
- Long-term operations and maintenance (O&M) and adaptive management of the ecotone slope will require foot access and hand tools to monitor and manage vegetation.

## Project Support

The proposed Project is a multi-functional restoration project. Inherent it its purpose and design is the expectation that the Project will restore historic flood control functions, sensitive species habitat, and improve water quality. As such it is expected to be a self-mitigating project resulting in net long-term benefits (including to regulated aquatic habitats and sensitive species).

The Project is well-aligned with a number of regional goals and planning documents. In particular, the Project accomplishes habitat restoration goals identified in the 2008 Baylands Master Plan, the 2017 Palo Alto Baylands Existing Conditions Report, the pending Baylands Comprehensive Conservation Plan (BCCP; expected to be finalized in 2021), the Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California, the Adaptation Atlas Project, and the City's recently-adopted Sea Level Rise policy.[1]

The Project also accomplishes several goals identified in the San Francisco Bay Subtidal Habitat Goals Project Report – which was prepared by a collaboration of numerous regulatory and conservation entities, the scientific community, and other stakeholders in the Bay - including:

- Integrating subtidal habitat restoration with other habitats – including nearby marsh and upland habitats - to provide greater ecological benefits, ameliorate habitat fragmentation, and help protect shorelines from climate change impacts including sea level rise (Executive Summary pg. S-17)
- Implementing pilot restoration projects that integrate subtidal habitat with other habitat types (Executive Summary pg. S-18)
- Protection of the water column, including reducing contaminants and improving water quality for fish (Ch. 3)
- Understanding how long term changes, particularly sea level rise, will alter the way various habitats function and interact (Ch. 3, Foundational Science Goal 2, Question B)
- Develop mechanisms to adapt to climate change (Ch. 3, Foundational Science Goal 4)

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1 City of Palo Alto, 2019. Sea Level Rise Adaptation. Available: https://www.cityofpaloalto.org/civicax/filebank/blobdload.aspx?t=71340.78&BlobID=70115.

- Develop a ‘continuum of habitat types from the bottom of the bay to tidal wetlands and grassland transition zones to upland areas’ (Ch. 10, Integrated Restoration, pg. 147)
- Understand the ecosystem services supported by marsh-subtidal integration and living shorelines, and in what quantities (Ch. 10, Integrated Restoration, Subtidal-Wetland Design Integration Science Goals 1 through 3, and Subtidal-Wetland Design Integration Restoration Goals 1 through 3)

The Project concept has received explicit support from the following groups (in response to the April 2019 Proposition 1[2] Grant Application):

- Bay Area Clean Water Agencies
- Baykeeper
- Coalition for Effluent Action Now in (CLEAN) South Bay
- Friends of Palo Alto Parks
- San Francisco Bay Regional Water Quality Control Board (Board)
- Tuolumne River Trust
- Santa Clara Valley Water District (Valley Water)

During the project’s conceptual presentation of the originally-preferred project location at the Central Reach (formerly referred to as the ‘Embarcadero Road’ site) at the Bay Restoration Regulatory Integration Team’s (BRRIT) December 2019 Pre-Application meeting, the NMFS representative expressed enthusiasm and support of this type of pilot project. The BCDC representative indicated that the project may be a suitable candidate for beta testing the EPA/RWQCB/USACE’s in-development framework for addressing habitat or ‘type conversion’ in permitting. During the project’s conceptual presentation of the new South Reach site at the BRRIT’s November 2020 Pre-Application meeting, all agency participants seemed generally supportive of the project concept and expressed appreciation for the additional studies and work that has been completed to date and in response to the December 2019 BRRIT input. The USFWS representative expressed appreciation for the project’s creation of additional of wildlife refugia habitat. And the NMFS representative’s written feedback was ‘as the first pilot ecotone design for a freshwater slope wetland in the Bay, the Project will provide an opportunity to better understand the biological outcomes associated with creating a novel, surrogate habitat for brackish ecotone wetlands largely lost from the Bay during habitat conversion of the 1800s.’

# Environmental Compliance

## CEQA

The Project will be subject to analysis pursuant to and compliance with the California Environmental Quality Act (CEQA);[3] the CEQA lead agency is expected to be the City of Palo Alto (City); responsible agencies pursuant to

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[2] Proposition 1 (2014) is the State of California’s voter-approved Water Bond (Assembly Bill 1471) which enacted the Water Quality Supply, and Infrastructure Improvement Act of 2014, which includes water supply infrastructure projects, such as public water system improvements, surface and groundwater storage, drinking water protection, water recycling and advanced water treatment technology, water supply management and conveyance, wastewater treatment, drought relief, emergency water supplies, and ecosystem and watershed protection and restoration.

[3] CEQA Plus would be triggered by Clean Water State Revolving Fund (SRF) program funds (as provided by the EPA and administered by the State Water Board). Something similar to CEQA Plus would be triggered by Water Infrastructure Finance and Innovation Act (WIFIA) program funds (as provided and administered by the EPA).

CEQA include the CDFW, RWQCB, and BCDC. In compliance with CEQA, either a Categorical Exemption (CatEx) or a Mitigated Negative Declaration (MND) are expected to be appropriate, as explained below. However, if the Project is perceived to have the potential to create a significant impact (and/or is subject to a significant amount of public objection), an EIR may be pursued, as discussed below.

### *Categorical Exemption*

Depending on the final selected site and proposed project configuration, the project may be eligible for a CEQA Categorical Exemption, per Section 15333, for small habitat restoration projects. The exemption applies to restoration projects which "do not exceed five acres in size and are necessary to ensure the maintenance, restoration, enhancement, or protection of habitat." As is the case for all potential Categorical Exemption classes, the CEQA Guidelines also state in Section 15300.2 that "a categorical exemption shall not be used for an activity where there is a reasonably possibility that the activity will have a significant effect on the environment due to unusual circumstances." In other words, the project must not result in any significant environmental impacts (including any impacts which require mitigation in order to render them less than significant). Therefore, for this exemption to apply, any known potentially-significant impacts (such as potential safety issues related to airport regulations and nearby habitat restoration activities, as detailed below) will need to be resolved such that their impacts are not considered significant (with or without mitigation).

It is worth noting that the need for a wildlife agency permit or approval, and the potential for some 'incidental take' of a protected species and/or their habitat associated with project implementation is not necessarily, in and of itself, a significant environmental effect as defined under CEQA. To explain further, although the final selected project site - regardless of the various site alternatives under consideration - is expected to support several sensitive biological species and their habitats, the anticipated short-term impacts associated with project construction are expected to be more than adequately offset by the long-term gains in habitat functions and services that would result from project implementation (not including the potential long-term regional benefits to species recovery from implementing a successful pilot project which may be replicated numerous times across the Bay in the future). As such, while the project may be required to obtain permits or approvals related to protected species and/or habitats, the permits are expected to authorize the short term impacts in light of the long term gains. The potential need for such permits or approvals in and of itself does not equate to a significant impact pursuant to CEQA. And furthermore, obtaining a permit does not equate to implementing a mitigation measure pursuant to CEQA. Finally, if avoidance and minimization measures (such as seasonal avoidance, the use of buffers, biological monitoring, etc.) are incorporated into the project description itself, then project implementation, with the measures included, would not be expected to result in a significant effect to biological resources. As such, the need for sensitive species permits or approvals alone should not render the project ineligible for the 15333 Categorical Exemption. To further support this notion, see the State Water Board's Amended Order for Clean Water Act Section 401 General Water Quality Certification for Small Habitat Restoration Projects,[4] which acknowledges that authorized 'take' of listed species may be part of an eligible project, while at the same time an eligible project must qualify for a CEQA Section 15333 Categorical Exemption; therefore, the two aspects are not mutually exclusive. However, agency feedback received at the December 2019 BRRIT Pre-Application Meeting[5] included concerns about the project's qualification for a CEQA CatEx due to the potential for listed species impacts. As such, the project team would need to demonstrate

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4 SWRCB File # SB12006GN, Special Condition D.4.

5 BRRIT Comments on Palo Alto Horizontal Levee Project, transmitted by Valary Bloom (USFWS, and BRRIT agency representative) on December 18, 2019 (attached herein).

the project's eligibility for the CatEx, if appropriate, in a manner that adequately addresses the BRRIT's (and any other CEQA responsible agencies') concerns about potentially-significant effects.

Examples of similar restoration projects which have been authorized pursuant to a CEQA CatEx (Section 15333) and also obtained species-related permits or approvals for 'take' include the following:

- Trout Unlimited's Albion River Large Wood Augmentation Project and Olsen Gulch Large Wood Augmentation Project (both support listed salmonids and core recovery habitat; both obtained CDFW approvals and coverage under a NMFS Programmatic Biological Opinion)
- Scott River Watershed Council's Miners Creek Beaver Dam Analogues Project and Patterson Creek Accelerated Wood Recruitment Project (both support listed salmonids and habitat; both obtained CDFW approvals and coverage under a NMFS Programmatic Biological Opinion)
- San Mateo County Resource Conservation District's Butano Creek Floodplain Restoration Project (supports listed riparian species and salmonids and their habitat; obtained CDFW approvals and coverage under a NMFS Programmatic Biological Opinion and associated USFWS consistency determination)
- San Mateo County Resource Conservation District's Bonde Weir Fish Passage and Channel Stabilization Project (supports salmonids and their habitats; obtained a CDFW permit, USFWS concurrence with avoidance measures for riparian species, and coverage under a NMFS Programmatic Biological Opinion)
- State Coastal Conservancy's San Francisco Bay Living Shorelines Project at Giant Marsh (supports salt marsh harvest mouse, California Ridgway's Rail [formerly California clapper rail], soft bird's beak, and California seablite; obtained a USFWS Biological Opinion/take coverage)

Of the three CEQA approaches discussed herein, a Categorical Exemption would be the fastest and most cost-effective, as it only requires internal documentation and an administrative action by the lead agency. No public outreach or hearings are required. There is a period during which the public may challenge (litigate) the lead agency's decision to file a Categorical Exemption, although it happens rarely[6].

### *IS/MND*

If it is expected that the project will result in certain environmental impacts, but all of these potentially significant impacts can be fully mitigated to below a level of significance, an IS/MND may be appropriate. Furthermore, if key public objections are expected to have been adequately addressed by the time of document publication (see Conclusion below re. public outreach), an IS/MND may be appropriate. An IS/MND includes a 30-day public circulation period and requires a public hearing for lead agency adoption of the document; it is during the public hearing stage that the document could be legally challenged. In general, because of the less-robust analysis included in IS/MNDs, they are easier to challenge than their more in-depth EIR counterparts (discussed below)[7].

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6 Filing a Notice of Exemption triggers a 35-day statute of limitations for litigation on CEQA grounds. If a Notice of Exemption is not filed, the statute of limitations becomes 180 days from either the date the decision is made to carry out or approve a project, or where no formal decision is required, 180 days from the date the project is commenced.

7 The "fair argument test" is the usual standard of review that is applied when the lead agency adopts a Negative Declaration. Under the fair argument test, if the record as whole contains substantial evidence that the proposed project may have a significant environmental effect, the lead agency must prepare an EIR even though there may be evidence to the contrary that the project will have no significant effects. (14 CCR § 15063 (b).) The fair argument standard creates a low threshold for the preparation of an EIR.

Examples of similar restoration projects which have been analyzed using an IS/MND and also obtained species-related permits or approvals for 'take' include the following:

- Oro Loma Sanitary District's Oro Loma Wet Weather Equalization and Ecotone Demonstration Project (supports salt marsh harvest mouse habitat; obtained CDFW and USFWS approvals)
- U.S. Fish and Wildlife Service's Yuba River Canyon Salmon Habitat Restoration Project (supports numerous freshwater/in-stream listed species and habitats; obtained NMFS Biological Opinion)
- Napa County's Napa River Restoration: Oakville to Oak Knoll Project (supports numerous freshwater/in-stream listed species and habitats; obtained CDFW, USFWS, and NMFS permits or approvals)
- Salmon Protection and Watershed Network's Lagunitas Creek Floodplain and Riparian Enhancement Project (supports numerous freshwater/in-stream listed species and habitats; obtained USFWS concurrence and NMFS Programmatic Biological Opinion coverage)
- Trinity County Resource Conservation District' West Weaver Creek Salmonid Habitat Rehabilitation Project (supports several in-stream listed species and habitats; obtained NMFS Programmatic Biological Opinion coverage)
- Santa Cruz Resource Conservation District's Zayante Creek Habitat Improvement Project[8] (supports listed salmonids and habitat; obtained CDFW approvals and coverage under a NMFS Biological Opinion; obtained SWRCB and EPA grant funding)

An IS/MND would be expected to require approximately 6-8 months to prepare on an aggressive schedule, and approximately 10 months on a more conservative schedule. As mentioned above, the lead agency must hold a public hearing to adopt the IS/MND; therefore, there is an opportunity for public objection, and IS/MNDs are typically easier to challenge than EIRs.

### *EIR*

If considerable public objection is perceived as likely, an EIR - as the document with the most thorough analysis prepared - may be the safest CEQA approach to select. Furthermore, an EIR must be prepared if there are any significant unmitigable environmental impact(s). The recommended approach for this project, if an EIR is selected, is to prepare a 'focused EIR.' A 'focused EIR' is not a technical CEQA document type, but rather a description of the document's composition, in which an in-depth analysis is prepared for those topics with anticipated controversy and/or significant impacts, while the remaining topics may be covered briefly. For this project, focused topics might likely include: Aesthetics, Biological Resources, Hydrology/Water Quality, Recreation, Land Use/Planning, Transportation, and Hazards and Hazardous Materials. The EIR's Notice of Preparation (NOP) would announce document's approach, as well as the list of topics to be more fully-analyzed; the public can comment on the approach and topic list in response to the NOP. Because of the generally positive and well-supported nature of this project, and because impacts are not anticipated in a number of the other topics, a 'full-blown' EIR analyzing all topics is not expected to be necessary.

A Focused EIR would be expected to require approximately 10-12 months to prepare on an aggressive schedule, and 12-16 months on a more conservative schedule. As mentioned above, the lead agency must issue an NOP, often holds a scoping meeting before document drafting, and typically holds a public meeting during the document's 45-day public circulation period. Finally, like the IS/MND, there is an opportunity for public

8 Santa Cruz Resource Conservation District, 2019. Zayante Creek Habitat Improvement Project. Available: http://rcdsantacruz.org/zayante-creek-restoration.

objection during the lead agency's certification of the EIR. However, as stated above, EIRs are typically more difficult to challenge than an IS/MND. Roughly speaking, in comparison to an IS/MND, preparing an EIR would be expected to cost 30-50% more than preparing an IS/MND.

### *CEQA Conclusion*

Ultimately, the CEQA analysis selected is a decision to be made at the discretion of the lead agency; these decisions are typically made based on the agency's preferences and level of exposure/risk tolerance. Regardless of the type of CEQA analysis pursued, the potential for considerable public and/or responsible agency[9] objection should be addressed early and head-on. An effective approach would be to conduct public outreach and hold meetings with various groups in order to explore their concerns and attempt to find mutually-agreeable solutions that would reduce or eliminate their likelihood to object during the CEQA and/or permitting processes. To increase the public's trust, a Memorandum of Understanding (MOU) could be prepared between the project proponents and the stakeholders, to document the issue(s) and agreed-upon solution(s). To address potential responsible agency concerns, the proposed CEQA document approach should be vetted with the state agencies early as well.

The CEQA approaches described above are listed in order of increasing complexity. For reference, the approximate cost to prepare CEQA documentation for a project of this type, including required studies, are provided in the following table.

**RANGE OF COSTS TO PREPARE CEQA DOCUMENTATION FOR THE PAHLPP**

| CEQA Document | Cost Range to Prepare |
|---|---|
| Categorical Exemption | $15,000 to $20,000 |
| IS/MND | $90,000 to $150,000 |
| Focused EIR | $150,000 to $200,000 |
| NEPA Documentation support (EA)[10] | $5,000 to $15,000 |

## NEPA

Based on the anticipated discretionary permit expected to be required from the USACE (which is assumed to take the federal lead agency role[11]), the Project will also be subject to compliance with the National Environmental Policy Act (NEPA). Based on USACE input received during the Project's BRITT presentations (attached), the Project is not likely to qualify for a Nationwide Permit(s) (such as NWP#27 – Restoration, NWP#31 – Maintenance of Existing Flood Control Facilities, NWP 54 – Living Shorelines, or some other combination of applicable Nationwide Permits), because the Project combines some elements that are typically authorized by a

[9] State agencies including the RWQCB and CDFW are 'responsible agencies' under CEQA.

[10] Assumes an EA would be authored by the Corps, and that it could largely be based upon CEQA IS/MND analysis; if a CatEx is used and little CEQA analysis text exists, this effort would increase by roughly $5,000 to $10,000.

[11] If some form of federal funding (e.g., an EPA grant) is obtained for the Project, or if the project takes place on federal lands, there will need to be a decision made about which federal agency takes the lead under NEPA – the landowner, permitting agency, or the funding agency. If the another agency serves as federal lead, their NEPA process may differ substantially from that described for the Corps herein; if the other federal agency's NEPA process is more involved than the Corps', the associated costs or additional timeline may outweigh the benefits of obtaining that federal funding.

NWP (like restoration) with some elements that do not (like reliance upon a man-made water source). As such, the Project is likely to require a USACE Individual Permit.

When a USACE Individual Permit is required, the USACE prepares an internal Decision Document which includes a project-specific NEPA analysis. Typically, for the majority of the Individual Permits the USACE issues, an Environmental Assessment (EA) would be prepared by the USACE (regardless of the CEQA document prepared). If, however, the project is expected to result in “significant” environmental impacts as defined under NEPA (per 40 CFR §1508.27), an Environmental Impact Statement (EIS) would be prepared by the USACE. It should be noted that an EIS is not always prepared in conjunction with a project that prepares a CEQA EIR; this is because, regardless of the project’s significant effects pursuant to CEQA, the USACE’ scope of analysis of project effects (those which are related directly to their permit action) may be restricted to certain aspects of the project which do not result in “significant” effects pursuant to NEPA. For this project, an EA is extremely likely to be prepared by the USACE, regardless of the CEQA document prepared. Finally, it should be noted that the USACE is the author of the NEPA document; however, the USACE may ask the applicant to provide draft NEPA analysis text, to enable their more efficient preparation of their NEPA documentation. Lastly, the USACE NEPA document is not subject to public circulation.

### Permitting

Finally, as stated above, the Project is expected to require a number of local, state, and federal regulatory permits and/or approvals, as summarized below.

## Regulatory Outreach Conducted to Date

As of December 2020, the Project team has conducted the following outreach to regulatory agencies:

- Submitted a **Project package on May 31, 2019 for consideration by the BRRIT**, as one of the first group of projects they will review. Amy Hutzel (San Francisco Bay Restoration Authority, or SFBRA) confirmed receipt of the package. Due to its conceptual status, we understand the Project was given a Tier 3 ranking by the BRITT. The Project package was based on the original (Central Reach) site.

- Submitted a Project summary to the RWQCB, associated with a request for agency support for the Project’s Proposition 1 funding application; in response, the Project team obtained a **letter of support from Lisa McCann, Assistant Executive Officer of the SF Bay RWQCB** (attached)**.**

- **Presented the Project at the BRRIT Pre-Application Meeting** on December 4, 2019, based upon the ‘Embarcadero Site’s’ (Central Reach) 30% Preliminary Design. Informal agency input received at the meeting was noted by the Project team, has been incorporated into this memo, and will be tracked for future project site selection and/or design refinement. Official comments and responses from the BRRIT agencies were received on December 18, 2019 (attached).

- Submitted a **Project package on October 21, 2020 for consideration by the BRRIT**, for review of the newly-selected (South Reach) site and revised project concept, which included an attempt to address BRRIT comments on the prior project site.

- **Presented the Project at the BRRIT Pre-Application Meeting** on November 4, 2020, based upon the newly-selected ‘South Reach’ Site and its 30% Preliminary Design. Informal agency input received at the meeting was noted by the Project team. Official comments and responses from the BRRIT agencies were received on November 20, 2020 (attached). BRRIT feedback (informal and official) has been incorporated into this memo and will be tracked for future project design refinement.

## Anticipated Permits Required

As mentioned above, because of the proposed Project's location in and adjacent to the waters of the San Francisco Bay, as well as the presence of regulated biological and cultural resources within the Project vicinity, the Project is expected to require a number of local, state, and federal regulatory permits and/or approvals. Anticipated permits and authorizations required for project implementation, including permit triggers, key notes, and approximate timelines, are summarized in **Table 1** below; the Table is organized by first presenting federal permits, followed by state, and then regional/local permits expected to be required. A typical environmental approval process, including the integration of CEQA and permitting, and the many interdependencies inherent to permitting for in-Bay projects is shown in **Figure 2**. It should be noted that the approximate agency review/processing times shown in Table 1 and Figure 2 do not include the time needed to prepare and submit permit applications (and time needed to prepare their required supporting information, as summarized in **Table 2** below).

Approximately 3 to 6 months should be budgeted for preparation of permit applications, not including any biological studies which may require longer durations or protocol requirements to be conducted during specific times of year.[12] Based on the comprehensive list of permits expected to be required (per Table 1), approximately 12-18 months should be budgeted for permit processing. Depending on the CEQA analysis selected (see above discussion), anywhere from 4 to 16 months may be required. Ideally, the CEQA process would be conducted several (1-6) months in advance of project permitting, depending on the specifics of the project and its applicable CEQA and permitting pathways, in order to allow for the CEQA document to near finalization as the CEQA-responsible state agencies are nearing their permit issuance.[13] Furthermore, the permit processing timelines shown in Table 1 reflect agency review and processing timeframes under targeted/'ideal' conditions, and do not include common agency delays (which often result from lack of staffing, workload challenges, budget or hiring freezes, or government shutdowns).

### Assumptions

This Permit Strategy assessment assumes the **proposed Project does not propose** the following:

- Dredging;
- Pile installation or drilling;[14] or

[12] The Project team should consult with wildlife biologists to identify possible studies which may require extra lead time or be restricted to certain seasons, and which therefore may need to be conducted well in advance of the preparation of permit applications. An example includes conducting 'protocol surveys' (following required agency-specific protocols) for California Ridgway's Rail, which should be conducted in the spring of any year. (Note: in keeping with this recommendation, ESA conducted protocol Rail surveys for the Project in spring 2020, as attached).

[13] While state permit applications can be submitted prior to CEQA completion, final state permits cannot be issued without a certified CEQA document or NOD.

[14] Piles could be required for certain levee structural needs. If piles are proposed, the specific location and/or installation methods could drive the need for different permits than those cited in Table 1. For example, in-water pile installation could pose potential harm to marine mammals or fish, and noise related to pile installation could pose harm to upland terrestrial (marsh) species.

- Any substantial new solid structural fill (such as cast-in-place concrete or sheetpile)[15] proposed within the waters of the Bay.

This assessment **does not address the following permits or agreements**, some of which may be required for Project implementation:

- Permits, approvals, or any coordination related to hazardous materials (including Department of Toxic Substances Control), if required;
- City-required Development, Building, Construction or Grading permits; or
- Permits which may be required for upland transport and/or disposal of excavated materials (including potentially contaminated materials)

The following federal, state, or regional **permits have been considered and are assumed not to be needed**, based on the anticipated existing site conditions (including potentially present resources) and the Project Understanding (above):

- USACE Sec 103 Permit (for transport and dumping of dredged materials in ocean waters) or Section 408 Permit (for engineering approval of modifications to USACE-built or -maintained facilities such as flood control channels or levees)
- USCG Special Use Permit
- Dredge Material Management Office (DMMO) approvals (as no dredging is proposed)

15 New or replacement concrete or other structures could be required in association with the connection of the existing and new culverts crossing the berm and horizontal levee at the South Reach Site, for example. The specific location, nature, and quantity of such solid fill could drive the need for different permits than those cited in Table 1.

**TABLE 1**
**ANTICIPATED PERMITS AND APPROVALS REQUIRED**

| Agency | Permit or Approval Type | Trigger | Information or Studies Req'd | Anticipated Acquisition Timeline[a] | Notes |
|---|---|---|---|---|---|
| **Federal** | | | | | |
| USACE | Sec. 404/10 Permit:<br>NWP, LOP, or IP<br>(CWA/RHA) | In-water equipment or work; discharge (i.e., placement) of structures or fill (including native soil) in waters and/or wetlands | Aquatic Resources Delineation (of jurisdictional waters/wetlands)<br>Biological Assessment (BA) for federally-listed species and habitats – *see NMFS & USFWS below*<br>Cultural Resources Assessment – s*ee SHPO below*<br>NOTE: for an IP, the USACE typically requires a 404(b)(1) Alternatives Analysis to demonstrate the project is 'least environmentally damaging practicable alternative' (LEDPA).<br>NOTE: As federal lead agency[b], the USACE requires compliance with other related federal laws listed below, prior to permit issuance:<br>• Sec. 7 FESA/MSA (per USFWS/ NMFS)<br>• Sec. 106 NHPA (SHPO)<br>• CZMA (BCDC)<br>• NEPA (if applicable) | NWP or LOP: ~3-6 months*<br>IP: ~12-18 months*<br>*requires completion of other federal environmental compliance processes (see left) which may increase timeframes by 3-12 months | Based on USACE feedback provided during the BRRIT process, an IP is expected to be required (potentially due to wetlands relying upon on-going wastewater inputs, or because it does not meet the terms and conditions of any existing NWPs; per Dec. 2019 BRRIT comments from USACE, as attached).<br>One benefit of an IP is that it can be issued to address construction impacts as well as impacts that could occur during long-term (O&M or adaptive management) activities, which would not be authorized via a USACE NWP.<br>Individual Permits (IPs) are issued for activities with more than minimal impacts – instead of a NWP. In some cases, the USACE may, at their discretion, require an IP for activities that would normally fit into a NWP if they are deemed not within the public interest or to have a significant level of public controversy<br>If an IP is selected, compensatory mitigation may be required[f] |

**TABLE 1**
**ANTICIPATED PERMITS AND APPROVALS REQUIRED**

| Agency | Permit or Approval Type | Trigger | Information or Studies Req'd | Anticipated Acquisition Timeline[a] | Notes |
|---|---|---|---|---|---|
| **Federal (cont.)** | | | | | |
| NMFS | Sec. 7 Compliance (FESA/MSA) | Adverse effects (harm, harassment, injury, mortality) to federally-listed aquatic species or critical habitats, typically from in-water equipment operations, turbidity or WQ impacts, and Hydroacoustic effects (e.g., pile driving) | *Biological Assessment* (BA) for federally-listed aquatic species, habitats, and Essential Fish Habitat (EFH)<br>Avoidance measures for sensitive species and habitats | No Effect: 0 months (n.a.)<br>Informal concurrence with NLTAA (for avoidance of all construction-related 'take'): ~3-6 months | "*No Effect*" or Concurrence with '*Not Likely to Adversely Affect (NLTAA) determination*' anticipated (depending on potential for in-water impacts).<br>May be eligible for existing 'programmatic' consultation[d].<br>Best to **restrict work to LTMS in-water work window (Jun 1-Nov 30 of any year)** to reduce effects and streamline permits.<br>May require pre-construction and/or protocol-level surveys.<br>May require mitigation for construction-related impacts and/or permanent loss of habitat/take of species.<br>Species with potential to occur[c]: green sturgeon and their CH; Central Coast steelhead; Central Valley fall-run Chinook salmon; eelgrass; EFH. |
| | MMPA Compliance<br>*not currently anticipated to be necessary*, if no in-water pile driving or dredging is proposed | Adverse effects (harm, harassment, injury, mortality) to non-listed marine mammals, typically from equipment operations and Hydroacoustic effects from impact and/or vibratory hammers - *not currently anticipated to result* | Analysis of effects, including Hydroacoustic calculations<br>*not currently anticipated to be necessary* | Permit (IHA/LOA, for construction-related 'take'): ~6-18 months.<br>*not currently anticipated to be necessary* | Take permit (IHA or LOA) is not likely to be necessary (assuming adequate avoidance related to in-water impacts, no in-water pile driving or dredging)<br>Species with potential to occur[c]: non-listed marine mammals including Pacific harbor seals (nearby foraging). |

**TABLE 1**
**ANTICIPATED PERMITS AND APPROVALS REQUIRED**

| Agency | Permit or Approval Type | Trigger | Information or Studies Req'd | Anticipated Acquisition Timeline[a] | Notes |
|---|---|---|---|---|---|
| **Federal (cont.)** | | | | | |
| USFWS | Sec. 7 Compliance (FESA) | Adverse effects (harm, harassment, injury, mortality) to federally-listed species and/or critical habitats | Biological Assessment (BA) for federally-listed species (generally 'terrestrial') and habitats<br>Avoidance measures for sensitive species (see specific recommendations in BRRIT comments, as attached)<br>Adaptive Management and Monitoring Plan (AMMP) to assess and increase project success over the long-term (including vegetation/habitat conversion and species use) | Biological Opinion (for construction-related 'take'): ~6-12 months<br>Informal concurrence (for avoidance of construction-related 'take'): ~3-6 months | Take permit (Biological Opinion) anticipated; however, informal concurrence with a 'NLTAA' determination may be possible, if adequate avoidance of construction impacts is possible<br>Best to utilize **fencing, hand removal of vegetation, and phased vegetation remova**l if possible and **restrict certain work to outside Ridgway's Rail breeding season (Feb 1-Aug 31 of any year)** to avoid impacts and streamline permits (per Dec. 2019 and Nov. 2020 BRRIT comments from USFWS, as attached).<br>May be eligible for existing 'programmatic' consultation[d].<br>May require pre-construction and/or protocol-level surveys.<br>May require mitigation for construction-related impacts and/or permanent loss of habitat/take of species.<br>Species with potential to occur[c]: Salt Marsh Harvest Mouse, Ridgway's Rail, California seablite, longfin smelt (candidate for listing) |
| FAA | Airport compliance with FAA guidance, including Advisory Circular AC 150/5400-33B | Hazardous wildlife attractants (incl. activities and/or land uses) on or near an operational public-use airport | Proposed Project information submittals (see Challenge 7.b.i and ii below) for FAA review/approval | TBD | This is **a key issue that should be addressed head-on and ASAP**.<br>FAA guidance recommends against wetland development within 5,000 ft. of an operational airport<br>Land use conflicts drove selection of an alternate site (the new South Reach site) from the former Embarcadero (Central Reach) Site.<br>Depending on airport and local land use concerns, perceived conflicts may drive design changes and/or the development of robust avoidance measures. |

**TABLE 1**
**ANTICIPATED PERMITS AND APPROVALS REQUIRED**

| Agency | Permit or Approval Type | Trigger | Information or Studies Req'd | Anticipated Acquisition Timeline[a] | Notes |
|---|---|---|---|---|---|
| **State** | | | | | |
| SWRCB/ RWQCB | 401 WQ Cert/WDRs (CWA/Porter-Cologne) | In-water work; discharge of structures or fill in waters; potential for degradation of waters of the State and their designated Beneficial Uses (per Basin Plans) | Impact assessment for WQ/designated Beneficial Uses<br>Hydrologic study(ies)<br>Adaptive Management and Monitoring Plan (AMMP) to assess and increase project success over the long-term (including water quality, hydrology, vegetation/habitat conversion and various designated beneficial uses)<br>NOTE: San Francisco Bay RWQCB may require an Alternatives Analysis to demonstrate the project is the LEDPA, per their new April 2020 Procedures[16]. | ~3-6 months | Needs completed CEQA to issue permit; SWRCB/RWQCB is a Responsible Agency pursuant to CEQA<br>Project may be eligible for the 'Small Habitat Restoration Projects' 401 Certification (as it is <5ac and 500lf), depending on other Project specifics<br>May require mitigation for any 'net loss' of waters/wetlands, in compliance with State's 'No Net Loss' policy[f]<br>Can be flexible about construction extensions into the wet season, assuming the wildlife agencies are in agreement, stormwater BMPs are robust, and the weather forecast is taken closely into account.<br>New EPA '401 Certification Rule' is applicable[17], effective Sept. 2020. Requirements should be generally addressed via the BRRIT process. |
| | NPDES Construction General Permit Compliance (CWA) | Ground disturbance >1acre (for non point-source discharges) | Storm Water Pollution Prevention Plan (SWPPP) | | Construction contractor (a licensed QSP/QSD) typically prepares SWPPP and applies for confirmation of coverage, just prior to construction |
| | NPDES Municipal Regional Permit (MRP) | Long-term site runoff, stormwater discharges, and treatment (of non point-source discharges) | Treatment methods including Low- Impact Development (LID) techniques, in compliance with Provision C.3 of the MRP | | Stormwater management plan will be reviewed and approved by the San Francisco RWQCB in coordination with the City<br>Applies to things like roads, paved surfaces, etc. |

16 The *State Wetland Definition and Procedures for Discharges of Dredged or Fill Material to Waters of the State* was finalized in April 2020 and includes a statewide requirement to prepare an Alternatives Analysis for most projects seeking 401 Certification. In some cases, the RWQCB will defer to the USACE's requirement for an Alternatives Analysis, such that one document can satisfy both agencies' permit programs; certain projects are granted exceptions to this procedural requirement by the RWQCB.

17 Under the new 401 Certification Rule, applicants must request a pre-application meeting at least 30 days before submittal of a 401 Certification application (but holding that meeting is subject to RWQCB discretion) and the 401 Certification application must be submitted before or concurrently with a USACE CWA permit application, if required.

**TABLE 1**
**ANTICIPATED PERMITS AND APPROVALS REQUIRED**

| Agency | Permit or Approval Type | Trigger | Information or Studies Req'd | Anticipated Acquisition Timeline[a] | Notes |
|---|---|---|---|---|---|
| **State (cont.)** | | | | | |
| SWRCB/ RWQCB (cont'd) | NPDES Wastewater Permit | Discharge of treated wastewater effluent | TBD | 8-12mo+ | City should apply for an early[18] reissuance of their RWQCP NPDES wastewater permit, to include PAHLPP (per Nov. 2020 BRRIT comments from RWQCB, as attached)<br>May need to demonstrate compliance with various receiving water limitations and/or include new limitations specific to PAHLPP.<br>May be able to point to Oro Loma treatment data for some demonstration of 'polishing' success in horizontal levees. |

18 The RWQCB's permitted schedule for reissuance of the City's RWQCP NPDES Wastewater Permit (#R2-2019-0015) was for a 2024 reissuance, with City submittal of an application for renewal no later than August 31, 2023.

**TABLE 1**
**ANTICIPATED PERMITS AND APPROVALS REQUIRED**

| Agency | Permit or Approval Type | Trigger | Information or Studies Req'd | Anticipated Acquisition Timeline[a] | Notes |
|---|---|---|---|---|---|
| **State (cont.)** | | | | | |
| CDFW | Sec. 2080/2081 Compliance (CESA)<br>Migratory Bird Treaty Act (MBTA) Compliance | Adverse effects (harm, harassment, injury, mortality) to state-listed species or critical habitats<br>Killing or destroying migratory birds, bird nests, and eggs<br>Potential for bird strikes | Biological Assessment (BA) for state-listed species and/or habitats *-not currently anticipated to be necessary*<br>Avoidance and Minimization Measures designed to protect Fully-Protected Species (see specific recommendations in Dec. 2019 and Nov. 2020 BRRIT comments, as attached) | Incidental Take Permit (ITP): ~6-12 months<br>*not currently anticipated to be necessary* | Needs completed CEQA to issue permit; CDFW is a Responsible Agency pursuant to CEQA<br>Project expected to result in some construction-related short-term potential for take.<br>Seek *'Consistency Determination'* (CD) with federal B.O. for co-listed species (listed under FESA and CESA) or *Incidental Take Permit* (ITP) for CESA-listed spp.<br>No ITPs can be issued for Fully-Protected (FP) species such as SMHM and black and Ridgway's rail, so adequate avoidance measures must be developed for FP species.<br>May be eligible for existing 'programmatic' consultation[d].<br>Best to **restrict vegetation/tree removal to outside nesting bird season (remove from Sept 1 – Jan 31)** to avoid effects to MBTA-protected birds. See additional avoidance measures per Nov. 2020 BRRIT comments from CDFW, as attached.<br>May require pre-construction and/or protocol-level surveys.<br>May require mitigation for construction-related impacts and/or permanent loss of habitat/take of species.<br>Species with potential to occur[c]: Salt Marsh Harvest Mouse, CA Ridgway's Rail, CA black rail, western snowy plover, Point Reyes bird's-beak, California seablite, saline clover, salt marsh wandering shrew, American badger, longfin smelt, Pacific lamprey, green sturgeon, white sturgeon, CCC steelhead, tricolored blackbird, Alameda song sparrow, Bryant's savannah sparrow, burrowing owl, San Francisco common yellowthroat, northern harrier, migratory birds. |

**TABLE 1**
**ANTICIPATED PERMITS AND APPROVALS REQUIRED**

| Agency | Permit or Approval Type | Trigger | Information or Studies Req'd | Anticipated Acquisition Timeline[a] | Notes |
|---|---|---|---|---|---|
| **State (cont.)** | | | | | |
| CDFW | Sec. 1600 Lake or Streambed Alteration Agreement (California Fish and Game Code)<br>*not currently anticipated to be necessary* | Substantial modification(s) to a streambed, including construction activities, placement of new structures, alteration of flow, etc. | Map of CDFW-regulated streambeds, to tops of banks and adjacent riparian areas<br>Existing habitats and wildlife information<br>Avoidance and Minimization Measures designed to protect streambeds, wildlife, and their habitats<br>All of the above - *not currently anticipated to be necessary, as Sec. 1600 permit not anticipated to be necessary* | Lake or Streambed Alteration Agreement (LSAA): ~3-6 months<br>*not currently anticipated to be necessary* | Sec. 1600 LSAA is not likely to be necessary, as the site does not support any freshwater/fluvial channels, and the tidal channel adjacent to the project is not likely subject to CDFW Section 1600 regulation (per Nov. 2020 BRRIT comments from CDFW, as attached).<br>Typically restricted to freshwater streams; unclear in brackish/tidal systems. Culvert drainage swale(s) crossing Project site may or may not be regulated.<br>Needs completed CEQA to issue permit; CDFW is a Responsible Agency pursuant to CEQA<br>May require mitigation for construction-related impacts and/or permanent loss of regulated areas.<br>This permit is often a 'hook' for ensuring CESA and MBTA compliance (see row above). |
| SHPO | Sec. 106 Compliance (NHPA) | Adverse effects to tribal, archaeological, or historic architectural resources, if present | *Historic Property Survey Report* (including tribal coordination, archaeology, and historic architecture) suitable for use in Sec. 106 consultation | ~3-12 months | |

**TABLE 1**
**ANTICIPATED PERMITS AND APPROVALS REQUIRED**

| Agency | Permit or Approval Type | Trigger | Information or Studies Req'd | Anticipated Acquisition Timeline[a] | Notes |
|---|---|---|---|---|---|
| **State (cont.)** | | | | | |
| SLC | Lease or Lease Amendment | Construction and/or structures within SLC land | Property Boundary Survey<br><br>Response from SLC about which existing lease, if any, applies to Project site and may require amendment.<br><br>If Lease/Amendment is Req'd:<br><br>Final Design Plans, stamped Engineering Design Drawings, and a contractor's Work Execution Plan (prior to start of construction)<br><br>Proof of Property Ownership<br><br>Current NPDES Permit (and for life of Lease)<br><br>Spill Prevention and Control Plan<br><br>Litter and Waste Management Plan<br><br>Environmental Justice evaluation<br><br>Pre-construction species surveys<br><br>Avoidance measures for sensitive species (incl. SMHM, Ridgway's Rail, burrowing owl, etc.) | ~6-18 months +<br><br>Note: this **is likely to be the longest and most demanding of the permitting processes (including legal review)** | Unclear whether Project site (Central Reach) is within SLC/leased lands; need to inquire/confirm with SLC, and may require a property boundary survey to confirm. (Note: **SLC Lease #PRC 7495.9** issued to City of Palo Alto applies to marsh enhancement facilities and a nature observation deck in the Project site vicinity, and is valid June 1, 1991 through May 31, 2040; SLC Lease #PRC 7495.9, as attached, may or may not apply to the selected Project site).<br><br>Needs completed CEQA to issue Lease or Amendment; SLC is a Responsible Agency pursuant to CEQA.<br><br>Will require restoration of temporary construction-related impacts.<br><br>Will require legal team review from both applicant and SLC.<br><br>Other information/studies required (see left) as informed by a recent SLC Lease Amendment issued to the City of Palo Alto (Lease No. PRC 9143.9, as attached) for a nearby property. |

**TABLE 1**
**ANTICIPATED PERMITS AND APPROVALS REQUIRED**

| Agency | Permit or Approval Type | Trigger | Information or Studies Req'd | Anticipated Acquisition Timeline[a] | Notes |
|---|---|---|---|---|---|
| **Regional** | | | | | |
| BCDC | Minor (Administrative) or Major Permit (McAteer-Petris Act, San Francisco Bay Plan [e])<br><br>Consistency - Coastal Zone Management Act (CZMA) | In-water work; discharge of structures or fill in or above waters of the Bay; landside improvements within the 100-ft Shoreline Band<br><br>Activities and improvements within the coastal zone (local CZMA authority delegated from CA Coastal Commission to BCDC) | Final Design Plans (prior to start of construction)<br><br>Proof of Property Ownership<br><br>Landscaping Plans<br><br>Public Access Plan<br><br>Detailed Public Improvements Plans<br><br>Utilities and Emergency Response Plans<br><br>Traffic and Circulation (including bicyclist and pedestrian) Plans<br><br>Sea Level Rise Adaptation Study<br><br>Demonstration of consistency with the CZMA and Bay Plan, as amended[e]<br><br>See also *Notes* on right re. other permits/ approvals req'd | ~6-12 months*<br><br>*requires completion of other local, state, and federal environmental compliance processes<br><br>May require the iterative DRB/ECRB review processes, which may increase timeframes to 12-18 months + - *per BRRIT Pre-Application Meeting input, <u>not currently anticipated to be necessary</u>*<br><br>See also *Notes* on right | Minor Permit is likely, per BRRIT input (the planned new Regionwide for small restoration projects is not yet available). If impacts to Bay resources are perceived as more than minimal, a Major Permit may be required<br><br>Schedule meeting with BCDC Bay Design Analysts re. proposed Public Access Plan improvements, including trail and related amenities, ASAP (per Nov. 2020 BRRIT comments from BCDC, as attached)<br><br>As a regional planning and land use agency, BCDC requires compliance with other related federal, state, and regional laws (including CEQA).<br><br>Technically **all other permits (404, 401, 1600, SLC, CEQA, etc.) must be issued and included in a 'complete application' to BCDC**, to begin BCDC permit processing (though they may agree to begin review/processing prior to having all final permits in-hand). As such, <u>the BCDC permit process usually ends last (or second to last, with USACE being last) and usually takes the longest to complete.</u><br><br>BCDC makes a CZMA consistency determination as a part of their final Permit action<br><br>Will likely require mitigation for any 'net loss' of waters/wetlands (including overwater shading). However, the forthcoming Bay Plan Amendment adds flexibility for in-Bay fill used for habitat projects in tidal waters.[e]<br><br>Not expected to require review by the Design Review Board (DRB) and the Engineering Criteria Review Board (ECRB) (would add significant delays). |

**TABLE 1**
**ANTICIPATED PERMITS AND APPROVALS REQUIRED**

| Agency | Permit or Approval Type | Trigger | Information or Studies Req'd | Anticipated Acquisition Timeline[a] | Notes |
|---|---|---|---|---|---|

NOTES:

[a] Timeline assumes a 'complete application' has been submitted. Does not include agency delays, which are common and can result from lack of staffing, workload challenges, budget or hiring freezes (including government shutdowns), and other unforeseen delays outside of ESA and the Project proponent's control. Also does not include time spent awaiting other agency permits or approvals required prior to final permit issuance.

[b] For the purposes of this memo it is assumed that the USACE will serve as the federal lead agency. However, if the Project receives significant federal funds (e.g., from the EPA), this assumption may no longer be valid.

[c] This species list is tentative, and based upon other nearby studies; it has not been verified for the site.

[d] Several resource agencies (such as USFWS, NMFS, CDFW) have existing 'programmatic' consultations, which are issued to authorize certain common activities if they meet the specific terms and conditions of the programmatic consultation. See *Recommended Permitting Strategies* #3 below for more detail.

[e] The BCDC recently (2019) amended its San Francisco Bay Plan (Bay Plan) to allow for additional flexibility for 'Bay fill' placed for habitat restoration. See *Recommended Permitting Strategies* #1f below for more detail, including BCDC's position on related adverse effects, 'type conversion,' and a planned new Regionwide Permit for restoration.

[f] The EPA Region 9, in coordination with the USACE and SF Bay RWQCB, is in the process of developing is scientific and/or policy changes regarding 'type conversion' associated with multi-objective restoration projects, including changing the agencies' approaches to assessing 'type conversion' and related permitting and mitigation requirements under the CWA.

ACRONYMS:

| | |
|---|---|
| BCDC | San Francisco Bay Conservation and Development Commission |
| BPA | Bay Plan Amendment |
| BRRIT | Bay Restoration Regulatory Integration Team |
| CDFW | California Department of Fish and Wildlife |
| CEQA | California Environmental Quality Act |
| CESA | California Endangered Species Act |
| CWA | Clean Water Act |
| CZMA | Coastal Zone Management Act |
| EFH | Essential Fish Habitat |
| EPA | Environmental Protection Agency |
| FAA | Federal Aviation Administration |
| FESA | Federal Endangered Species Act |
| IHA | Incidental Harassment Authorization |
| IP | Individual Permit |
| LOA | Letter of Authorization |
| LOP | Letter of Permission |
| LTMS | Long Term Management Strategy |
| MBTA | Migratory Bird Treaty Act |
| MMPA | Marine Mammal Protection Act |
| MRP | Municipal Regional Permit |
| MSA | Magnuson-Stevens Fishery Conservation and Management Act |
| NEPA | National Environmental Protection Act |
| NHPA | National Historic Preservation Act |
| NMFS | National Marine Fisheries Service |
| NLTAA | Not Likely to Adversely Affect |
| NPDES | National Pollutant Discharge Elimination System |
| NWP | Nationwide Permit |
| QSP/QSD | Qualified SWPPP Practitioner/Developer |
| RHA | Rivers & Harbors Act |
| RWQCB | Regional Water Quality Control Board |
| SHPO | State Historic Preservation Officer |
| SMHM | Salt Marsh Harvest Mouse |
| SWPPP | Stormwater Pollution Prevention Plan |
| SWRCB | State Water Resources Control Board |
| USACE | U.S. Army Corps of Engineers |
| USCG | U.S. Coast Guard |
| USEPA | U.S. Environmental Protection Agency |
| WDRs | Waste Discharge Requirements |
| WQ Cert | Water Quality Certification |

SOURCE: ESA, 2020

**TABLE 2**
**SUPPORTING STUDIES EXPECTED TO BE REQUIRED FOR PERMITTING**

| Study | Permit or Approval Type Requiring It | Notes |
|---|---|---|
| Aquatic Resources Delineation Report | USACE Section 404/10, RWQCB Section 401 Cert/WDRs, and BCDC Permit | Used to quantify and characterize existing features, and to calculate project impacts. Formerly called a 'Wetland Delineation' |
| Biological Assessment (BA) | USACE Section 404/10 – to demonstrate FESA compliance; SLC Lease | Assesses potential presence of, and project effects on, federally-listed species and/or habitats (protected by NMFS and/or USFWS) |
| CDFW Avoidance Memo | CDFW Concurrence with no take for Fully Protected Species; SLC Lease | Memo documenting proposed avoidance and/or minimization measures to ensure no take of fully protected species (ideally to be developed in coordination with CDFW) |
| Protocol-level species surveys | USFWS/NMFS Biological Opinion or Concurrence (for FESA compliance), CDFW CESA compliance; SLC Lease | May be required to support USFWS/NMFS decisions about listed species presence and/or impacts. May have seasonal restrictions and need to be conducted well in advance of permit application preparation.<br><br>May be required to support determination that no CDFW ITP is required for state-listed CESA-protected species.<br><br>2020 protocol surveys were conducted for California Ridgway's Rail (attached). |
| Rare Plant Surveys | USFWS Biological Opinion or Concurrence (for FESA compliance) | May be required to support USFWS decisions about rare plant presence and/or impacts. May have seasonal restrictions and need to be conducted well in advance of permit application preparation. |
| Cultural Resources Assessment/Section 106 Report | USACE Section 404/10 – to demonstrate NHPA compliance | Assesses potential presence of, and project effects on, cultural resources such as tribal, archaeological, or historic architectural resources (regulated by SHPO) |
| Calculation of Project Impacts to Aquatic Resources | USACE Section 404/10, RWQCB Section 401 Cert/WDRs, and BCDC Permit | Overlay Project Design (including cut and fill) over Aquatic Resources Delineation polygons (and other key jurisdictional datum like BCDC '100 ft Shoreline Band). Distinguish between permanent and temporary impacts. |
| Comparison of Pre-and Post-Project Aquatic Resource Functions and Services | USACE Section 404/10, RWQCB Section 401 Cert/WDRs, and BCDC Permit | Used to demonstrate project benefits, justify project impacts, and calculate the need for compensatory mitigation (if applicable) |
| Hydrology Report | RWQCB Section 401 Cert/WDRs, BCDC Permit | May be required to demonstrate adequate design considerations for erosion, water treatment, or hydrologic support for target restoration species. |
| Storm Water Control Plan | SWRCB/RWQCB NPDES Municipal Regional Stormwater Permit | Required to complete a Stormwater Control Plan that provides rationale for post-construction storm water quality treatment. |
| SWPPP | SWRCB/RWQCB Construction General Permit | Required for construction projects > 1ac, to demonstrate adequate construction-period erosion protection |
| Construction Monitoring Plan | USACE Section 404/10, RWQCB Section 401 Cert/WDRs, BCDC Permit, and others (per Nov. 2020 BRRIT General Guidance recommendations, as attached) | Requested by the BRRIT. Provides an opportunity to solicit agency input/approval of proposed avoidance and minimization measures. |

**TABLE 2**
**SUPPORTING STUDIES EXPECTED TO BE REQUIRED FOR PERMITTING**

| Study | Permit or Approval Type Requiring It | Notes |
|---|---|---|
| Dilution and Mixing Studies | SWRCB/RWQCB NPDES Wastewater Permit | May be required for City's update to RWQCP permit, to demonstrate compliance with effluent treatment requirements |
| Property Boundary Survey | SLC Lease | Used to confirm site boundaries and location relative to SLC jurisdictional lands (and determination of whether Lease or Lease Amendment may be required) |
| Spill Prevention and Control Plan | SLC Lease | |
| Litter and Waste Management Plan | SLC Lease | |
| Environmental Justice evaluation | SLC Lease | Per a recently implemented Policy: https://www.slc.ca.gov/envirojustice/ |
| Public Access Plan; Public Improvements Plan | BCDC Permit | To demonstrate pedestrian and bicycle access routes, amenities (trash, signage, etc.) |
| Sea Level Rise (SLR) Adaptation Study | BCDC Permit | To demonstrate adequate calculation of and design measures to respond to SLR through 2050 and beyond; should also address design project life in light of SLR (per Nov. 2019 BRRIT comments, as attached). |
| Adaptive Management and Monitoring Plan (AMMP) | RWQCB Section 401 Cert/WDRs, BCDC Permit, USFWS Section 7 Consultation/Biological Opinion | To address: monitoring metrics, methods, duration, and frequency; performance criteria; adaptive management if performance criteria are not met; long-term management and maintenance (per Dec. 2019 and Nov. 2020 BRRIT comments, as attached). |
| Landscaping Plans, Utilities and Emergency Response Plans | BCDC Permit | May not be required for this project/site; to confirm with BCDC |
| Traffic and Circulation Plans | BCDC Permit | May not be required for this project/site; to confirm with BCDC |
| Alternatives Analysis (per 404b1 Guidelines) | USACE Section 404/10, RWQCB Section 401 Cert/WDRs, and BCDC Permit | May be required to demonstrate proposed project is the 'least environmentally damaging practicable alternative" which accomplishes the stated project purpose, |
| Obstruction Aeronautical Study | FAA Guidelines/approval (on airport land or adjacent) | To confirm whether this study is required on lands adjacent to, but not on, airport land. |
| FAA Obstruction Evaluation/ Airport Airspace Analysis (Form FAA 7460-1 – Notice of Proposed Construction or Alteration | FAA Guidelines/approval (on airport land or adjacent) | To confirm whether this study is required on lands adjacent to, but not on, airport land. |

# Permitting Challenges, Strategies and General Recommendations

## Permitting Challenges

The following are the Project's anticipated permitting/regulatory challenges:

1. **Permanent impacts to existing waters and wetlands** (such as tidal marsh, non-tidal wetlands, and 'other waters') – due to the permanent placement of fill in, and the resulting losses of, jurisdictional

waters/wetlands.[19] *If agencies view the Project as having net permanent impacts that are not permitted and/or not outweighed by Project benefits,* ***compensatory mitigation could be required*** *(and could be extremely costly). However, if these impacts are considerably problematic for permitting, project design could likely be adjusted to lessen the challenge.*

2. **Type conversion –** converting habitat types, such as tidal wetlands to brackish wetlands, brackish wetlands to freshwater wetlands, etc. as a result of fill placement for Project objectives. *If agencies view the type conversion as not permitted and/or not resulting in net benefits,* ***compensatory mitigation could be required*** *(and could be extremely costly).*

3. **Impacts to sensitive species** (i.e., state- or federally-listed species such as Salt Marsh Harvest Mouse, Ridgway's Rail, etc.). It is important to note that adverse impacts are expected to be primarily construction-related short-term impacts, with anticipated long-term benefits to these same species - a key project objective. *However, if agencies view the Project as having impacts that are not permitted and/or not outweighed by Project benefits,* ***compensatory mitigation could be required*** *(and could be extremely costly). Furthermore,* ***avoidance and/or minimization measures to protect sensitive species are likely to be required before, during, and for many years after construction****, and are also expected to be extremely costly.*

4. There is **no existing Aquatic Resources Delineation nor any recent Biological or Cultural Resource studies** for the proposed site (or siting alternatives), due to a lack of funding at this time (note: these are planned to be undertaken during future Project phases). Therefore, precise calculations of potential Project impacts and/or post-Project habitat creation are not yet possible.

5. **Potential changes to the Project's design, permitting processes, construction methods, and/or timelines – as a potential outcome of coordination with the San Francisco Bay (SAFER Bay) Feasibility Study and USACE Shoreline Project**

    a. Note: coordination with these projects is expected to be necessary or highly recommended (and potential integration, though not planned at this time, may influence Project's berm design), in order to achieve adequate levee design/flood protection (for future additions/modifications anticipated under the SAFER Bay and/or Shoreline projects).

6. Expected **informational and timeline challenges with various environmental compliance (CEQA and permitting) processes , which will add costs and time to project approval/implementation**:

    a. The SLC's lease and/or lease amendment process tends to be lengthy, have extensive informational requirements, and require legal team involvement (also lengthy).

    b. The BCDC's permit process also tends to be lengthy, have extensive (and often costly) informational requirements, and their review timeline technically does not begin until after receipt of all other completed environmental compliance requirements (completion of CEQA/NEPA, issuance of final permits, etc.). BCDC's permit process will include the time needed to identify public access solutions (including the relocation of the public trail) that achieves a balance between the various and sometimes competing goals of a multi-benefit project.

[19] Permanent impacts, or perceived controversy surrounding a project's impacts to waters/wetlands, could drive the USACE's selection of a more complex permitting pathway (such as an Individual Permit, rather than a more streamlined Nationwide Permit), thereby increasing the time and costs associated with permitting.

c. The USACE's Individual Permit process (which is expected to be required, per Nov. 2020 BRRIT feedback as attached) can be lengthy, has a requirement for an Alternatives Analysis and NEPA documentation (addressed above), and includes a pubic noticing process.

d. The RWQCB's recently-adopted Policies related to 401 Certification (addressed above) have a requirement for preparation of an Alternatives Analysis.

e. Preparation of studies or materials to support the City's pursuit of reissuance of their RWQCP-wide NPDES wastewater permit, to include PAHLPP.

f. Preparation of a CEQA EIR or Focused EIR (if selected) may be lengthy and will include public noticing.

g. Based on the novel nature of the Project, and its numerous long-term objectives and regional implications, a number of studies, plans or other reports are expected to be required (which could become costly) such as an Adaptive Management and Monitoring Plan (AMMP), a Construction Monitoring Plan, and potential hydrologic and/or water quality studies (some of which are recommended per the attached BRRIT feedback)

7. **Inherent conflicts between Project goals and Federal Aviation Administration (FAA) guidance associated with the nearby Palo Alto Airport, which may present considerable obstacles or hurdles** to Project design and approval timelines. *As mentioned during the Dec. 2019 BRRIT Pre-Application Meeting, the USACE must take such issues (if perceived as a 'major controversy') into account as a part of their permitting process and public interest determination; this issue may also factor into the CEQA analysis and public input process.*

   a. FAA guidance makes specific recommendations against wetland development within 5,000 feet of an operational airport. Note: the entirety of the PAHLPP (as well as Harbor Marsh and the Don Edwards Wildlife Refuge) is located within 5,000 feet of the Palo Alto Airport. (**FAA Circular - Attachment 1**)

   b. FAA regulations require coordination with and/or approvals by the FAA for proposed construction/development projects at and in the vicinity of airports.

      i. The Palo Alto Airport is a vulnerable facility with additional requirements for safety and efficient use of navigable airspace. An obstruction aeronautical study is required by the FAA to evaluate any proposed structures, and make a determination of permanent and temporary impacts[20] (HDR, 2019).

      ii. The FAA Obstruction Evaluation / Airport Airspace Analysis (Form FAA 7460-1 – Notice of Proposed Construction or Alteration) should be submitted when design details are known, and additional filings are required to the FAA to assess temporary construction impacts a minimum of 45 days prior to the start of work[21].

   c. If certain conflicts with FAA guidance associated with the Palo Alto airport cannot be resolved, other facets of the Project design may need to be modified or the Project may not be possible to implement in the region.

[20] Project team to confirm whether this study is required on lands adjacent to, but not on, airport land.
[21] Project team to confirm whether this study is required on lands adjacent to, but not on, airport land.

d. Note that the SAFER Bay Levee Project is considering incorporating horizontal levees along segments of the flood control levee and creating tidal wetland habitat as mitigation to impacted wetlands, which could occur within 5,000 feet of the airport (HDR, 2019).

Suggested strategies to address the Projects' anticipated challenges are presented below (in an order corresponding to the above challenges); some general strategies for streamlining and/or increasing successful permitting follow.

## Recommended Permitting Strategies

The following permitting strategies are recommended to address the challenges enumerated above:

1. (Permanent impacts to existing waters and wetlands) - Conduct robust regulatory and resource agency coordination, taking advantage of newly-developed or currently-developing policy changes which are aimed at better addressing restoration and sea level rise adaptation Projects in the Bay. For example:

   a. Engage with regulatory agencies as soon as possible, and continue engagement throughout Project design evolution.

   b. Present the Project several times at the BRRIT 'Pre-Application Interagency Meeting' (Note: first presentation of the 'Central Reach' site was completed on Dec. 4, 2019; second presentation of the new 'South Reach' site was completed on Nov. 4, 2020) hosted by the RWQCB and attended by the multiple state and federal regulatory agency members of the BRRIT, in order to solicit key agency feedback on potential constraints or recommended approaches, as well as to garner early conceptual agency support for the Project. The BRRIT encourages projects to present more than one time, to accompany the refinement of project design and the incorporation of prior BRRIT input.

      Presenting at the BRRIT meetings will require:

      - Contacting the BRITT to request a calendar slot as soon as possible (suggest: no later than 1 month before)
      - Submitting a Project Summary (required: no later than 2 weeks before)
      - Preparing a day-of presentation (typically PowerPoint) with assigned roles and talking points, targeting 20-25 minutes (leaving 25-30 minutes for discussion/Q&A)
      - Contact BRRIT staff (Anniken Lydon was contacted for the December 4$^{th}$ 2019 meeting; Valary Bloom was contacted for the November 4$^{th}$ 2020 meeting) for more information about required submittals for future meetings.

   c. Make periodic direct outreach to BRRIT agency staff and their management, to encourage their continued future involvement with and support of the Project.

   d. **Continue to engage with the BRRIT** throughout Project evolution.

      The Project team should **provide regular updates to, and request feedback from, the BRRIT staff, throughout the Project's duration**. In addition, the 30% Preliminary Design Report (PDR) should be submitted to the BRRIT for their review/feedback. (Note: The 30% PDR was submitted for the 'South Reach' site prior to the November 2020 BRRIT presentation).

The Project team should **request that the BRRIT schedule a site tour and/or second meeting presentation, if deemed beneficial, as soon as possible.** (Note: this may be done in combination with the team's presentation of the 60% Designs, which the BRRIT suggested happen in mid-2021, per attached BRRIT Nov. 2020 feedback).

e. Engage with higher-level agency staff/management, who have broader regional vision and decision-making power, and can empower staff at the permit-processing level to interpret existing regulations more broadly to support restoration.

f. **Align with and utilize the BCDC's -recent Bay Plan Amendment (BPA No. 1-17) which adopted policy changes regarding the placement of in-Bay fill for habitat restoration**, found in the 'Fill for Habitat Amendment' to the San Francisco Bay Plan (see **BCDC Fill for Habitat Fact Sheet – Attachment 2**, which was prepared prior to the BPA's adoption/approval; more current information can be found at **https://bcdc.ca.gov/BPAFHR/FillHabitat.html**). The amended policies are explained in detail in BCDC's May 24, 2019 Staff Report (available online) entitled *Bay Fill for Habitat Restoration, Enhancement, and Creation in a Changing Bay* and became effected in December 2019. Important notes:

The new Bay Plan language modifies the "minor amount of fill" policies so that habitat restoration projects are reviewed using the same measure ("minimum amount necessary for the project purpose") as any other project that proposes "Bay fill."

BCDC also acknowledges that allowing more fill in the Bay for habitat projects could result in some adverse impacts and conversions of some habitat types (a.k.a. 'type conversion') to another (such as marsh to upland to allow future marsh migration), the consequences of which are difficult to predict. To address the potential harm, BCDC proposes that, where appropriate, additional habitat monitoring and plans that provide additional actions where impacts may be significant (adaptive management plans) should be developed and carried out.

Based on these policies and BRRIT feedback to date, the Project should plan to prepare an Adaptive Management and Monitoring Plan (AMMP) as part of, or to satisfy, final permitting requirements[22]. (Note: the AMMP is planned for preparation during future phases).

Finally, the BCDC is planning to amend its regulations to create a new Regionwide permit for small restoration projects, and to add regulations that would allow certain restoration projects to be approved administratively without a Commission public hearing and vote. (Note: as of November 2020, this permit is not yet available).

g. For use in agency communications and in seeking early conceptual feedback regarding Project impacts and benefits, **prepare a comparison Table of pre- and post-Project aquatic habitats, including their associated functions and services, to summarize the Project's anticipated impacts and (more importantly) the Project's intended habitat gains and "functional lift."** (Note: this information is planned for preparation in a Compensatory Mitigation Memo during future phases).

To **approximate the quantity of <u>existing</u> aquatic habitats at the Project site** (prior to conducting an Aquatic Resources Delineation, if funding is not available), utilize existing topography, site aerials (with vegetative signatures), and specific tidal datum (such as MHW, HAT) to prepare a rough 'desk' delineation of waters and wetlands. This would rely upon the extrapolation of specific tidal datum, that can broadly be correlated to various waters/habitat types, in order to generalize the location of these features without extensive fieldwork. If possible, these data would be 'spot-verified' in the field. This 'desk delineation' could then be used for rough calculations of project impacts and comparisons against

[22] Per December 2019 and November 2020 BRRIT feedback.

post-project gains. (Note: an Aquatic Resources or 'Jurisdictional' Delineation, which will provide precise quantities of existing aquatic habitats at the site, is planned for preparation in future phases).

**Approximate existing suitable habitat for sensitive species** using the same existing topographic (and hydrologic?) information, as well as vegetative signatures on aerial photographs (which can hopefully be correlated with site photographs and/or the team's direct knowledge of the site). (Note: vegetation mapping and an assessment of habitat suitability for sensitive species are planned for preparation in future phases).

To **approximate Project <u>impacts</u> to, and <u>post-Project gains</u>** in, aquatic habitats, utilize the conceptual design plans overlaid upon the existing habitats, as approximated (per above). Make a best estimate of the distinctions between and quantities of 'creation,' 'restoration,' and 'enhancement' that would result from Project implementation. Reflect this in the Table comparing pre- and post-Project aquatic habitats and functions and services (suggested above). (Note: based on other studies planned for future phases per above notes, an assessment of precise project impacts and anticipated gains will also be possible and is planned in future phases).

As soon as possible, **identify the approximate quantity and type(s) of compensatory mitigation which could be required**, for any permanent habitat "losses" or other project impacts to regulated resources, **as well as the specific agency guidance documents or standards which will govern the nature of the mitigation**. (Note: based on other studies and analyses planned for future phases per above notes, an assessment of potential compensatory mitigation requirements will be possible and is planned – in coordination with continued BRRIT guidance on the nature of the requirements - in future phases).

h. Look to the Oro Loma Project for any lessons learned regarding mitigation.

   This should help limit Project vulnerabilities to unexpected requirements and costs, as well as to plan and budget for mitigation requirements as part of overall Project costs.

i. Seek and **utilize relevant expertise** from the Oro Loma project, and from Jeremy Lowe (design elements), Peter Baye (ecological needs including native plants and water demands), David Sedlak (water treatment), and others as appropriate, throughout Project design advancement, **to best communicate Project constraints, design choices, and post-Project benefits**.

j. Present/**showcase the Project as part of the region's newly-developing "Transforming Shorelines Collaborative,"** to increase awareness and publicity about the Project as well as to plan to collect input on key project challenges and to share lessons learned. Note: the Project at the original (Central Reach) site was presented during the first meeting of the Transforming Shorelines Collaborative, on March 2, 2020.

2. (Type conversion) - **Same as #1** above.

   To the extent practicable, **align with and utilize the EPA/USACE/RWQCB's in-progress/draft scientific and/or policy changes regarding type conversion associated with multi-objective restoration projects, outlined in the 'Framework for Wetland "Type Conversion" Analysis' (EPA R9 - Attachment 3)** request for proposals issued in October 2018 by EPA Region 9. These 3 agencies are working towards developing improved and consistent strategies for assessing aquatic resource type conversions within the Clean Water Act framework, to assist in permitting and compensatory mitigation decisions. A draft document is expected in March 2020.(Note: as of the November 2020 BRRIT meeting, this framework was still in development and beta-testing, including for the McInnis Marsh project).

3. (Impacts to sensitive species) **- Same as #1** above.

   **Plan for seasonal avoidance** of sensitive species (such as Ridgway's Rail breeding season from approx. February 1 through August 31, migratory bird nesting season from February to August, and conducting in-water work within the LTMS window of June 1 to November 30th) to the extent practicable. **Actively coordinate with the Project design team and regulatory agencies to ensure sensitive species avoidance measures can be carried out in a cost-effective manner** (recommended measures to date include: utilizing biological monitors, exclusion fencing when practicable, buffers around active bird nests, avoidance of marsh-adjacent construction during extreme high tides, hand-removal of vegetation to the extent practicable, minimizing and/or attenuating construction noise to the extent practicable, etc.). Actively engage the BRRIT team and other CEQA-responsible agencies, as appropriate, to determine the most suitable CEQA approach for the project, in light of potential 'take' of listed species. See Dec. 2019 and Nov. 2020 BRRIT comments, attached, for more recommendations.

   If feasible, conduct multiple years of protocol surveys for sensitive species (such as California Ridgway's Rail) prior to construction **(**per Dec. 2019 and Nov. 2020 BRRIT comments, attached).

   Note: to further the Project team's understanding of habitat suitability and presence/absence of California Ridgway's Rail at the Project and in the general vicinity of Harbor Marsh, ESA conducted California Ridgway's Rail protocol surveys in spring 2020. The results are provided in a Memorandum (**Attachment 4**). In summary, the Harbor Marsh and vicinity are a known high-density site for the rail.

4. (No existing Delineation, or recent Biological or Cultural Resource studies) - **Same as #1.g.** above. Note: these studies are planned in a future phase).

   Use a hybrid of the Hydrogeomorphic method (HGM) and California Rapid Assessment Method (CRAM) methods to assess impacts and benefits. (Note: these forms of assessment are likely to be conducted and used in the planned Compensatory Mitigation memorandum to be prepared in a future phase).

5. (Coordination with flood control improvement projects) **- Continue strategic conversations and coordination with the SAFER Bay and USACE Shoreline Study teams**, to identify potential synergies, constraints, and/or make decisions within the context of the broader regional framework and needs.

   Leverage teaming partner HDR's knowledge of design and geotechnical issues for similar projects and regional specifics, and HT Harvey's knowledge of local sensitive species issues and successful approaches (for SMHM, Ridgway's Rail, etc.), from their roles in the SAFER Bay project.

   To enable potential future integration, the City has selected a design option that includes a small inboard side berm as an interim flood protection measure; the berm will be designed to enable future integration (inclusion or replacement of the berm) with a SAFER Bay/Shoreline study levee, as reflected in the South Reach site's revised 30% PDR (ESA, 2020).

6. (Informational and timeline challenges with various environmental compliance (CEQA and permitting) processes - **Plan for a longer timeline to complete CEQA and permitting processes, and seek additional Project funding to address costly informational and permitting requirement as well as a longer timeline**. <u>And:</u> Same as #1 above.

   **Immediately initiate an inquiry with SLC** to determine if the Project site is within SLC jurisdiction/leased lands[23], and whether a new lease or lease amendment will be required. To support this inquiry, **consider engaging a Professional Land Surveyor to conduct a boundary survey**, and/or request Official Records

[23] SLC Lease #PRC 7495.9 issued to City of Palo Alto applies to marsh enhancement facilities and a nature observation deck in the Project site vicinity, and is valid June 1, 1991 through May 31, 2040. This lease may apply to the Project site.

and a Title Report from the County, for use in communications with SLC (and for useful information on known land encumbrances such as PG&E easements, etc.).

Complete the Project's CEQA analysis,[24] and then prepare and submit Draft applications to the SLC and BCDC as soon as possible, to obtain agency input on informational gaps and key concerns. As part of these applications, plan to include the avoidance, minimization, and mitigation measures required by the SLC in their recent Amendment of Palo Alto's Lease No. PRC 9143.9 (**Attachment 5;** see especially MM BIO-1 through -6. Note that Lease No. PRC 9143.9 is provided solely as a recent and nearby example of the SLC's typical lease requirements; Lease No, PRC 7495.9, also included in Attachment 5, is an older long-term lease which may in fact apply to the Project site).

Plan for a lengthy and iterative negotiation process with BCDC regarding Project modification and/or mitigation requests, including for things like **maximum public shoreline access**. Schedule a meeting with BCDC Bay Design Analysts to discuss their public access recommendations and requirements (Note: this was suggested by BCDC, per attached BRRIT Nov. 2020 feedback). Host a public workshop(s) to gather additional input on public access interest and/or concerns.

To the extent possible, prepare an Alternatives Analysis that meets the requirements to support both the USACE Individual Permit and RWQCB 401 Certification policies. (Note: this approach is planned for a future phase).

Utilize lessons learned and data from the Oro Loma Horizontal Levee Pilot Project, and EOA's expertise, to increase the RWQCB's NPDES unit's comfort level around the PAHLPP's added 'polishing' benefits to treated wastewater effluent, without requiring additional costly studies and/or long-term water quality testing.

Leverage the ESA team's successes with the preparation of plans and studies (such as Adaptive Management and Monitoring Plans) for other restoration projects in the region, to increase the likelihood of agency approval and potentially shorten their approval processes around such plans and studies.

7. (Conflicts between Project goals and FAA Guidance) **– Prioritize continued strategic conversations and coordination with the Palo Alto Airport staff and leadership** (who are well versed in FAA regulations), to identify potential opportunities and/or constraints, and to make decisions within the context of the broader regional framework and needs. Note: based on these conflicts, the Project team abandoned the original site and selected an alternative site – referred to as the 'South Reach' site - which is intentionally located off airport property but still within the Palo Alto Baylands, to reduce or eliminate some of these conflicts and advance a pilot project in the near term.

   However, due to the selected site's location near the airport, some of the coordination strategies raised in the FAA circular (AC No 150/5200-33B) may still need to be employed, such as direct FAA coordination; enlisting of a qualified wildlife damage management biologist to provide input and/or evaluate proposed project design; preparing a Wildlife Hazard Management Plan (WHMP) to develop specific measures to minimize risk; and proposing to install signage and conduct other forms of public education (such as holding public meetings or nature walks) to discourage activities that would attract certain wildlife. Based on the importance of this issue to the Project's viability and perceived success for the City and the region, t**he City should address compatibility with FAA Guidelines with Palo Alto Airport staff head-on and ASAP**.

[24] SLC and BCDC may not review a draft application until the Project's CEQA analysis is complete.

## General Recommendations for Streamlining Permitting and/or Increasing Permitting Success:

The following permitting strategies are recommended more generally, to reduce permitting timelines, obstacles, and mitigation burdens:

- Actively engage with stakeholders and CEQA-responsible agencies, including the BRRIT team, to **attempt to resolve potentially-significant environmental effects and to determine the most suitable CEQA approach** for the project.

- **Bring the Project, and its key benefits, to the attention of each Agency's management/decision-makers** (i.e., above the staff level) to ensure bigger-picture thinking and prioritization

- **Utilize a 'Permit Tracking Table'** to best stay on schedule and manage concurrent permitting processes

- Empower and encourage the Project design team to **identify and document constraints in siting, design configurations, and/or construction methodologies**, which can then be conveyed to regulators to increase understanding and support of the final selected site and proposed design.

- **Leverage municipal resources and political attention to encourage agency cooperation and support, especially from higher-level staff (i.e., management and directors)**; this can smooth out some regulatory issues that may arise at the staff level, if current regulations or guidance (generally not written to facilitate restoration at this time) are interpreted too narrowly.

- **Leverage existing Project support from regulatory agencies and the scientific community**, to encourage additional agency and stakeholder support and seek additional sources of funding. For example, leverage the RWQCB's recent Letter of Support (**Attachment 6**) or the attention the Project may have received as part of the Transforming Shorelines Collaborative.

- With respect to sensitive species and/or habitats, develop a schedule to represent sensitive windows (such as nesting seasons) for those species with high potential to be present at the site; actively coordinate with engineers and construction specialists throughout Project design, to **ensure construction timing can maximize avoidance of the site's sensitive species' windows**.

- Craft **definitions of and timelines for restoration/mitigation 'success criteria' carefully**, to ensure they are realistic; focus on qualitative (not quantitative) measures and realistic timeframes for attainment; avoid commitments that would be 'in perpetuity.'

- Carefully consider and **limit the duration and level of detail proposed for long-term Project and/or mitigation monitoring and reporting**, as these efforts are often committed to without enough consideration (in order to facilitate expedited permitting), but are typically far costlier than originally envisioned.

- **Focus potential adaptive management strategies on aspects of the Project which affect habitat, hydrology, and water quality outcomes**. Describe the feedback loop of how monitoring vegetation on the horizontal levee and in the adjacent tidal marsh will influence discharge rate schedule seasonally and over the longer term. Adaptive management would include incrementally increasing flows while observing vegetation response until the desired response has been achieved. Once the desired vegetation response has been achieved, further monitoring would allow for fine-tuning the hydrology to maintain the desired ecologic habitat bands along and adjacent to the horizontal levee. Additionally, water quality monitoring after the treatment zone can be correlated with hydraulic retention time and season to both meet vegetative habitat and treatment goals. As mentioned previously, the Project should plan to prepare a Monitoring and Adaptive Management Plan as part of, or to satisfy, final permitting requirements.

## Conclusions

In conclusion, ESA recommends the Project team continue agency outreach efforts, following the recent presentation of the Project, in concept, at the November 4, 2020 BRRIT Pre-Application Meeting. Continued engagement with the BRRIT team should occur throughout project evolution. The next near-term recommended step would be to submit any specific questions to the BRRIT team (which may be any unanswered questions from the team's review of the BRRIT's December 2019 feedback [**Attachment 7**]or the BRRIT's formal comments/suggestions from the November 2020 meeting, included as **Attachment 8**). These questions should be aimed at clarifying key agency concerns, confirming the likely permitting and CEQA pathways and supporting information required, and identifying specific permitting requirements that could jeopardize project viability in light of funding limitations (such as costly compensatory mitigation requirements or lengthy permit or CEQA processes). In addition, the team should schedule and plan for the next BRRIT presentation at the 60% design stage, in approximately mid-2021.Four other near-term recommended next steps would be 1) for the project team to begin engaging with the City's Planning group, to identify potentially-appropriate CEQA approaches, based on known potentially-significant issues and in light of agency and stakeholder feedback to date, 2) to initiate an inquiry with SLC to determine if the Project site is within SLC jurisdiction/leased lands, and whether a new lease or lease amendment will be required (including engaging a Professional Land Surveyor to prepare a boundary survey and/or request Official Records and a Title Report from the County), 3) to schedule a meeting with BCDC Bay Design Analysts to further discussions about feasible and appropriate public access improvements and design, and 4) to schedule geotechnical site investigations needed for design advancement (per the next phase of work) prior to the onset of various sensitive species' nesting seasons (i.e., prior to February 1, 2021), if possible.

Lastly, and perhaps most importantly, ESA recommends the team address the potential airport land/FAA guidance conflicts ASAP and head-on, by urgently prioritizing engagement and coordination with the City of Palo Alto Airport staff and leadership, in order to make key decisions about project design as soon as possible. Similarly, ESA recommends the project team continue public/stakeholder outreach, to attempt to resolve concerns about the trail relocation and design. Finally, after these two key conflicts have been addressed to the extent possible, ESA recommends the Project team continue to coordinate with and seek regulatory agency buy-in and rally political support from local government representatives for the Project, in anticipation of leveraging that support during likely permitting 'hang-ups' during the process.

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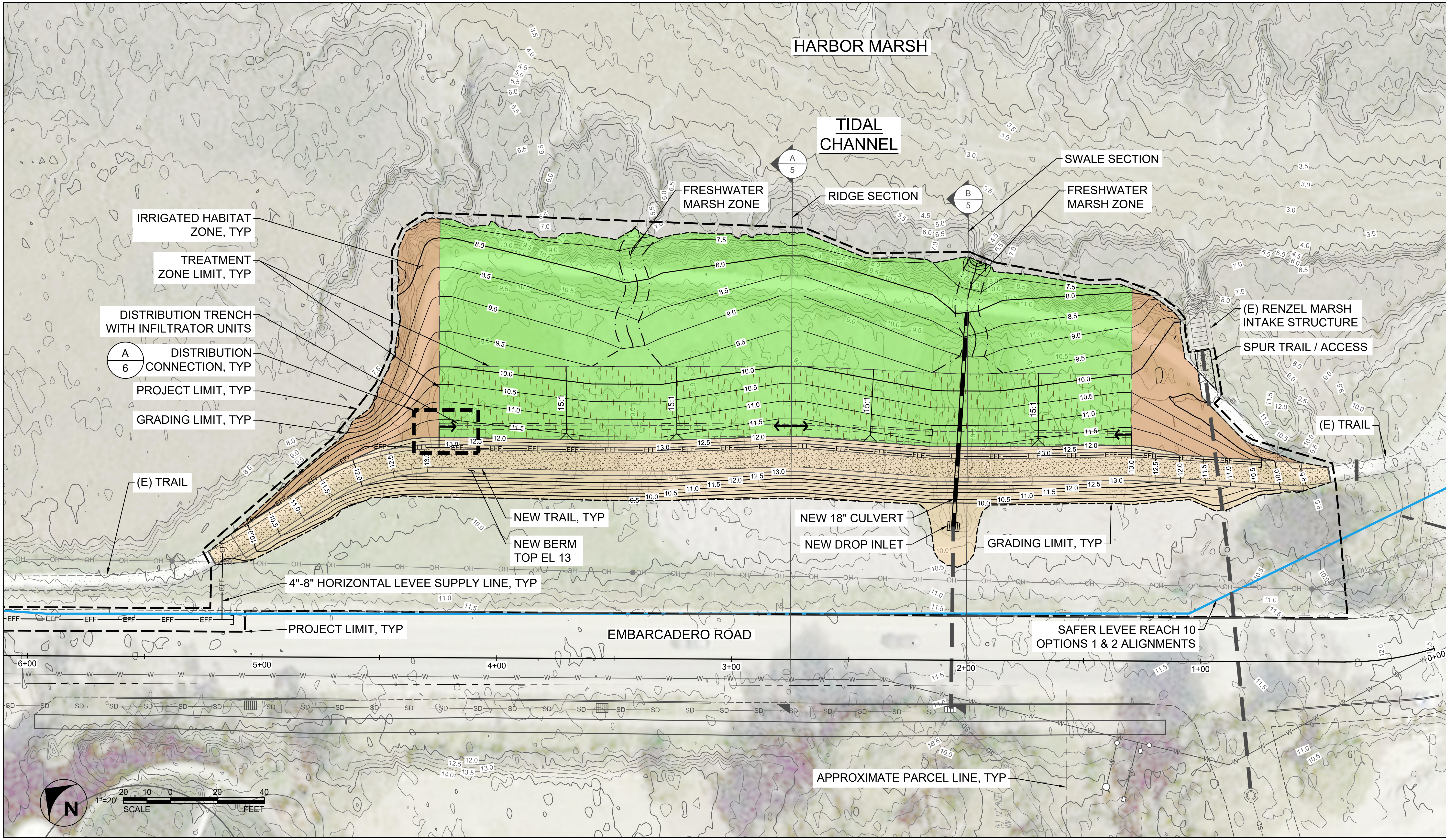


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NOTES

1. AERIAL ORTHOIMAGERY FROM NORTHROP GRUMMAN (2015), AS DOWNLOADED FROM USGS EARTH EXPLORER DATABASE. IMAGERY WAS COLLECTED BY NORTHROP GRUMMAN BETWEEN FEBRUARY 20 TO FEBRUARY 24, 2015.
2. ALL ELEVATIONS ARE ON NORTH AMERICAN VERTICAL DATUM 1988 (NAVD88).

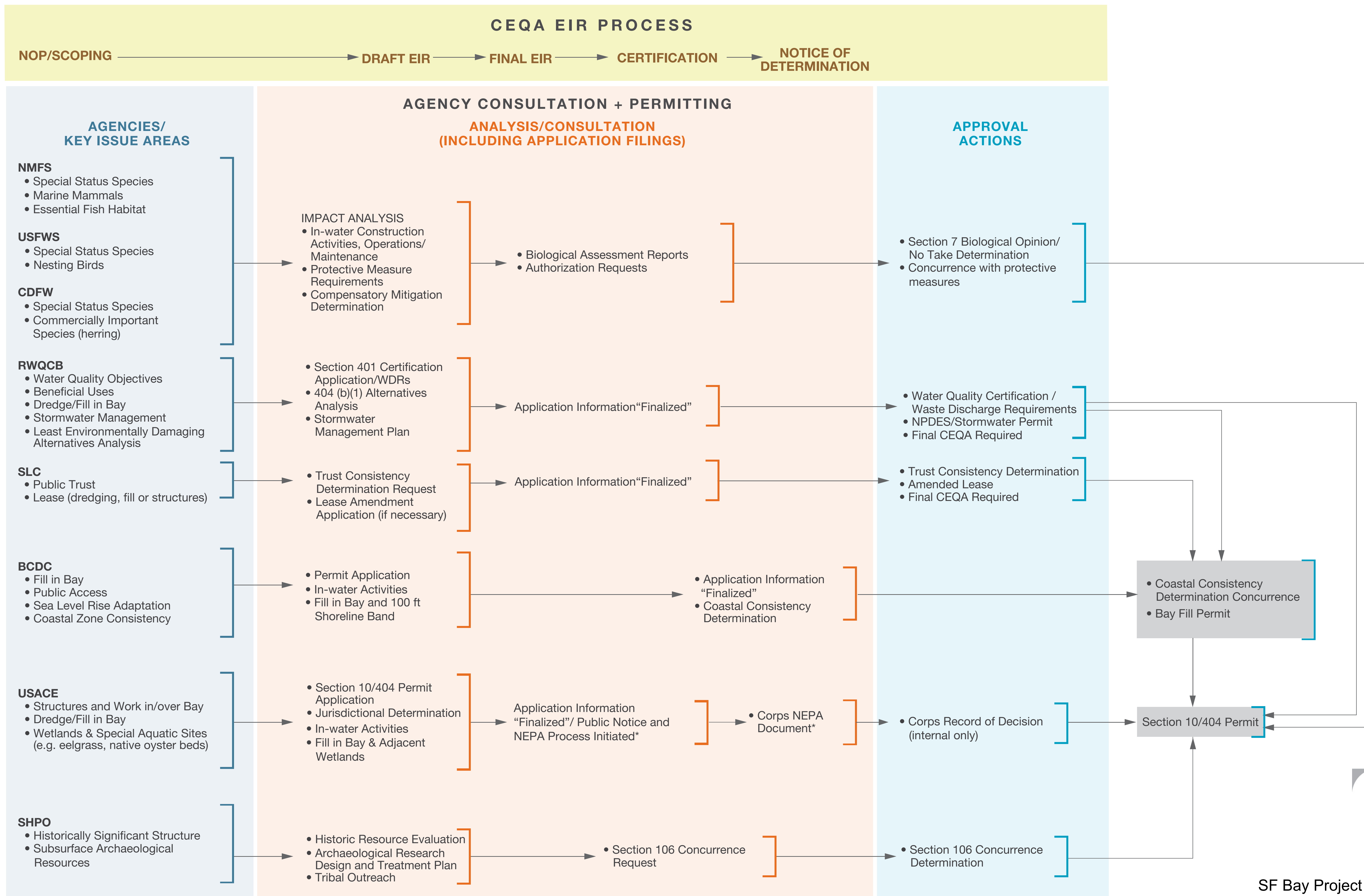
ESA

PALO ALTO HORIZONTAL LEVEE D181306.01

**FIGURE 1**

South Reach Phase 1A Plan View - 30% Conceptual Design

## SAN FRANCISCO BAY PROJECT PERMITTING: GENERALIZED




Source: ESA 2020

**Figure 2**
SF Bay Project CEQA and Permitting Flow Chart-2020

**NMFS** = National Marine Fisheries Service (NOAA Fisheries)
**USFWS** = U.S. Fish and Wildlife Service
**CDFW** = California Department of Fish and Wildlife
**RWQCB** = Regional Water Quality Control Board
**SLC** = State Lands Commission
**SHPO** = State Historic Preservation Office
**BCDC** = San Francisco Bay Conservation and Development Commission
**USACE** = U.S. Army Corps of Engineers
***** = USACE public Notice and NEPA process are only trigged if an individual permit is required; Nationwide permits are pre-authorized pursuant to NEPA.

# Attachment 1

## FAA Circular

U.S. Department
of Transportation

**Federal Aviation
Administration**

# Advisory Circular

| | | |
|---|---|---|
| **Subject: HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AIRPORTS** | **Date:** 8/28/2007<br>**Initiated by:** AAS-300 | **AC No:** 150/5200-33B<br>**Change:** |

**1. PURPOSE.** This Advisory Circular (AC) provides guidance on certain land uses that have the potential to attract hazardous wildlife on or near public-use airports. It also discusses airport development projects (including airport construction, expansion, and renovation) affecting aircraft movement near hazardous wildlife attractants. Appendix 1 provides definitions of terms used in this AC.

**2. APPLICABILITY**. The Federal Aviation Administration (FAA) recommends that public-use airport operators implement the standards and practices contained in this AC. The holders of Airport Operating Certificates issued under Title 14, Code of Federal Regulations (CFR), Part 139, Certification of Airports, Subpart D (Part 139), may use the standards, practices, and recommendations contained in this AC to comply with the wildlife hazard management requirements of Part 139. Airports that have received Federal grant-in-aid assistance must use these standards. The FAA also recommends the guidance in this AC for land-use planners, operators of non-certificated airports, and developers of projects, facilities, and activities on or near airports.

**3. CANCELLATION.** This AC cancels AC 150/5200-33A, *Hazardous Wildlife Attractants on or near Airports*, dated July 27, 2004.

**4. PRINCIPAL CHANGES.** This AC contains the following major changes, which are marked with vertical bars in the margin:

**a.** Technical changes to paragraph references.

**b.** Wording on storm water detention ponds.

**c.** Deleted paragraph 4-3.b, *Additional Coordination.*

**5. BACKGROUND.** Information about the risks posed to aircraft by certain wildlife species has increased a great deal in recent years. Improved reporting, studies, documentation, and statistics clearly show that aircraft collisions with birds and other wildlife are a serious economic and public safety problem. While many species of wildlife can pose a threat to aircraft safety, they are not equally hazardous. Table 1 ranks the wildlife groups commonly involved in damaging strikes in the United States according to their relative hazard to aircraft. The ranking is based on the 47,212 records in the FAA National Wildlife Strike Database for the years 1990 through 2003. These hazard rankings, in conjunction with site-specific Wildlife Hazards Assessments (WHA), will help airport operators determine the relative abundance and use patterns of wildlife species and help focus hazardous wildlife management efforts on those species most likely to cause problems at an airport.

Most public-use airports have large tracts of open, undeveloped land that provide added margins of safety and noise mitigation. These areas can also present potential hazards to aviation if they encourage wildlife to enter an airport's approach or departure airspace or air operations area (AOA). Constructed or natural areas—such as poorly drained locations, detention/retention ponds, roosting habitats on buildings, landscaping, odor-causing rotting organic matter (putrescible waste) disposal operations, wastewater treatment plants, agricultural or aquaculture activities, surface mining, or wetlands—can provide wildlife with ideal locations for feeding, loafing, reproduction, and escape. Even small facilities, such as fast food restaurants, taxicab staging areas, rental car facilities, aircraft viewing areas, and public parks, can produce substantial attractions for hazardous wildlife.

During the past century, wildlife-aircraft strikes have resulted in the loss of hundreds of lives worldwide, as well as billions of dollars in aircraft damage. Hazardous wildlife attractants on and near airports can jeopardize future airport expansion, making proper community land-use planning essential. This AC provides airport operators and those parties with whom they cooperate with the guidance they need to assess and address potentially hazardous wildlife attractants when locating new facilities and implementing certain land-use practices on or near public-use airports.

**6. MEMORANDUM OF AGREEMENT BETWEEN FEDERAL RESOURCE AGENCIES.** The FAA, the U.S. Air Force, the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, and the U.S. Department of Agriculture - Wildlife Services signed a Memorandum of Agreement (MOA) in July 2003 to acknowledge their respective missions in protecting aviation from wildlife hazards. Through the MOA, the agencies established procedures necessary to coordinate their missions to address more effectively existing and future environmental conditions contributing to collisions between wildlife and aircraft (wildlife strikes) throughout the United States. These efforts are intended to minimize wildlife risks to aviation and human safety while protecting the Nation's valuable environmental resources.

DAVID L. BENNETT
Director, Office of Airport Safety
and Standards

Table 1. Ranking of 25 species groups as to relative hazard to aircraft (1=most hazardous) based on three criteria (damage, major damage, and effect-on-flight), a composite ranking based on all three rankings, and a relative hazard score. Data were derived from the FAA National Wildlife Strike Database, January 1990–April 2003.[1]

| | Ranking by criteria | | | | |
|---|---|---|---|---|---|
| Species group | Damage[4] | Major damage[5] | Effect on flight[6] | Composite ranking[2] | Relative hazard score[3] |
| Deer | 1 | 1 | 1 | 1 | 100 |
| Vultures | 2 | 2 | 2 | 2 | 64 |
| Geese | 3 | 3 | 6 | 3 | 55 |
| Cormorants/pelicans | 4 | 5 | 3 | 4 | 54 |
| Cranes | 7 | 6 | 4 | 5 | 47 |
| Eagles | 6 | 9 | 7 | 6 | 41 |
| Ducks | 5 | 8 | 10 | 7 | 39 |
| Osprey | 8 | 4 | 8 | 8 | 39 |
| Turkey/pheasants | 9 | 7 | 11 | 9 | 33 |
| Herons | 11 | 14 | 9 | 10 | 27 |
| Hawks (buteos) | 10 | 12 | 12 | 11 | 25 |
| Gulls | 12 | 11 | 13 | 12 | 24 |
| Rock pigeon | 13 | 10 | 14 | 13 | 23 |
| Owls | 14 | 13 | 20 | 14 | 23 |
| H. lark/s. bunting | 18 | 15 | 15 | 15 | 17 |
| Crows/ravens | 15 | 16 | 16 | 16 | 16 |
| Coyote | 16 | 19 | 5 | 17 | 14 |
| Mourning dove | 17 | 17 | 17 | 18 | 14 |
| Shorebirds | 19 | 21 | 18 | 19 | 10 |
| Blackbirds/starling | 20 | 22 | 19 | 20 | 10 |
| American kestrel | 21 | 18 | 21 | 21 | 9 |
| Meadowlarks | 22 | 20 | 22 | 22 | 7 |
| Swallows | 24 | 23 | 24 | 23 | 4 |
| Sparrows | 25 | 24 | 23 | 24 | 4 |
| Nighthawks | 23 | 25 | 25 | 25 | 1 |

[1] Excerpted from the *Special Report for the FAA, "Ranking the Hazard Level of Wildlife Species to Civil Aviation in the USA: Update #1, July 2, 2003".* Refer to this report for additional explanations of criteria and method of ranking.

[2] Relative rank of each species group was compared with every other group for the three variables, placing the species group with the greatest hazard rank for $\geq$ 2 of the 3 variables above the next highest ranked group, then proceeding down the list.

[3] Percentage values, from Tables 3 and 4 in Footnote 1 of the *Special Report*, for the three criteria were summed and scaled down from 100, with 100 as the score for the species group with the maximum summed values and the greatest potential hazard to aircraft.

[4] Aircraft incurred at least some damage (destroyed, substantial, minor, or unknown) from strike.

[5] Aircraft incurred damage or structural failure, which adversely affected the structure strength, performance, or flight characteristics, and which would normally require major repair or replacement of the affected component, or the damage sustained makes it inadvisable to restore aircraft to airworthy condition.

[6] Aborted takeoff, engine shutdown, precautionary landing, or other.

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# Table of Contents

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## SECTION 1.

## GENERAL SEPARATION CRITERIA FOR HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AIRPORTS.

**1-1. INTRODUCTION.** When considering proposed land uses, airport operators, local planners, and developers must take into account whether the proposed land uses, including new development projects, will increase wildlife hazards. Land-use practices that attract or sustain hazardous wildlife populations on or near airports can significantly increase the potential for wildlife strikes.

The FAA recommends the minimum separation criteria outlined below for land-use practices that attract hazardous wildlife to the vicinity of airports. Please note that FAA criteria include land uses that cause movement of hazardous wildlife onto, into, or across the airport's approach or departure airspace or air operations area (AOA). (See the discussion of the synergistic effects of surrounding land uses in Section 2-8 of this AC.)

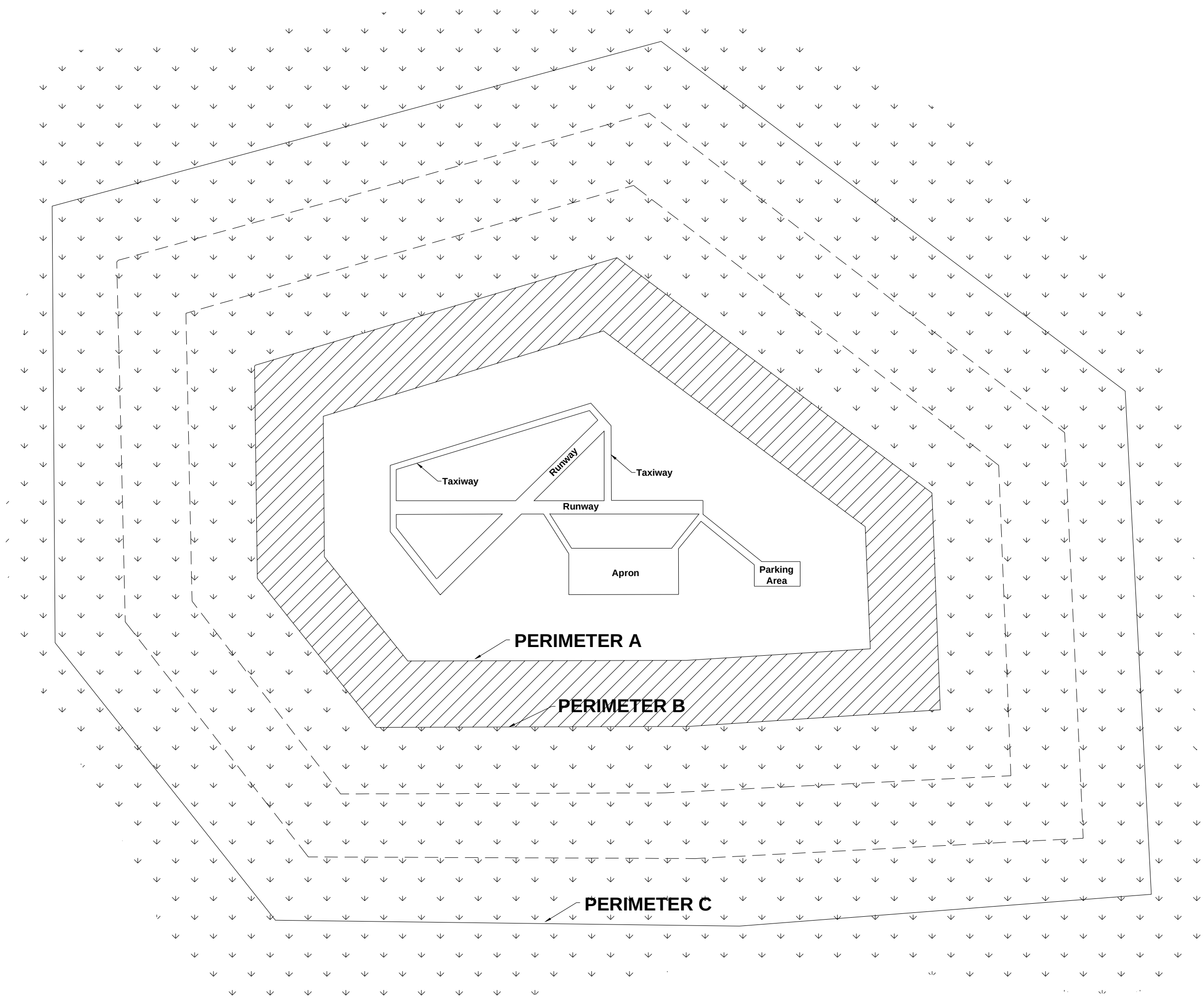
The basis for the separation criteria contained in this section can be found in existing FAA regulations. The separation distances are based on (1) flight patterns of piston-powered aircraft and turbine-powered aircraft, (2) the altitude at which most strikes happen (78 percent occur under 1,000 feet and 90 percent occur under 3,000 feet above ground level), and (3) National Transportation Safety Board (NTSB) recommendations.

**1-2. AIRPORTS SERVING PISTON-POWERED AIRCRAFT.** Airports that do not sell Jet-A fuel normally serve piston-powered aircraft. Notwithstanding more stringent requirements for specific land uses, the FAA recommends a separation distance of 5,000 feet at these airports for any of the hazardous wildlife attractants mentioned in Section 2 or for new airport development projects meant to accommodate aircraft movement. This distance is to be maintained between an airport's AOA and the hazardous wildlife attractant. Figure 1 depicts this separation distance measured from the nearest aircraft operations areas.

**1-3. AIRPORTS SERVING TURBINE-POWERED AIRCRAFT.** Airports selling Jet-A fuel normally serve turbine-powered aircraft. Notwithstanding more stringent requirements for specific land uses, the FAA recommends a separation distance of 10,000 feet at these airports for any of the hazardous wildlife attractants mentioned in Section 2 or for new airport development projects meant to accommodate aircraft movement. This distance is to be maintained between an airport's AOA and the hazardous wildlife attractant. Figure 1 depicts this separation distance from the nearest aircraft movement areas.

**1-4. PROTECTION OF APPROACH, DEPARTURE, AND CIRCLING AIRSPACE.** For all airports, the FAA recommends a distance of 5 statute miles between the farthest edge of the airport's AOA and the hazardous wildlife attractant if the attractant could cause hazardous wildlife movement into or across the approach or departure airspace.

Figure 1. Separation distances within which hazardous wildlife attractants should be avoided, eliminated, or mitigated.




PERIMETER A: For airports serving piston-powered aircraft, hazardous wildlife attractants must be 5,000 feet from the nearest air operations area.

PERIMETER B: For airports serving turbine-powered aircraft, hazardous wildlife attractants must be 10,000 feet from the nearest air operations area.

PERIMETER C: 5-mile range to protect approach, departure and circling airspace.

## SECTION 2.

## LAND-USE PRACTICES ON OR NEAR AIRPORTS THAT POTENTIALLY ATTRACT HAZARDOUS WILDLIFE.

**2-1. GENERAL.** The wildlife species and the size of the populations attracted to the airport environment vary considerably, depending on several factors, including land-use practices on or near the airport. This section discusses land-use practices having the potential to attract hazardous wildlife and threaten aviation safety. In addition to the specific considerations outlined below, airport operators should refer to *Wildlife Hazard Management at Airports,* prepared by FAA and U.S. Department of Agriculture (USDA) staff. (This manual is available in English, Spanish, and French. It can be viewed and downloaded free of charge from the FAA's wildlife hazard mitigation web site: http://wildlife-mitigation.tc.FAA.gov.). And, *Prevention and Control of Wildlife Damage,* compiled by the University of Nebraska Cooperative Extension Division. (This manual is available online in a periodically updated version at: ianrwww.unl.edu/wildlife/solutions/handbook/.)

**2-2. WASTE DISPOSAL OPERATIONS.** Municipal solid waste landfills (MSWLF) are known to attract large numbers of hazardous wildlife, particularly birds. Because of this, these operations, when located within the separations identified in the siting criteria in Sections 1-2 through 1-4, are considered incompatible with safe airport operations.

**a. Siting for new municipal solid waste landfills subject to AIR 21.** Section 503 of the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (Public Law 106-181) (AIR 21) prohibits the construction or establishment of a new MSWLF within 6 statute miles of certain public-use airports. Before these prohibitions apply, both the airport and the landfill must meet the very specific conditions described below. These restrictions do not apply to airports or landfills located within the state of Alaska.

The airport must (1) have received a Federal grant(s) under 49 U.S.C. § 47101, et. seq.; (2) be under control of a public agency; (3) serve some scheduled air carrier operations conducted in aircraft with less than 60 seats; and (4) have total annual enplanements consisting of at least 51 percent of scheduled air carrier enplanements conducted in aircraft with less than 60 passenger seats.

The proposed MSWLF must (1) be within 6 miles of the airport, as measured from airport property line to MSWLF property line, and (2) have started construction or establishment on or after April 5, 2001. Public Law 106-181 only limits the construction or establishment of some new MSWLF. It does not limit the expansion, either vertical or horizontal, of existing landfills.

NOTE: Consult the most recent version of AC 150/5200-34, *Construction or Establishment of Landfills Near Public Airports,* for a more detailed discussion of these restrictions.

b. **Siting for new MSWLF not subject to AIR 21.** If an airport and MSWLF do not meet the restrictions of Public Law 106-181, the FAA recommends against locating MSWLF within the separation distances identified in Sections 1-2 through 1-4. The separation distances should be measured from the closest point of the airport's AOA to the closest planned MSWLF cell.

c. **Considerations for existing waste disposal facilities within the limits of separation criteria.** The FAA recommends against airport development projects that would increase the number of aircraft operations or accommodate larger or faster aircraft near MSWLF operations located within the separations identified in Sections 1-2 through 1-4. In addition, in accordance with 40 CFR 258.10, owners or operators of existing MSWLF units that are located within the separations listed in Sections 1-2 through 1-4 must demonstrate that the unit is designed and operated so it does not pose a bird hazard to aircraft. (See Section 4-2(b) of this AC for a discussion of this demonstration requirement.)

d. **Enclosed trash transfer stations.** Enclosed waste-handling facilities that receive garbage behind closed doors; process it via compaction, incineration, or similar manner; and remove all residue by enclosed vehicles generally are compatible with safe airport operations, provided they are not located on airport property or within the Runway Protection Zone (RPZ). These facilities should not handle or store putrescible waste outside or in a partially enclosed structure accessible to hazardous wildlife. Trash transfer facilities that are open on one or more sides; that store uncovered quantities of municipal solid waste outside, even if only for a short time; that use semi-trailers that leak or have trash clinging to the outside; or that do not control odors by ventilation and filtration systems (odor masking is not acceptable) do not meet the FAA's definition of fully enclosed trash transfer stations. The FAA considers these facilities incompatible with safe airport operations if they are located closer than the separation distances specified in Sections 1-2 through 1-4.

e. **Composting operations on or near airport property.** Composting operations that accept only yard waste (e.g., leaves, lawn clippings, or branches) generally do not attract hazardous wildlife. Sewage sludge, woodchips, and similar material are not municipal solid wastes and may be used as compost bulking agents. The compost, however, must never include food or other municipal solid waste. Composting operations should not be located on airport property. Off-airport property composting operations should be located no closer than the greater of the following distances: 1,200 feet from any AOA or the distance called for by airport design requirements (see AC 150/5300-13, *Airport Design*). This spacing should prevent material, personnel, or equipment from penetrating any Object Free Area (OFA), Obstacle Free Zone (OFZ), Threshold Siting Surface (TSS), or Clearway. Airport operators should monitor composting operations located in proximity to the airport to ensure that steam or thermal rise does not adversely affect air traffic. On-airport disposal of compost by-products should not be conducted for the reasons stated in 2-3f.

**f. Underwater waste discharges.** The FAA recommends against the underwater discharge of any food waste (e.g., fish processing offal) within the separations identified in Sections 1-2 through 1-4 because it could attract scavenging hazardous wildlife.

**g. Recycling centers.** Recycling centers that accept previously sorted non-food items, such as glass, newspaper, cardboard, or aluminum, are, in most cases, not attractive to hazardous wildlife and are acceptable.

**h. Construction and demolition (C&D) debris facilities.** C&D landfills do not generally attract hazardous wildlife and are acceptable if maintained in an orderly manner, admit no putrescible waste, and are not co-located with other waste disposal operations. However, C&D landfills have similar visual and operational characteristics to putrescible waste disposal sites. When co-located with putrescible waste disposal operations, C&D landfills are more likely to attract hazardous wildlife because of the similarities between these disposal facilities. Therefore, a C&D landfill co-located with another waste disposal operation should be located outside of the separations identified in Sections 1-2 through 1-4.

**i. Fly ash disposal.** The incinerated residue from resource recovery power/heat-generating facilities that are fired by municipal solid waste, coal, or wood is generally not a wildlife attractant because it no longer contains putrescible matter. Landfills accepting only fly ash are generally not considered to be wildlife attractants and are acceptable as long as they are maintained in an orderly manner, admit no putrescible waste of any kind, and are not co-located with other disposal operations that attract hazardous wildlife.

Since varying degrees of waste consumption are associated with general incineration (not resource recovery power/heat-generating facilities), the FAA considers the ash from general incinerators a regular waste disposal by-product and, therefore, a hazardous wildlife attractant if disposed of within the separation criteria outlined in Sections 1-2 through 1-4.

**2-3. WATER MANAGEMENT FACILITIES.** Drinking water intake and treatment facilities, storm water and wastewater treatment facilities, associated retention and settling ponds, ponds built for recreational use, and ponds that result from mining activities often attract large numbers of potentially hazardous wildlife. To prevent wildlife hazards, land-use developers and airport operators may need to develop management plans, in compliance with local and state regulations, to support the operation of storm water management facilities on or near all public-use airports to ensure a safe airport environment.

**a. Existing storm water management facilities.** On-airport storm water management facilities allow the quick removal of surface water, including discharges related to aircraft deicing, from impervious surfaces, such as pavement and terminal/hangar building roofs. Existing on-airport detention ponds collect storm water, protect water quality, and control runoff. Because they slowly release water after storms, they create standing bodies of water that can attract hazardous wildlife. Where the airport has developed a Wildlife Hazard Management Plan (WHMP) in accordance with Part 139, the FAA requires immediate correction of any wildlife hazards arising from existing storm water facilities located on or near airports, using appropriate wildlife hazard mitigation techniques. Airport operators should develop measures to minimize hazardous wildlife attraction in consultation with a wildlife damage management biologist.

Where possible, airport operators should modify storm water detention ponds to allow a maximum 48-hour detention period for the design storm. The FAA recommends that airport operators avoid or remove retention ponds and detention ponds featuring dead storage to eliminate standing water. Detention basins should remain totally dry between rainfalls. Where constant flow of water is anticipated through the basin, or where any portion of the basin bottom may remain wet, the detention facility should include a concrete or paved pad and/or ditch/swale in the bottom to prevent vegetation that may provide nesting habitat.

When it is not possible to drain a large detention pond completely, airport operators may use physical barriers, such as bird balls, wires grids, pillows, or netting, to deter birds and other hazardous wildlife. When physical barriers are used, airport operators must evaluate their use and ensure they will not adversely affect water rescue. Before installing any physical barriers over detention ponds on Part 139 airports, airport operators must get approval from the appropriate FAA Regional Airports Division Office.

The FAA recommends that airport operators encourage off-airport storm water treatment facility operators to incorporate appropriate wildlife hazard mitigation techniques into storm water treatment facility operating practices when their facility is located within the separation criteria specified in Sections 1-2 through 1-4.

**b. New storm water management facilities.** The FAA strongly recommends that off-airport storm water management systems located within the separations identified in Sections 1-2 through 1-4 be designed and operated so as not to create above-ground standing water. Stormwater detention ponds should be designed, engineered, constructed, and maintained for a maximum 48–hour detention period after the design storm and remain completely dry between storms. To facilitate the control of hazardous wildlife, the FAA recommends the use of steep-sided, rip-rap lined, narrow, linearly shaped water detention basins. When it is not possible to place these ponds away from an airport's AOA, airport operators should use physical barriers, such as bird balls, wires grids, pillows, or netting, to prevent access of hazardous wildlife to open water and minimize aircraft-wildlife interactions. When physical barriers are used, airport operators must evaluate their use and ensure they will not adversely affect water rescue. Before installing any physical barriers over detention ponds on Part 139 airports, airport operators must get approval from the appropriate FAA Regional Airports Division Office. All vegetation in or around detention basins that provide food or cover for hazardous wildlife should be eliminated. If soil conditions and other requirements allow, the FAA encourages the use of underground storm water infiltration systems, such as French drains or buried rock fields, because they are less attractive to wildlife.

**c. Existing wastewater treatment facilities.** The FAA strongly recommends that airport operators immediately correct any wildlife hazards arising from existing wastewater treatment facilities located on or near the airport. Where required, a WHMP developed in accordance with Part 139 will outline appropriate wildlife hazard mitigation techniques. Accordingly, airport operators should encourage wastewater treatment facility operators to incorporate measures, developed in consultation with a wildlife damage management biologist, to minimize hazardous wildlife attractants. Airport operators should also encourage those wastewater treatment facility operators to incorporate these mitigation techniques into their standard operating practices. In addition, airport operators should consider the existence of wastewater treatment facilities when evaluating proposed sites for new airport development projects and avoid such sites when practicable.

**d. New wastewater treatment facilities.** The FAA strongly recommends against the construction of new wastewater treatment facilities or associated settling ponds within the separations identified in Sections 1-2 through 1-4. Appendix 1 defines wastewater treatment facility as "any devices and/or systems used to store, treat, recycle, or reclaim municipal sewage or liquid industrial wastes." The definition includes any pretreatment involving the reduction of the amount of pollutants or the elimination of pollutants prior to introducing such pollutants into a publicly owned treatment works (wastewater treatment facility). During the site-location analysis for wastewater treatment facilities, developers should consider the potential to attract hazardous wildlife if an airport is in the vicinity of the proposed site, and airport operators should voice their opposition to such facilities if they are in proximity to the airport.

**e. Artificial marshes.** In warmer climates, wastewater treatment facilities sometimes employ artificial marshes and use submergent and emergent aquatic vegetation as natural filters. These artificial marshes may be used by some species of flocking birds, such as blackbirds and waterfowl, for breeding or roosting activities. The FAA strongly recommends against establishing artificial marshes within the separations identified in Sections 1-2 through 1-4.

**f. Wastewater discharge and sludge disposal.** The FAA recommends against the discharge of wastewater or sludge on airport property because it may improve soil moisture and quality on unpaved areas and lead to improved turf growth that can be an attractive food source for many species of animals. Also, the turf requires more frequent mowing, which in turn may mutilate or flush insects or small animals and produce straw, both of which can attract hazardous wildlife. In addition, the improved turf may attract grazing wildlife, such as deer and geese. Problems may also occur when discharges saturate unpaved airport areas. The resultant soft, muddy conditions can severely restrict or prevent emergency vehicles from reaching accident sites in a timely manner.

**2-4. WETLANDS.** Wetlands provide a variety of functions and can be regulated by local, state, and Federal laws. Normally, wetlands are attractive to many types of wildlife, including many which rank high on the list of hazardous wildlife species (Table 1).

**NOTE:** If questions exist as to whether an area qualifies as a wetland, contact the local division of the U.S. Army Corps of Engineers, the Natural Resources Conservation Service, or a wetland consultant qualified to delineate wetlands.

**a. Existing wetlands on or near airport property.** If wetlands are located on or near airport property, airport operators should be alert to any wildlife use or habitat changes in these areas that could affect safe aircraft operations. At public-use airports, the FAA recommends immediately correcting, in cooperation with local, state, and Federal regulatory agencies, any wildlife hazards arising from existing wetlands located on or near airports. Where required, a WHMP will outline appropriate wildlife hazard mitigation techniques. Accordingly, airport operators should develop measures to minimize hazardous wildlife attraction in consultation with a wildlife damage management biologist.

**b. New airport development.** Whenever possible, the FAA recommends locating new airports using the separations from wetlands identified in Sections 1-2 through 1-4. Where alternative sites are not practicable, or when airport operators are expanding an existing airport into or near wetlands, a wildlife damage management biologist, in consultation with the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, and the state wildlife management agency should evaluate the wildlife hazards and prepare a WHMP that indicates methods of minimizing the hazards.

**c. Mitigation for wetland impacts from airport projects.** Wetland mitigation may be necessary when unavoidable wetland disturbances result from new airport development projects or projects required to correct wildlife hazards from wetlands. Wetland mitigation must be designed so it does not create a wildlife hazard. The FAA recommends that wetland mitigation projects that may attract hazardous wildlife be sited outside of the separations identified in Sections 1-2 through 1-4.

**(1) Onsite mitigation of wetland functions.** The FAA may consider exceptions to locating mitigation activities outside the separations identified in Sections 1-2 through 1-4 if the affected wetlands provide unique ecological functions, such as critical habitat for threatened or endangered species or ground water recharge, which cannot be replicated when moved to a different location. Using existing airport property is sometimes the only feasible way to achieve the mitigation ratios mandated in regulatory orders and/or settlement agreements with the resource agencies. Conservation easements are an additional means of providing mitigation for project impacts. Typically the airport operator continues to own the property, and an easement is created stipulating that the property will be maintained as habitat for state or Federally listed species.

Mitigation must not inhibit the airport operator's ability to effectively control hazardous wildlife on or near the mitigation site or effectively maintain other aspects of safe airport operations. Enhancing such mitigation areas to attract hazardous wildlife must be avoided. The FAA will review any onsite mitigation proposals to determine compatibility with safe airport operations. A wildlife damage management biologist should evaluate any wetland mitigation projects that are needed to protect unique wetland functions and that must be located in the separation criteria in Sections 1-2 through 1-4 before the mitigation is implemented. A WHMP should be developed to reduce the wildlife hazards.

**(2) Offsite mitigation of wetland functions.** The FAA recommends that wetland mitigation projects that may attract hazardous wildlife be sited outside of the separations identified in Sections 1-2 through 1-4 unless they provide unique functions that must remain onsite (see 2-4c(1)). Agencies that regulate impacts to or around wetlands recognize that it may be necessary to split wetland functions in mitigation schemes. Therefore, regulatory agencies may, under certain circumstances, allow portions of mitigation to take place in different locations.

**(3) Mitigation banking.** Wetland mitigation banking is the creation or restoration of wetlands in order to provide mitigation credits that can be used to offset permitted wetland losses. Mitigation banking benefits wetland resources by providing advance replacement for permitted wetland losses; consolidating small projects into larger, better-designed and managed units; and encouraging integration of wetland mitigation projects with watershed planning. This last benefit is most helpful for airport projects, as wetland impacts mitigated outside of the separations identified in Sections 1-2 through 1-4 can still be located within the same watershed. Wetland mitigation banks meeting the separation criteria offer an ecologically sound approach to mitigation in these situations. Airport operators should work with local watershed management agencies or organizations to develop mitigation banking for wetland impacts on airport property.

**2-5. DREDGE SPOIL CONTAINMENT AREAS.** The FAA recommends against locating dredge spoil containment areas (also known as Confined Disposal Facilities) within the separations identified in Sections 1-2 through 1-4 if the containment area or the spoils contain material that would attract hazardous wildlife.

**2-6. AGRICULTURAL ACTIVITIES.** Because most, if not all, agricultural crops can attract hazardous wildlife during some phase of production, the FAA recommends against the used of airport property for agricultural production, including hay crops, within the separations identified in Sections 1-2 through 1-4. . If the airport has no financial alternative to agricultural crops to produce income necessary to maintain the viability of the airport, then the airport shall follow the crop distance guidelines listed in the table titled "Minimum Distances between Certain Airport Features and Any On-Airport Agricultural Crops" found in AC 150/5300-13, *Airport Design*, Appendix 17. The cost of wildlife control and potential accidents should be weighed against the income produced by the on-airport crops when deciding whether to allow crops on the airport.

**a. Livestock production.** Confined livestock operations (i.e., feedlots, dairy operations, hog or chicken production facilities, or egg laying operations) often attract flocking birds, such as starlings, that pose a hazard to aviation. Therefore, The FAA recommends against such facilities within the separations identified in Sections 1-2 through 1-4. Any livestock operation within these separations should have a program developed to reduce the attractiveness of the site to species that are hazardous to aviation safety. Free-ranging livestock must not be grazed on airport property because the animals may wander onto the AOA. Furthermore, livestock feed, water, and manure may attract birds.

**b. Aquaculture.** Aquaculture activities (i.e. catfish or trout production) conducted outside of fully enclosed buildings are inherently attractive to a wide variety of birds. Existing aquaculture facilities/activities within the separations listed in Sections 1-2 through 1-4 must have a program developed to reduce the attractiveness of the sites to species that are hazardous to aviation safety. Airport operators should also oppose the establishment of new aquaculture facilities/activities within the separations listed in Sections 1-2 through 1-4.

**c. Alternative uses of agricultural land.** Some airports are surrounded by vast areas of farmed land within the distances specified in Sections 1-2 through 1-4. Seasonal uses of agricultural land for activities such as hunting can create a hazardous wildlife situation. In some areas, farmers will rent their land for hunting purposes. Rice farmers, for example, flood their land during waterfowl hunting season and obtain additional revenue by renting out duck blinds. The duck hunters then use decoys and call in hundreds, if not thousands, of birds, creating a tremendous threat to aircraft safety. A wildlife damage management biologist should review, in coordination with local farmers and producers, these types of seasonal land uses and incorporate them into the WHMP.

## 2-7. GOLF COURSES, LANDSCAPING AND OTHER LAND-USE CONSIDERATIONS.

**a. Golf courses.** The large grassy areas and open water found on most golf courses are attractive to hazardous wildlife, particularly Canada geese and some species of gulls. These species can pose a threat to aviation safety. The FAA recommends against construction of new golf courses within the separations identified in Sections 1-2 through 1-4. Existing golf courses located within these separations must develop a program to reduce the attractiveness of the sites to species that are hazardous to aviation safety. Airport operators should ensure these golf courses are monitored on a continuing basis for the presence of hazardous wildlife. If hazardous wildlife is detected, corrective actions should be immediately implemented.

**b. Landscaping and landscape maintenance.** Depending on its geographic location, landscaping can attract hazardous wildlife. The FAA recommends that airport operators approach landscaping with caution and confine it to airport areas not associated with aircraft movements. A wildlife damage management biologist should review all landscaping plans. Airport operators should also monitor all landscaped areas on a continuing basis for the presence of hazardous wildlife. If hazardous wildlife is detected, corrective actions should be immediately implemented.

Turf grass areas can be highly attractive to a variety of hazardous wildlife species. Research conducted by the USDA Wildlife Services' National Wildlife Research Center has shown that no one grass management regime will deter all species of hazardous wildlife in all situations. In cooperation with wildlife damage management biologist, airport operators should develop airport turf grass management plans on a prescription basis, depending on the airport's geographic locations and the type of hazardous wildlife likely to frequent the airport

Airport operators should ensure that plant varieties attractive to hazardous wildlife are not used on the airport. Disturbed areas or areas in need of re-vegetating should not be planted with seed mixtures containing millet or any other large-seed producing grass. For airport property already planted with seed mixtures containing millet, rye grass, or other large-seed producing grasses, the FAA recommends disking, plowing, or another suitable agricultural practice to prevent plant maturation and seed head production. Plantings should follow the specific recommendations for grass management and seed and plant selection made by the State University Cooperative Extension Service, the local office of Wildlife Services, or a qualified wildlife damage management biologist. Airport operators should also consider developing and implementing a preferred/prohibited plant species list, reviewed by a wildlife damage management biologist, which has been designed for the geographic location to reduce the attractiveness to hazardous wildlife for landscaping airport property.

**c. Airports surrounded by wildlife habitat.** The FAA recommends that operators of airports surrounded by woodlands, water, or wetlands refer to Section 2.4 of this AC. Operators of such airports should provide for a Wildlife Hazard Assessment (WHA) conducted by a wildlife damage management biologist. This WHA is the first step in preparing a WHMP, where required.

**d. Other hazardous wildlife attractants.** Other specific land uses or activities (e.g., sport or commercial fishing, shellfish harvesting, etc.), perhaps unique to certain regions of the country, have the potential to attract hazardous wildlife. Regardless of the source of the attraction, when hazardous wildlife is noted on a public-use airport, airport operators must take prompt remedial action(s) to protect aviation safety.

**2-8. SYNERGISTIC EFFECTS OF SURROUNDING LAND USES.** There may be circumstances where two (or more) different land uses that would not, by themselves, be considered hazardous wildlife attractants or that are located outside of the separations identified in Sections 1-2 through 1-4 that are in such an alignment with the airport as to create a wildlife corridor directly through the airport and/or surrounding airspace. An example of this situation may involve a lake located outside of the separation criteria on the east side of an airport and a large hayfield on the west side of an airport, land uses that together could create a flyway for Canada geese directly across the airspace of the airport. There are numerous examples of such situations;

therefore, airport operators and the wildlife damage management biologist must consider the entire surrounding landscape and community when developing the WHMP.

## SECTION 3.

## PROCEDURES FOR WILDLIFE HAZARD MANAGEMENT BY OPERATORS OF PUBLIC-USE AIRPORTS.

**3.1. INTRODUCTION.** In recognition of the increased risk of serious aircraft damage or the loss of human life that can result from a wildlife strike, the FAA may require the development of a Wildlife Hazard Management Plan (WHMP) when specific triggering events occur on or near the airport. Part 139.337 discusses the specific events that trigger a Wildlife Hazard Assessment (WHA) and the specific issues that a WHMP must address for FAA approval and inclusion in an Airport Certification Manual.

**3.2. COORDINATION WITH USDA WILDLIFE SERVICES OR OTHER QUALIFIED WILDLIFE DAMAGE MANAGEMENT BIOLOGISTS.** The FAA will use the Wildlife Hazard Assessment (WHA) conducted in accordance with Part 139 to determine if the airport needs a WHMP. Therefore, persons having the education, training, and expertise necessary to assess wildlife hazards must conduct the WHA. The airport operator may look to Wildlife Services or to qualified private consultants to conduct the WHA. When the services of a wildlife damage management biologist are required, the FAA recommends that land-use developers or airport operators contact a consultant specializing in wildlife damage management or the appropriate state director of Wildlife Services.

**NOTE:** Telephone numbers for the respective USDA Wildlife Services state offices can be obtained by contacting USDA Wildlife Services Operational Support Staff, 4700 River Road, Unit 87, Riverdale, MD, 20737-1234, Telephone (301) 734-7921, Fax (301) 734-5157 *(http://www.aphis.usda.gov/ws/)*.

**3-3. WILDLIFE HAZARD MANAGEMENT AT AIRPORTS: A MANUAL FOR AIRPORT PERSONNEL.** This manual, prepared by FAA and USDA Wildlife Services staff, contains a compilation of information to assist airport personnel in the development, implementation, and evaluation of WHMPs at airports. The manual includes specific information on the nature of wildlife strikes, legal authority, regulations, wildlife management techniques, WHAs, WHMPs, and sources of help and information. The manual is available in three languages: English, Spanish, and French. It can be viewed and downloaded free of charge from the FAA's wildlife hazard mitigation web site: http://wildlife-mitigation.tc.FAA.gov/. This manual only provides a starting point for addressing wildlife hazard issues at airports. Hazardous wildlife management is a complex discipline and conditions vary widely across the United States. Therefore, qualified wildlife damage management biologists must direct the development of a WHMP and the implementation of management actions by airport personnel.

There are many other resources complementary to this manual for use in developing and implementing WHMPs. Several are listed in the manual's bibliography.

**3-4. WILDLIFE HAZARD ASSESSMENTS, TITLE 14, CODE OF FEDERAL REGULATIONS, PART 139.** Part 139.337(b) requires airport operators to conduct a Wildlife Hazard Assessment (WHA) when certain events occur on or near the airport.

Part 139.337 (c) provides specific guidance as to what facts must be addressed in a WHA.

**3-5. WILDLIFE HAZARD MANAGEMENT PLAN (WHMP).** The FAA will consider the results of the WHA, along with the aeronautical activity at the airport and the views of the airport operator and airport users, in determining whether a formal WHMP is needed, in accordance with Part 139.337. If the FAA determines that a WHMP is needed, the airport operator must formulate and implement a WHMP, using the WHA as the basis for the plan.

The goal of an airport's Wildlife Hazard Management Plan is to minimize the risk to aviation safety, airport structures or equipment, or human health posed by populations of hazardous wildlife on and around the airport.

The WHMP must identify hazardous wildlife attractants on or near the airport and the appropriate wildlife damage management techniques to minimize the wildlife hazard. It must also prioritize the management measures.

**3-6. LOCAL COORDINATION.** The establishment of a Wildlife Hazards Working Group (WHWG) will facilitate the communication, cooperation, and coordination of the airport and its surrounding community necessary to ensure the effectiveness of the WHMP. The cooperation of the airport community is also necessary when new projects are considered. Whether on or off the airport, the input from all involved parties must be considered when a potentially hazardous wildlife attractant is being proposed. Airport operators should also incorporate public education activities with the local coordination efforts because some activities in the vicinity of your airport, while harmless under normal leisure conditions, can attract wildlife and present a danger to aircraft. For example, if public trails are planned near wetlands or in parks adjoining airport property, the public should know that feeding birds and other wildlife in the area may pose a risk to aircraft.

Airport operators should work with local and regional planning and zoning boards so as to be aware of proposed land-use changes, or modification of existing land uses, that could create hazardous wildlife attractants within the separations identified in Sections 1-2 through 1-4. Pay particular attention to proposed land uses involving creation or expansion of waste water treatment facilities, development of wetland mitigation sites, or development or expansion of dredge spoil containment areas. At the very least, airport operators must ensure they are on the notification list of the local planning board or equivalent review entity for all communities located within 5 miles of the airport, so they will receive notification of any proposed project and have the opportunity to review it for attractiveness to hazardous wildlife.

**3-7 COORDINATION/NOTIFICATION OF AIRMEN OF WILDLIFE HAZARDS.** If an existing land-use practice creates a wildlife hazard and the land-use practice or wildlife hazard cannot be immediately eliminated, airport operators must issue a Notice to Airmen (NOTAM) and encourage the land–owner or manager to take steps to control the wildlife hazard and minimize further attraction.

## SECTION 4.

## FAA NOTIFICATION AND REVIEW OF PROPOSED LAND-USE PRACTICE CHANGES IN THE VICINITY OF PUBLIC-USE AIRPORTS

### 4-1. FAA REVIEW OF PROPOSED LAND-USE PRACTICE CHANGES IN THE VICINITY OF PUBLIC-USE AIRPORTS.

**a.** The FAA discourages the development of waste disposal and other facilities, discussed in Section 2, located within the 5,000/10,000-foot criteria specified in Sections 1-2 through 1-4.

**b.** For projects that are located outside the 5,000/10,000-foot criteria but within 5 statute miles of the airport's AOA, the FAA may review development plans, proposed land-use changes, operational changes, or wetland mitigation plans to determine if such changes present potential wildlife hazards to aircraft operations. The FAA considers sensitive airport areas as those that lie under or next to approach or departure airspace. This brief examination should indicate if further investigation is warranted.

**c.** Where a wildlife damage management biologist has conducted a further study to evaluate a site's compatibility with airport operations, the FAA may use the study results to make a determination.

### 4-2. WASTE MANAGEMENT FACILITIES.

**a. Notification of new/expanded project proposal.** Section 503 of the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (Public Law 106-181) limits the construction or establishment of new MSWLF within 6 statute miles of certain public-use airports, when both the airport and the landfill meet very specific conditions. See Section 2-2 of this AC and AC 150/5200-34 for a more detailed discussion of these restrictions.

The Environmental Protection Agency (EPA) requires any MSWLF operator proposing a new or expanded waste disposal operation within 5 statute miles of a runway end to notify the appropriate FAA Regional Airports Division Office and the airport operator of the proposal (40 CFR 258, *Criteria for Municipal Solid Waste Landfills*, Section 258.10, *Airport Safety*). The EPA also requires owners or operators of new MSWLF units, or lateral expansions of existing MSWLF units, that are located within 10,000 feet of any airport runway end used by turbojet aircraft, or within 5,000 feet of any airport runway end used only by piston-type aircraft, to demonstrate successfully that such units are not hazards to aircraft. (See 4-2.b below.)

When new or expanded MSWLF are being proposed near airports, MSWLF operators must notify the airport operator and the FAA of the proposal as early as possible pursuant to 40 CFR 258.

**b. Waste handling facilities within separations identified in Sections 1-2 through 1-4.** To claim successfully that a waste-handling facility sited within the separations identified in Sections 1-2 through 1-4 does not attract hazardous wildlife and does not threaten aviation, the developer must establish convincingly that the facility will not handle putrescible material other than that as outlined in 2-2.d. The FAA strongly recommends against any facility other than that as outlined in 2-2.d (enclosed transfer stations). The FAA will use this information to determine if the facility will be a hazard to aviation.

**c. Putrescible-Waste Facilities.** In their effort to satisfy the EPA requirement, some putrescible-waste facility proponents may offer to undertake experimental measures to demonstrate that their proposed facility will not be a hazard to aircraft. To date, no such facility has been able to demonstrate an ability to reduce and sustain hazardous wildlife to levels that existed before the putrescible-waste landfill began operating. For this reason, demonstrations of experimental wildlife control measures may not be conducted within the separation identified in Sections 1-2 through 1-4.

**4-3. OTHER LAND-USE PRACTICE CHANGES.** As a matter of policy, the FAA encourages operators of public-use airports who become aware of proposed land use practice changes that may attract hazardous wildlife within 5 statute miles of their airports to promptly notify the FAA. The FAA also encourages proponents of such land use changes to notify the FAA as early in the planning process as possible. Advanced notice affords the FAA an opportunity (1) to evaluate the effect of a particular land-use change on aviation safety and (2) to support efforts by the airport sponsor to restrict the use of land next to or near the airport to uses that are compatible with the airport.

The airport operator, project proponent, or land-use operator may use FAA Form 7460-1, *Notice of Proposed Construction or Alteration*, or other suitable documents similar to FAA Form 7460-1 to notify the appropriate FAA Regional Airports Division Office. Project proponents can contact the appropriate FAA Regional Airports Division Office for assistance with the notification process.

It is helpful if the notification includes a 15-minute quadrangle map of the area identifying the location of the proposed activity. The land-use operator or project proponent should also forward specific details of the proposed land-use change or operational change or expansion. In the case of solid waste landfills, the information should include the type of waste to be handled, how the waste will be processed, and final disposal methods.

**a. Airports that have received Federal grant-in-aid assistance.** Airports that have received Federal grant-in-aid assistance are required by their grant assurances to take appropriate actions to restrict the use of land next to or near the airport to uses that are compatible with normal airport operations. The FAA recommends that airport operators to the extent practicable oppose off-airport land-use changes or practices within the separations identified in Sections 1-2 through 1-4 that may attract hazardous wildlife. Failure to do so may lead to noncompliance with applicable grant assurances. The FAA will not approve the placement of airport development projects pertaining to aircraft movement in the vicinity of hazardous wildlife attractants without appropriate mitigating measures. Increasing the intensity of wildlife control efforts is not a substitute for eliminating or reducing a proposed wildlife hazard. Airport operators should identify hazardous wildlife attractants and any associated wildlife hazards during any planning process for new airport development projects.

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## APPENDIX 1. DEFINITIONS OF TERMS USED IN THIS ADVISORY CIRCULAR.

1. **GENERAL.** This appendix provides definitions of terms used throughout this AC.

   1. **Air operations area.** Any area of an airport used or intended to be used for landing, takeoff, or surface maneuvering of aircraft. An air operations area includes such paved areas or unpaved areas that are used or intended to be used for the unobstructed movement of aircraft in addition to its associated runway, taxiways, or apron.

   2. **Airport operator.** The operator (private or public) or sponsor of a public-use airport.

   3. **Approach or departure airspace.** The airspace, within 5 statute miles of an airport, through which aircraft move during landing or takeoff.

   4. **Bird balls.** High-density plastic floating balls that can be used to cover ponds and prevent birds from using the sites.

   5. **Certificate holder.** The holder of an Airport Operating Certificate issued under Title 14, Code of Federal Regulations, Part 139.

   6. **Construct a new MSWLF.** To begin to excavate, grade land, or raise structures to prepare a municipal solid waste landfill as permitted by the appropriate regulatory or permitting agency.

   7. **Detention ponds.** Storm water management ponds that hold storm water for short periods of time, a few hours to a few days.

   8. **Establish a new MSWLF.** When the first load of putrescible waste is received on-site for placement in a prepared municipal solid waste landfill.

   9. **Fly ash.** The fine, sand-like residue resulting from the complete incineration of an organic fuel source. Fly ash typically results from the combustion of coal or waste used to operate a power generating plant.

   10. **General aviation aircraft.** Any civil aviation aircraft not operating under 14 CFR Part 119, Certification: Air Carriers and Commercial Operators.

   11. **Hazardous wildlife.** Species of wildlife (birds, mammals, reptiles), including feral animals and domesticated animals not under control, that are associated with aircraft strike problems, are capable of causing structural damage to airport facilities, or act as attractants to other wildlife that pose a strike hazard

   12. **Municipal Solid Waste Landfill (MSWLF).** A publicly or privately owned discrete area of land or an excavation that receives household waste and that is not a land application unit, surface impoundment, injection well, or waste pile, as those terms are defined under 40 CFR § 257.2. An MSWLF may receive

other types wastes, such as commercial solid waste, non-hazardous sludge, small-quantity generator waste, and industrial solid waste, as defined under 40 CFR § 258.2. An MSWLF can consist of either a stand alone unit or several cells that receive household waste.

13. **New MSWLF.** A municipal solid waste landfill that was established or constructed after April 5, 2001.

14. **Piston-powered aircraft.** Fixed-wing aircraft powered by piston engines.

15. **Piston-use airport.** Any airport that does not sell Jet-A fuel for fixed-wing turbine-powered aircraft, and primarily serves fixed-wing, piston-powered aircraft. Incidental use of the airport by turbine-powered, fixed-wing aircraft would not affect this designation. However, such aircraft should not be based at the airport.

16. **Public agency.** A State or political subdivision of a State, a tax-supported organization, or an Indian tribe or pueblo (49 U.S.C. § 47102(19)).

17. **Public airport.** An airport used or intended to be used for public purposes that is under the control of a public agency; and of which the area used or intended to be used for landing, taking off, or surface maneuvering of aircraft is publicly owned (49 U.S.C. § 47102(20)).

18. **Public-use airport.** An airport used or intended to be used for public purposes, and of which the area used or intended to be used for landing, taking off, or surface maneuvering of aircraft may be under the control of a public agency or privately owned and used for public purposes (49 U.S.C. § 47102(21)).

19. **Putrescible waste.** Solid waste that contains organic matter capable of being decomposed by micro-organisms and of such a character and proportion as to be capable of attracting or providing food for birds (40 CFR §257.3-8).

20. **Putrescible-waste disposal operation.** Landfills, garbage dumps, underwater waste discharges, or similar facilities where activities include processing, burying, storing, or otherwise disposing of putrescible material, trash, and refuse.

21. **Retention ponds.** Storm water management ponds that hold water for several months.

22. **Runway protection zone (RPZ).** An area off the runway end to enhance the protection of people and property on the ground (see AC 150/5300-13). The dimensions of this zone vary with the airport design, aircraft, type of operation, and visibility minimum.

23. **Scheduled air carrier operation.** Any common carriage passenger-carrying operation for compensation or hire conducted by an air carrier or commercial

operator for which the air carrier, commercial operator, or their representative offers in advance the departure location, departure time, and arrival location. It does not include any operation that is conducted as a supplemental operation under 14 CFR Part 119 or as a public charter operation under 14 CFR Part 380 (14 CFR § 119.3).

**24. Sewage sludge.** Any solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in a treatment works. Sewage sludge includes, but is not limited to, domestic septage; scum or solids removed in primary, secondary, or advanced wastewater treatment process; and a material derived from sewage sludge. Sewage does not include ash generated during the firing of sewage sludge in a sewage sludge incinerator or grit and screenings generated during preliminary treatment of domestic sewage in a treatment works. (40 CFR 257.2)

**25. Sludge.** Any solid, semi-solid, or liquid waste generated form a municipal, commercial or industrial wastewater treatment plant, water supply treatment plant, or air pollution control facility or any other such waste having similar characteristics and effect. (40 CFR 257.2)

**26. Solid waste.** Any garbage, refuse, sludge, from a waste treatment plant, water supply treatment plant or air pollution control facility and other discarded material, including, solid liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved materials in domestic sewage, or solid or dissolved material in irrigation return flows or industrial discharges which are point sources subject to permits under section 402 of the Federal Water Pollution Control Act, as amended (86 Stat. 880), or source, special nuclear, or by product material as defined by the Atomic Energy Act of 1954, as amended, (68 Stat. 923). (40 CFR 257.2)

**27. Turbine-powered aircraft.** Aircraft powered by turbine engines including turbojets and turboprops but excluding turbo-shaft rotary-wing aircraft.

**28. Turbine-use airport.** Any airport that sells Jet-A fuel for fixed-wing turbine-powered aircraft.

**29. Wastewater treatment facility.** Any devices and/or systems used to store, treat, recycle, or reclaim municipal sewage or liquid industrial wastes, including Publicly Owned Treatment Works (POTW), as defined by Section 212 of the Federal Water Pollution Control Act (P.L. 92-500) as amended by the Clean Water Act of 1977 (P.L. 95-576) and the Water Quality Act of 1987 (P.L. 100-4). This definition includes any pretreatment involving the reduction of the amount of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties in wastewater prior to or in lieu of discharging or otherwise introducing such pollutants into a POTW. (See 40 CFR Section 403.3 (q), (r), & (s)).

**30. Wildlife.** Any wild animal, including without limitation any wild mammal, bird, reptile, fish, amphibian, mollusk, crustacean, arthropod, coelenterate, or other invertebrate, including any part, product, egg, or offspring thereof (50 CFR 10.12, *Taking, Possession, Transportation, Sale, Purchase, Barter, Exportation, and Importation of Wildlife and Plants*). As used in this AC, wildlife includes feral animals and domestic animals out of the control of their owners (14 CFR Part 139, Certification of Airports).

**31. Wildlife attractants.** Any human-made structure, land-use practice, or human-made or natural geographic feature that can attract or sustain hazardous wildlife within the landing or departure airspace or the airport's AOA. These attractants can include architectural features, landscaping, waste disposal sites, wastewater treatment facilities, agricultural or aquaculture activities, surface mining, or wetlands.

**32. Wildlife hazard.** A potential for a damaging aircraft collision with wildlife on or near an airport.

**33. Wildlife strike.** A wildlife strike is deemed to have occurred when:

**a.** A pilot reports striking 1 or more birds or other wildlife;

**b.** Aircraft maintenance personnel identify aircraft damage as having been caused by a wildlife strike;

**c.** Personnel on the ground report seeing an aircraft strike 1 or more birds or other wildlife;

**d.** Bird or other wildlife remains, whether in whole or in part, are found within 200 feet of a runway centerline, unless another reason for the animal's death is identified;

**e.** The animal's presence on the airport had a significant negative effect on a flight (i.e., aborted takeoff, aborted landing, high-speed emergency stop, aircraft left pavement area to avoid collision with animal) (Transport Canada, Airports Group, *Wildlife Control Procedures Manual*, Technical Publication 11500E, 1994).

**2. RESERVED.**

# Attachment 2

## BCDC Fill for Habitat Fact Sheet

# Fill For Habitat Amendment Fact Sheet

## Why did BCDC amend the San Francisco Bay Plan to allow more Bay Fill to help habitat projects?

Sea level is rising and will continue to rise into the future. Rising seas present an unprecedented threat to Bay Area ecosystems and neighboring communities. The State of California has reviewed the science and determined that valuable habitats will experience more frequent flooding and average higher water levels over time that could threaten their survival. Additionally, other habitats such as oyster and eelgrass beds will be under deeper water, impacting their survival as well. To help these habitats adjust to rising sea levels and more frequent and longer periods of flooding, several actions may be needed, such as placing more sediment in restoration sites, building higher elevation habitats, or providing hard surfaces in areas needed by Bay species such as native oysters. The San Francisco Bay Conservation and Development Commission (BCDC) currently considers placement of material for such actions as a form of "Bay fill," which its current law and policies seek to minimize, but which may be necessary in larger amounts to address habitat needs in light of rising sea levels.

## What can BCDC do to address this problem?

BCDC's *San Francisco Bay Plan* (Bay Plan) policies currently restrict the amount of "Bay fill" and dredged sediment that can be used for habitat projects in tidal waters to a "minor" amount. These policies could become problematic in the future as sea level rises and managers of habitat areas and restoration projects propose large-scale actions to help these areas adapt. These actions could include creating larger, wider levees that provide habitat benefits and area for marshes to migrate landward, adding sediment to raise the elevation of existing marshes, and creating new marsh and other limited habitats such as eelgrass and artificial oyster reefs. These actions may also provide additional benefits, such as protecting shorelines by reducing wave energy. The new Bay Plan language modifies the "minor amount of fill" policies so that habitat restoration projects are reviewed using the same measure ("minimum amount necessary for the project purpose") as any other project that proposes "Bay fill." BCDC acknowledges that allowing more fill in the Bay for habitat projects could result in some adverse impacts and conversions of some habitat types to another (such as marsh to upland to allow future marsh migration), the consequences of which are difficult to predict. To address the potential harm, BCDC proposes that, where appropriate, additional habitat monitoring and plans that provide additional actions where impacts may be significant (adaptive management plans) should be developed and carried out.

# How do the new policies change the way BCDC evaluates proposed projects?

The new policies will:

- Acknowledge the positive effects of some fill projects.
- Allow more fill for habitat in the Bay
- Scale the amount of monitoring and adaptive management with the project's goals, level of risk, size, and lifespan.
- Incorporate principles of regional goals and project sustainability into the consideration of restoration projects
- Encourage pilot projects and research to further our understanding of sea level rise adaptation
- Allow more beneficial reuse of dredged sediment for most habitat projects in the Bay
- Directly encourage the completion of the Middle Harbor Enhancement Area
- Help expedite the permitting of Bay restoration

# Why did BCDC decide to amend the Bay Plan to address this issue?

Recognizing the need to use more fill in habitat projects so they could adapt to sea level rise, the Commission created a Commissioner working group, the Bay Fill Policies Working Group (BFPWG). The BFPWG began meeting in 2015 with the charge of "making recommendations to the full Commission whether its law and policies regarding Bay fill need to be amended to adapt to rising sea levels". The group recognized that several Bay Plan policies limit Bay fill habitat projects to not more than a "minor" amount of fill or dredged sediment, and the policies had constrained the permitting of a few projects. Another BCDC planning study titled "Policies for a Rising Bay" (PRB) also began in 2015. PRB evaluated the Commission's laws and policies in light of threats to the Bay from rising sea levels and determined that changes were needed. This process also identified that the "minor amount of fill" policy restricted habitat projects and recommended a policy amendment.  During this same period, the Commission began a series of public workshops on rising sea levels. The issue of "fill for habitat" was identified as a priority issue through the workshops, and on July 20, 2017, the Commission voted to initiate a Bay Plan amendment to address this issue.

# What is Bay Fill?

“Fill” is defined in the Bay Plan and the McAteer-Petris Act as “earth or any other substance or material placed in the Bay, including piers, pilings, and floating structures moored in the Bay for extended periods.” “Bay fill” specifically refers to fill in BCDC’s Bay jurisdiction and certain waterways jurisdiction (portions of large tributaries to the Bay). The Bay is defined as “all areas that are subject to tidal action from the south end of the Bay to the Golden Gate (Point Bonita-Point Lobos) and to the Sacramento River line (a line between Stake Point and Simmons Point [in Suisun Channel], extended northeasterly to the mouth of Marshall Cut [in Collinsville]), including all sloughs, and specifically, the marshlands lying between mean high tide and five feet above mean sea level; tidelands (land lying between mean high tide and mean low tide); and submerged lands (land lying below mean low tide).”

# What are some examples of projects that have used Bay Fill for habitat improvement?

As part of the Sonoma Creek Enhancement project, the U.S. Fish and Wildlife Service (USFWS) placed 24,200 cubic yards of sediment and dredged to provide an improved tidal channel in the marsh to create a 10-acre ecotone levee (an area of higher land at the back of the marsh that provides animals a place to get out of the water during high tides and flooding). The project converted approximately three acres of tidal marsh to upland habitat. This action was difficult to permit under BCDC’s existing policies, which limited the volume to a “minor amount of fill.” Had this policy not been in place, the USFWS would have created a larger upland habitat using more fill, which would have provided more of this needed habitat.

The Audubon Society’s Aramburu Island Enhancement Project placed approximately 7,650 cubic yards of sand, gravel, rock and oyster shell over an approximately 2.17-acre area of the Bay to improve habitat on a human-made island. This included creating a beach environment, promoting native oyster colonization, and placing tree trunks and other woody materials to help keep the sand and shells in place to foster the beach development. This project was easier to define as “minor fill” under BCDC’s current policies.

Other habitat projects that used fill in the  Bay include the State Coastal Conservancy’s Living Shorelines Project sites at the San Rafael and Hayward Shorelines, and the San Francisco Estuary Invasive Spartina Project that created small mounded areas within existing marshes to provide places for marsh animals to go during high tides.

# What is the San Francisco Bay Plan and how is it used?

The *San Francisco Bay Plan* (Bay Plan) contains the policies that the San Francisco Bay Conservation and Development Commission (BCDC) uses to determine whether and how proposed projects can be approved and constructed within the Commission's jurisdiction. BCDC's jurisdiction consists of the San Francisco Bay, tidal marshes, salt ponds, managed wetlands, "certain waterways", and the shoreline within 100 feet of the Bay. The California State Legislature directed BCDC to keep the Bay Plan up to date by amending it to reflect and address new information and issues.

# Will there be unintended consequences of allowing more Bay Fill?

Potential impacts from fill include burial of plants and invertebrates, impacts of construction equipment or placement of hard surfaces on soft mudflats (e.g. oyster reef balls), the potential for non-native invasive species to colonize the site, higher levels of sediment and turbidity in Bay waters, and conversion of one habitat type to another, such as tidal marsh to uplands, or mudflats to tidal marsh. BCDC has policies in the Bay Plan that safeguard against the potential negative impacts that may be caused by placing fill, which would be analyzed during the permitting process. The proposed policies will provide further protection.

# Did BCDC receive input on the policies from technical experts, the public, local governments and others?

Yes. BCDC staff and the Bay Fill Policies Working Group reviewed the existing scientific research and interviewed many restoration professionals, public agencies, organizations, and stakeholders in preparation for this policy amendment. BCDC also met with stakeholders in workshops, conferences, and coordination meetings. BCDC held a Commissioner Workshop on March 21, 2019 on this topic, which included BCDC Commissioners and staff, interested stakeholders, and members of the public. Three rounds of discussion were held that gave the participants information via topical posters and the opportunity to provide feedback on each policy issue.

# When will the new policies be applied?

After the Commission vote on October 3, the amendment must be approved by the State Office of Administrative Law and the National Oceanic and Atmospheric Administration's Office for Coastal Management. The policies will likely take effect by early 2020 depending on the state and federal approval process timing.

# What else is BCDC doing to improve the resilience of the Bay Area’s ecosystems beyond amending the Bay Plan?

In addition to the Bay Plan amendments, BCDC is planning to amend its regulations to create a new regionwide permit for small restoration projects, and to add regulations that would allow certain restoration projects to be approved administratively without a Commission public hearing and vote. BCDC staff regularly participate in interagency efforts to improve the permitting process for restoration projects, such as (1) the new Bay Restoration Regulatory Integration Team (BRRIT), on which state and federal agency representatives will collaboratively process applications for Bay restoration projects, (2) assisting in the development of a Wetlands Regional Monitoring Program, and (3) the Environmental Protection Agency’s Habitat Type Conversion Guidance development. Following adoption of these new Bay Plan policies, BCDC will be developing guidance documents to assist with their implementation.

# Attachment 3

EPA R9 Type
Conversion Framework

October 2018
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# EPA Region 9, Wetlands Section

## Framework for Wetland "Type Conversion" Analysis

**Problem Statement:** Large-scale restoration projects are often converting one 'type' of Waters of the State/U.S. (Waters) to another 'type' (e.g., managed salt ponds into tidal marshes) and place fill for management objectives such as flood risk reduction, habitat complexity, and access trail improvements. Conversion can result in a net loss of Waters, and therefore be interpreted by regulatory and resource agencies as necessitating compensatory wetland mitigation. Additionally, from a Clean Water Act (CWA) permitting standpoint, determination of the Least Environmentally Damaging Project Alternative (LEDPA) is difficult. This scenario occurs quite frequently in the San Francisco Bay area and has ramifications for voluntary wetland restoration efforts that are desired by the restoration community and resource agencies at large. Multi-benefit flood control projects usually supported by Army Corps Civil Works and complex mitigation banks also face this situation, which leads to higher project costs, especially in areas with exceedingly high land values. Current approaches to type conversion analysis are also leading to project delays due to a lack of regulatory certainty. Type conversion will certainly be exacerbated over time with sea level rise in coastal communities.

**Project Objective:** To identify strategies for assessing aquatic resource type conversion actions in CWA permitting in the SF Bay Region. This includes understanding existing national and regional approaches and regulatory mechanisms within both restoration and mitigation bank contexts for evaluating compensatory mitigation requirements. Federal and state agencies, including EPA, USACE SPN, and California Regional Water Boards (RB), are currently engaged in improving regulatory decision-making and permitting for regional environmental outcomes; type conversion is an acknowledged problem. We desire to have a draft product ready for these agencies' comment by EOY 2019 to stay in step with this interagency regional effort. This work would be directly applicable to 404 and 401 regulatory programs in Region 9, thus supporting the capacity of our state partners, and could certainly be applicable as a pilot to other regulatory efforts and Corps districts in the country.

**Scope of Activities:** The scope of this effort requires addressing questions pertinent to both wetland science and policy, and thus will require multiple levels of inquiry and potentially multiple contractors/partners. Some of the guiding questions include:

- What tools are most appropriate and available to evaluate ecological function and services when one wetland type is 'traded' for another?
- What are the primary indicators to assess when determining compensatory mitigation requirements with type change? The temporal aspects and uncertainty factors for these indicators must be addressed as well.
- Are there key geographic/watershed scales that this evaluation should occur at?
- What policy guidance exists to assist regulators with type conversion analysis? What baseline information do regulators need to document and improve their decisions?
- Identify any further policy and/or regulatory efforts needed.

October 2018
J. Siu

Contractor will perform literature review of readily available information, including agency white papers and guidance and regional foundational documents (e.g. Baylands Ecosystem Habitat Goals Project, the SF Estuary Blueprint, etc.), on wetland type conversion analysis and regulation. Contractor will interview key staff and managers at the EPA, Corps, San Francisco Water Board and other potential key stakeholders to identify current regulatory analysis practices when conversion of wetland type is proposed. Contractor will also review current wetland assessment methods and tracking systems for wetlands restoration and mitigation projects including CRAM, HGM, EcoAtlas (Wetlands Tracker), OARM, and other potential sources. Additionally, EPA and contractor will engage with a technical advisory panel (TAP) of federal and state regulatory and resource agencies whom are regularly involved in assessing wetland type conversion for permitting. Three webinars will be held with the TAP to guide, vet, and review EPA's recommendations for the proposed framework. The final deliverable will be a peer-reviewed white paper or technical memorandum that provides: 1) a general framework outlining procedures for evaluating type conversion based on ecological management goals and desired habitat functions (rather than just wetland type and extent), 2) effective science-based approaches to qualitatively/semi-quantitatively analyze and document type conversion decisions, and 3) determine how agencies could utilize this framework in a standard way to inform their current decision-making processes.

# Attachment 4

## ESA CRR Spring 2020 Survey Memo

# memorandum

| | |
|---|---|
| date | February 11, 2020 |
| to | Samantha Engelage, P.E., Senior Engineer, Environmental Services Division, City of Palo Alto |
| cc | Priya Finnemore, Technical Associate, ESA; Scott Stoller, Senior Managing Associate, ESA; Jill Sunahara, Program Manager, ESA |
| from | Leonard Liu, Senior Associate Biologist, ESA |
| subject | Results of California Ridgway's Rail Surveys at Harbor Marsh for the Palo Alto Horizontal Levee Project |

Dear Ms. Engelage,

Environmental Science Associates (ESA) recently completed surveys for Federal- and State-listed California Ridgway's rail (CRR; *Rallus obsoletus obsoletus*), formerly known as California clapper rail (*Rallus longirostris obsoletus*), at the Palo Alto Horizontal Levee Project (Project), Santa Clara County, California (Figure 1). Surveys for the Project were conducted at stations along Embarcadero Road adjacent to tidal salt marsh at Harbor Marsh in Palo Alto. This survey effort was undertaken to determine the presence of breeding rails near the Project. Activities for the Project could adversely affect CRR during the nesting season through direct and indirect impacts.

ESA detected numerous CRR in Harbor Marsh adjacent to the Project Area. ESA is submitting these survey results for your review, and also will notify United States Fish and Wildlife Service (USFWS) and California Department of Fish and Wildlife (CDFW) of the survey results.

**Project Location**

The Project site is located in southwest San Francisco Bay in Palo Alto, Santa Clara County, California. Access to the site is from Embarcadero Road. The Project is in upland or developed habitat, bordering tidal salt marsh in Harbor Marsh, which was formerly the Palo Alto Yacht Harbor and mouth of San Francisquito Creek (Figure 2). Harbor Marsh has been passively restoring since 1986, when the citizens of Palo Alto voted to close the harbor. To the west are Palo Alto Golf Course, Palo Alto Airport, and Palo Alto Regional Water Quality Control Plant (RWQCP). Harriet Mundy Marsh and the Lucy Evans Baylands Nature Interpretive Center are to the north, Byxbee Park is to the south, and Hooks Island and Mayfield Slough Flood Control Basin are to the east. Habitats within 700 feet of the Project include tidal salt marsh, tidal flat/shallow bay, and ruderal upland habitats.

The tidal salt marsh is of high quality, as it has numerous secondary and tertiary channels and mostly native vegetation-- dominated by perennial pickleweed (*Salicornia pacifica*) with patches of Pacific cordgrass (*Spartina foliosa*) and hybrid *Spartina alterniflora* in channels and marsh gumplant (*Grindelia stricta*) along many channels, and smaller patches of salt grass (*Distichlis spicata*), fleshy jaumea (*Jaumea carnosa*), and alkali heath (*Frankenia salina*).

Shallow bay and tidal mudflat habitats are unvegetated and found in the tidally influenced former channels of the harbor and the old mouth of San Francisquito Creek, adjacent to tidal salt marsh.

Developed areas contain ruderal upland, coyote brush (*Baccharis pilularis*), wild radish (*Raphanus sativus*), black mustard (*Brassica nigra*), eucalyptus (*Eucalyptus* spp.), annual grasses, and various ornamental plantings.

**Project Description**

The San Francisco Estuary Project and the City of Palo Alto plan to construct a horizontal levee pilot project at a location bordering Harbor Marsh (Figure 2). The horizontal levee will consist of: 1) a flood protection levee on the landward side for flood protection, 2) a permeable subsurface treatment zone for wastewater polishing, and 3) a habitat transition zone downslope of the treatment zone (Figure 3). Horizontal levees are a novel approach intended to: 1) create habitat for special status species by replicating freshwater seeps that historically occurred on gently sloping transitional zones from the uplands into tidal marshes, 2) provide sea-level rise adaptation by creating high tide refugia and marsh migration accommodation space in light of sea level rise, as well as increasing carbon sequestration through accretion of freshwater wetland plant biomass, and 3) filter highly treated wastewater through a subsurface zone to provide polishing-level treatment prior to discharge to San Francisco Bay. This Project builds on the experience gained through design, construction, and monitoring of the Oro Loma Horizontal Levee Demonstration Project in San Lorenzo, California (BO# 08ESMF00-2014-F-0372).

**Methods**

ESA conducted surveys to detect rails in accordance with the methods outlined in the California Clapper Rail Survey Protocol guidance document (USFWS 2015). ESA used three (3) avian survey stations to cover the west side of Harbor Marsh (Figure 4, Table 1). The stations previously had been used for surveys by Point Blue Conservation Science and the California Coastal Conservancy's Invasive *Spartina* Project (ISP). Each station covered approximately 31 acres with 200-meter (656-foot) radii around each station; total coverage was approximately 93 acres. Approximately 38 acres of the total survey area was coastal salt marsh habitat suitable for rail use (San Francisco Estuary Institute 2011).

Surveys conformed to the following parameters:

- Passive-listening surveys were conducted until CRR were detected, in which each of the listening stations was manned continuously during the survey. If CRR had not been detected within 700 feet of the listening stations after the first two passive-listening surveys, two active (call-playback) surveys would have been conducted.
- All surveys were conducted within a two hour (120-minute) period surrounding sunrise or sunset, starting no more than 60 minutes before sunrise or sunset and terminating within 60 minutes of sunrise and sunset. Each station was occupied for a total of 120 minutes during passive surveys.
- Surveys were not conducted when tides greater than 4.5 feet NGVD were predicted at the Golden Gate Bridge during the survey period (adjusted to the time of high tide at the Project Area), or during full moon periods.

- Surveys were not conducted when winds are over 10 miles per hour or gusts over 12 miles per hour, or during moderate to heavy rain, in order to increase detectability of vocalizations.

Per the protocol, all CRR vocalizations were noted, including the types, locations and times, on a detailed map of the survey area. Each biologist used a compass and distance estimation to locate detected listed rails on a map. Weather conditions were recorded at the beginning and end of each survey. Noise level at the site was qualitatively assessed on a zero (0) to four (4) scale: 0, no noise; 1, faint noise; 2, moderate noise (probably can't hear some birds beyond 100m); 3, loud noise (probably can't hear some birds beyond 50m); 4, intense noise (probably can't hear some birds beyond 25m).

Surveys were led by Leonard Liu (USFWS Permit #TE94998A-1), with assistance from ESA wildlife biologists Sharon Dulava and Erika Walther. Field assistants had previous experience with rail surveys and had demonstrated their ability to detect, identify, and map rail vocalizations.

ESA conducted a passive survey on January 31, 2020 (Table 2).

**Results**

Listening conditions during the surveys were good, with some noise from the RWQCP and airport limiting detectability of birds beyond 100 meters (164 feet). ESA detected numerous California Ridgway's rails during the surveys at all three stations. ESA then grouped the detections based on timing and counter-vocalizations to discern possible territorial boundaries. ESA estimates that there are 14 to 15 territories or generalized core locations within 300 meters (984 feet) of the survey stations (Figure 4). ESA estimates that the grouped detections represent approximately 28 to 30 CRR.

Alameda song sparrow (*Melospiza melodia pusillula*) was detected in the tidal marsh area, as well as saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*). Potential predators detected during surveys included northern harrier (*Circus hudsonius*) and American crow (*Corvus brachyrhynchos*). All bird species encountered during surveys are presented in Table 3.

**Conclusions**

The survey results conform to the most recent surveys at Harbor Marsh conducted by ISP in 2019 indicating that this is a high density CRR site (J. McBroom, pers. comm.). Project activities will need mitigation measures to avoid negative short-term impacts to CRR. Such measures include but are not limited to: restricting use of heavy equipment in close proximity to known CRR locations during the breeding season (approximately February 1 through August 31); restricting activities in close proximity to suitable habitat during extreme high tides when CRR may be forced out of tidal marsh; implementing worker education training to help workers recognize CRR and understand the importance of avoiding harm to CRR; and monitoring of work activities by a qualified biologist. With the implementation of prudent mitigation measures that avoid direct and indirect effect to this species during the breeding season, this restoration project should result in a net benefit for CRR.

Recovery of CRR will necessitate expansion of habitat transitions, as well as restoration of sites located in close proximity to existing breeding populations to facilitate dispersal and population expansion, in order to realize the resilient landscape that CRR will need this century to adapt to the challenges of sea level rise.

I, Leonard Liu (TE-94998A-1) certify that the information in this survey report and attached exhibits fully and accurately represents my work.

________________________

Signature

_February 11, 2020__________

Date

**References**

San Francisco Estuary Institute. 2011. "Bay Area Aquatic Resource Inventory (BAARI) wetlands version 4 GIS Data." https://www.sfei.org/baari

U.S. Fish and Wildlife Service (USFWS). Sacramento Office. June, 2015. California Clapper Rail Survey Protocol.

Table 1. California Ridgway's rail survey points at Palo Alto Harbor Marsh. Coordinates are in UTM NAD 83 zone 10S.

| Station ID | X-coordinate | Y-coordinate |
|---|---|---|
| PAHA01 | 579302 | 4145979 |
| PAHA02 | 578898 | 4145912 |
| PAHA03 | 578873 | 4145418 |

Table 2. Results of 2020 California Ridgway's rail surveys. Noise code: 0, no noise; 1, faint noise; 2, moderate noise; 3, loud noise; 4, intense noise.

| Round | Date | Acres surveyed | Rails Detected | Temp. start (°F) | Temp. end (°F) | Sky start | Sky end | Wind speed start (mph) | Wind speed end (mph) | Noise code |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 31-Jan | 93 | 28-30 | 43 | 47 | Part cloud | Part cloud | 0 | 2 | 2 |

Table 3. Other birds detected during 2020 California Ridgway's rail surveys.

| Common name | Scientific name | Common name | Scientific name |
|---|---|---|---|
| Bufflehead | *Bucephala albeola* | American avocet | *Recurvirostra americana* |
| Mallard | *Anas platyrhynchos* | Willet | *Tringa semipalmata* |
| Northern shoveler | *Spatula clypeata* | Greater yellowlegs | *Tringa melanoleuca* |
| American green-winged teal | *Anas crecca carolinensis* | Ring-billed gull | *Larus delawarensis* |
| Ruddy duck | *Oxyura jamaicensis* | Snowy egret | *Egretta thula* |
| American wigeon | *Mareca americana* | Northern harrier | *Circus hudsonius* |
| Canada goose | *Branta canadensis* | American crow | *Corvus brachyrhynchos* |
| American coot | *Fulica americana* | Common raven | *Corvus corax* |
| Double-crested cormorant | *Phalacrocorax auritus* | Marsh wren | *Cistothorus palustris* |
| Killdeer | *Charadrius vociferus* | Bewick's wren | *Thryomanes bewickii* |
| Black-bellied plover | *Pluvialis squatarola* | Say's phoebe | *Sayornis saya* |
| Wilson's snipe | *Gallinago delicata* | Black phoebe | *Sayornis nigricans* |
| Long-billed curlew | *Numenius americanus* | Saltmarsh common yellowthroat | *Geothlypis trichas sinuosa* |
| Dowitcher spp. | *Limnodromus spp.* | White-crowned sparrow | *Zonotrichia leucophrys* |
| Least sandpiper | *Calidris minutilla* | Alameda song sparrow | *Melospiza melodia* |
| Western sandpiper | *Calidris mauri* | California towhee | *Melozone crissalis* |
| Black-necked stilt | *Himantopus mexicanus* | House finch | *Haemorhous mexicanus* |


DWG: \\sfo-file01\esapwa\Data\projects_2012\D120042.03 - Oro Loma IRVMP Support\09 CAD\Figures\20200228_Working\FIG01_Site_Location.dwg USER: Brent Davis PLOT DATE: 2/28/2020 3:36:14 PM

NOTE: AERIAL ORTHOIMAGERY FROM NORTHROP GRUMMAN (2015), AS DOWNLOADED FROM USGS EARTH EXPLORER DATABASE. IMAGERY WAS COLLECTED BY NORTHROP GRUMMAN BETWEEN FEBRUARY 20 TO FEBRUARY 24, 2015.

PALO ALTO HORIZONTAL LEVEE
D181306.00

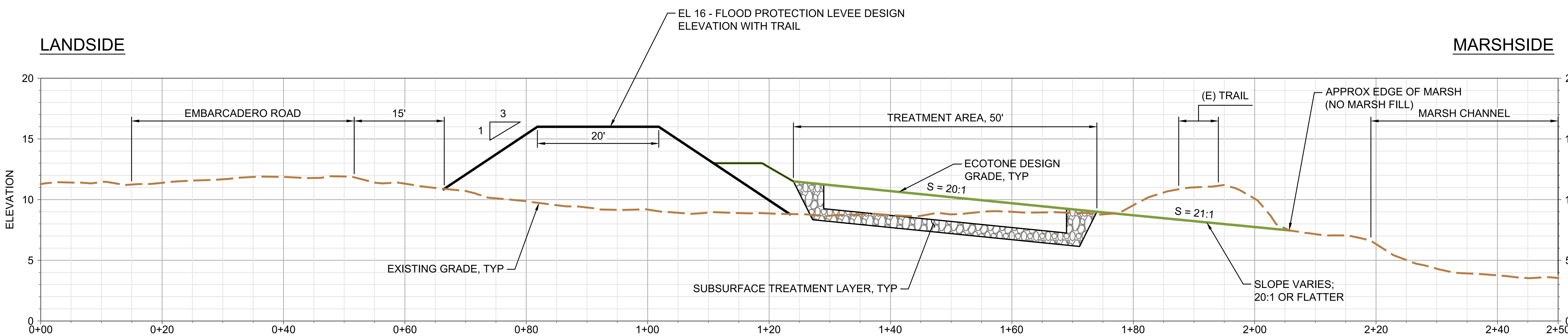
**FIGURE 1**
SITE LOCATION MAP

ESA


NOTE: AERIAL ORTHOIMAGERY FROM NORTHROP GRUMMAN (2015), AS DOWNLOADED FROM USGS EARTH EXPLORER DATABASE. IMAGERY WAS COLLECTED BY NORTHROP GRUMMAN BETWEEN FEBRUARY 20 TO FEBRUARY 24, 2015.

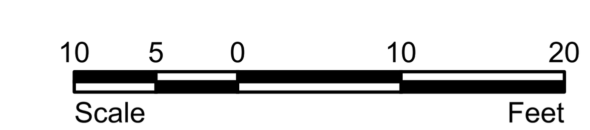
PALO ALTO HORIZONTAL LEVEE
D181306.00

**FIGURE 2**
EMBARCADERO
ROAD OVERVIEW




A
3
SECTION
EMBARCADERO ROAD
VERT: 1" = 10'
HORIZ: 1" = 20'

NOTE: EXISTING GRADE SURFACE IS APPROXIMATE AND BASED ON USGS TOPOGRAPHIC LIDAR (USGS, 2010), AS DOWNLOADED FROM THE NOAA OFFICE FOR COASTAL MANAGEMENT. ELEVATIONS ARE PRESENTED IN NORTH AMERICAN VERTICAL DATUM OF 1988.




DWG: \\Sfo-file01\esapwa\Data\projects_2012\D120042.03 - Oro Loma IRWMP Support\09 CAD\Figures\20200228_Working\FIG03_EMBARCADERO_SOUTH_XS.dwg USER: Brent Davis PLOT DATE: 2/28/2020 3:35:20 PM

PALO ALTO HORIZONTAL LEVEE
D181306.00

ESA

**FIGURE 3**
EMBARCADERO SOUTH
CROSS SECTION


SOURCE: ESA; ESRI; DigitalGlobe 2017

Palo Alto Horizontal Levee Project D181306.0

**Figure 4**
Rail Survey Stations and Rail Detection Locations

ESA

# Attachment 5

Palo Alto's Lease No. PRC 9143.9 and b: 7495.9 (also red notes)

ESA

Note: this SLC Amendment (PRC# 9143.9) is provided to serve as a recent nearby example of the measures that could be required for the PAHLPP; it does not address the lands at the currently-proposed 'South Reach' site proposed for the PAHLPP.

RECORDED AT THE REQUEST OF
AND WHEN RECORDED MAIL TO:
STATE OF CALIFORNIA
State Lands Commission
Attn: Title Unit
100 Howe Avenue, Suite 100-South
Sacramento, CA 95825-8202

**STATE OF CALIFORNIA**
**OFFICIAL BUSINESS**
Document entitled to free recordation
pursuant to Government Code Section 27383

*SPACE ABOVE THIS LINE FOR RECORDER'S USE*

A.P.N.: Various

County: Santa Clara

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## STATE OF CALIFORNIA
## STATE LANDS COMMISSION

## AMENDMENT OF LEASE NO. PRC 9143.9

**WHEREAS**, the State of California, acting through the State Lands Commission, hereinafter called Lessor, and City of Palo Alto., have heretofore entered into an agreement designated as Lease No. PRC 9143.9 (Lease), authorized by the State Lands Commission on August 15, 2014, and executed by the State Lands Commission on August 28, 2014, whereby Lessor granted to said Lessee a General Lease – Public Agency Use covering certain State Land situated in Santa Clara County; and

**WHEREAS**, Section 3, Paragraph 16(e) provides that the Lease may be terminated and its terms, covenants and conditions amended, revised, or supplemented only by mutual written agreement of the Lessor and the Lessee (hereinafter referred to as the Parties); and

**WHEREAS**, by reason of the foregoing, it is now the desire of the Parties to amend the Lease.

**NOW THEREFORE**, the Parties hereto agree as follows:

1. The existing Exhibit B, Site and Location Map, to the Lease is hereby deleted in its entirety and replaced with Exhibit B, Site and Location Map, attached and by reference made a part of the Lease and this Amendment (for reference purposes only).

2. Exhibit C, a Mitigation Monitoring Program, is attached and by reference made a part of the Lease and this Amendment.

3. Section 1, Basic Provisions, of the Lease is hereby amended to include the following:

a. **LAND USE OR PURPOSE**, to add: Continued use and maintenance of a 54-inch-diameter concrete outfall pipeline (with a 60-inch-diameter corrugated metal pipe section approximately 24 feet long), the maintenance of a 36-inch-diameter emergency outfall pipeline, and the construction, use, and maintenance of a 63-inch-diameter outfall pipeline.

To replace: '60-inch-diameter steel outfall pipeline' with '60-inch-diameter storm drain pipeline'

b. **AUTHORIZED IMPROVEMENTS,** to add: a 36-inch-diameter emergency outfall pipeline and a 54-inch-diameter concrete outfall pipeline.

To replace: '60-inch diameter steel outfall pipeline' with '60-inch-diameter storm drain pipeline'

c. **AUTHORIZED IMPROVEMENTS** under **TO BE CONSTRUCTED**, to add: a 63-inch-diameter outfall pipeline.

4. Section 2, Special Provisions, which includes one provision, to add the following provisions:

2. Lessee acknowledges that the Lease Premises and adjacent upland are located in an area that may be subject to effects of climate change, including sea-level rise. To prepare for the potential effects of sea-level rise, including flood damage, erosion damage, tsunamis, and damage from waves and storm-created debris, the Lessee acknowledges and agrees to the following:

a. Hazards associated with sea-level rise may require additional maintenance or protection strategies regarding the improvements on the Lease Premises.

b. Consistent with Section 3, Paragraph 8, the Lessee assumes the risks associated with such potential hazards and agrees to be solely responsible for all damages, costs, and liabilities to or incurred by Lessee arising as a result of the impacts of such hazards on the Lease Premises. Any additional maintenance or protection strategies necessitated by such hazards and proposed to be implemented by Lessee may require additional approval by Lessor pursuant to Section 3, Paragraph 5(a) and be subject to environmental review.

3. Lessee shall maintain a current National Pollutant Discharge Elimination System (NPDES) permit during the term of the Lease.

4. At least ninety (90) days prior to start of construction of the new 63-inch-diameter outfall project, Lessee shall provide the following for Lessor's review and approval:

a. A final set of engineering design drawings "as issued for construction", certified (stamped, signed, and dated) by a California registered Civil/Structural Engineer, for the new 63-inch diameter outfall project. Also, include the following information in the following drawings:

   i. Sheet No. C-02 – (a) details of proposed abandonment for the existing 36-inch diameter emergency outfall, such as pipeline segments to be removed, abandoned in place, both ends plugged with concrete, acceptable trench backfill materials and minimum relative compactions required, and (b) proposed minimum cover for the new 63-inch-diameter outfall.

   ii. Sheet No. C-05 – (a) continuous pipeline alignment in both plan and profile, (b) details of pipeline material, wall thickness, coating for the existing 54-inch dimeter concrete outfall and 60-inch-diameter storm drain pipelines, and (c) existing 60-inch diameter corrugated metal pipe (CMP) which represents a segment of the 54-inch dimeter concrete outfall.

b. A final set of engineering design drawings "as issued for construction", certified (stamped, signed, and dated) by a California registered Civil/Structural Engineer, for the existing 54-inch-diameter concrete outfall rehabilitation project.

c. A final set of detailed design calculations certified (stamped, signed, and dated) by a California registered Civil/Structural Engineer. The calculations shall consider loadings from aircraft (if applicable), soil cover due to the proposed elevated levee crest, etc.

d. A set of construction contract specifications.

e. A contractor's work execution plan providing details of step-by-step procedures for the project, manpower, equipment, safety procedures, site restoration, etc. Include details of design and drawings for any shoring (sheet piles) and cofferdam with supporting calculations, certified (stamped, signed, and dated) by a California registered Civil/Structural Engineer. Also, include details of precautionary measures to prevent damage to the existing pipelines during installation of new pipeline.

f. A set of approved contractor's welding procedures, qualifying welder's certificates, and welding inspection and quality control program and procedures.

g. Details of the new pipeline hydrotest procedures and the test pressure, duration, and passing criteria that will be used.

h. A project specific hazardous spill contingency plan. It shall include but not be limited to procedures to be implemented, specific designation of the on-site person who will have responsibility for implementing the plan, on-site spill response materials/tools/equipment, and spill notification protocol and procedures. The plan shall include equipment refueling procedures to prevent/minimize potential spills. It shall also include a complete list of the agencies (with telephone number) to be notified, including but not limited to California State Lands Commission's 24-hour emergency notification number (562) 590-5201, California Governor's Office of Emergency Services (Cal OES) contact number (800) 852-7550, etc.

i. A construction schedule showing all significant work activities that will take place during the course of construction.

5. Work shall be carried out in conformance with all applicable federal, state, and local regulations, requirements, and current industry standards.

6. Within sixty (90) days of completion of the new 63-inch-diameter outfall project, Lessee shall provide post-construction project verification including:

   a. A set of "as-built" construction plans, certified (stamped, signed, and dated) by a California registered Civil/Structural Engineer, showing all design changes or other amendments to the construction as originally approved.

   b. Certified copies of all completed pipeline integrity test results (hydrotests, gauging runs etc.) including copies of any failed test results with an explanation of the reason for failure.

   c. A post-construction written narrative report confirming completion of the project with discussion of any significant field changes or other modifications to the approved design or execution plan, and providing details of any extraordinary occurrences such as spill incidents, accidents involving serious injury or loss of life etc. It shall include backfill compaction test results including those that passed and did not pass the acceptance criteria. In addition, it shall include written confirmation of site clean-up verification with videography/photography records.

   d. Details of the post construction maintenance program that provides for leak monitoring and regular internal inspections of the pipeline.

7. Within sixty (90) days of completion of the existing 54-inch-diameter outfall rehabilitation project, Lessee shall provide a set of "as-built" construction plans, certified (stamped, signed, and dated) by a California registered Civil/Structural Engineer, showing all design changes or other amendments to the construction as originally approved.

8. Within six (6) months of the lease execution, Lessee shall conduct a condition assessment, certified by a California registered Civil/Structural Engineer, of the existing 60-inch diameter storm drain pipeline within the Lease Premises and at least once every five (5) years thereafter. Additionally, Lessee shall conduct such assessments when warranted by extraordinary circumstances such as an accident or a significant seismic event. The assessment schedule may be modified by mutual agreement among the parties hereto. At no cost to Lessor, Lessee shall promptly submit copies of the results of condition assessment, including reports, findings, and recommendations, to Lessor.

9. The existing 54-inch-diameter concrete outfall rehabilitation project shall be completed no later than six (6) months after the new 63-inch-diameter HDPE outfall line has been put into operation. Within five (5) years of completion of the 54-inch diameter concrete outfall rehabilitation project, Lessee shall conduct a condition assessment, certified by a California registered Civil/Structural Engineer, of the pipeline within the Lease Premises and at least once every five (5) years thereafter. Additionally, Lessee shall conduct such assessments when warranted by extraordinary circumstances such as an accident or a significant seismic event. The assessment schedule may be modified by mutual agreement among the parties hereto. At no cost to Lessor, Lessee shall promptly submit copies of the results of condition assessment, including reports, findings, and recommendations, to Lessor.

10. Lessee shall execute a reimbursement agreement with Lessor for any and all Lessor staff costs reasonably incurred reviewing and approving material required under Section 2, Paragraph 4, 6, 7, 8, and 9.

11. At no cost to Lessor and no later than 90 days after the completion of the new 63-inch diameter outfall pipeline, Lessee shall submit detailed drawings of all improvements and man-made structures both under and above ground within the lease premises.

12. Lessee agrees to be bound by and fully carry out, implement, and comply with all mitigation measures and reporting obligations identified as Lessee's, or the party

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responsible per the Mitigation Monitoring Program (MMP) attached hereto as Exhibit C and by this reference made a part of this Lease, or as modified by Lessor as permitted by law.

The effective date of this Amendment to the Lease shall be February 4, 2019.

This Amendment is a portion of Lease No. PRC 9143.9 with a beginning date of August 15, 2014, consisting of three sections with a total of 18 pages.

All other terms and conditions of the lease shall remain in full force and effect.

This Agreement will become binding on the Lessor only when duly executed on behalf of the State Lands Commission of the State of California.

**IN WITNESS WHEREOF**, the parties hereto have executed this Amendment as of the dates hereafter affixed.

LESSEE:
CITY OF PALO ALTO

By: EDWARD SHIKADA

Title: City Manager

Date: 1/17/2019

LESSOR:
STATE OF CALIFORNIA
STATE LANDS COMMISSION

By: Robert Brian Bugsch

Title: Chief, Land Management Division

Date: APR 25 2019

APPROVED AS TO FORM:

Assistant City Attorney

Execution of this document was authorized by the California State Lands Commission on

FEBRUARY 4, 2019

(Month Day Year)

Attachments:
EXHIBIT B: Site and Location Map
EXHIBIT C: Mitigation Monitoring Program

**ATTACH ACKNOWLEDGMENT**

# ACKNOWLEDGMENT

| |
|---|
| A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document. |

State of California
County of Sacramento )

On April 25, 2019 before me, Kalyn Buchan, Notary Public
(insert name and title of the officer)

personally appeared Robert Brian Bugsch,
who proved to me on the basis of satisfactory evidence to be the person~~(s)~~ whose name~~(s)~~ is/~~are~~ subscribed to the within instrument and acknowledged to me that he/~~she/they~~ executed the same in his/~~her/their~~ authorized capacity~~(ies)~~, and that by his/~~her/their~~ signature~~(s)~~ on the instrument the person~~(s)~~, or the entity upon behalf of which the person~~(s)~~ acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

KALYN BUCHAN
COMM. # 2250551
NOTARY PUBLIC-CALIFORNIA
SACRAMENTO COUNTY
MY COMM. EXP. JULY 20, 2022

Signature Kalyn Buchan (Seal)

## CERTIFICATE OF ACKNOWLEDGMENT
(Civil Code § 1189)

| |
|---|
| A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document. |

STATE OF CALIFORNIA )

COUNTY OF SANTA CLARA )

On JANUARY 17, 2019, before me, DONNA M. HARTMAN, a notary public in and for said County, personally appeared EDWARD SHIKADA who proved to me on the basis of satisfactory evidence to be the person~~(s)~~ whose name~~(s)~~ is/~~are~~ subscribed to the within instrument and acknowledged to me that he/~~she~~/they executed the same in his/~~her~~/~~their~~ authorized capacity~~(ies), and~~ and that by his/~~her~~/~~their sig~~nature~~(s) on~~ the instrument the person~~(s),~~ or the entity upon behalf of which the person~~(s)~~ acted, executed the instrument.

I certify under penalty of perjury under the laws of the State of California that the foregoing paragraph is true and correct.

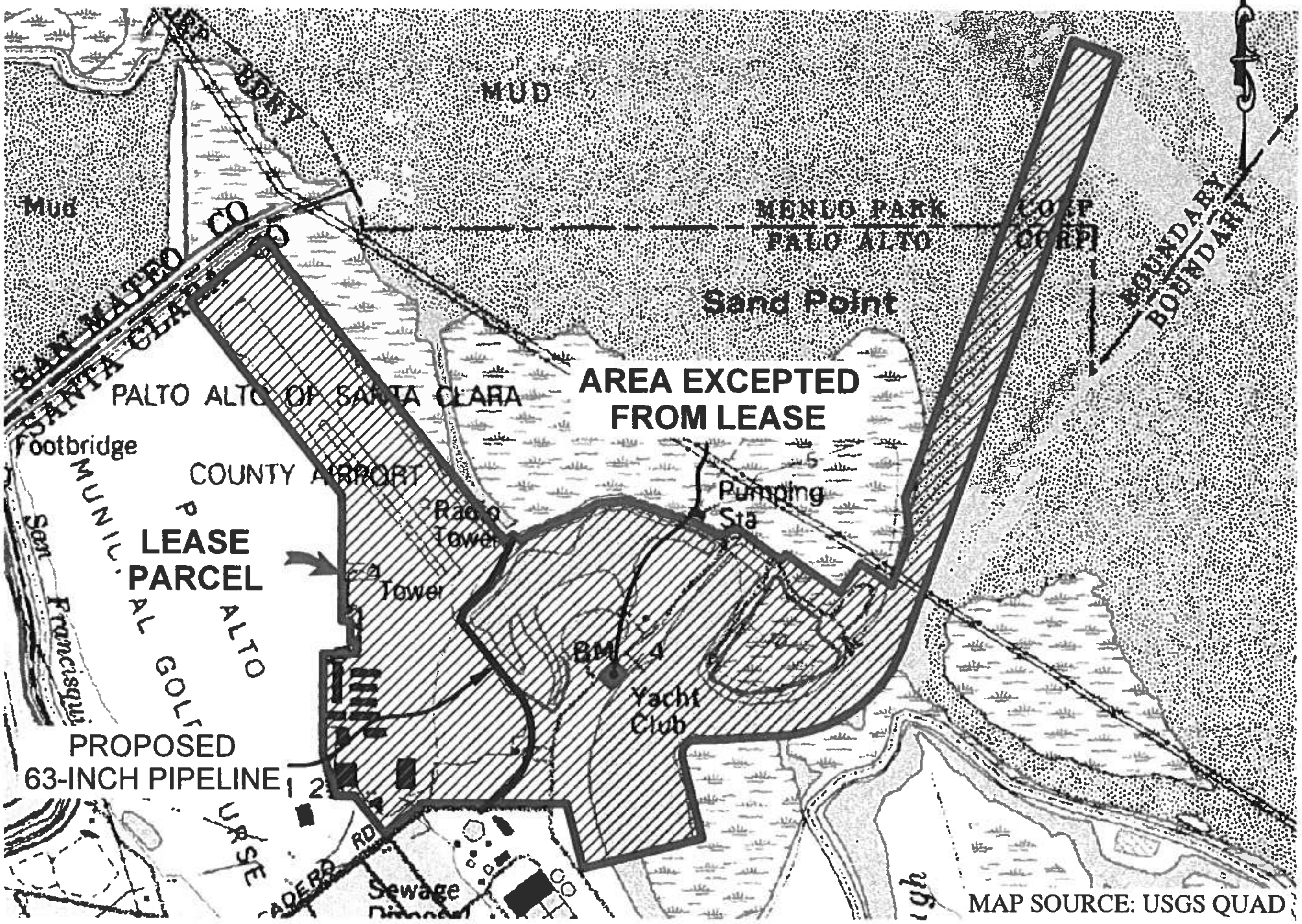
WITNESS my hand and official seal.

Donna M. Hartman

DONNA M. HARTMAN
COMM. # 2097808
NOTARY PUBLIC-CALIFORNIA
SANTA CLARA COUNTY
MY COMM. EXP. JAN. 23, 2019

NO SCALE

## SITE




PALO ALTO AIRPORT AND
PALO ALTO YACHT HARBOR

NO SCALE

## LOCATION


MAP SOURCE: USGS QUAD

This Exhibit is solely for purposes of generally defining the lease premises, is based on unverified information provided by the Lessee or other parties and is not intended to be, nor shall it be construed as, a waiver or limitation of any State interest in the subject or any other property.

# Exhibit B

PRC 9143.9
CITY OF PALO ALTO
GENERAL LEASE -
PUBLIC AGENCY USE
SANTA CLARA COUNTY


JWP 08/06/18

**EXHIBIT C**
**CALIFORNIA STATE LANDS COMMISSION**
**MITIGATION MONITORING PROGRAM**

Regional Water Quality Control Plant New Outfall Project
(PRC 9143, State Clearinghouse No. 2017122060)

---

The California State Lands Commission (Commission or CSLC) is a responsible agency under the California Environmental Quality Act (CEQA) for the Regional Water Quality Control Plant New Outfall Project (Project). The CEQA lead agency for the Project is the City of Palo Alto.

In conjunction with approval of this Project, the Commission adopts this Mitigation Monitoring Program (MMP) for the implementation of mitigation measures for the portion(s) of the Project located on Commission lands. The purpose of a MMP is to impose feasible measures to avoid or substantially reduce the significant environmental impacts from a project identified in an Environmental Impact Report (EIR) or a Mitigated Negative Declaration (MND). State CEQA Guidelines section 15097, subdivision (a), states in part:[1]

> *In order to ensure that the mitigation measures and project revisions identified in the EIR or negative declaration are implemented, the public agency shall adopt a program for monitoring or reporting on the revisions which it has required in the project and the measures it has imposed to mitigate or avoid significant environmental effects. A public agency may delegate reporting or monitoring responsibilities to another public agency or to a private entity which accepts the delegation; however, until mitigation measures have been completed the lead agency remains responsible for ensuring that implementation of the mitigation measures occurs in accordance with the program.*

The lead agency adopted an MND, State Clearinghouse No. 2017122060, adopted a Mitigation Monitoring and Reporting Program (MMRP) for the whole of the Project (see Exhibit C, Attachment C-1), and remains responsible for ensuring that implementation of the mitigation measures occurs in accordance with its program. The Commission's action and authority as a responsible agency apply only to the mitigation measures listed in Table C-1 below. The full text of each mitigation measure, as set forth in the MMRP prepared by the CEQA lead agency and listed in Table C-1, is incorporated by reference in this Exhibit C.

---

[1] The State CEQA Guidelines are found at California Code of Regulations, title 14, section 15000 et seq.

**Table C-1. Project Impacts and Applicable Mitigation Measures**

| Potential Impact | Mitigation Measure (MM)[2] |
|---|---|
| Air Quality | AIR-1 |
| Biological Resources | BIO-1<br>BIO-2<br>BIO-3<br>BIO-4<br>BIO-5<br>BIO-6 |
| Cultural Resources | CULT-1 |
| Geology and Soils | GEO-1 |
| Noise | NOISE-1 |
| Transportation/Traffic | TRAFFIC-1 |
| Tribal Cultural Resources | TRIBAL-1 |

[2] See Attachment C-1 for the full text of each MM taken from the MMRP prepared by the CEQA lead agency.

# ATTACHMENT C-1

## Mitigation Monitoring and Reporting Program Adopted by the City of Palo Alto

CITY OF PALO ALTO

# Mitigation Monitoring + Reporting Program

| | | | |
|---|---|---|---|
| **PROJECT NAME** | Regional Water Quality Control Plant New Outfall Project | **APPLICATION NUMBER** | N/A |
| **APPLICANT AGREEMENT** | James Allen, Regional Water Quality Control Plant Manager | **DATE** | 5/1/18 |
| **APPROVED BY** | City Council | | 5/21/18 |
| **APPLICANT/OWNER** | Tom Kapushinski, P.E. / LEED AP, Project Engineer<br>City of Palo Alto<br>Public Works Department - Regional Water Quality Control Plant<br>2501 Embarcadero Way<br>Palo Alto, CA 94303 | | |

The Final Mitigated Negative Declaration (MND) for the Regional Water Quality Control Plant New Outfall Project identifies the mitigation measures that will be implemented to reduce the impacts associated with the project. The California Environmental Quality Act (CEQA) was amended in 1989 to add Section 21081.6, which requires a public agency to adopt a monitoring and reporting program for assessing and ensuring compliance with any required mitigation measures applied to proposed development. As stated in section 21081.6(a)(1) of the Public Resources Code:

*... the public agency shall adopt a reporting or monitoring program for the changes made to the project or conditions of project approval, adopted in order to mitigate or avoid significant effects on the environment.*

Section 21081.6 also provides general guidelines for implementing mitigation monitoring programs and indicates that specific reporting and/or monitoring requirements, to be enforced during project implementation, shall be defined as part of adopting an EIR.

The mitigation monitoring table lists those mitigation measures that would be included as conditions of approval for the project. To ensure that the mitigation measures are properly implemented, a monitoring program has been devised which identifies the timing and responsibility for monitoring each measure.

| Environmental Impact | Mitigation Measure | Responsible for Implementation | Timing of Compliance | Oversight of Implementation |
|---|---|---|---|---|
| | **AIR QUALITY** | | | |
| AIR-1 | Mitigation Measure AIR-1<br><br>During any construction period ground disturbance, the applicant shall ensure that the project contractor implements measures to control dust and exhaust. Implementation of the measures recommended by Bay Area Air Quality Management District (BAAQMD) and listed below would reduce the air quality impacts associated with grading and new construction to a less-than-significant level. The contractor shall implement the following best management practices that are required of all projects:<br><br>1. All exposed surfaces (e.g., parking areas, staging areas, soil piles, graded areas, and unpaved access roads) shall be watered two times per day.<br>2. All haul trucks transporting soil, sand, or other loose material off-site shall be covered.<br>3. All visible mud or dirt track-out onto adjacent public roads shall be removed using wet power vacuum street sweepers at least once per day. The use of dry power sweeping is prohibited.<br>4. All vehicle speeds on unpaved roads shall be limited to 15 miles per hour (mph).<br>5. All roadways, driveways, and sidewalks to be paved shall be completed as soon as possible. Building pads shall be laid as soon as possible after grading unless seeding or soil binders are used.<br>6. Idling times shall be minimized either by shutting | Applicant/Contractor | During Construction | Planning and Community Environment Department and Public Works Department |

| Environmental Impact | Mitigation Measure | Responsible for Implementation | Timing of Compliance | Oversight of Implementation |
| --- | --- | --- | --- | --- |
| | equipment off when not in use or reducing the maximum idling time to five minutes (as required by the California airborne toxics control measure Title 13, Section 2485 of California Code of Regulations [CCR]). Clear signage shall be provided for construction workers at all access points.<br>7. All construction equipment shall be maintained and properly tuned in accordance with manufacturer's specifications. All equipment shall be checked by a certified mechanic and determined to be running in proper condition prior to operation.<br>8. Post a publicly visible sign with the telephone number and person to contact at the Lead Agency regarding dust complaints. This person shall respond and take corrective action within 48 hours. The Air District's phone number shall also be visible to ensure compliance with applicable regulations.<br>9. The Contractor shall prepare a SWPPP, to be submitted and approved by the City prior to the start of construction<br>10. The Contractor shall install rumble strips for trucks exiting the site. | | | |
| | **BIOLOGICAL RESOURCES** | | | |
| BIO-1 | Mitigation Measure BIO-1<br><br>Protocol level rare plant surveys shall be conducted within suitable habitat and during the blooming periods of Point Reyes bird's-beak, California seablite, and saline clover, in order to confirm the presence or absence of these species within the project site. Surveys for Point Reyes bird's beak and California seablite shall be conducted during the late season, June through October, and surveys for saline clover shall be conducted between April and June, based on the individual specie's blooming season. If these rare plant species are observed during surveys, they shall be avoided by construction if feasible. If avoidance is not feasible, seed shall be collected for replanting, or whole individuals transplanted to a nearby | Applicant/Contractor | Prior to During, and After Construction | Planning and Community Environment Department and Public Works Department |

| Environmental Impact | Mitigation Measure | Responsible for Implementation | Timing of Compliance | Oversight of Implementation |
|---|---|---|---|---|
| | protected area containing suitable habitat prior to construction, or stored for replanting in the construction area following completion of construction. Transplanted or reseeded individuals shall be monitored for a minimum of two years following construction to ensure transplantation success. If transplanted individuals do not successfully establish, seed or individuals from established and healthy local populations shall be collected and planted at the project site. | | | |
| BIO-2 | Mitigation Measure BIO-2<br><br>The measures listed below shall be implemented prior to or during construction activities within or adjacent to potential SMHM habitat:<br>a) Prior to ground disturbing activities within and adjacent to potential SMHM habitat, all vegetation within the Project footprint shall be removed using hand-operated tools in the presence of a qualified biological monitor (see below).<br>b) Following vegetation removal, exclusion barriers and/or fencing shall be installed to exclude individuals of this species from areas of active construction. The design of the exclusion barriers and fencing shall be approved by a qualified biologist and shall be installed in the presence of a qualified biological monitor. The fence shall be made of a material that does not allow SMHM to pass through, and the bottom shall be buried to a depth of a minimum of 4 inches so that these species cannot crawl under the fence. All support for the exclusion fencing shall be placed on the inside of the Project footprint.<br>c) A qualified biological monitor shall be present during wildlife exclusion fence installation and removal, and during all vegetation clearing and initial ground disturbance conducted in vegetation in and adjacent to marsh habitats. The monitor shall | Applicant/Contractor | Prior to and During Construction | Planning and Community Environment Department and Public Works Department |

| Environmental Impact | Mitigation Measure | Responsible for Implementation | Timing of Compliance | Oversight of Implementation |
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| | have demonstrated experience in biological construction monitoring and knowledge of the biology of the listed species that may be found in the Action Area, including SMHM and CRR. The monitor(s) shall have the authority to halt construction, if necessary, if noncompliance actions occur. The biological monitor(s) shall be the contact person for any employee or contractor who might inadvertently kill or injure a listed species or anyone who finds a dead, injured, or entrapped listed species. Following vegetation removal in potential habitat areas, fence installation, and initial ground disturbance, the biological monitor shall still conduct weekly site checks to provide guidance for fence maintenance, provide environmental sensitivity training, and document compliance with permit conditions.<br>d) The biological monitor shall provide an endangered species training program to all personnel involved in Project construction. At a minimum, the employee education program shall consist of a brief presentation by persons knowledgeable about the biology of listed species with potential to occur in the Action Area, and about their legislative protection to explain concerns to contractors and their employees involved with implementation of the Project. The program shall include a description of these species and their habitat needs; any reports of occurrences in the area; an explanation of the status of these species and their protection under State and Federal legislation; as well as a list of measures being taken to reduce impacts to these species during construction.<br>e) Food-related trash items such as wrappers, cans, bottles, and food scraps shall be disposed of in solid, closed containers (trash cans) and removed at the end of each work day from the investigation site to eliminate an attraction to predators of listed | | | |

| Environmental Impact | Mitigation Measure | Responsible for Implementation | Timing of Compliance | Oversight of Implementation |
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| | species.<br>f) At the end of each work period, all open trenches shall either be securely covered or shall have exit ramps installed to prevent entry and/or entrapment of SMHM.<br>g) If a listed species is observed at any time during construction, work shall not be initiated or shall be stopped immediately until the animal leaves the vicinity of the work area of its own volition. If the animal in question does not leave the work area, work shall not be reinitiated until the appropriate agency is contacted and has made a decision on how to proceed with work activities. The biological monitor shall direct the contractor on how to proceed accordingly. The biological monitor or any other persons at the site shall not pursue, capture, handle, or harass any species observed. | | | |
| BIO-3 | Mitigation Measure BIO-3<br><br>Construction of the project within the RWQCP and airport grounds shall be timed to occur within the CRR nesting season so that construction in other areas closer to suitable habitat and outside of existing areas of disturbance may be completed outside of the nesting season. Construction of the new outfall pipeline that would occur within the existing levee and the small reach of construction that would occur within the unnamed slough would avoid the CRR nesting season. Protocol level surveys for CRR shall be completed prior to construction to provide information regarding the location of nesting rails. However, based on a variety of factors, construction shall occur both within and outside of the CRR breeding season. Specifically:<br>• Construction of the new outfall pipeline within the levee and in the unnamed slough (between Station 14+00 and 27+49) shall occur between September 1 and January 31 to avoid the CRR breeding season. | Applicant/Contractor | During Construction | Planning and Community Environment Department and Public Works Department |

| Environmental Impact | Mitigation Measure | Responsible for Implementation | Timing of Compliance | Oversight of Implementation |
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| | • In-water construction in the unnamed slough shall be completed between September 1 and November 30 to avoid the windows for both CRR and listed fish species. | | | |
| BIO-4 | Mitigation Measure BIO-4<br><br>To avoid impacts to burrowing owl, a pre-construction burrowing owl survey shall be conducted by a qualified biologist of potential habitat areas (the Airport apron and along the adjacent levee berm top) at most 14 days from the initiation of project activities, irrespective of time of year. If burrowing owl is detected on the site, a no-disturbance buffer around the active burrow shall be enacted until work is finished or a qualified biologist confirms the burrow is no longer in use. This buffer shall be 250 feet if work is conducted in the area during the nesting season (February 1 – August 31) and 160 feet if work is conducted in the area outside of the nesting season. If the burrow cannot be avoided and work is to be conducted outside the nesting season, burrowing owls shall be passively excluded from the site following the procedures outlined in the Staff Report on Burrowing Owl Mitigation (California Department of Fish and Game 2012). | Applicant/Contractor | Prior to and During Construction | Planning and Community Environment Department and Public Works Department |
| BIO-5 | Mitigation Measure BIO-5<br><br>All in-water work (i.e., in tidal areas at the unnamed slough) shall be conducted between June 15 and November 30 and will incorporate all avoidance measures listed in the regulatory permits. Installation of sheet piles in tidal waters, if necessary, shall occur by the use of a vibratory hammer during low tide. If impact pile driving is necessary, an evaluation of potential hydroacoustic impacts to fish shall be required, and if necessary additional measures shall be employed to ensure that underwater sound is reduced to levels that | Applicant/Contractor | During Construction | Planning and Community Environment Department and Public Works Department |

| Environmental Impact | Mitigation Measure | Responsible for Implementation | Timing of Compliance | Oversight of Implementation |
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| | are below those that will cause injury to fish. Such additional measures may include:<br><br>• Hydroacoustic monitoring by a sound engineer during in water pile driving work.<br>• Use of a "soft start" to clear fish from the area of acoustic effect.<br>• Use of a wood cushion block between the hammer and the pile.<br>• Use of a bubble curtain or other similar technique to reduce underwater noise.<br>• Complete all impact pile driving work at low tide.<br>• Limiting the number of pile strikes in a day to reduce the cumulative sound pressure impacts to fish. | | | |
| BIO-6 | Mitigation Measure BIO-6<br><br>• All construction documents shall include requirements for the restoration of temporary excavations in wetlands back to preconstruction grade, and revegetation of temporarily disturbed areas using appropriate native vegetation. Appropriate native vegetation may include pickleweed, saltgrass, Atriplex, and other salt tolerant wetland plant species. Pickleweed and saltgrass may be selectively harvested from adjacent tidal marsh and seasonal wetland areas for transplantation to temporarily impacted areas for restoration.<br>• Limits of construction, wetlands, and buffers shall be clearly marked with high-visibility construction fencing.<br>• Site access of machinery shall be restricted to as few areas as possible to prevent soil compaction.<br>• Appropriate erosion control measures shall be used around soil stockpiles, graded slopes, and slurry management facilities. Erosion control materials shall be wildlife friendly and shall avoid the use of | Applicant/Contractor | Prior to and During Construction | Planning and Community Environment Department and Public Works Department |

| Environmental Impact | Mitigation Measure | Responsible for Implementation | Timing of Compliance | Oversight of Implementation |
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| | plastic netting or fixed aperture netting.<br>• A spill prevention and control plan shall be required as part of project specifications to minimize the chance of toxic spills. Spill kits shall be present for any work adjacent to open waters. All spills of oil and other hazardous materials shall be immediately cleaned u and contained. Any hazardous materials cleaned up or used on-site would be properly disposed of at an approved disposal facility.<br>• Litter and Waste Management – Waste collection areas shall be designated on-site. Only watertight dumpsters and trash cans shall be used and inspected for leaks. Dumpsters and cans shall be inspected at the end of each work day when it is raining or windy. Waste collection shall occur regularly. Litter shall be picked up daily. | | | |
| | **CULTURAL RESOURCES** | | | |
| CULT-1 | Mitigation Measure CULT-1<br><br>If buried materials are encountered, all soil disturbing work shall be halted at the location of any discovery until a qualified archaeologist or paleontologist completes a significance evaluation of the find(s) pursuant to Section 106 of the National Historic Preservation Act (36CFR60.4) and CEQA guidelines (§15064.5[f]), and the State Lands Commission Attorney has been contacted to consult. Prehistoric archaeological site indicators include: obsidian and chert flakes and chipped stone tools; grinding and mashing implements (e.g., slabs and handstones, and mortars and pestles); bedrock outcrops and boulders with mortar cups; and locally darkened midden soils. Midden soils may contain a combination of any of the previously listed items with the possible addition of bone and shell remains, and fire-affected stones. Historic period site indicators generally include: fragments of glass, ceramic, and metal objects; milled and split lumber; and structure and feature remains such as building foundations and discrete trash deposits (e.g., | Applicant/Contractor | During Construction | Planning and Community Environment Department and Public Works Department |

| Environmental Impact | Mitigation Measure | Responsible for Implementation | Timing of Compliance | Oversight of Implementation |
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| | wells, privy pits, dumps). The final disposition of any archaeological , historical, and paleontological resources recovered on-site under the jurisdiction off the California State Lands Commission shall be approved by the Commission. | | | |
| | **GEOLOGY/SOILS** | | | |
| GEO-1 | Mitigation Measure GEO-1<br><br><u>Dewatering</u><br><br>The construction contractor shall implement a dewatering system to preserve the undisturbed bearing capacity of the existing subgrade soils at the bottom of excavations and shall meet the following minimum performance standards:<br><br>• Stable excavation walls and bottom shall be provided;<br>• A reasonably dry base of excavation shall be provided;<br>• Native soils shall be filtered and loss of ground from dispersion or erosion shall be prevented;<br>• Piping (boiling) of the excavation bottom shall be prevented;<br>• All dewatering and shoring systems shall be installed and removed in accordance with governing (e.g., County, State) requirements; and<br>• The contractor shall allow for the controlled release of groundwater to its static level in a manner that prevents disturbance of bottom soils and prevents flotation or movements of structures or pipelines.<br><br>The contractor shall be prepared to implement alternative systems should the initial dewatering system fail to achieve these minimum performance requirements. The contractor shall be prepared to locally dewater or modify construction excavations, if and where needed, to provide stable and reasonably dry | Applicant/Contractor | During Construction | Planning and Community Environment Department and Public Works Department |

| Environmental Impact | Mitigation Measure | Responsible for Implementation | Timing of Compliance | Oversight of Implementation |
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| | excavations. The dewatering system shall be localized, targeted, and short-term (days) in order to prevent consolidation and subsidence from prolonged dewatering.<br><br><u>Shoring</u><br><br>The contractor shall be required to shore the anticipated 12-foot deep excavations with interlocking sheetpiles in accordance with California Division of Occupational Safety and Health (Cal/OSHA) regulations and all other recommendations provided in the site-specific Geotechnical report (Appendix D). All shoring plans shall be submitted to the City for review and approval prior to the start of construction activities. The construction shall ensure the shoring system meets all the minimum performance standards for shoring listed in the Geotechnical Report. | | | |
| | **HAZARDS & HAZARDOUS MATERIALS** | | | |
| HAZ-1 | See Mitigation Measure TRAFFIC-1 Below. | | | |
| | **NOISE** | | | |
| NOISE-1 | Mitigation Measure NOISE-1<br>The City shall provide all construction workers appropriate hearing protection. | Applicant | During Construction | Planning and Community Environment Department and Public Works Department |
| | **TRANSPORTATION/TRAFFIC** | | | |
| TRAFFIC-1 | Mitigation Measure TRAFFIC-1<br><br>• Prior to issuance of a grading permit, the City shall prepare and submit a Traffic Control Plan for review and approval. The Traffic Control Plan shall include best management practices and traffic measures including but not limited to: | Applicant/Contractor | Prior to and During Construction | Planning and Community Environment Department and Public Works Department |

| Environmental Impact | Mitigation Measure | Responsible for Implementation | Timing of Compliance | Oversight of Implementation |
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| | ○ The City shall require the contractor to provide for passage of emergency vehicles through the project site at all times.<br>○ The City shall require the contractor to maintain access to all uses during project construction.<br>○ The City shall use traffic cones, signs, lighted barricades, lights, and flagmen as described and specified in the Caltrans Manual of Uniform Traffic Control Devices, current edition, California Supplement, Part 6 Temporary Traffic Control to provide for public safety and convenience during construction.<br>○ The contractor shall install advance warning signs to alert bicyclists and motorists of the work zone and lane closures. Advance warning signs may be reflective signs, changeable message boards, cones, and barricades.<br>○ Flagging and other means of traffic control shall be required to allow for the safe movement of traffic through the work zone. The contractor shall provide flaggers to temporarily hold traffic for staging equipment or construction.<br>○ The City shall provide advanced notice to area residents, schools and emergency agencies when employing temporary traffic control measures. In addition, prior to the start of construction, the City shall provide emergency services with the proposed construction schedule.<br>○ The City shall require the construction contractor to provide for passage of emergency vehicles through the project site at all times.<br>○ The City shall require the construction contractor to maintain convenient access to driveways and buildings near the work area unless otherwise approved by the City in advance.<br>○ The City shall restore pavement, curbs, gutters, | | | |

| Environmental Impact | Mitigation Measure | Responsible for Implementation | Timing of Compliance | Oversight of Implementation |
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| | and sidewalks, as necessary, to pre-disturbance conditions or better.<br>o The temporary traffic control/detour portion of the project shall include one additional detour sign posted at the bicycle/pedestrian bridge across San Francisquito Creek between East Palo Alto and Palo Alto. Users approaching from East Palo Alto need to be directed to the detour route. | | | |
| | **TRIBAL CULTURAL RESOURCES** | | | |
| TRIBAL-1 | Mitigation Measure TRIBAL-1<br><br>In the event that an unanticipated tribal cultural resource is exposed during project construction, work within 30 feet of the discovery shall stop until a City-approved cultural resources professional can identify and evaluate the significance of the discovery and develop recommendations. Recommendations could include preparation of a Treatment Plan, which could require recordation, collection and analysis of the discovery; preparation of a technical report; and curation of the collection and supporting documentation in an appropriate depository. | Applicant/Contractor | During Construction | Planning and Community Environment Department and Public Works Department |

STATE OF CALIFORNIA
STATE LANDS COMMISSION

F ECORDERS USE ONLY

Note: this SLC Lease (PRC# 7495.9) is a long-term (49 year) lease issued circa 1991, which may apply to the PAHLPP 'South Reach' site (TBD).

RECORDED AT THE REQUEST OF
State of California/State Lands Commission
Official Business - Document entitled to free recordation pursuant to Government Code Section 27383.

WHEN RECORDED MAIL TO
State Lands Commission
1807 - 13th Street
Sacramento, CA 95814
Attention: Title Unit

W 21124

LEASE NO. PRC 7495.9

This Lease consists of this summary and the following attached and incorporated parts:

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| Section 1 | Basic Provisions |
| Section 2 | Special Provisions amending or supplementing Section 1 or 4 |
| Section 3 | Description of Lease Premises |
| Section 4 | General Provisions |

## SECTION 1

## BASIC PROVISIONS

The STATE OF CALIFORNIA, hereinafter referred to as Lessor acting by and through the STATE LANDS COMMISSION, (1807 - 13th Street, Sacramento, California 95814), pursuant to Division 6 of the Public Resources Code and Title 2, Division 3 of the California Administrative Code, and for consideration specified in the Lease,

does hereby lease, demise and let to: CITY OF PALO ALTO
hereinafter referred to as Lessee:
WHOSE MAILING ADDRESS IS: 2501 Embarcadero Way
Palo Alto, California 94303

those certain lands described in Section 3 subject to the reservations, terms, covenants and conditions of this Lease.

LEASE TYPE: General Permit - Public Agency Use

LAND TYPE: Filled sovereign land LOCATION: Palo Alto, Santa Clara County

LAND USE OR PURPOSE: Marsh enhancement facilities and nature observation deck

TERM: Forty-nine (49) years; beginning June 1, 1991 and ending May 31, 2040, unless sooner terminated as provided under this Lease.

(State Copy)

CONSIDERATION: The public use and benefit with the State reserving the right at any time to set a monetary rental if the Commission finds such action to be in the State's best interest, as to any portion of the property ultimately confirmed into State ownership.

AUTHORIZED IMPROVEMENTS: Bay inlet structure, inlet piping, bird observation deck, pump station, and culvert along Matadero Creek

LIABILITY INSURANCE: N/A

SURETY BOND OR OTHER SECURITY: N/A

## SECTION 2
## SPECIAL PROVISIONS

BEFORE THE EXECUTION OF THIS LEASE, ITS PROVISIONS ARE AMENDED, REVISED OR SUPPLEMENTED AS FOLLOWS:

The State alleges that the State, by reason of its sovereignty, is the owner of some right, title, or interest within the leased premises resulting from its legal character as tideland or submerged lands, in whole or in part. Lessee denies the State's allegations and asserts Lessee's ownership free and clear of any such State sovereign right, title, or interest. A final resolution of the title dispute will require time-consuming and costly studies of the evidence and may also require litigation. In avoidance of the time, expense, and uncertainties required to confirm the respective interests of either party, this permit is being issued to Lessee without clearing the title claims of the parties and, except for the rights granted to Lessee and the other terms and conditions of this permit, the issuance by State and the acceptance by Lessee, of the within permit, is without prejudice to any other claims, demands, causes of action, contentions, or assertions by either party at any time of their ownership of any right, title, or interest within the leased premises, or any portion thereof, whether the dispute is the subject of pending litigation, or otherwise. However, nothing contained herein shall prevent either party from receiving the benefits of, or enforcing in any lawful manner, the other terms and conditions of this permit, and State shall take no action that will unreasonably interfere with the uses of the leased premises by Lessee pursuant to the terms and conditions of this permit.

Paragraph 2(c)(2), Section 4, entitled "General Provisions" is hereby amended to provide that the State's reserved right to set a monetary rental, if ever exercised, shall apply only to that portion of the property ultimately confirmed into State ownership either by agreement, or by a final judgment rendered by a court of competent jurisdiction.

Paragraphs 11(c), 12, and 5 of Section 4 are hereby amended to provide that any right of State contained in said paragraphs authorizing the State to: repossess the leased premises; remove persons, property, or improvements from leased premises; require Lessee to remove all improvements from leased premises; remove natural resources or grant leases to remove natural resources from the leased premises; if ever exercised, shall apply only to that portion of the leased premises ultimately confirmed into State ownership either by agreement, or by a final judgment rendered by a court of competent jurisdiction.

The second sentence of Paragraph 13, said paragraph entitled "Quitclaim", in Section 4, is amended to read: "Should Lessee, upon request by Lessor, fail or refuse to deliver the release as aforesaid, a written notice by Lessor reciting the failure or refusal of the Lessee to execute and deliver said release as herein provided, shall from the date of recordation of such notice, be conclusive evidence against Lessee and all persons claiming under Lessee of the termination of this lease." (The wording "and any claims and rights of Lessee in the Lease Premises" is deleted.)

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SAN FRANCISCO BAY
SOUTH ARM YACHT HARBOR
BAY INLET STRUCTURE
PIPELINE TIDAL INFLOW FROM YACHT HARBOR
CITY WWTP
SALT MARSH INLET STRUCTURE
RECLAIMED WATER
INFLUENT PIPELINE EXTENSION
REFUSE DISPOSAL AREA
SALT MARSH (Approximate Extent of Tidal Inundation)
ITT FACILITY
FRESHWATER MARSH
BAYSHORE FREEWAY (U.S. 101)
PUMP STATION TO MATADERO CREEK
MATADERO CREEK
EFFLUENT PIPELINE TO CREEK
ADJUSTABLE OUTLET CONTROL STRUCTUR
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# SECTION 4

# GENERAL PROVISIONS

1. **GENERAL**
These provisions are applicable to all leases, permits, rights-of-way, easements, or licenses or other interests in real property conveyed by the State Lands Commission.

2. **CONSIDERATION**
(a) **Categories**
(1) **Rental**
Lessee shall pay the annual rental as stated in this Lease to Lessor without deduction, delay or offset, on or before the beginning date of this Lease and on or before each anniversary of its beginning date during each year of the Lease term.

(2) **Non-Monetary Consideration**
If the consideration to Lessor for this lease is the public use, benefit, health or safety, Lessor shall have the right to review such consideration at any time and set a monetary rental if the State Lands Commission, at its sole discretion, determines that such action is in the best interest of the State.

(b) **Modification**
Lessor may modify the method, amount or rate of consideration effective on each fifth anniversary of the beginning date of this Lease. Should Lessor fail to exercise such right effective on any fifth anniversary it may do so effective on any one (1) of the next four (4) anniversaries following such fifth anniversary, without prejudice to its right to effect such modification on the next or any succeeding fifth anniversary. No such modification shall become effective unless Lessee is given at least thirty (30) days notice prior to the effective date.

(c) **Penalty and Interest**
Any installments of rental accruing under this Lease not paid when due shall be subject to a penalty and shall bear interest as specified in Public Resources Code Section 6224 and the Lessor's then existing administrative regulations governing penalty and interest.

3. **BOUNDARIES**
This lease is not intended to establish the State's boundaries and is made without prejudice to either party regarding any boundary claims which may be asserted presently or in the future.

4. **LAND USE**
(a) **General**
Lessee shall use the Lease Premises only for the purpose or purposes stated in this Lease and only for the operation and maintenance of the improvements expressly authorized in this Lease. Lessee shall commence use of the Lease Premises within ninety (90) days of the beginning date of this lease or within ninety (90) days of the date set for construction to commence as set forth in this lease, whichever is later. Lessee shall notify Lessor within ten (10) days after commencing the construction of authorized improvements and within sixty (60) days after completing them. Lessee's discontinuance of such use for a period of ninety (90) days shall be conclusively presumed to be an abandonment.

(b) **Continuous Use**
Lessee's use of the Lease Premises shall be continuous from commencement of the Lease until its expiration.

(c) **Repairs and Maintenance**
Lessee shall, at its own expense, keep and maintain the Lease Premises and all improvements in good order and repair and in safe condition. Lessor shall have no obligation for such repair and maintenance.

(d) **Additions, Alterations and Removal**
(1) Additions - No improvements other than those expressly authorized in this Lease shall be constructed by the Lessee on the Lease Premises without the prior written consent of Lessor.

(2) Alteration or Removal - Except as provided under this Lease, no alteration or removal of improvements on or natural features of the Lease Premises shall be undertaken without the prior written consent of Lessor.

(e) **Conservation**
Lessee shall practice conservation of water and other natural resources and shall prevent pollution and harm to the environment.

(f) **Toxics**
Lessee shall not manufacture or generate hazardous wastes on the Lease Premises unless specifically authorized under other terms of this Lease. Lessee shall be fully responsible for any hazardous wastes, substances or materials as defined under federal, state or local law, regulation, or ordinance that are manufactured, generated, used, placed, disposed, stored, or transported on the Lease Premises during the Lease term and shall comply with and be bound by all applicable provisions of such federal, state or local law regulation or ordinance dealing with such wastes, substances or materials. Lessee shall notify Lessor and the appropriate governmental emergency response agency(ies) immediately in the event of any release or threatened release of any such wastes, substances or materials.

(g) **Enjoyment**
Subject to the provisions of paragraph 5 (a) (2) below, nothing in this Lease shall preclude Lessee from excluding persons from the Lease Premises when their presence or activity constitutes a material interference with Lessee's use and enjoyment of the Lease Premises as provided under this Lease.

(h) **Discrimination**
Lessee in its use of the Lease Premises shall not discriminate against any person or class of persons on the basis of race, color, creed, religion, national origin, sex, age, or handicap.

(i) **Residential Use**

No portion of the Lease Premises shall be used as a location for a residence or for the purpose of mooring a structure which is used as a residence. For purposes of this Lease, a residence or floating residence includes but is not limited to boats, barges, houseboats, trailers, cabins or combinations of such facilities or other such structures which provide overnight accommodations to the Lessee or others.

5. **RESERVATIONS, ENCUMBRANCES AND RIGHTS-OF-WAY**

(a) **Reservations**

(1) Lessor expressly reserves all natural resources in or on the Lease Premises, including but not limited to timber and minerals as defined under Public Resources Code Sections 6401 and 6407, as well as the right to grant leases in and over the Lease Premises for the extraction of such natural resources; however, such leasing shall be neither inconsistent nor incompatible with the rights or privileges of Lessee under this lease.

(2) Lessor expressly reserves a right to go on the Lease Premises and all improvements for any purpose associated with this Lease or for carrying out any function required by law, or the rules, regulations or management policies of the State Lands Commission. Lessor shall have a right of reasonable access to the Lease Premises across Lessee owned or occupied lands adjacent to the Lease Premises for any purpose associated with this Lease.

(3) Lessor expressly reserves to the public an easement for convenient access across the Lease Premises to other State-owned lands located near or adjacent to the Lease Premises and a right of reasonable passage across and along any right-of-way granted by this lease; however, such easement or right-of-way shall be neither inconsistent nor incompatible with the rights or privileges of Lessee under this Lease.

(4) Lessor expressly reserves the right to lease, convey, or encumber the Lease Premises, in whole or in part, during the lease term for any purpose not inconsistent or incompatible with the rights or privileges of Lessee under this Lease.

(b) **Encumbrances**

This Lease may be subject to pre-existing contracts, leases, licenses, easements, encumbrances and claims and is made without warranty by Lessor of title, condition or fitness of the land for the stated or intended purpose.

6. **RULES, REGULATIONS AND TAXES**

(a) Lessee shall comply with and be bound by all presently existing or subsequently enacted rules, regulations, statutes or ordinances of the State Lands Commission or any other governmental agency or entity having lawful authority and jurisdiction.

(b) Lessee understands and agrees that a necessary condition for the granting and continued existence of this Lease is that Lessee obtain and maintain all permits or other entitlements.

(c) Lessee accepts responsibility for and agrees to pay any and all possessory interest taxes, assessments, user fees or service charges imposed on or associated with the leasehold interest, improvements or the Lease Premises and such payment shall not reduce rental due Lessor under this Lease and Lessor shall have no liability for such payment.

7. **INDEMNITY**

(a) Lessor shall not be liable and Lessee shall indemnify, hold harmless and, at the option of Lessor, defend Lessor, its officers, agents, and employees against and for any and all liability, claims, damages or injuries of any kind and from any cause, arising out of or connected in any way with the issuance , enjoyment or breach of this Lease or Lessee's use of the Lease Premises except for any such liability, claims, damage or injury solely caused by the negligence of Lessor, its officers, agents and employees.

(b) Lessee shall notify Lessor immediately in case of any accident, injury or casualty on the Lease Premises.

8. **INSURANCE**

(a) Lessee shall obtain and maintain in full force and effect during the term of this lease comprehensive general liability insurance and property damage insurance, with such coverage and limits as may be reasonably requested by the State from time to time, but in no event for less than the sum(s) specified, insuring Lessee and Lessor against any and all claims or liability arising out of the ownership, use, occupancy, condition or maintenance of the Lease Premises and all improvements.

(b) The insurance policy or policies shall name the State of California, its officers, employees and volunteers as insureds as to the Lease Premises and shall identify the Lease by its assigned number. Lessee shall provide Lessor with a certificate of such insurance and shall keep such certificate current. The policy (or endorsement) must provide that the insurer will not cancel the insured's coverage without thirty (30) days prior written notice to the State. The State will not be responsible for any premiums or other assessments on the policy. The coverage provided by the insured (Lessee) shall be primary and non-contributing.

(c) The insurance coverage specified in this Lease shall be in effect at all times during the Lease term and subsequently until all of the Lease Premises have been either accepted as improved, by Lessor, or restored by Lessee.

9. **SURETY BOND**

(a) Lessee shall provide a surety bond or other security device acceptable to Lessor, for the specified amount, and naming the State of California as the assured, to guarantee to Lessor the faithful observance and performance by Lessee of all of the terms, covenants and conditions of this Lease.

(b) Lessor may require an increase in the amount of the surety bond or other security device to cover any additionally authorized improvements, alterations or purposes and any modification of consideration.

(c) The surety bond or other security device shall be maintained in full force and effect at all times during the Lease term and subsequently until all of the Lease Premises have been either accepted as improved, by Lessor, or restored by Lessee as provided elsewhere in this Lease.

10. **ASSIGNMENT, ENCUMBRANCING OR SUBLETTING**

(a) Lessee shall not either voluntarily or by operation of law, assign, transfer, mortgage, pledge, hypothecate or encumber this Lease and shall not sublet the Lease Premises, in whole or in part, or allow any person other than the Lessee's employees, agents, servants and invitees to occupy or use all or any portion of the Lease Premises without the prior written consent of Lessor, which consent shall not be unreasonably withheld.

(b) The following shall be deemed to be an assignment or transfer within the meaning of this Lease:

(1) If Lessee is a corporation, any dissolution, merger, consolidation or other reorganization of Lessee or sale or other transfer of a percentage of capital stock of Lessee which results in a change of controlling persons, or the sale or other transfer of substantially all the assets of Lessee.

(2) If Lessee is a partnership, a transfer of any interest of a general partner, a withdrawal of any general partner from the partnership, or the dissolution of the partnership.

(c) If this lease is for sovereign lands, it shall be appurtenant to adjoining littoral or riparian land and Lessee shall not transfer or assign its ownership interest or use rights in such adjoining lands separately from the leasehold rights granted herein without the prior written consent of Lessor.

(d) If Lessee desires to assign, sublet, encumber or otherwise transfer all or any portion of the Lease Premises, Lessee shall do all of the following:

(1) give prior written notice to Lessor.

(2) provide the name and complete business organization and operational structure of the proposed assignee, sublessee, secured third party or other transferee; and the nature of the use of and interest in the Lease Premises proposed by the assignee, sublessee, secured third party or other transferee. If the proposed assignee, sublessee or secured third party is a general or limited partnership, or a joint venture, provide a copy of the partnership agreement or joint venture agreement, as applicable.

(3) provide the terms and conditions of the proposed assignment, sublease, or encumbrancing or other transfer;

(4) provide audited financial statements for the two most recently completed fiscal years of the proposed assignee, sublessee, secured party or other transferee; and provide pro forma financial statements showing the projected income, expense and financial condition resulting from use of the lease premises; and

(5) provide such additional or supplemental information as Lessor may reasonably request concerning the proposed assignee, sublessee, secured party or other transferee.

Lessor will evaluate proposed assignees, sublessees, secured third parties and other transferees and grant approval or disapproval according to standards of commercial reasonableness considering the following factors within the context of the proposed use: the proposed party's financial strength and reliability, their business experience and expertise, their personal and business reputation, their managerial and operational skills, their proposed use and projected rental, as well as other relevant factors.

(e) Lessor shall have a reasonable period of time from the receipt of all documents and other information required under this provision to grant or deny its approval of the proposed party.

(f) Lessee's mortgage or hypothecation of this Lease, if approved by Lessor, shall be subject to terms and conditions found in a separately drafted standard form (Agreement and Consent to Encumbrancing of Lease) available from Lessor upon request.

(g) Upon the express written assumption of all obligations and duties under this Lease by an assignee approved by Lessor, the Lessee may be released from all liability under this Lease arising after the effective date of assignment and not associated with Lessee's use, possession or occupation of or activities on the Lease Premises; except as to any hazardous wastes, substances or materials as defined under federal state or local law, regulation or ordinance manufactured, generated, used, placed, disposed, stored or transported on the Lease Premises.

(h) If the Lessee files a petition or an order for relief is entered against Lessee, under Chapters 7,9,11 or 13 of the Bankruptcy Code (11 USC Sect. 101, et seq.) then the trustee or debtor-in-possession must elect to assume or reject this Lease within sixty (60) days after filing of the petition or appointment of the trustee, or the Lease shall be deemed to have been rejected, and Lessor shall be entitled to immediate possession of the Lease Premises. No assumption or assignment of this Lease shall be effective unless it is in writing and unless the trustee or debtor-in-possession has cured all defaults under this Lease (monetary and non-monetary) or has provided Lessor with adequate assurances (1) that within ten (10) days from the date of such assumption or assignment, all monetary defaults under this Lease will be cured; and (2) that within thirty (30) days from the date of such assumption, all non-monetary defaults under this Lease will be cured; and (3) that all provisions of this Lease will be satisfactorily performed in the future.

11. **DEFAULT AND REMEDIES**

(a) **Default**

The occurrence of any one or more of the following events shall immediately and without further notice constitute a default or breach of the Lease by Lessee:

(1) Lessee's failure to make any payment of rental, royalty, or other consideration as required under this Lease.

(2) Lessee's failure to obtain or maintain liability insurance or a surety bond or other security device as required under this Lease.

(3) Lessee's vacation or abandonment of the Lease Premises (including the covenant for continuous use as provided for in paragraph 4) during the Lease term.

(4) Lessee's failure to obtain and maintain all necessary governmental permits or other entitlements.

(5) Lessee's failure to comply with all applicable provisions of federal, state or local law regulation or ordinance dealing with hazardous waste, substances or materials as defined under such law.

(6) Lessee's failure to commence to construct and to complete construction of the improvements authorized by this Lease within the time limits specified in this Lease.

(7) Lessee's failure to comply with applicable provisions of federal, state or local laws or ordinances relating to issues of Health and Safety.

(b) Lessee's failure to observe or perform any other term, covenant or condition of this Lease to be observed or performed by the Lessee when such failure shall continue for a period of thirty (30) days after Lessor's giving written notice; however, if the nature of Lessee's default or breach under this paragraph is such that more than thirty (30) days are reasonably required for its cure, then Lessee shall not be deemed to be in default or breach if Lessee commences such cure within such thirty (30) day period and diligently proceeds with such cure to completion.

(c) **Remedies**

In the event of a default or breach by Lessee and Lessee's failure to cure such default or breach, Lessor may at any time and with or without notice do any one or more of the following:

(1) Re-enter the Lease Premises, remove all persons and property, and repossess and enjoy such premises.

(2) Terminate this Lease and Lessee's right of possession of the Lease Premises. Such termination shall be effective upon Lessor's giving written notice and upon receipt of such notice Lessee shall immediately surrender possession of the Lease Premises to Lessor.

(3) Maintain this Lease in full force and effect and recover any rental, royalty, or other consideration as it becomes due without terminating Lessee's right of possession regardless of whether Lessee shall have abandoned the Lease Premises.

(4) Exercise any other right or remedy which Lessor may have at law or equity.

12. **RESTORATION OF LEASE PREMISES**

(a) Upon expiration or sooner termination of this Lease, Lessor, upon written notice may take title to any or all improvements, including fills, or Lessor may require Lessee to remove all or any such improvements at its sole expense and risk; or Lessor may itself remove or have removed all or any portion of such improvements at Lessee's sole expense. Lessee shall deliver to Lessor such documentation as may be necessary to convey title to such improvements to Lessor free and clear of any liens, mortgages, loans or any other encumbrances.

(b) In removing any such improvements Lessee shall restore the Lease Premises as nearly as possible to the conditions existing prior to their installation or construction.

(c) All plans for and subsequent removal and restoration shall be to the satisfaction of Lessor and shall be completed within ninety (90) days after the expiration or sooner termination of this Lease or after compliance with paragraph 12(d), whichever is the lesser.

(d) In removing any or all the improvements Lessee shall be required to obtain any permits or other governmental approvals as may then be required by lawful authority.

(e) Lessor may at any time during the lease term require Lessee to conduct at its own expense and by a contractor approved by Lessor an independent environmental site assessment or inspection for the presence or suspected presence of hazardous wastes, substances or materials as defined under federal, state or local law, regulation or ordinance manufactured, generated, used, placed, disposed, stored or transported on the Lease Premises during the term of the Lease. Lessee shall provide the results of the assessment or inspection to Lessor and the appropriate governmental response agency(ies) and shall further be responsible for removing or taking other appropriate remedial action regarding such wastes, substances or materials in accordance with applicable federal, state or local law regulation or ordinance.

13. **QUITCLAIM**

Lessee shall, within ninety (90) days of the expiration or sooner termination of this Lease, execute and deliver to Lessor in a form provided by Lessor a good and sufficient release of all rights under this Lease. Should Lessee fail to or refuse to deliver such a release, a written notice by Lessor reciting such failure or refusal shall, from the date of its recordation, be conclusive evidence against Lessee of the termination of this Lease and all other claimants.

14. **HOLDING-OVER**
Any holding-over by Lessee after the expiration of the Lease term, with or without the express or implied consent of Lessor, shall constitute a tenancy from month to month and not an extension of the Lease term and shall be on the terms, covenants, and conditions of this Lease, except that the annual rental then in effect shall be increased by twenty five percent (25%).

15. **ADDITIONAL PROVISIONS**

(a) **Waiver**

(1) No term, covenant, or condition of this Lease and no default or breach of any such term, covenant or condition shall be deemed to have been waived, by Lessor's acceptance of a late or nonconforming performance or otherwise, unless such a waiver is expressly acknowledged by Lessor in writing.

(2) Any such waiver shall not be deemed to be a waiver of any other term, covenant or condition of any other default or breach of any term, covenant or condition of this Lease.

(b) **Time**
Time is of the essence of this Lease and each and all of its terms, covenants or conditions in which performance is a factor.

(c) **Notice**
All notices required to be given under this Lease shall be given in writing, sent by U.S. Mail with postage prepaid, to Lessor at the offices of the State Lands Commission and the Lessee at the address specified in this Lease. Lessee shall give Lessor notice of any change in its name or address.

(d) **Consent**
Where Lessor's consent is required under this Lease its consent for one transaction or event shall not be deemed to be a consent to any subsequent occurrence of the same or any other transaction or event.

(e) **Changes**
This Lease may be terminated and its term, covenants and conditions amended, revised or supplemented only by mutual written agreement of the parties.

(f) **Successors**
The terms, covenants and conditions of this Lease shall extend to and be binding upon and inure to the benefit of the heirs, successors, and assigns of the respective parties.

(g) **Joint and Several Obligation**
If more than one Lessee is a party to this Lease, the obligations of the Lessees shall be joint and several.

(h) **Captions**
The captions of this Lease are not controlling and shall have no effect upon its construction or interpretation.

(i) **Severability**
If any term, covenant or condition of this Lease is determined by a court of competent jurisdiction to be invalid, it shall be considered deleted and shall not invalidate any of the remaining terms, covenants and conditions.

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**STATE OF CALIFORNIA - STATE LANDS COMMISSION**

**LEASE P.R.C. NO.** 7495.9

This Lease shall only become effective when approved by the State Lands Commission of the State of California and a duly executed copy has been delivered to Lessee. The submission of this Lease by Lessor, its agent or representative for examination by Lessee does not constitute an option or offer to lease the Premises upon the terms and conditions contained herein or a reservation of the Premises in favor of Lessee. Lessee's submission of an executed copy of this Lease to Lessor shall constitute an offer to Lessor to lease the Premises on the terms and conditions set forth herein.

**IN WITNESS WHEREOF,** the parties hereto have executed this Lease as of the date hereafter affixed.

**LESSEE:** CITY OF PALO ALTO

**STATE OF CALIFORNIA**
**STATE LANDS Commission**

By: [signature]

Deputy Chief
Division of Land
Title: Management and Conservation

CITY MANAGER

Date: MAY 01 1991

## CORPORATE ACKNOWLEDGMENT

NO. 202

State of California
County of Santa Clara } SS.

On this the 21 day of March 19 91, before me,
Carmela J. Luciani,
the undersigned Notary Public, personally appeared
William Zaner,
☒ personally known to me
☐ proved to me on the basis of satisfactory evidence
to be the person(s) who executed the within instrument as City Manager or on behalf of the corporation therein named, and acknowledged to me that the corporation executed it.
WITNESS my hand and official seal.

OFFICIAL SEAL
CARMELA J. LUCIANI
Notary Public-California
SANTA CLARA COUNTY
My Commission Expires
April 8, 1994

Carmela J. Luciani
Notary's Signature

7120 122

# Attachment 6

## RWQCB's recent Letter of Support

ESA

# San Francisco Bay Regional Water Quality Control Board

November 26, 2019

Douglas Bosco, Chair
State Coastal Conservancy
1515 Clay Street, 10th Floor
Oakland, CA 94612

Dear Mr. Bosco

I am writing this letter to express support on behalf of the San Francisco Bay Regional Water Quality Control Board for the Palo Alto Horizontal Levee Pilot Project's application to the Coastal Conservancy Proposition 1 Grant Program for funds needed to progress the project's design.

The San Francisco Estuary Partnership (SFEP), in collaboration with the City of Palo Alto, has been working on a preliminary design for a horizontal levee pilot project located in the Palo Alto Baylands. The project will provide multiple benefits to residents and visitors, and will incorporate public access, green infrastructure solutions including habitat enhancements, and protection from flooding and sea level rise. We expect the project will provide transitional and refugia habitat for marsh species such as the endangered salt marsh harvest mouse and Ridgeway's rail. This transitional habitat has been decimated by development along the shoreline and is a high restoration priority for resource agencies. Finally, the project will utilize highly treated wastewater to irrigate the vegetated ecotone thus providing additional benefits of polishing treatment of the wastewater prior to discharge to the Bay and serve as a model to other wastewater treatment plants and agencies in the region that are also evaluating their sea level rise adaptation and beneficial reuse of treated wastewater.

Approval of this grant application will bring project design to a "shovel ready" stage, promote horizontal levees and multi-beneficial alternatives to traditional flood-control levees.

We are hopeful this grant application will be given strong consideration.

Sincerely,

Lisa H McCann

Lisa Horowitz McCann
Assistant Executive Officer

cc: Samantha Engleage, City of Palo Alto, Samanth.Engelage@CityofPaloAlto.org
Karen North, City of Paolo Alto, Karin.North@CityofPaloAlto.org

# Attachment 7

## BRRIT Dec 2019 Feedback

# BRRIT Comments on

# Palo Alto Horizontal Levee Pilot Project

Ms. Finnemore,
Thank you for meeting with the Bay Restoration Regulatory Integration Team (BRRIT) on Dec 4, 2019 to discuss the Palo Alto Horizontal Levee Pilot Project (Project). We greatly appreciated the opportunity to meet with you to discuss your project. Below please find a list of initial concerns and comments from each of the BRRIT team's representative agencies. Since this project is early in the design phase, we may have additional comments at a future time. Also, please be aware that there may be duplicative concerns amongst the agencies.

During our meeting, we agreed that you would send us the 30 percent designs when they are completed for our review. We also agreed to potentially meet again when site selection for the Project is finalized and before you develop 60 percent designs.

If you require clarification pertaining to our questions or would otherwise like to discuss your Project further, please contact Valary Bloom at valary_bloom@fws.gov or 916-930-2645. She will be the BRRIT point of contact for this Project.

Best regards,
BRRIT

**Meeting Date:** Dec 4, 2019
**Location:** RWQCB offices at 1515 Clay Street, Oakland, Ca
**Meeting Participants:** Frances Malamud-Roam (USACE), Valary Bloom (USFWS), Agnes Farres (RWQCB), Alison Weber-Stover (NMFS), Tami Schane (CDFW), Anniken Lydon (BCDC), Jill Sunahara (ESA), Heidi Nutters (SFEP), Samantha Engelage (City of Palo Alto), Scott Stoller (ESA), Priya Finnemore (ESA, by phone)

**Federal:**

*USACE*

1. We will need a delineation of the aquatic resources on site for the project area. You can choose whether you want us to issue a jurisdictional determination. This project would need both the Section 10 waters and the Section 404 waters delineated. The Corps website provides information on what is needed for the delineation and the different types of JDs that we can issue. See: https://www.spn.usace.army.mil/Missions/Regulatory/Jurisdiction-Determinations/
2. Permit path – if this project is restoring/enhancing aquatic resources without resulting in more than minor adverse impacts, it could fit within a NWP 27 – but we would need to learn more about what the impacts of the project would be. Are existing wetlands being impacted by the water treatment system proposed, or by the horizontal levee? Meaning are we losing existing marsh as transitional upland habitat is created? Would the project result in self-sustaining wetland habitat, or would it need on-going irrigation?
   An Individual permit would be required if the project has more than minor adverse impacts to aquatic resources; or if the project required ongoing maintenance/irrigation in the future. Since

this would be an on-going water treatment facility, I think it may not qualify for a NWP 27, because of the continuous maintenance; finally if the project would result in an adverse environmental impact or if the project has any controversies.

3. Please let us know whether this project would result in conversions of one aquatic type habitat to another aquatic type habitat (example would be open waters to tidal marsh, or pickleweed marsh to freshwater marsh). We will want to work with you to evaluate the effects of that conversion. Please also provide information on whether existing aquatic habitat would be converted to upland habitat (a permanent loss of waters).
4. Please follow up with the airport on whether this restoration project would potentially result in more aquatic species colliding with airplanes.
5. We will need sufficient information to initiate section 106 of the National Historic Properties Act consultation with the SHPO for potential impacts to Historic properties. The information we need would include a determination of the Area of Potential Effects (APE, we can discuss this with you), including depth of excavation; a cultural resource inventory report that is less than 2 years old for your project APE and a buffer area of at least ¼ mile; evaluations of eligibility for listing on the National Register of Historic Places for any cultural resources within the project APE; and an assessment of potential effects to any eligible historic properties.
6. We will need quantities of the impacts within Corps' jurisdictional aquatic resources: the volume of fill placed (temporary and permanent separately), the area of jurisdictional resources filled; if you are doing any work within Section 10 waters, include the area of work, the excavation and fill quantities too.
7. We will need enough information to initiate section 7 of the Endangered Species Act consultation with both the USFWS and the NMFS. This should include a description of the Action Area, the ESA-listed species that may occur within the Action Area; an assessment of the habitat for ESA-listed species within the project area; the potential effects of the project on ESA-listed species; the proposed conservation measures to avoid/minimize effects to species; your conclusions on the effects to ESA-listed species. The Corps makes the determination, but we rely on the information provided in your application and we then consult with the FWS and/or NMFS for their concurrence and take coverage (if Formal consultation is required). Most of the information that we will need will be clarified by the USFWS & NMFS BRRIT staff members, so I will rely on them to provide specifics of what would be needed for the consultation.
8. Please provide information on the State Lands encroachment permit status.
9. Your project may need review for compliance with the Marine Mammal Protection Act and the Corps permit will require that this has been completed. Please reach out to the NOAA office in Long Beach (NOAA 501 W Ocean Blvd, Long Beach CA 90802; (562) 980-4000). Ali Weber-Stover may be able to refer you to someone.

*NMFS*

1. NMFS is supportive of restoration projects in the Palo Alto Baylands that increase or improve tidal and subtidal estuarine habitat and complexity.
2. NMFS protected species and habitats that could occur in or near the proposed project include the following:
    a. CCC Steelhead and their critical habitat. The project is located between San Francisquito Creek and Stevens Creek, essential populations of CCC steelhead in NMFS Recovery Plan

for the species (National Marine Fisheries Service. 2016. Final Coastal Multispecies Recovery Plan. National Marine Fisheries Service, West Coast Region, Santa Rosa, California.)

b. sDPS green sturgeon and critical habitat. Green sturgeon can be present in San Francisco Bay year round.

c. Essential Fish Habitat – salmon, groundfish, coastal pelagic.

d. Habitat Area of Particular Concern - San Francisco Estuary.

3. NMFS will be considering the impacts to protected species and habitats and will be interested in the project actions that would avoid and minimize impacts to protected resources. NMFS cannot consider net benefits when evaluating adverse impacts to listed species. The applicant should consider project elements listed below.
   a. *Limiting in-water work*. Conducting in-water work at low tide when fish are not present can prevent take of listed species.

   b. *Timing of in-water work*. If in-water work cannot be avoided, working outside of the primary salmonid migration window (June 15 to November 30 ) will limit the presence of listed salmonids in the action area. Green sturgeon can be present in the area year round.

   c. *Turbidity and Water Quality.* Incorporating project elements or minimization measures that will limit changes to water quality and disturbance to benthic habitat may also be important.

   d. *EFH.* Adverse impacts to EFH may be unavoidable with in-water work.

   e. *Wastewater.* The applicant should provide reports or other evidence to NMFS confirming treated wastewater is suitable to discharge into the Bay (such as NPDES report or other monitoring reports provided to the Water Board).

   f. *Hydrology.* The applicant should provide reports or analysis of changes to hydrology in the action area if any changes are anticipated as a result of the project.

*USFWS*

1. *Irrigation of the ecotone*. This appears to be a natural location for placement of much-needed ecotone habitat and we appreciate the diversity of microhabitats that you're attempting to create within it (Fig 1). I'm not clear in Fig 1 whether the "irrigated habitat zones" at the north and south end of the ecotone are to be irrigated with the treated wastewater. If so, I only see the outfall depicted at the north end. Is the idea that the treated wastewater would come out of the perforated pipe at or near the new plantings thereby irrigating them and then percolate through the ground into the underground seepage area, then out onto the marsh plain? As you might know, while the initial plantings in the revegetated areas may require supplemental water the first year, after that, year-round water is not necessary and can actually damage native plants, even those adapted to the high marsh/ upland ecotone band. Dealing with year-round supplemental fresh water should be considered as part of your revegetation plan.
2. I see that the underground seepage area is 50' long from uphill to downhill edge, but how long does it need to be (i.e., what's the length vs width)?

3. Do you have confidence that the increased volume of freshwater delivered to Harbor Marsh won't result in a significantly changed vegetative community? Please provide this discussion in your biological assessment.
4. *Cal seablite*. Jill mentioned there may be California sea-blite onsite. I note an historic record but thought it'd been extirpated. If existing, those individuals would need to be flagged and avoided by a good margin during construction. And outfall relocation should not result in freshening of the hydrology for sea-blite. It's a perennial and can be surveyed for anytime. Opportunities for incorporating reintroduction of this species into the revegetation plan should be investigated (avoiding fresher areas).
5. Due to the potential for this project to impact several federally listed species, it is unlikely the project will fit under a Categorical Exclusion to CEQA.
6. If initial and/or long-term vegetation mgmt is to involve herbicide, it would need to be done only in areas well away from listed species habitat and may trigger other restrictions as well.
7. Initial construction is likely to affect the Ca Ridway's rail (CRR) and salt marsh harvest mouse (SMHM) if they are onsite. If work cannot avoid the Feb 1- Aug 31 breeding season for CRR, we recommend CRR surveys in accordance with the June 2015 *California Clapper Rail Survey Protocol,* in January of the year you hope to begin construction (multiple years are even better). As discussed, if found to be present, construction during the Feb 1- Aug 31 breeding season could occur if construction within 700 feet of CRR calling centers can be avoided. Project phasing is highly recommended such that construction during the breeding season would be restricted to upland areas furthest from CRR habitat.
8. Other measures that help minimize effects to CRR and SMHM are: a USFWS and CDFW-approved biologist with experience recognizing rail vocalizations must be onsite during construction activities occurring within 700 feet of suitable habitat and shall have stop-work authority in the event of non-compliance; all crews working in marsh will be trained by that approved biologist; all *biologists* accessing the marsh will be trained in CRR vocalizations and identification of nests; crews working in marsh will have GPS locations or maps of the most current occurrences onsite; work activities will be restricted to daylight hours 30 minutes after sunrise and 30 minutes before sunset; project activities should avoid high tides (or at least extreme high tides) and periods when the marsh plain is inundated; if a SMHM or SMHM nest is observed within work areas, all work will cease and a 50-100 foot no-disturbance buffer implemented until the SMHM has left on it's own (or young have weaned and left the area). Also recommended is use of noise reducing construction equipment and strategic installation of noise barriers.
9. A strategy should be developed to remove vegetation in SMHM habitat with non-mechanized equipment only down to a height through which you could see SMHM if they were present. Removed vegetation should be taken offsite so that it's not reoccupied by mice. You could then gently encourage any remaining SMHM out by brushing through the vegetation, with the handle of a rake for example, so that they escape toward the larger habitat patch (ideally that you'll not be removing). Once you are confident all SMHM have left the vegetation, you could move in with mechanized equipment to clear the remainder of vegetation. Then you'd immediately install exclusion fencing. Guidelines can be provided that pertain to specifics of exclusion fencing.

10. An assessment of any western snowy plover reports in the area would be useful, along with consideration of whether there may be effects to that species from construction. There are California Natural Diversity Database records from 2002 and 2009 of western snowy plovers nearby.

**State:**

*CDFW*

1. Special-status species to consider in this project include (but may not be limited to) FE and SE salt-marsh harvest mouse and CA Ridgway's rail (both also fully protected - FP); ST CA black rail (also FP); ST longfin smelt; FT and state species of special concern western snowy plover; FT Central California Coast steelhead; FT and state species of special concern green sturgeon; state species of special concern white sturgeon, Pacific lamprey, burrowing owl, salt-marsh wandering shrew, and American badger.
2. For FP species, need to avoid take as defined by Fish and Game Code Section 86 as to hunt, pursue, catch, capture, or kill, or attempt to do those things.
3. Recommend that rail surveys (for both species) are conducted to determine presence and breeding status in the marsh to help guide construction phasing.
4. Measures to minimize impacts to marsh species include, but are not limited to, avoiding work during the rail breeding season which is February 1-August 31; implementing a 700-foot buffer from rail habitat; utilizing non-motorized hand tools if removing vegetation in habitat suitable for salt-marsh harvest mouse; avoiding the stockpiling of removed vegetation to areas well outside of the project area where they can not be recolonized by salt-marsh harvest mice. Note that it may be possible to modify some measures to some degree depending on specific work activities and proximity of those activities to species-specific suitable habitat.
5. Is there any data available on the effect of discharge treated water on marsh species, in particular the potential uptake of trace contaminants such as pharmaceuticals by marsh plants and their subsequent effects on wildlife species in the area?
6. Will long-term vegetation management include the use of herbicides?
7. Project impacts to stream channels (if applicable) will require a 1602 Streambed Alteration Agreement.
8. Recommend 2081 Incidental Take Permit for impacts to state-listed (non-fully protected) species, such as longfin smelt, if applicable.
9. Airport considerations - CDFW recommends early engagement in discussions with the nearby airport to determine that the project will be consistent with setback requirements in FAA regulations. Is there any data available regarding bird strikes at this airport? Note the potential conflict with the airport in terms of bird strikes may vary depending on species of birds and the proximity of the marsh to runways. Need careful consideration of not only aviation safety issues but also the potential for the project to encourage increased bird in the marsh and serve as a population sink for some avian species due to bird strikes.
10. Due to the potential for this project to impact a number of different special-status species, the project appears to be an unlikely fit for a categorical exemption under CEQA.

11. Recommend that you coordinate with local vector control agency to ensure that project is designed such that it doesn't create a mosquito nuisance issue if there are nearby communities that would be affected as such.
12. Habitat restoration or enhancement projects, as defined by the Habitat Restoration and Enhancement Act (AB 2193), are projects with the primary purpose of improving fish and wildlife habitat and meet the eligibility requirements for the State Water Resources Control Board's Order for Clean Water Act Section 401 General Water Quality Certification for Small Habitat Restoration Projects. Projects approved under the Act must be consistent with widely recognized restoration practices, must avoid or minimize any incidental impacts, and must result in measurable environmental benefits. Projects must be 5 acres or less or 500 linear feet or less. For more information, please see CDFW's webpage at https://www.wildlife.ca.gov/Conservation/Environmental-Review/HRE-Act.
13. Should consider any impacts to the commercially- and recreationally-important Pacific herring.

*BCDC*

1. **Project Design.** BCDC may have additional comments/concerns after a particular site is selected for the pilot project. The proposed project involves constructing a transition zone (30:1 or 15:1 slope) that provides flood protection and also contains subsurface infrastructure to further polish tertiary treated water coming from the City of Palo Alto's Regional Water Quality Control Plant. The treated water would eventually seep through the transition area and make it's way down into Harbor Marsh in BCDC's Bay jurisdiction. BCDC will need further information on potential fill quantities in our jurisdiction in the future, and the life of the project, to understand the appropriate permit type that the project would qualify for and to advise your team on any additional assessments that may be required.
2. **Sea Level Rise.** We appreciate that the project involves adding a transition zone in front of an existing trail and roadway to provide flood protection and that you intend to include public access along the levee. We understand that the current levee system near the potential project sites is not FEMA certified and areas behind the levee are currently experiencing flooding. The proposed project would raise the levee elevation and be a pilot project testing the application of treated water to the vegetation on the transition zone slope. BCDC has some concerns about the potential sea level rise impacts on the functioning of the subsurface infrastructure system in the levee and whether seepage would still occur as sea level rises. We discussed this a little in the pre-application meeting, but if there is other information available to discuss potential impacts, it would be great to discuss this at our next meeting. Additionally, it would be good to know what adaptation strategies are being proposed beyond 2050 if the project is intended to be in place beyond that time.
3. **Public Access.** In the project information that was submitted to the BRRIT, there were specific questions regarding the public access at the site. BCDC may have some additional thoughts after a specific site has been selected. The proposed public access would be built on top of the transition zone slope. Please take a look at BCDC's Public Access Design Guidelines for guidance on the design of the public access area/trails. Additionally, it would be good to consider adaptation strategies for the levee and public access areas if the project is intended to be in place longer than midcentury and flooding or overtopping could occur.

4. **BCDC Bay Fill Amendment.** In the pre-application meeting, there was a specific question about BCDC's Bay Fill Amendment to the San Francisco Bay Plan that was adopted by the Commission this year. BCDC is still waiting on review of the proposed amendments to the Bay Plan from the Office of Administrative Law Review and NOAA's Office for Coastal Management. Once these amendments are approved, they would apply to any projects submitted thereafter. From the timing mentioned at the meeting, it is likely that these policies will be in place by the time an application is submitted for this project.
5. **Monitoring.** This project involves some unknown designs and techniques, and monitoring will be required to help us determine whether the project is functioning as intended.
6. BCDC will likely have additional guidance to offer following the site selection and after receiving more information about the portions of the project that are in different BCDC jurisdictions.
7. While not a regulatory requirement for any of the BRRIT agencies, the BRRIT suggests that your team also talk to the local Mosquito Abatement District in the near future to ensure that the project design for the site includes appropriate circulation, limits standing freshwater, and minimizes the potential for mosquitos to inhabit the site.

*RWQCB*

1. During our meeting, the Project asked about the possibility of qualifying for coverage under State Board's General Certification for Small Habitat Restoration Projects. Projects qualifying under the General Certification must be conducted primarily for the purpose of habitat restoration and are limited to five acres or a cumulative total of 500 linear feet. The Project will likely not qualify under the General Certification because (1) the habitat restoration proposed is part of a larger project that includes other elements such as flood protection, and (2) depending on the final site chosen, the Project may exceed 500 linear feet. We plan to issue Water Quality Certification for the proposed Project, which should not significantly affect the amount of time needed for permit issuance.
2. Also during our meeting, the Project discussed whether the Project would qualify for a categorical exemption under CEQA. We question whether the Project qualifies for a categorical exemption given the potential for effects on special status species and potentially significant public concern/interest that would seem to require CEQA review. As a Responsible Agency under CEQA, we must be able to concur with the CEQA document findings and determine that any significant environmental effects that are within our purview and jurisdiction have been identified and will be mitigated to less-than-significant levels.
3. We will require a Monitoring and Adaptive Management Plan that describes monitoring metrics, methods, duration, and frequency; includes performance criteria to evaluate the Project's progress towards meeting goals and objectives; discusses adaptive management that may be implemented if performance criteria are not met; and includes long-term management and maintenance.
4. Please provide more detailed information on how the Project will evolve and adapt under sea level rise predictions through 2050. Also, discuss any planning or adaptation strategies under sea level rise predictions beyond 2050.
5. We will need to coordinate with Water Board staff in our NPDES Division and Watershed Division (Discharges to Land section) to determine permitting requirements for the use of treated wastewater to irrigate the ecotone levee.

# Attachment 8

BRRIT Nov 2020 Feedback

To: Priya Finnemore, ESA

From: Bay Restoration Regulatory Integration Team (BRRIT)

Subject: Pre-Application Meeting #2 - Palo Alto Horizontal Levee Pilot Project

Ms. Finnemore,

Thank you for meeting with the Bay Restoration Regulatory Integration Team (BRRIT) on Wednesday, November 4, 2020 to discuss the Palo Alto Horizontal Levee Pilot Project. The purpose of the meeting was to update the BRRIT on the new location chosen for the project and to share the 30 percent designs prepared for the new project location. During the meeting, we discussed avoidance and minimization measures for sensitive species and habitats, preferred trail alignments, and permitting. We also discussed scheduling our next meeting after you have developed 60 percent designs.

This letter provides responses to questions you provided at our pre-application meeting and feedback to inform your Preliminary Design Report which you plan to finalize by the end of this year. Below we provide responses to your targeted questions (much of it verbally discussed as well), general guidance and agency-specific feedback. Please contact Valary Bloom at valary_bloom@fws.gov or (916) 930-2645 if you have questions or would like to discuss further, as she is your point of contact for this Project.

**PAHL Project Team Targeted Questions:**

**1. Any new/additional feedback on the location of the public trail relative to treatment areas and/or wildlife habitat? (From previous BRRIT feedback, we understand the preference is to try to have the trail on the outer edge of created habitats, and to have informational signage to require leashed dogs and staying on trails, etc.).**

Answer:

USFWS: It's not entirely clear what is meant by "outer edge of created habitats", but to be clear, to reduce disruption to listed wildlife, we'd prefer the trail to be located near the *inner* (landward) edge of created habitats (so atop the 12' berm at the height of the horizontal levee, or the future levee even further west). Please see below for more feedback on trail siting.

BCDC: BCDC's policies say that public access should be sited, designed, and managed to prevent significant adverse effects on wildlife. We are happy to continue discussing public access on this site to ensure that any trail is designed and managed to minimize impacts to wildlife within or near the project area.

**2. Any additional wildlife design suggestions or recommended Avoidance & Minimization measures for SMHM and Ridgway's Rail, since last BRRIT meeting and feedback? (See Section IX – Sensitive Species Considerations and Recent Studies above, for previous suggestions and responses to date).**

Answer:

USFWS: We were pleased to see avoidance and minimization measures from our 12/18/19 comment document echoed in the materials prepared for this 2nd pre-application mtg. Please see comments below from CDFW (particularly comment #4) for several useful additional measures for your consideration. Also, please stay in close collaboration with other flood protection planning efforts in the region so that disturbance events and incursions into listed species habitat may be limited.

**3. Any new thoughts about permit types, since previous BRRIT? (BCDC mentioned a new restoration Regionwide; the 'Small Habitat Restoration' permit was mentioned by RWQCB; the USACE wasn't sure about a NWP27 based on hydrologic source not being self-sustaining and mentioned a NWP for flood protection, and what about NWP 54 for Living Shorelines? Or the proposed NWP E for Water Reclamation and Reuse?)? And do any other existing Programmatic permits seem applicable here?**

<u>Answer</u>: Please see responses under appropriate agencies below.

**4. Any news/updates about the EPA Region 9 'type conversion' framework, and potential for this project to be a 'beta test' (as mentioned during Dec. 2019 BRRIT meeting)?**

<u>Answer:</u> A final draft of the Wetland Type Conversion Framework was released earlier this year. Currently, the beta test for the framework is still the McInnis Marsh Project in Marin County. We do appreciate your interest in application of PAHL to the framework. Once the framework has been beta-tested, if you are interested in preparing an analysis of your project based on this framework, we can provide the draft to you. There is a fair amount of analysis and data required for this, but the BRRIT could potentially assist you with that. USACE: I am not sure how much area of Waters of the US are to be impacted by this project, however, or whether the project would actually result in a type conversion.

**5. The Project team is still assuming the RWQCP can amend its NPDES permit for what will essentially be a new final effluent discharge location/point. Any input from the RWQCB's NPDES Division folks about specific studies needed (e.g., dilution, mixing zone, etc.) for this permitting approach?**

<u>Answer</u>: Please see response under Water Board's comments below.

**<u>General Guidance</u>**

1. **Mosquito Abatement:** The BRRIT recommends that you coordinate with the local vector control agency to ensure the project is designed such that it doesn't create a mosquito nuisance issue to nearby communities.
2. **Monitoring and Adaptive Management:** Many agencies will require a Monitoring and Adaptive Management Plan that, describes monitoring metrics, methods, duration, and frequency; includes performance criteria to evaluate the Project's progress towards meeting goals and objectives; discusses adaptive management that may be implemented if performance criteria are not met; and includes long-term management and maintenance. If long-term management and maintenance will impact species, that should also be included in our environmental assessment.
3. **Construction Monitoring:** A construction monitoring plan should also be included with your application, if appropriate.
4. **Draft Reports and Plans:** Please feel free to share any draft reports and plans with us so we can provide early guidance and feedback.

5. **Pre-application Satisfaction Survey:** The BRRIT is developing a pre-application satisfaction survey to get feedback from project proponents on their experience during the pre-application process. We hope to learn how we can improve their experience and better serve the restoration community. Project proponents can take the survey as often as needed and at any stage during the pre-application process. We hope to make the survey available on our website by Dec 2020.

**Specific Agency Feedback**

**Federal**

*USACE*

1. Apologies for not being present during the majority of the meeting. I would be happy to meet via phone/web meeting/ site visit to answer questions if you like.
2. Please be aware that the new 401 Certification Rule has come into effect as of September 11, 2020. This means that you, as applicants, are required to provide the Corps with documentation that you requested a pre-filing meeting with the RWQCB at least 30 days prior to submitting your Water Quality Certification application. You are also responsible to submit that WQC application to the Water Board and the Corps concurrently when you submit applications. Since you are working directly with the BRRIT, these requirements can be handled as we proceed along our pre-app and application submittal process.
3. With regard to your questions about permitting strategy with the Corps: as you indicated, the NWPs are currently being re-issued. I do not think that this project would fit within the proposed NWP E as it is described in the Fed Register, as that NWP seems to be specifically aimed at reclamation and re-use activities and, while there is a polishing component to this proposed project, I don't think it would be considered as a water re-use/reclamation project. I believe that as the project is currently described, it would not fit within any of the NWPs.
4. O & M: the Corps generally does not include operations and maintenance when we issue permits for the construction of projects. However, we can include some maintenance actions as adaptive management in an individual permit, and those actions would only be authorized for the life of the permit (5 years). I would want to have more details on what these O & M activities are, since they may not involve activities that the Corps would regulate.
5. Please remember, when you submit your project applications, to include a recent cultural resources inventory and any information on Native American outreach that you may have done as part of your CEQA process.

*NMFS*

1. As the first pilot ecotone design for a freshwater slope wetland in the Bay, the Project will provide an opportunity to better understand the biological outcomes associated with creating a novel, surrogate habitat for brackish ecotone wetlands largely lost from the Bay during habitat conversion of the 1800s.
2. No additional comments, please refer to NMFS comments in our 12/18/19 comment letter for information on work windows that would avoid the primary salmonid migration season and additional avoidance and minimization measures to consider when conducting in-water work.

*USFWS*

1. I appreciated the explanation of Leonard Liu's CRR hotspot study noting the relative lack of CRR where brackish vegetation persists. We learned from your team that lower salinity is especially

apparent at low tide and not as much at high tide. However, given two high and two low tides per day, and in the absence of knowing what freshwater residency time is required for type conversion at the site, we must assume that expansion of brackish marsh vegetation due to increased freshwater discharge could occur and that would negatively affect CRR at Harbor Marsh. That said, during your presentation, project engineers stated their belief that any brackish conversion would be minimal and limited to the toe of the slope, as opposed to spreading across the slough channel into the interior of Harbor Marsh. Additionally, it was suggested that the City of Palo Alto would monitor any vegetation changes carefully and could adaptively manage the volumes to reduce outflow should unacceptable conversion occur. We should further discuss together what those vegetation conversion thresholds should be and you should be clear about proposed thresholds/success criteria and adaptive management commitments in your project description when the time comes to apply for permits.

2. Recreational land uses adjacent to high quality CRR habitat bring the potential for disruption of breeding or foraging behaviors. However, while the project includes trail upgrades in other locations, because the berm that provides the current public trail directly adjacent to Harbor Marsh would be removed, it appears that the proposed project would result in a reduction of public recreation directly adjacent to the highest quality CRR habitat. Since it is hoped that high marsh/upland ecotone plantings along the toe of the horizontal levee will provide high marsh refugia for rails, it will be important to limit dogs in the area. Ideally dogs would be excluded or at the very least, leash laws would be strictly enforced.
3. Have you confirmed whether *Suaeda californica* is onsite? It seemed like there was some question from the project team in Dec 2019 as to whether that was the case.
4. Vegetation removal. At the meeting, it was explained that the footprint of vegetation removal will be very limited. In cases such as this, to minimize effects to SMHM, hand removal (use of non-motorized hand tools) is highly encouraged and seems feasible in this circumstance. If not possible, then the phased removal and fencing strategy discussed in USFWS comment #9 of our 12/18/19 comments is suggested.

**State**

*BCDC*

1. **Permitting Approach.** BCDC does not have a regionwide permit for restoration projects at this time. Based upon the information provided in this meeting, the project does appear to be small and to have limited impacts on Bay resources, so it would likely qualify for an administrative permit. However, this may change based upon the actual quantification of the impacts and if there are any significant environmental impacts or impacts to public access as a result of the project that cause the project to need to be considered by the Commission as a major permit.
2. **Public Access Design.** We are checking in with our Bay Design Analysts regarding the proposed public access to get their thoughts on the proposed design and realignment of the public access trail. It would be a good idea to setup a meeting to discuss the public access plan with our Bay Design Analysts and discuss their feedback on the conceptual design at your earliest convenience. As discussed in the meeting, it appears that setting the Bay Trail back along the road would reduce the overall area for the public access trail and increase the noise that the public may experience while walking along the new alignment. The design should consider how to create an overall public access experience that improves upon the existing pathway.

3. Please also see comments from the 12/18/19 BRRIT letter.

*CDFW*

1. Based on the information provided during our meeting, it sounded like the existing trail will be moved back toward Embarcadero Road, further away from existing rail habitat. It also sounded like it is planned to maintain the spur trail to the existing intake structure, and perhaps include some signage for outreach but not to expand the spur trail or to include other trail access at this location. CDFW supports this to minimize trail-related disturbance to rails in the marsh.
2. We discussed during the meeting how to approach working with the seasonal work restrictions (avoiding Feb 1-Aug 31 for rails, and avoiding Dec 1-early/mid June for fisheries and the wet season). Sequencing elements of your project can be an effective way to efficiently complete construction activities in compliance with work window restrictions. In addition, ensuring that staging and stockpiling activities, as well as access routes are placed away from areas that will become tidally inundated or in close proximity to sensitive species (I.e., rails) will help avoid complications associated with seasonal work restrictions.
3. As discussed during the meeting, any necessary vegetation removal that is suitable for federal and state endangered and state fully protected salt-marsh harvest mouse with non-motorized hand tools only is a key avoidance/minimization measure.
4. Other avoidance/minimization measures pertaining to salt-marsh harvest mouse, federal and state endangered and state fully protected California Ridgway's rail, and state threatened and state fully protected California black rail include, but are not limited to; ensuring a 700-foot buffer from rail habitat during rail breeding season (buffer may be reduced during non-breeding season), avoiding placement of stockpiled vegetation or erosion control materials where they may be recolonized by salt-marsh harvest mouse (note that mice can temporarily disperse well away from their suitable habitat and find such items to be suitable cover), use of portable acoustic barriers between the work site and rail habitat, avoidance of work during high tides (species may move further up into the upland to seek high-tide refugia), avoiding nighttime work, and striving to complete work within one construction season.
5. Jan 15-Sept 1 is the typical nesting season for raptors and migratory birds, and work should be conducted in consideration of seasonal avoidance and appropriate buffers to active nests.
6. More information will be needed to determine the likelihood of presence of other species listed under the California Endangered Species Act. However, species that may potentially be present and should be considered in the impacts analysis for this project may include, but are not limited to, the state threatened tricolored blackbird and federal candidate and state threatened longfin smelt. Take of state listed species is a violation of Fish and Game Code and if any project activities may result in take of CESA-listed species, then CDFW recommends obtaining take authorization through a 2018 Incidental Take Permit.
7. Other species to consider include state species of special concern, including burrowing owl, salt-marsh wandering shrew, western snowy plover, American badger, Pacific lamprey, green sturgeon, and white sturgeon.
8. Based on the information provided during the meeting, it appears that the tidal channel adjacent to the project originates and terminates within the Bay, and does not receive discharge from a fluvial stream channel. It does not appear that this tidal channel is likely subject to Fish and Game Code 1600.

*Water Board*

1. NPDES staff are currently planning to reissue the RWQCP NPDES permit in 2024. If you are planning to complete project construction by 2023 and will need authorization for the new discharge point, you can request that we reissue your NPDES permit early and submit a full application that includes the horizontal levee project. NPDES staff are unlikely to amend the existing NPDES permit if we will need to take your NPDES permit before our Board again within 12 months to reissue the expiring permit. Please let me know if you need my help in coordinating with NPDES staff.
2. This project may qualify under State Board's General Water Quality Certification for Small Habitat Restoration Projects. I can confirm this once I get more information on the extent of the Project's temporary and permanent impacts in waters of the State.

**Meeting Participants:**

Priya Finnemore, ESA
Samantha Engelage, PM, City of Palo Alto
Heidi Nutters, SF Estuary Partnership
Mark Lindley, ESA
John Bourgeois, ESA
Marisa Landicho, ESA
Christie Beeman, ESA
Corps: Frances Malamud-Roam
NMFS: Alison Weber-Stover
USFWS: Valary Bloom
CDFW: Tami Schane
BCDC: Anniken Lydon
Water Board: Agnes Farres

# Appendix E
## Preliminary Design Cost Estimate

ESA

BY: ENVIRONMENTAL SCIENCE ASSOCIATES 9/23/2020

**Palo Alto Horizontal Levee Pilot Project (PAHLPP)**
**PROJECT CONSTRUCTION BUDGET**
**Preliminary Design Engineers Estimate of Probable Constrcution Cost**

| NO. | ITEM | QUANTITY | UNIT OF | UNIT PRICE | TOTAL |
|---|---|---|---|---|---|
| 1 | MOBILIZATION & GENERAL CONDITIONS (10%) | 1 | LS | $ 77,000 | $ 77,000 |
| 2 | TRAFFIC CONTROL | 1 | LS | $ 20,000 | $ 20,000 |
| 3 | CLEARING AND GRUBBING | 1.0 | AC | $ 8,240 | $ 8,200 |
| 4 | EXCLUSION FENCING | 1,200 | LF | $ 16 | $ 19,200 |
| 5 | SUPPLEMENTAL EROSION CONTROL MEASURES AND SWPPP COMPLIANCE | 1 | LS | $ 40,000 | $ 40,000 |
| 6 | DEMO CULVERTS, CONCRETE STRUCTURES & OFF HAUL | 1 | LS | $ 60,000 | $ 60,000 |
| 7 | REMOVE INTERPRETIVE SIGN AND RETURN TO CITY | 1 | LS | $ 1,200 | $ 1,200 |
| 8 | 18-INCH RCP CULVERT PIPE | 96 | LF | $ 150 | $ 14,400 |
| 9 | DRAINAGE STRUCTURES AND APPURTENANCES | 1 | LS | $ 5,000 | $ 5,000 |
| 10 | APPURTENANCES FOR RWQCP CONNECTION | 1 | LS | $ 98,000 | $ 98,000 |
| 11 | 8" TREATED EFFLUENT SUPPLY PIPE | 1,250 | LF | $ 120 | $ 150,000 |
| 12 | 4" DISTRIBUTION SUPPLY LINE | 350 | LF | $ 50 | $ 17,500 |
| 13 | APPURTENANCES FOR DISTRIBUTION TO HORIZONTAL LEVEE | 4 | LS | $ 4,000 | $ 16,000 |
| 14 | INFILTRATION CHAMBER | 236 | LF | $ 23 | $ 5,400 |
| 15 | SAND | 96 | CY | $ 144 | $ 13,900 |
| 16 | GRAVEL | 375 | CY | $ 196 | $ 73,500 |
| 17 | WOOD CHIPS DELIVERY & MIXING W GRAVEL/SAND/SOIL | 100 | CY | $ 77 | $ 7,700 |
| 18 | FILTER FABRIC | 1,000 | SY | $ 3.61 | $ 3,600 |
| 19 | EXCAVATION | 2,850 | CY | $ 10 | $ 28,500 |
| 20 | HABITAT FILL | 960 | CY | $ 16 | $ 15,400 |
| 21 | BERM FILL | 2,050 | CY | $ 20 | $ 41,000 |
| 22 | IMPORTED BERM FILL | 900 | CY | $ 40 | $ 36,000 |
| 23 | TRAIL SURFACE - CLASS 2AB | 75 | CY | $ 103 | $ 7,700 |
| 24 | FIBER ROLLS | 550 | LF | $ 5 | $ 2,800 |
| 25 | SEEDING - EROSION CONTROL | 0.24 | AC | $ 5,150 | $ 1,200 |
| 26 | SEEDING - WETLAND | 0.70 | AC | $ 5,150 | $ 3,600 |
| 27 | HORIZONTAL LEVEE PLANTING | 0.70 | AC | $ 35,150 | $ 24,600 |
| 28 | TEMPORARY IRRIGATION | 1 | LS | $ 15,000 | $ 15,000 |
| 29 | PLANT ESTABLISHMENT | 3 | YR | $ 12,000 | $ 36,000 |
| **SUBTOTAL (2020 DOLLARS)** | | | | | **$ 842,400** |
| | | | CONTINGENCY: | 30% | $ 253,000 |
| | | | ESCALATION (3% FOR 5 YEARS) | 16% | $ 134,000 |
| | | | TOTAL: | | **$ 1,229,400** |
| **SOFT COSTS** | | | | | |
| | FINAL DESIGN + PERMITTING + CEQA | | | | $ 905,000 |
| | CONSTRUCTION MONITORING | | | | $ 200,000 |
| | CONSTRUCTION MANAGEMENT | | | 15% | $ 184,000 |
| | | | | | **$ 2,518,400** |

# Appendix F
## Oro Loma Bird Survey

**Oro Loma Sanitary District Bird Survey (12/2/17)**

On 12/2/2017, Amy Chong and Diony Gamoso, both Biological Sciences Technicians with the Presidio Trust, did a bird census at the Oro Loma Sanitary District. Specifically, our surveys were in the Ecotone Slope and the Wet Weather Equalization Basin. The project team included the Oro Loma Sanitary District, ESA, U.C. Berkeley, consultant Peter Baye, Save The Bay, and Bay Institute. The restoration project was implemented in 2015 and 2016. We were curious what species of birds were now using these newly created habitats.

**Method:** We used an Area Search method for our census. This consisted of us slowly walking the perimeter of the two sites, identifying bird species present by both sight and calls. We also included any species observed using the berms that border each site. We tried not to double-count birds, and were conservative in our estimates of numbers. Hence, the total number for each species observed is likely on the low side. Specific habitat usage (ex. "in willows"), was often noted.

I. Ecotone Slope
Time: 08:45-10:10am, Weather: Hazy, calm, approx 50 degrees F

Note: W = winter range     R = within year-round range for this species

| Species | # | W or R | Notes |
|---|---|---|---|
| 1. White-tailed Kite | 2 | R | One was hovering (hunting) over site |
| 2. Golden-crowned Sparrow | 1 | W | |
| 3. White-crowned Sparrow | 1 | R | |
| 4. Song Sparrow | 6 | R | |
| 5. Black Phoebe | 2 | R | One of them on berm |
| 6. Common Yellowthroat | 1 | R | In Cattails |
| 7. Marsh Wren | 1 | R | In Cattails |
| 8. Western Meadowlark | 3 | R | On berm |
| 9. Anna's Hummingbird | 2 | R | In willows |
| 10. American Crow | 2 | R | On berm |
| 11. Fox Sparrow | 2 | W | In willows |
| 12. Yellow-rumped Warbler | 6 | W | In willows |

Note: we also heard 1 Pacific chorus frog at this location

II. Wet Weather Equalization Basin
Time: 10:45-11:47am, Weather: Hazy, calm, approx 56 degrees F

| Species | # | W or R | Notes |
|---|---|---|---|
| 1. Mallard | 31 | R | 15 females,16 males; in water |
| 2. Northern Shoveler | 4 | W | 3 females, 1 male; in water |
| 3. Snowy Egret | 2 | R | |
| 4. Black Phoebe | 2 | R | |
| 5. Great Egret | 1 | R | |
| 6. White-crowned Sparrow | 9 | R | Small flocks feeding amid weedy edges of ponds, or weedy berms |
| 7. American Crow | 4 | R | |
| 8. Golden-Crowned Sparrow | 2 | W | |
| 9. Western Meadowlark | 2 | R | On weedy berm |
| 10. Song Sparrow | 2 | R | On weedy berm, or pond edges |
| 11. Savannah Sparrow | 5 | R | On weedy berm |
| 12. Lesser Goldfinch | 5 | R | On weedy berm |
| | | | |

**Comments:**

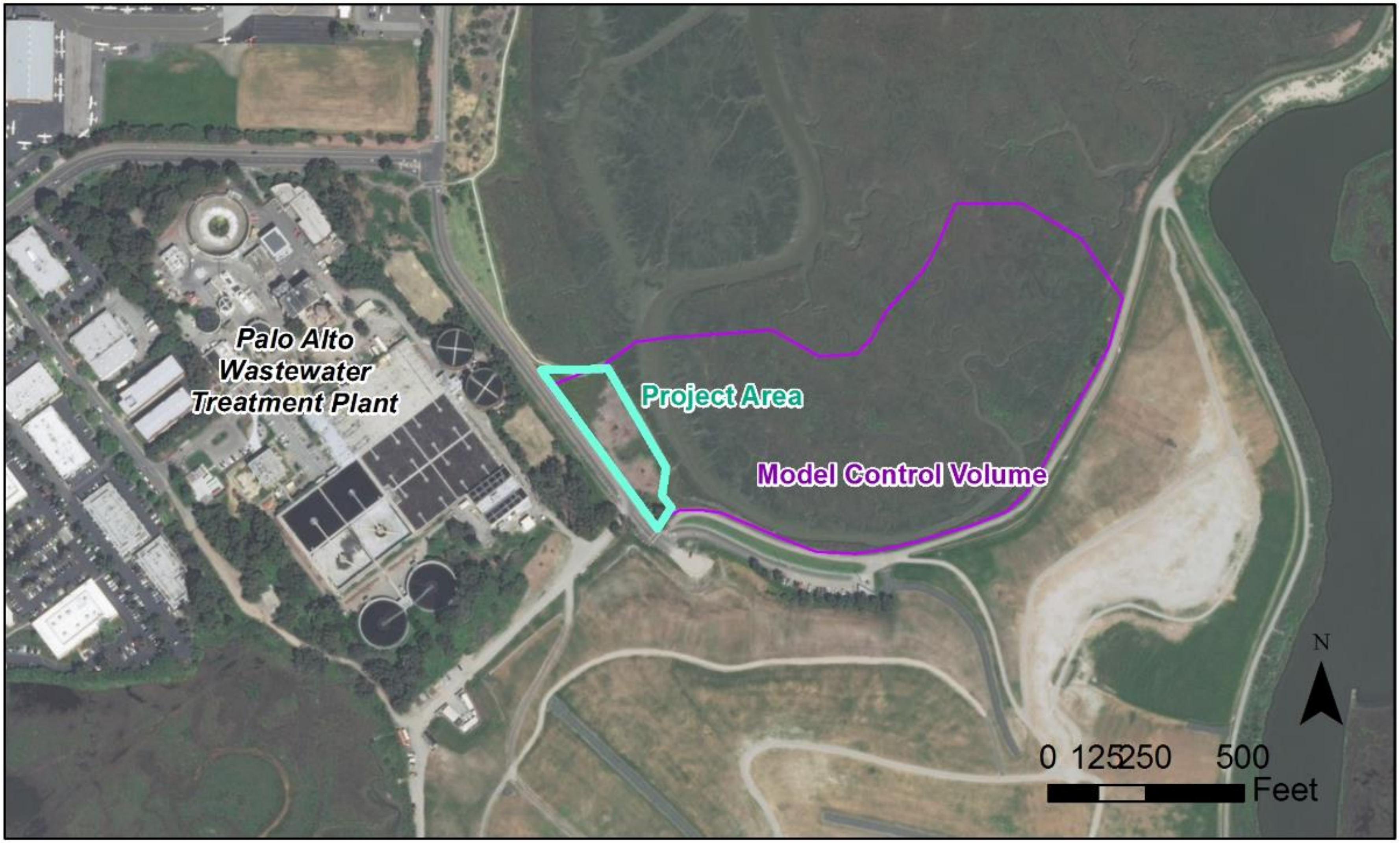
We both had a fun morning doing the survey! We were happy to see that the project site has developed so nicely.

There were some species that tended to use microhabitats within the sites. For example, the Yellow-rumped Warblers, Fox Sparrows, and Anna's Hummingbirds, were all associated with the willows. The Cattails seemed to provide preferred foraging sites for the Common Yellowthroat and Marsh Wren. Even the weedy berms, covered with senesced annual plants provided good foraging habitat to the different sparrows – likely finding dropped seeds.

We are already excited about coming back in the Spring to do a breeding bird survey!

# Appendix G

Salinity Modeling Results

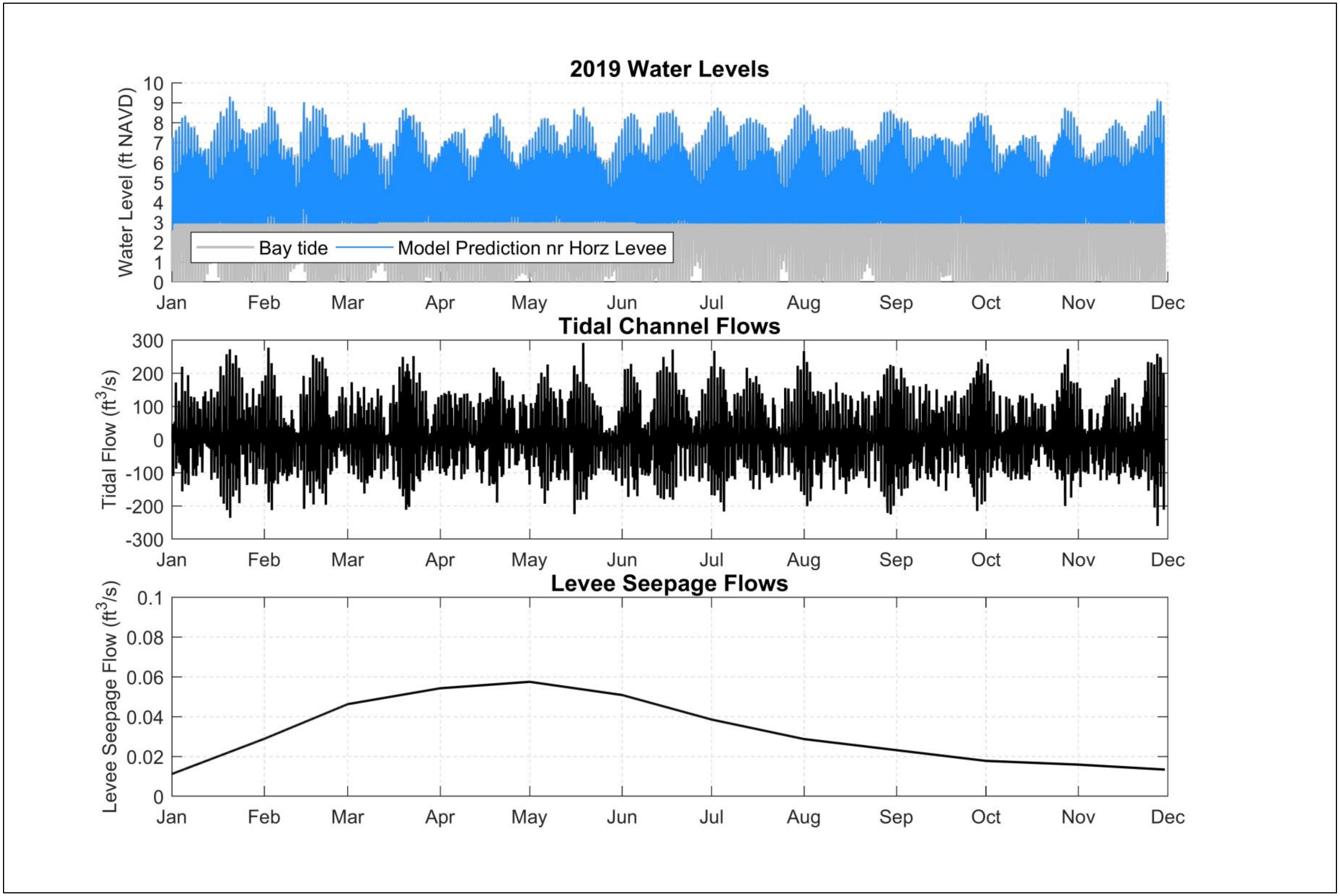



Note: The modeled domain covers 16 acres of Harbor Marsh, which is 20% of the marsh's total area. Effects of the horizontal levee freshwater discharge would be even less beyond this model domain since even greater dilution of the horizontal levee freshwater discharge would occur when a larger area is considered.

Palo Alto Horizontal Levee . D201801306.00

**Figure G-1**

Site Map and Project Area

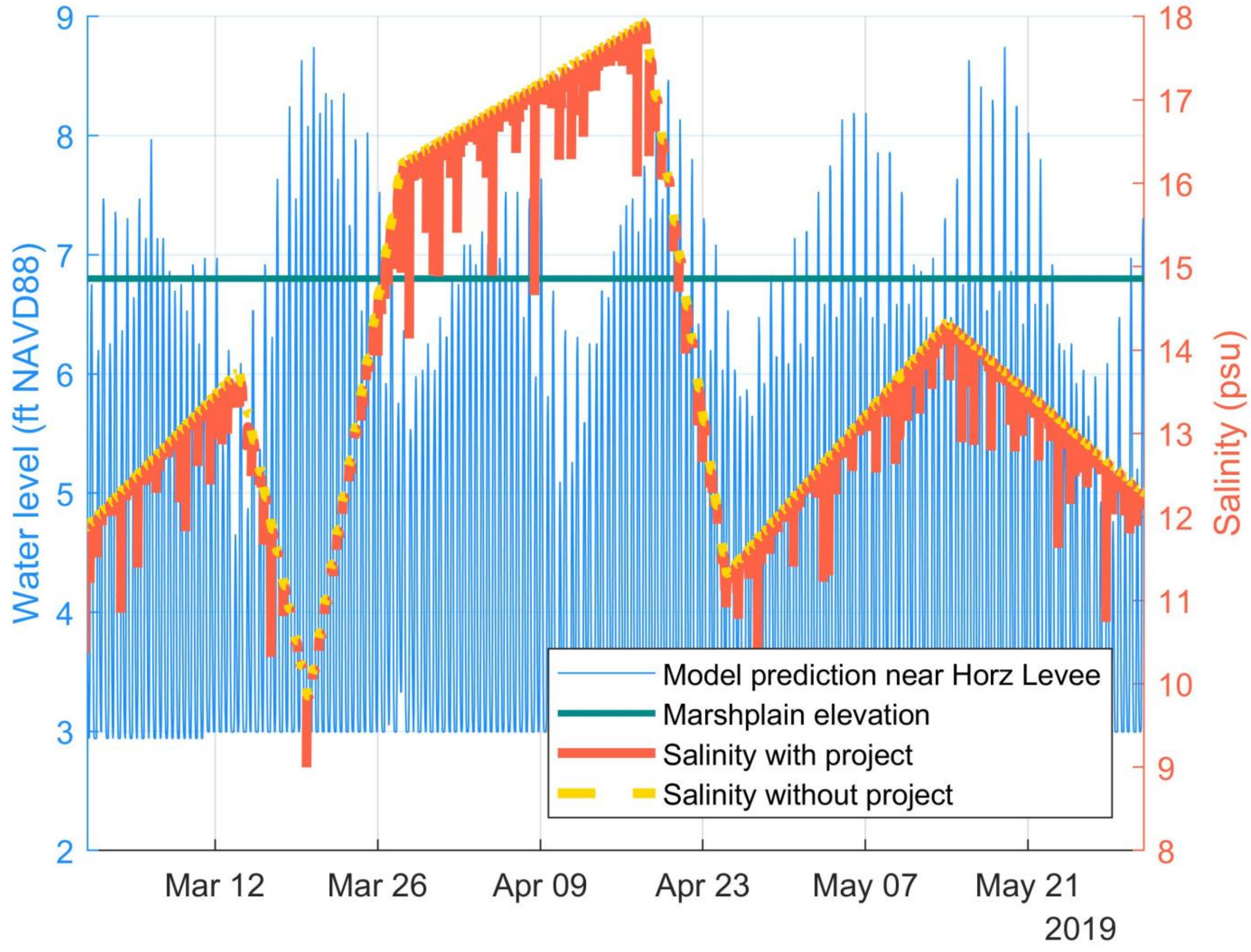



Note: Top panel - Bay tide water levels are interpolated from NOAA Redwood City and Coyote Creek stations; water levels near the horizontal levee are based on a water balance model using topography of the marsh and channels in the domain shown in Figure G-1. Middle panel - tidal discharge is the predicted exchange between the model volume and the Bay due to the Bay tides. Bottom panel - the much smaller discharge from the horizontal levee is based on assumed levee operations (see Section 4.7).



**Figure G-2**

2019 Water levels and predicted flows

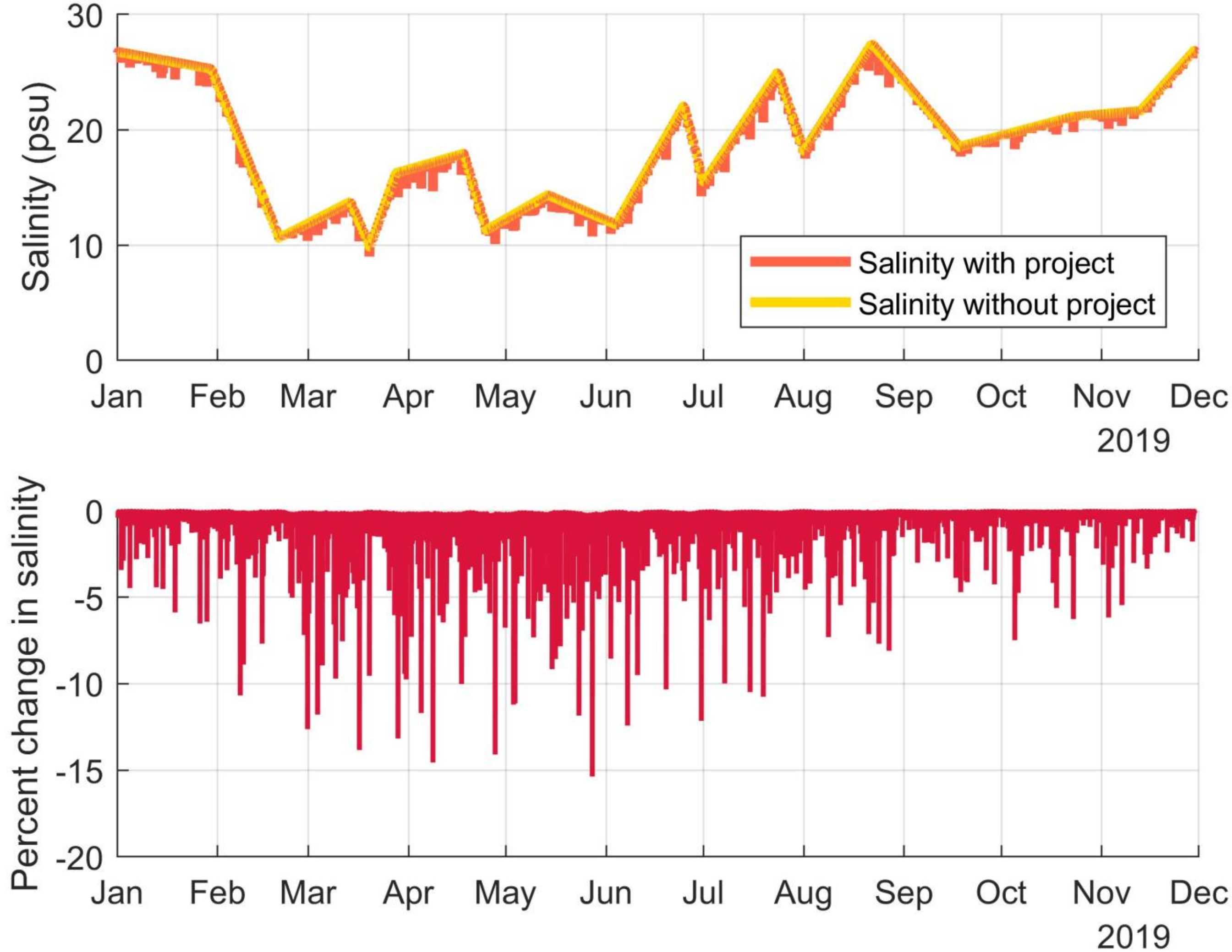



Note: Predicted salinity in the model domain, assuming full and instantaneous mixing of the fresh horizontal levee discharge with the saline Bay water, is shown for with and without project conditions. The ambient Bay salinity is interpolated from monthly USGS sampling just outside Harbor Marsh (Schraga et al. 2018). The effect of the project is minor throughout the spring, the active growing season. These are the largest effects of the year, as shown in Figure G-4.



**Figure G-3**

Predicted Salinity - Spring

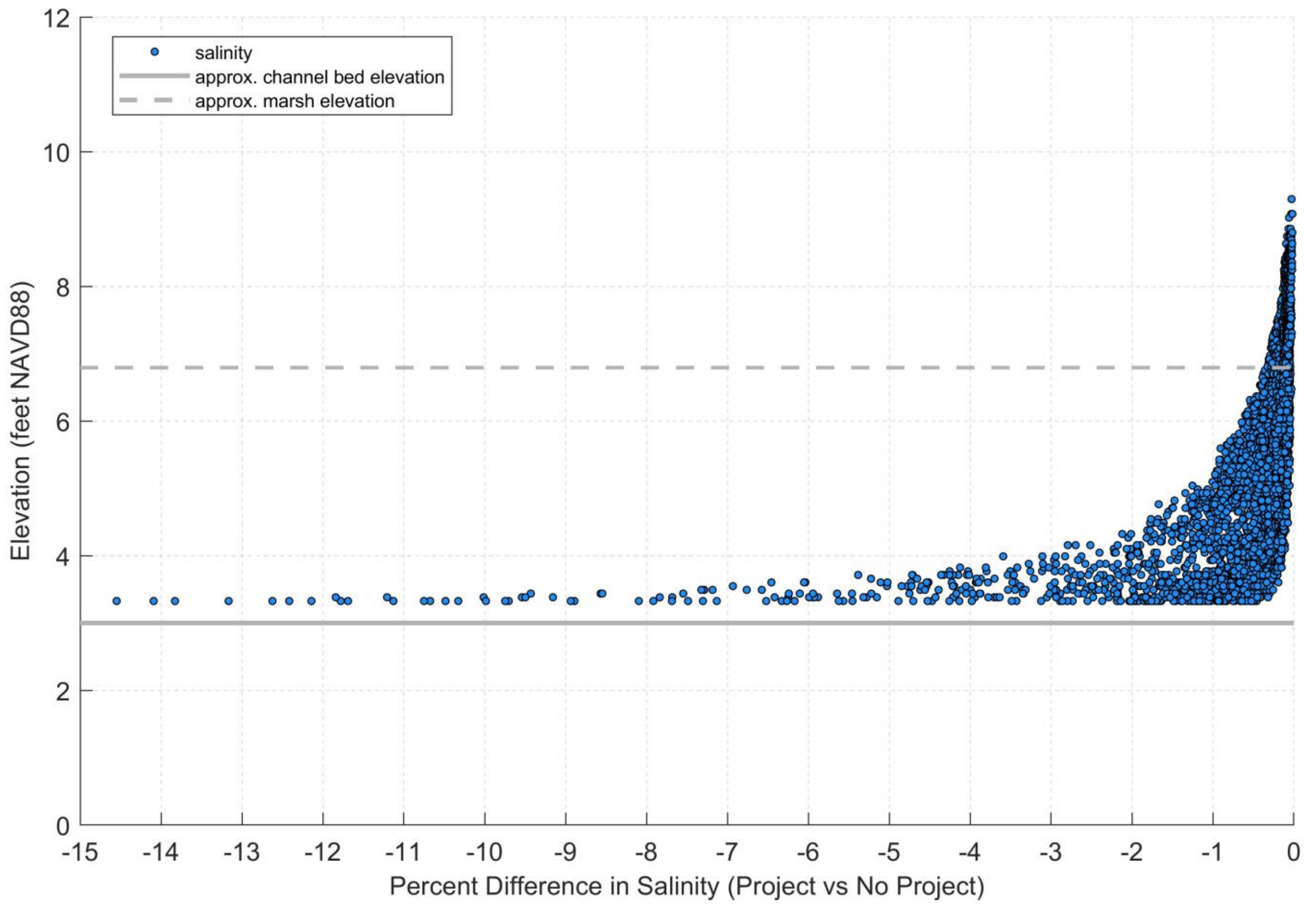



Note: Top panel – over the course of a full year, salinity changes due to the project are largest during the spring, when horizontal levee discharge is highest (Figure G-2) and ambient Bay salinity is lowest. However, even for these conditions the largest percent decrease in salinity is 15% and this larger changes occur when water levels are below the marshplain elevation (see Figure G-5).



**Figure G-4**

Predicted Salinity – Full Year and Percent Change

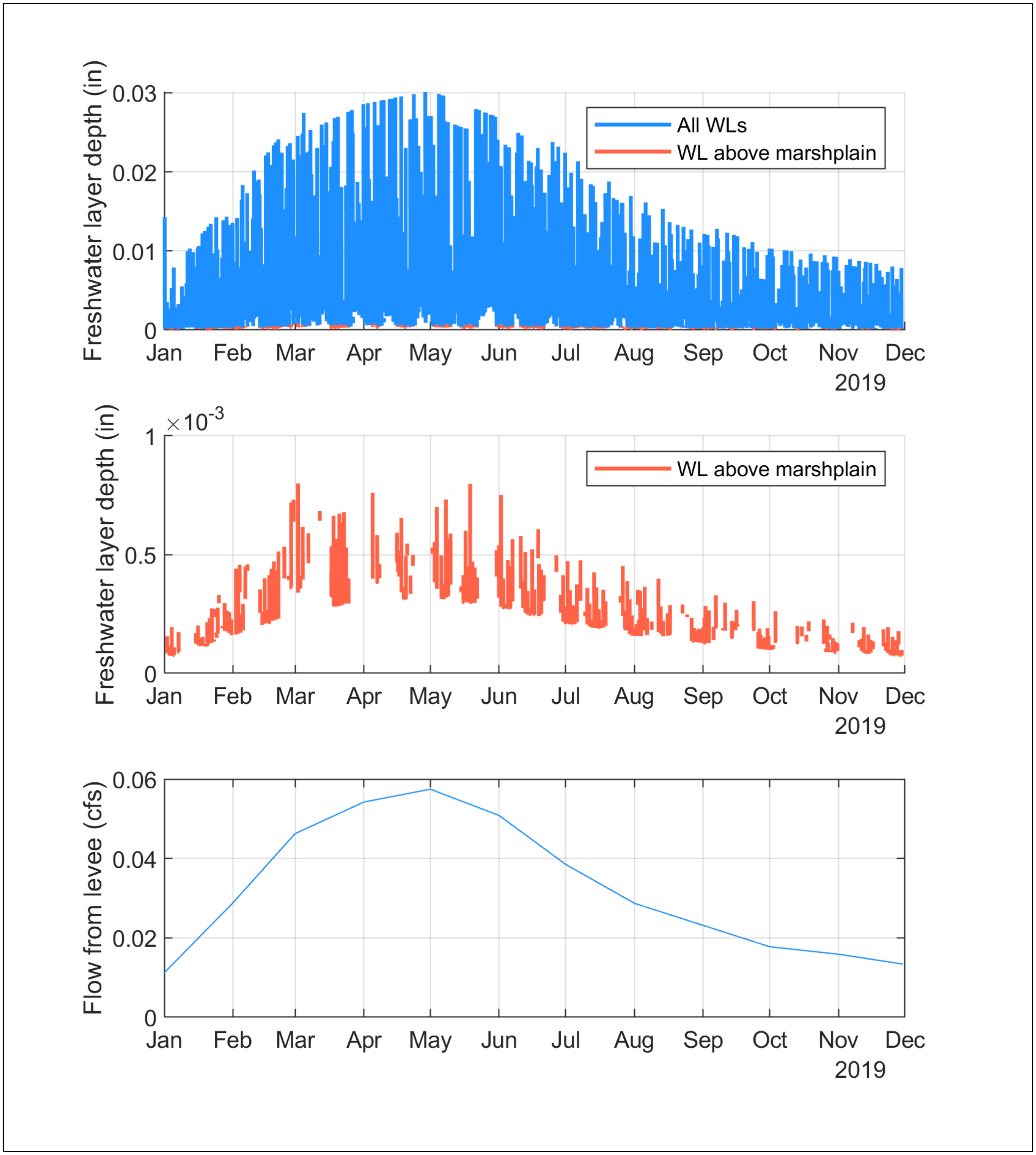



Note: Comparing water level in the model domain (Figure G-2, top panel) with the percent change in salinity (Figure G-4, bottom panel) indicates that the only times when the salinity decrease due to the horizontal levee's freshwater discharge is greater than 3% is when there is one foot or less of water in the tidal channel and the water level is well below the elevation of the vegetated marshplain.



**Figure G-5**

Water Level vs Percent Change in Salinity




Note: If no mixing is assumed such that the less-dense freshwater floats on the more-dense saline water, the predicted freshwater layer thicknesses are shown for all water levels (top panel) and water levels above the marshplain (middle panel). Even for this most impactful case of no dilution of the freshwater by mixing, the layer thickness and hence its likely effect on the marshplain would be negligible. The layer thickness is a function of discharge from the levee (bottom panel), so if needed, the levee discharge can be reduced to further limit the influence of fresh water on the existing salt marsh.

Palo Alto Horizontal Levee . D201801306.00

**Figure G-6**

Surface Freshwater Layer Thickness

# Appendix H

Ridgway's Rail Resources Memorandum

ESA

180 Grand Avenue
Suite 1050
Oakland, CA 94612
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www.esassoc.com

# memorandum

| | |
|---|---|
| date | October 13, 2020 |
| to | Samantha Engelage, P.E., Senior Engineer, Environmental Services Division, City of Palo Alto |
| cc | |
| from | Leonard Liu, Senior Associate Biologist |
| subject | California Ridgway's Rail Habitat Impact Assessment – Palo Alto Horizontal Levee Pilot Project |

Dear Ms. Engelage,

The purpose of this Biological Resources Technical Memorandum is to review potential effects of the Palo Alto Horizontal Levee Pilot Project (PAHLPP; Project) on endangered California Ridgway's rail (*Rallus obsoletus obsoletus*, CRR; also known as California clapper rail, *R. longirostris obsoletus*).

The San Francisco Estuary Partnership and the City of Palo Alto plan to construct the PAHLPP at a location bordering Harbor Marsh (Figure 1). The horizontal levee will consist of: 1) a berm on the landward side, 2) a permeable subsurface treatment zone for wastewater polishing, and 3) a habitat transition zone downslope of the treatment zone (Figure 2). Horizontal levees are a novel approach intended to: 1) create habitat for special status species by replicating freshwater seeps that historically occurred on gently sloping transitional zones from the uplands into tidal marshes, 2) provide sea-level rise adaptation by creating high tide refugia and marsh migration accommodation space, as well as increasing carbon sequestration through accretion of freshwater wetland plant biomass, and 3) filter highly treated wastewater through a subsurface zone to provide polishing-level treatment prior to discharge to San Francisco Bay. This Project builds on the experience gained through design, construction, and monitoring of the Oro Loma Horizontal Levee Demonstration Project in San Lorenzo, California (BO# 08ESMF00-2014-F-0372).

By adding a new local source of freshwater input to the marsh, there is potential for the discharge of filtered freshwater from this Project to locally convert existing coastal salt marsh into brackish marsh (Figure 3). South San Francisco Bay CRR typically occur in tidal marshes dominated by perennial pickleweed (*Salicornia pacifica*) and cordgrass (*Spartina foliosa* or *S. alterniflora* x *foliosa*), often with patches of marsh gumplant (*Grindelia stricta* var. *angustifolia*) along the banks of tidal sloughs. CRR use small tidal channels with dense overhanging vegetation as foraging habitat and travel corridors, and nest on the ground under dense vegetation. Other marsh qualities which support denser CRR populations include: larger marsh size; nearby presence of additional tidal marshes; existence of high tide refugia; and buffers or transitional zones between the marsh and upland areas (Albertson and Evens 2000; USFWS 2013).

However, ESA and others have noted the presence of populations of CRR in brackish marsh habitats in both San Pablo Bay (e.g., Petaluma River, Napa River) at generally low to moderate densities as well as in South San Francisco Bay (e.g., Guadalupe Slough, Alviso Slough, Goose Point, Triangle Marsh) at generally low densities (Albertson and Evens 2000; HTH 1990; Liu et al. 2012; OEI 2019; USFWS 2013). The presence of large patches of alkali bulrush (*Bolboschoenus maritimus*), an indicator of brackish conditions, has also been documented at Harbor Marsh. The purpose of this memorandum is to ascertain if the addition of freshwater at the Project site will negatively affect CRR by analyzing detected locations of CRR and alkali bulrush at Harbor Marsh in order to determine if CRR currently inhabit alkali bulrush at Harbor Marsh, or if they avoid it due to its perceived lower habitat value.

## Project Location

The Project site is located in southwest San Francisco Bay in Palo Alto, Santa Clara County, California. Access to the site is from Embarcadero Road (also known locally as Harbor Road). The Project is in upland or developed habitat, bordering tidal salt marsh in Harbor Marsh, which was formerly the Palo Alto Yacht Harbor and mouth of San Francisquito Creek (Figure 1). Harbor Marsh has been passively restoring since 1986, when the citizens of Palo Alto voted to close the harbor. To the west are Palo Alto Golf Course, Palo Alto Airport, and Palo Alto Regional Water Quality Control Plant (RWQCP). Harriet Mundy Marsh and the Lucy Evans Baylands Nature Interpretive Center are to the north, Byxbee Park is to the south, and Hooks Island and Mayfield Slough Flood Control Basin are to the east. Habitats within 700 feet of the Project include northern coastal salt marsh, tidal flat/shallow bay, and ruderal upland habitats, as well as developed areas.

The salt marsh is of high quality, as it has numerous secondary and tertiary channels and mostly native vegetation-- dominated by perennial pickleweed with patches of Pacific cordgrass (*Spartina foliosa*) and hybrid *Spartina* (*S. alterniflora* x *foliosa*) in channels and marsh gumplant along many channels, and patches of alkali bulrush, salt grass (*Distichlis spicata*), fleshy jaumea (*Jaumea carnosa*), and alkali heath (*Frankenia salina*). However, the strip of marsh immediately adjacent to the Project is quite narrow and adjacent to a large existing tidal channel (Figure 3).

Shallow bay and tidal mudflat habitats are unvegetated and found in the tidally influenced former channels of the harbor and the old mouth of San Francisquito Creek, adjacent to salt marsh. Developed areas and ruderal uplands are populated by coyote brush (*Baccharis pilularis*), wild radish (*Raphanus sativus*), black mustard (*Brassica nigra*), eucalyptus (*Eucalyptus* spp.), annual grasses, and various ornamental plantings.

## Methods

ESA hydrologists conducted a salinity analysis by applying a water balance model using topography of the marsh and channels near the site to study the potential effects of the introduction of freshwater to the salt marsh at Harbor Marsh (Palo Alto Horizontal Levee Pilot Project South Reach Draft Preliminary Design Report, Appendix G).

ESA conducted a passive survey on January 31, 2020 to detect rails in accordance with the methods outlined in the California Clapper Rail Survey Protocol guidance document (USFWS 2015). ESA used three (3) avian survey stations to cover the west side of Harbor Marsh (Figure 4, PAHA01, 02, and 03). The stations previously had been used for CRR surveys by Point Blue Conservation Science (PBCS) and the California Coastal Conservancy's Invasive *Spartina* Project (ISP). The memo prepared in February, 2020 conveying the passive survey findings is included in Appendix 1 below.

ESA also analyzed data from CRR surveys conducted by PBCS and ISP at Harbor Marsh and Hooks Island from 2008 to 2020 (no data for 2018). Surveys were distributed in three rounds about 3 to 5 weeks apart from the period mid-January to mid-April, except for 2008 when all three rounds were conducted in March and April. Different survey protocols were used: type A from 2008 to 2016 without call-broadcast of CRR vocalizations to solicit responses; and type NAm from 2012 and 2017 to 2020 with call-broadcast of CRR and California black rail (*Laterallus jamaicencis coturniculus*) vocalizations (OEI 2018a). The type NAm survey in 2012 differed from later years in that call-broadcast of three non-listed rail species were included in the call-broadcasts. No effort was made to separate out the results of different survey protocols. ESA projected estimated CRR locations using ArcTools bearing to line, and vertex to point. Non-CRR detections and detections mapped outside of Harbor Marsh and Hooks Island were omitted from further analysis. ESA then conducted an optimized hot spot analysis to discern regions of CRR clustering in Harbor Marsh. The optimized hot spot analysis tool in the GIS software (ArcMap) creates a map that displays statistically significant clusters of incident data. The tool uses spatial statistics to calculate clusters of data by analyzing each feature in relation to neighboring features (ESRI 2017; Getis and Ord 1992). The results indicate with 95% or greater confidence areas of non-random clustering.

ESA digitized known and presumed alkali bulrush locations using real-color National Agriculture Imagery Program and Sentinel-2 infrared imagery from 2018 and 2020 respectively with Peter Baye's report as a guide to identifying the aerial signature of large patches of alkali bulrush (Baye 2019). ESA then compared the locations of alkali bulrush to ESA's 2020 survey results and the results of the hot spot analysis of 2008 to 2020 data.

## Results

ESA determined through the salinity analysis that effects of freshwater addition from the Project on the existing salt marsh will be minimal, as there is a negligible effect on salinity when tidal water level is above the marsh plain, and salinity drops slightly on outgoing tides, since the channel adjacent to the Project at falling tides has a much smaller volume than the channel and the marsh plain at high tide, and is being diluted with levee seepage (Palo Alto Horizontal Levee Pilot Project South Reach Draft Preliminary Design Report, Appendix G).

ESA detected numerous California Ridgway's rails during the surveys at all three stations. ESA then grouped the detections based on timing and counter-vocalizations to discern possible territorial boundaries. ESA estimated that there are 14 to 15 territories or generalized core locations within 300 meters (984 feet) of the western survey stations (Figure 4). ESA estimated that the grouped detections represented approximately 28 to 30 CRR.

The optimized hotspot analysis using 12 years of data (2008 to 2020) found with 95% or greater confidence that CRR detections were clustered in the central portion of Harbor Marsh, around the main channel in the site and the largest contiguous patch of marsh (Figure 5). The hotspots were located adjacent to the eastern boundary of Harbor Marsh but separated from the edges around the rest of the marsh. Hook Island CRR hotspots were located in the middle portion of the island at the southern edge.

ESA found large patches of alkali bulrush visible in aerial imagery to be concentrated in the southern portion of Harbor Marsh, while alkali bulrush at Hooks Island appeared to be more widely distributed with some concentrations along the southern edge and across the middle of the island (Figure 5). Patches were mostly within 100 feet of other patches. ESA mapped a total of 2.32 acres of alkali bulrush in about 107.2 total acres of marsh (SFEI 2011).

Three of the 14 to 15 territories from ESA's 2020 CRR survey were in or around the mapped alkali bulrush patches in Harbor Marsh. Alkali bulrush within the CRR hotspots amounted to 0.89 acres, about 38% of the mapped alkali bulrush patches in Harbor Marsh and Hooks Island (ESA 2020).

**Discussion**

The results of the hotspot analysis appear to signal that CRR vocalize most frequently from the largest contiguous part of the marsh that also is densely channelized and most distant from developed areas in Harbor Marsh and Hooks Island, which conforms to prior assessments of habitat quality for CRR (Albertson and Evens 2000; Liu et al. 2012; USFWS 2013; OEI 2019). The overlap with areas of presumed alkali bulrush appears to be of lesser importance, as the hotspots at Harbor Marsh do not encompass all of the mapped bulrush, nor are they completely outside them. The hotspots at Hooks Island also appear to be focused in an area of high channel density. The edges of the island are not hotspots, though detectability of vocalizations from the edges at the two survey stations along the south edge of the island may also have an impact.

The results of ESA's 2020 CRR survey also show some overlap between CRR and alkali bulrush locations. The three stations on the west side do not effectively cover much of the hotspot area on the east side of Harbor Marsh, but CRR were documented using areas immediately adjacent to the Project site, as well as areas in or near mapped alkali bulrush.

At both Harbor Marsh and Hooks Island, edge effects and proximity to development may have affected vocalization locations. Noise from the airport, RWQCP, roads, and parking lots may inhibit calling rates and habitat suitability. Utility infrastructure, including high-tension electricity transmission lines across the north side of Hooks Island, landscaping and buildings provide perches and nesting locations for raptors and corvids preying upon CRR and nests.

There are several important caveats to this analysis.

1. Alkali bulrush locations were not ground truthed, so their sizes and locations are not necessarily accurate. It would be advisable to confirm the boundaries and identities of at least several of the locations. Also, this analysis presumes that the alkali bulrush patches are persistent through the entire 13-year time period. It would be remarkable if there were not some changes, but for this analysis the patches are assumed to be static. A review of historical imagery on Google Earth show recurring patches of non-pickleweed vegetation in the mapped alkali bulrush locations, so ESA presumes that the mapping is sufficiently accurate for the purposes of informing the results of this analysis.
2. Other factors such as channel density, presence of cordgrass, and distance from development were not rigorously mapped or included in this analysis, and could contribute to the pattern of CRR detections. Biotic factors likely varied throughout the time period of the analysis, and additional human disturbances could affect survey results.
3. The use of call count survey data to map CRR locations is not necessarily the most accurate representation of CRR usage of the site, and consequently not necessarily an indication of habitat quality. For example, it is possible that more dominant CRR vocalize less and have secure territories in other locations, while less dominant CRR vocalize from contested locations.

Nonetheless, the results of the analysis appear to generally conform to current knowledge of some of the habitat preferences of CRR. Well-developed tidal channels and dense vegetation are important components of their habitat, providing cover from predators while foraging. Also, CRR are affected by edge effects, which affects survival and breeding success when predators have easier access to interior parts of a marsh (Albertson and Evens 2000; Liu et al. 2012; USFWS 2013).

It is somewhat surprising that CRR were not detected more regularly from the most southern patches of alkali bulrush, as the height of the vegetation would appear to provide good cover. It is possible that the dispersed pattern of bulrush patches diminishes their value as cover. Some North Bay marshes have extensive brackish marsh vegetation with large, dense patches of alkali bulrush and support robust breeding populations of CRR (Albertson and Evens 2000; Liu et al. 2012; USFWS 2013). Some

South San Francisco Bay brackish marshes (e.g., Guadalupe Slough, Alviso Slough, Goose Point) support likely nesting populations of CRR, albeit at relatively low densities; recent surveys have detected CRR in portions of marshes that are broader with well-developed tidal channels lined with marsh gumplant and marsh plains covered by densely thatched alkali bulrush (OEI 2018a; OEI 2018b; OEI 2019).

The differences in population density of CRR at brackish marshes between the North Bay and South Bay may have less to do with habitat preferences or suitability, and more to do with existing large populations and other founder effects, dispersal opportunities, local predators, local disturbances. Studies directly comparing salt marshes and brackish marshes are generally lacking. The highest density CRR marshes are found in the South Bay (East Palo Alto and San Leandro Bay), though the Corte Madera and Gallinas Creek complexes in North Bay are close (Liu et al. 2012). Surveys in 1990 showed marshes with intermediate salinity (e.g., Alviso, Triangle, Goose Pt.) to have slightly higher densities than more saline (e.g., Calaveras Pt., Mowry Slough) or brackish (e.g., Drawbridge, Warm Springs) marshes (HTH 1990). An analysis of CRR survey data from 2005 to 2011 found a positive relationship between CRR density and increasing salinity, though not as strong as the relationship with channel density and tidal range, with a peak in density at the highest spring salinity levels (about 25 psu).

While it is possible that habitat conversion from salt marsh to brackish marsh will occur with addition of freshwater at the Project site, the results of the salinity analysis strongly suggest that this a less likely scenario. Furthermore, brackish marsh vegetation does not necessarily preclude healthy CRR populations. More intensive mapping of CRR habitat use (i.e., telemetry studies), as well as nest monitoring to determine breeding success, would be needed to conclusively determine if alkali bulrush and brackish marshes in general support CRR recovery or a detrimental to their survival in South San Francisco Bay.

In the absence of such studies, it will be necessary to rely on regional monitoring of interannual fluctuations in CRR detections and densities to estimate effects on the population. It is unlikely that the Project, given its limited size and scope, will have a significant impact on CRR populations at either the site or regional level. The site is considered a core CRR monitoring location and is monitored annually by PBCS or ISP. ESA recommends post-construction monitoring of vegetation evolution on and around the Project site. If it is possible to determine that there is a negative impact, adaptive management of freshwater inputs (e.g., decreasing the amount of freshwater entering the horizontal levee system) to Harbor Marsh should be implemented to maintain conditions conducive to prevent transition to brackish marsh.

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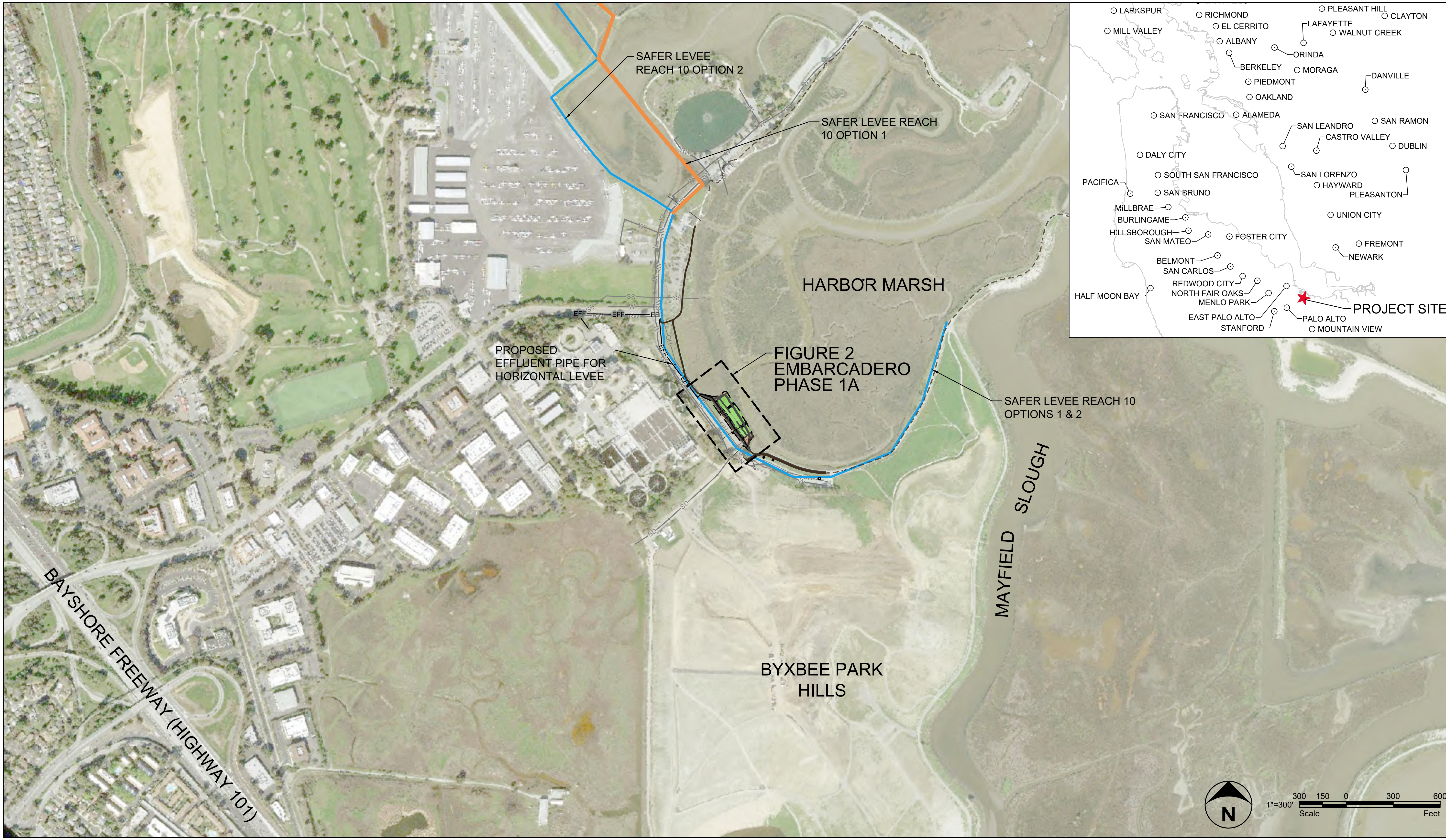


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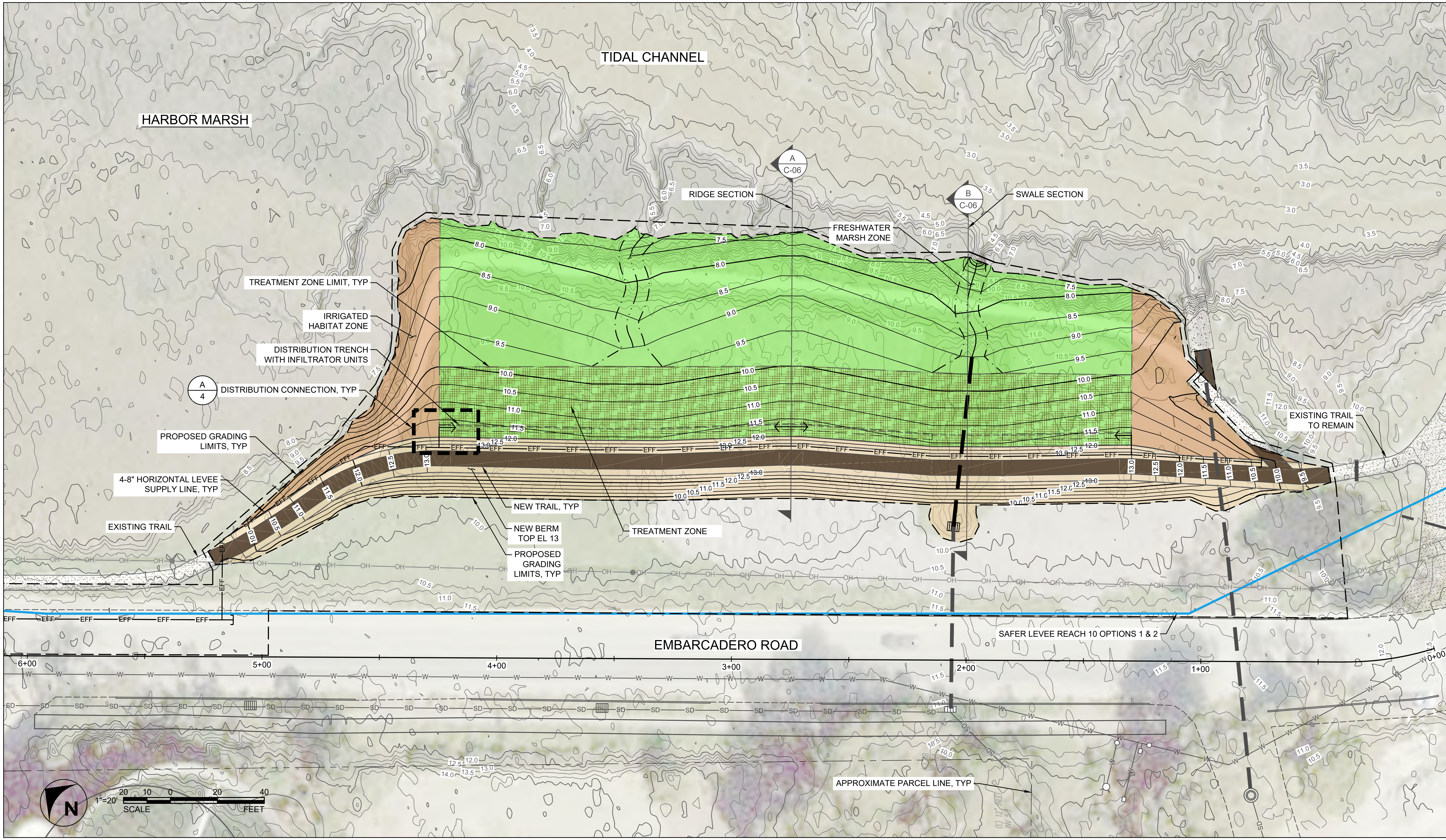
NOTE: AERIAL ORTHOIMAGERY FROM NORTHROP GRUMMAN (2015), AS DOWNLOADED FROM USGS EARTH EXPLORER DATABASE. IMAGERY WAS COLLECTED BY NORTHROP GRUMMAN BETWEEN FEBRUARY 20 TO FEBRUARY 24, 2015.

PALO ALTO HORIZONTAL LEVEE D181306.01

**FIGURE 1**
SITE LOCATION MAP

ESA

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PALO ALTO HORIZONTAL LEVEE D181306.01

**FIGURE 2**

EMBARADERO ROAD PHASE 1 PLAN VIEW

ESA

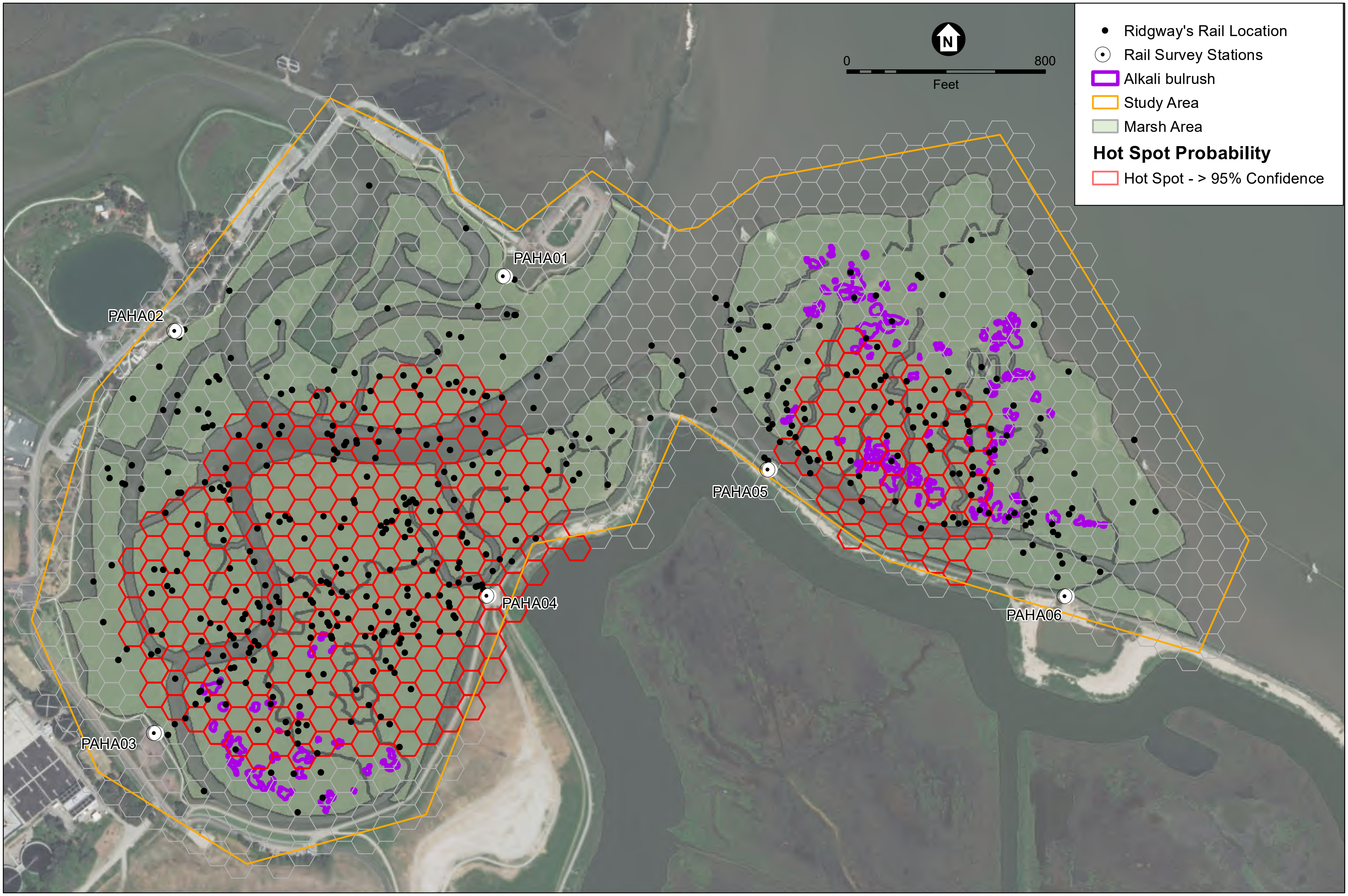
Figure 3. Coastal salt marsh at low tide below PAHLPP site. Native cordgrass (darker green) lines parts of the edge of the mudflat, and patches of alkali bulrush (brown) are visible in the distance on the upper right.


SOURCE: ESA; ISP; ESRI; DigitalGlobe 2017

Palo Alto Horizontal Levee Project D181306.0

**Figure 4**
ESA 2020 Rail Survey Detection Locations

ESA




SOURCE: ESA; PBCS; ISP; SFEI; ESRI; DigitalGlobe 2017

Palo Alto Horizontal Levee Project D181306.0

**Figure 5**
Ridgway's Rail Location Hot Spots (2008-2020 PBCS and ISP Surveys)

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Suite 1050
Oakland, CA 94612
510.839.5066 phone
510.839.5825 fax

www.esassoc.com

# Appendix 1

## Passive Survey Memorandum

# memorandum

| | |
|---|---|
| date | February 11, 2020 |
| to | Samantha Engelage, P.E., Senior Engineer, Environmental Services Division, City of Palo Alto |
| cc | Priya Finnemore, Technical Associate, ESA; Scott Stoller, Senior Managing Associate, ESA; Jill Sunahara, Program Manager, ESA |
| from | Leonard Liu, Senior Associate Biologist, ESA |
| subject | Results of California Ridgway's Rail Surveys at Harbor Marsh for the Palo Alto Horizontal Levee Project |

Dear Ms. Engelage,

Environmental Science Associates (ESA) recently completed surveys for Federal- and State-listed California Ridgway's rail (CRR; *Rallus obsoletus obsoletus*), formerly known as California clapper rail (*Rallus longirostris obsoletus*), at the Palo Alto Horizontal Levee Project (Project), Santa Clara County, California (Figure 1). Surveys for the Project were conducted at stations along Embarcadero Road adjacent to tidal salt marsh at Harbor Marsh in Palo Alto. This survey effort was undertaken to determine the presence of breeding rails near the Project. Activities for the Project could adversely affect CRR during the nesting season through direct and indirect impacts.

ESA detected numerous CRR in Harbor Marsh adjacent to the Project Area. ESA is submitting these survey results for your review, and also will notify United States Fish and Wildlife Service (USFWS) and California Department of Fish and Wildlife (CDFW) of the survey results.

**Project Location**

The Project site is located in southwest San Francisco Bay in Palo Alto, Santa Clara County, California. Access to the site is from Embarcadero Road. The Project is in upland or developed habitat, bordering tidal salt marsh in Harbor Marsh, which was formerly the Palo Alto Yacht Harbor and mouth of San Francisquito Creek (Figure 2). Harbor Marsh has been passively restoring since 1986, when the citizens of Palo Alto voted to close the harbor. To the west are Palo Alto Golf Course, Palo Alto Airport, and Palo Alto Regional Water Quality Control Plant (RWQCP). Harriet Mundy Marsh and the Lucy Evans Baylands Nature Interpretive Center are to the north, Byxbee Park is to the south, and Hooks Island and Mayfield Slough Flood Control Basin are to the east. Habitats within 700 feet of the Project include tidal salt marsh, tidal flat/shallow bay, and ruderal upland habitats.

The tidal salt marsh is of high quality, as it has numerous secondary and tertiary channels and mostly native vegetation-- dominated by perennial pickleweed (*Salicornia pacifica*) with patches of Pacific cordgrass (*Spartina foliosa*) and hybrid *Spartina alterniflora* in channels and marsh gumplant (*Grindelia stricta*) along many channels, and smaller patches of salt grass (*Distichlis spicata*), fleshy jaumea (*Jaumea carnosa*), and alkali heath (*Frankenia salina*).

Shallow bay and tidal mudflat habitats are unvegetated and found in the tidally influenced former channels of the harbor and the old mouth of San Francisquito Creek, adjacent to tidal salt marsh.

Developed areas contain ruderal upland, coyote brush (*Baccharis pilularis*), wild radish (*Raphanus sativus*), black mustard (*Brassica nigra*), eucalyptus (*Eucalyptus* spp.), annual grasses, and various ornamental plantings.

**Project Description**

The San Francisco Estuary Project and the City of Palo Alto plan to construct a horizontal levee pilot project at a location bordering Harbor Marsh (Figure 2). The horizontal levee will consist of: 1) a flood protection levee on the landward side for flood protection, 2) a permeable subsurface treatment zone for wastewater polishing, and 3) a habitat transition zone downslope of the treatment zone (Figure 3). Horizontal levees are a novel approach intended to: 1) create habitat for special status species by replicating freshwater seeps that historically occurred on gently sloping transitional zones from the uplands into tidal marshes, 2) provide sea-level rise adaptation by creating high tide refugia and marsh migration accommodation space in light of sea level rise, as well as increasing carbon sequestration through accretion of freshwater wetland plant biomass, and 3) filter highly treated wastewater through a subsurface zone to provide polishing-level treatment prior to discharge to San Francisco Bay. This Project builds on the experience gained through design, construction, and monitoring of the Oro Loma Horizontal Levee Demonstration Project in San Lorenzo, California (BO# 08ESMF00-2014-F-0372).

**Methods**

ESA conducted surveys to detect rails in accordance with the methods outlined in the California Clapper Rail Survey Protocol guidance document (USFWS 2015). ESA used three (3) avian survey stations to cover the west side of Harbor Marsh (Figure 4, Table 1). The stations previously had been used for surveys by Point Blue Conservation Science and the California Coastal Conservancy's Invasive *Spartina* Project (ISP). Each station covered approximately 31 acres with 200-meter (656-foot) radii around each station; total coverage was approximately 93 acres. Approximately 38 acres of the total survey area was coastal salt marsh habitat suitable for rail use (San Francisco Estuary Institute 2011).

Surveys conformed to the following parameters:

- Passive-listening surveys were conducted until CRR were detected, in which each of the listening stations was manned continuously during the survey. If CRR had not been detected within 700 feet of the listening stations after the first two passive-listening surveys, two active (call-playback) surveys would have been conducted.
- All surveys were conducted within a two hour (120-minute) period surrounding sunrise or sunset, starting no more than 60 minutes before sunrise or sunset and terminating within 60 minutes of sunrise and sunset. Each station was occupied for a total of 120 minutes during passive surveys.
- Surveys were not conducted when tides greater than 4.5 feet NGVD were predicted at the Golden Gate Bridge during the survey period (adjusted to the time of high tide at the Project Area), or during full moon periods.

- Surveys were not conducted when winds are over 10 miles per hour or gusts over 12 miles per hour, or during moderate to heavy rain, in order to increase detectability of vocalizations.

Per the protocol, all CRR vocalizations were noted, including the types, locations and times, on a detailed map of the survey area. Each biologist used a compass and distance estimation to locate detected listed rails on a map. Weather conditions were recorded at the beginning and end of each survey. Noise level at the site was qualitatively assessed on a zero (0) to four (4) scale: 0, no noise; 1, faint noise; 2, moderate noise (probably can't hear some birds beyond 100m); 3, loud noise (probably can't hear some birds beyond 50m); 4, intense noise (probably can't hear some birds beyond 25m).

Surveys were led by Leonard Liu (USFWS Permit #TE94998A-1), with assistance from ESA wildlife biologists Sharon Dulava and Erika Walther. Field assistants had previous experience with rail surveys and had demonstrated their ability to detect, identify, and map rail vocalizations.

ESA conducted a passive survey on January 31, 2020 (Table 2).

**Results**

Listening conditions during the surveys were good, with some noise from the RWQCP and airport limiting detectability of birds beyond 100 meters (164 feet). ESA detected numerous California Ridgway's rails during the surveys at all three stations. ESA then grouped the detections based on timing and counter-vocalizations to discern possible territorial boundaries. ESA estimates that there are 14 to 15 territories or generalized core locations within 300 meters (984 feet) of the survey stations (Figure 4). ESA estimates that the grouped detections represent approximately 28 to 30 CRR.

Alameda song sparrow (*Melospiza melodia pusillula*) was detected in the tidal marsh area, as well as saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*). Potential predators detected during surveys included northern harrier (*Circus hudsonius*) and American crow (*Corvus brachyrhynchos*). All bird species encountered during surveys are presented in Table 3.

**Conclusions**

The survey results conform to the most recent surveys at Harbor Marsh conducted by ISP in 2019 indicating that this is a high density CRR site (J. McBroom, pers. comm.). Project activities will need mitigation measures to avoid negative short-term impacts to CRR. Such measures include but are not limited to: restricting use of heavy equipment in close proximity to known CRR locations during the breeding season (approximately February 1 through August 31); restricting activities in close proximity to suitable habitat during extreme high tides when CRR may be forced out of tidal marsh; implementing worker education training to help workers recognize CRR and understand the importance of avoiding harm to CRR; and monitoring of work activities by a qualified biologist. With the implementation of prudent mitigation measures that avoid direct and indirect effect to this species during the breeding season, this restoration project should result in a net benefit for CRR.

Recovery of CRR will necessitate expansion of habitat transitions, as well as restoration of sites located in close proximity to existing breeding populations to facilitate dispersal and population expansion, in order to realize the resilient landscape that CRR will need this century to adapt to the challenges of sea level rise.

I, Leonard Liu (TE-94998A-1) certify that the information in this survey report and attached exhibits fully and accurately represents my work.

________________________
Signature

_February 11, 2020__________
Date

## References

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U.S. Fish and Wildlife Service (USFWS). Sacramento Office. June, 2015. California Clapper Rail Survey Protocol.

Table 1. California Ridgway's rail survey points at Palo Alto Harbor Marsh. Coordinates are in UTM NAD 83 zone 10S.

| Station ID | X-coordinate | Y-coordinate |
|---|---|---|
| PAHA01 | 579302 | 4145979 |
| PAHA02 | 578898 | 4145912 |
| PAHA03 | 578873 | 4145418 |

Table 2. Results of 2020 California Ridgway's rail surveys. Noise code: 0, no noise; 1, faint noise; 2, moderate noise; 3, loud noise; 4, intense noise.

| Round | Date | Acres surveyed | Rails Detected | Temp. start (°F) | Temp. end (°F) | Sky start | Sky end | Wind speed start (mph) | Wind speed end (mph) | Noise code |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 31-Jan | 93 | 28-30 | 43 | 47 | Part cloud | Part cloud | 0 | 2 | 2 |

Table 3. Other birds detected during 2020 California Ridgway's rail surveys.

| Common name | Scientific name |
|---|---|
| Bufflehead | *Bucephala albeola* |
| Mallard | *Anas platyrhynchos* |
| Northern shoveler | *Spatula clypeata* |
| American green-winged teal | *Anas crecca carolinensis* |
| Ruddy duck | *Oxyura jamaicensis* |
| American wigeon | *Mareca americana* |
| Canada goose | *Branta canadensis* |
| American coot | *Fulica americana* |
| Double-crested cormorant | *Phalacrocorax auritus* |
| Killdeer | *Charadrius vociferus* |
| Black-bellied plover | *Pluvialis squatarola* |
| Wilson's snipe | *Gallinago delicata* |
| Long-billed curlew | *Numenius americanus* |
| Dowitcher spp. | *Limnodromus spp.* |
| Least sandpiper | *Calidris minutilla* |
| Western sandpiper | *Calidris mauri* |
| Black-necked stilt | *Himantopus mexicanus* |

| Common name | Scientific name |
|---|---|
| American avocet | *Recurvirostra americana* |
| Willet | *Tringa semipalmata* |
| Greater yellowlegs | *Tringa melanoleuca* |
| Ring-billed gull | *Larus delawarensis* |
| Snowy egret | *Egretta thula* |
| Northern harrier | *Circus hudsonius* |
| American crow | *Corvus brachyrhynchos* |
| Common raven | *Corvus corax* |
| Marsh wren | *Cistothorus palustris* |
| Bewick's wren | *Thryomanes bewickii* |
| Say's phoebe | *Sayornis saya* |
| Black phoebe | *Sayornis nigricans* |
| Saltmarsh common yellowthroat | *Geothlypis trichas sinuosa* |
| White-crowned sparrow | *Zonotrichia leucophrys* |
| Alameda song sparrow | *Melospiza melodia* |
| California towhee | *Melozone crissalis* |
| House finch | *Haemorhous mexicanus* |


DWG: \\Sfo-file01\esapwa\Data\projects_2012\D120042.03 - Oro Loma IRWMP Support\09 CAD\Figures\20200228_Working\FIG01_Site_Location.dwg USER: Brent Davis PLOT DATE: 2/28/2020 3:36:14 PM

NOTE: AERIAL ORTHOIMAGERY FROM NORTHROP GRUMMAN (2015), AS DOWNLOADED FROM USGS EARTH EXPLORER DATABASE. IMAGERY WAS COLLECTED BY NORTHROP GRUMMAN BETWEEN FEBRUARY 20 TO FEBRUARY 24, 2015.

PALO ALTO HORIZONTAL LEVEE
D181306.00

**FIGURE 1**
SITE LOCATION MAP

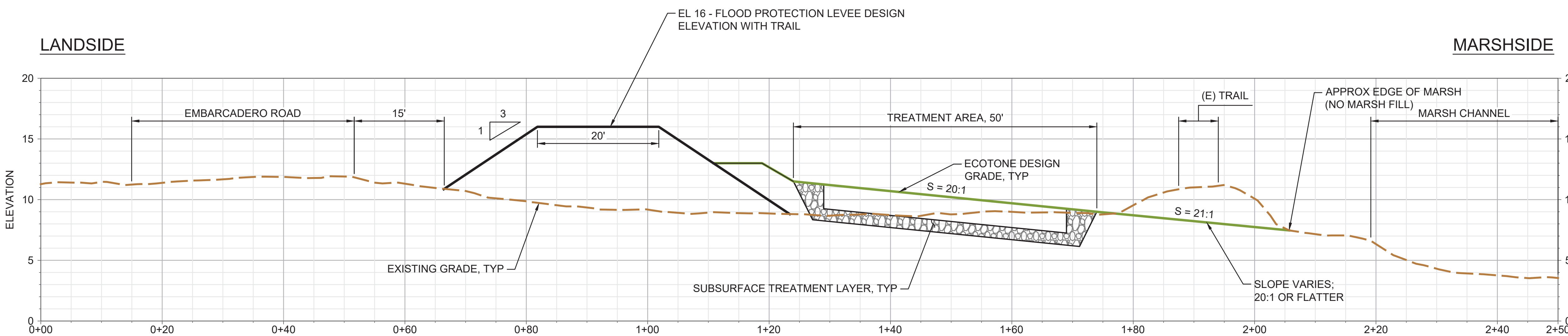
ESA


NOTE: AERIAL ORTHOIMAGERY FROM NORTHROP GRUMMAN (2015), AS DOWNLOADED FROM USGS EARTH EXPLORER DATABASE. IMAGERY WAS COLLECTED BY NORTHROP GRUMMAN BETWEEN FEBRUARY 20 TO FEBRUARY 24, 2015.

PALO ALTO HORIZONTAL LEVEE
D181306.00

**FIGURE 2**
EMBARCADERO
ROAD OVERVIEW

ESA




A
3
SECTION
EMBARCADERO ROAD
VERT: 1" = 10'
HORIZ: 1" = 20'

NOTE: EXISTING GRADE SURFACE IS APPROXIMATE AND BASED ON USGS TOPOGRAPHIC LIDAR (USGS, 2010), AS DOWNLOADED FROM THE NOAA OFFICE FOR COASTAL MANAGEMENT. ELEVATIONS ARE PRESENTED IN NORTH AMERICAN VERTICAL DATUM OF 1988.

10 5 0 10 20
Scale Feet

DWG: \\Sfo-file01\esapwa\Data\projects_2012\D120042.03 - Oro Loma IRWMP Support\09 CAD\Figures\20200228_Working\FIG03_EMBARCADERO_SOUTH_XS.dwg USER: Brent Davis PLOT DATE: 2/28/2020 3:35:20 PM

PALO ALTO HORIZONTAL LEVEE
D181306.00

**FIGURE 3**
EMBARCADERO SOUTH
CROSS SECTION

ESA


SOURCE: ESA; ESRI; DigitalGlobe 2017

Palo Alto Horizontal Levee Project D181306.0

**Figure 4**
Rail Survey Stations and Rail Detection Locations

ESA

# Appendix I

## Site Selection Memorandum

1425 N. McDowell Boulevard
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# memorandum

date October 14, 2020

to Samantha Engelage, PE, Senior Engineer, Environmental Services Division, City of Palo Alto

cc

from Liane Ware, PE, Project Manager

subject Site Selection – Palo Alto Horizontal Levee Pilot Project

Dear Ms. Engelage,

During the preliminary design process for the originally preferred project location at the Central Reach of Harbor Marsh, a potential land use compatibility issue came to light regarding Federal Aviation Administration (FAA) guidance on the proximity of wetlands habitats to public airports. Although the FAA guidance related to creation of wetlands habitat applies to all lands within a certain distance of an operational airport, within which all of the Palo Alto Baylands - and therefore all of the alternative sites - are located, this issue was expected to be particularly challenging for the originally preferred project site (Central Reach), due its location on City Airport property. Therefore, the City wanted to consider alternative sites that could better adhere to FAA guidance to address comments/concerns from the Palo Alto Airport.

Subsequently, the City identified a number of potential sites for the Palo Alto Horizontal Levee Pilot Project. The project locations considered and approaches are described and considered potential locations are shown in the included figure at the end of this memo.

**Option 1 - No Pilot Project**

This option would absorb the pilot project into the larger levee system at the Palo Alto Baylands to be constructed as part of the SAFER Bay or Shoreline Study levee. In this option, the City would lobby to include a pilot horizontal levee system as part of a potential SAFER Bay/Shoreline Study levee. While the City could not guarantee that a horizontal levee component would be included in the final levee plans, there is a reasonable chance that the City could successfully add a horizontal levee element to the larger project since they are a critical stakeholder in the larger levee improvement project. As with all sites and options considered, coordination and/or approval from the FAA and adherence to some or all applicable FAA guidelines related to creation of wetlands habitat is expected to be necessary. For this option, FAA coordination may more appropriately be led by the SAFER Bay or Shoreline Study team.

There could be significant cost benefit for the project with this comprehensive approach for the Shoreline Study and horizontal levee to be designed and constructed together if the USACE-assigned economic impact area number 1 project qualifies for a high enough benefit-cost ratio to successfully compete nationally for federal funding. Federal funding would cover 65% of the flood protection portion of the defined project, which may exclude the ecotone slope and habitat restoration elements. The remaining costs to cover the 35% of the flood protection project plus the full amount of the habitat restoration would be owed by the City of Palo Alto and Valley Water. The 35% project cost share could be covered by credits received for real estate acquisitions (all lands, easements, rights-of-way, relocations and disposal areas (LERRD)) necessary to implement the project (USACE, 2014).

The timeline under this option is expected to require 10 to 20 years until construction, and the SAFER Bay/Shoreline Study may not consider local scale, site-specific data in design of the horizontal levee. The focus would primarily be on engineering soundness with respect to flood protection and secondarily include ecosystem and habitat restoration elements where possible within the project. This option would not allow for the demonstration period of the constructed pilot project to inform on performance ahead of construction of future horizontal levee and ecotone elements that could be added to the larger SAFER Bay/Shoreline Study levee project. Consequently, this option was not chosen by the City to move forward.

**Option 2 - South Reach with Horizontal and Flood Protection Levees**

Under this option, the proposed pilot project would move to a new location approximately 600 feet south of the originally preferred Central Reach location. This option would include construction of the horizontal levee and adjacent portion (approximately 450 LF) of the flood protection levee as one system in the South Reach site location. Under this option, the flood control levee in this limited reach would be constructed before the SAFER Bay/Shoreline Study levee is implemented. As with all sites and options considered, due to the site's proximity to an operational airport, coordination and/or approval from the FAA and adherence to some or all applicable FAA guidelines related to creation of wetlands habitat is expected to be necessary.

This project would be designed and permitted as a stand-alone project such that the future flood protection levee to the north and south of the project would be separate and would connect to the South Reach horizontal levee system in subsequent years. This reach of the proposed horizontal levee and irrigated ecotone along Embarcadero Road (shortened to project site available length) was presented in the Conceptual Design alternatives memo (ESA, 2018b) and shares an alignment with the full SAFER Bay Reach 10 levee. This option could include two sub-options to either construct the flood protection levee to its full height or construct a levee core to partial height, which would require the SAFER Bay/Shoreline Study flood control levee project to raise the levee to the design elevation during subsequent construction.

Constructing the full height flood protection levee in one stage simplifies integration with the larger flood control levee improvements since this segment would not require any re-work. Construction of the full flood protection levee would be likely to require two seasons to allow for settlement and strengthening of the bay mud subgrade to achieve the full flood control levee design height. Completion would be targeted by 2025. This option would have the added cost of the additional (imported) fill to meet the flood control levee height requirements. In addition, installing only a 450-foot length of levee to the design elevation of 16 feet (plus up to an additional 1.5 feet for overburden) could create a visually awkward “island” in the landscape. For reference, Embarcadero Road in this area is at elevation 11.5 feet on the Bay side.

It is possible that the full-height SAFER Bay levee could be permitted as part of this option with the full height levee constructed in accordance with the SFCJPA’s schedule. Depending on SFJPA’s schedule and permit durations, this may or may not be feasible. Constructing the partial height levee core raised concerns by the SFCJPA that the need to obtain a second round of permits for raising the levee would be complicated by potential wildlife impacts created by introduction of the horizontal levee.

Option 2 allows for the pilot system to generate timely data to incorporate into design specifications for the Safer Bay/Shoreline Study levee as well as inform on the horizontal levee performance for other projects being planned for the Bay shoreline. It would require relocation of the overhead utility alignment along the east edge of Embarcadero Road (and associated PG&E and franchise utility coordination), but impacts to the habitat created by the PAHLPP would be minimized in the full-height approach. Under this option, the City would bear the full cost to construct the flood protection levee core as there would be no cost share under this option since the project would be ahead of the SAFER Bay/Shoreline Study levee. Thus, it would be a more expensive project without dedicated funding at this time; however, there would be a potential for grant funding. The flood protection levee core would need to be built to the USACE specifications, or it may be demolished and reconstructed during implementation of the SAFER Bay/Shoreline Study levee. This option is expected to be self-mitigating by creating more wetland habitat than would be impacted by the project. However, this approach would limit the potential for future mitigation credit needs for impacts associated with the SAFER Bay/Shoreline Study levee.

**Option 3 - South Reach Horizontal Levee Only**

This option would be similar to Option 2, but would focus on construction of the 450-LF horizontal levee and irrigated ecotone in the South Reach site location. The option includes a smaller, lower inboard berm (for which USACE specifications are not intended) instead of the flood protection levee. This project would be designed and permitted as a stand-alone project offset from Embarcadero Road such that the future, parallel SAFER Bay/Shoreline Study flood protection levee would be a separate project that would connect to the PAHLPP in subsequent years. As with all sites and options considered, due to the site’s proximity to an operational airport, coordination and/or approval from the FAA and adherence to some or all applicable FAA guidelines related to creation of wetlands habitat is expected to be necessary.

This project has the smallest possible footprint while still constructing the pilot system that allows for improved ecosystem and habitat restoration. It would also provide generation of timely data to incorporate into design specifications for the SAFER Bay/Shoreline Study levee and to inform on the horizontal levee performance for other projects. Impacts to the existing habitat created by the pilot would be minimized as compared to other options. The narrower footprint of this project approach is focused on creation of the habitat slope with a low (approximate four-foot tall) berm along the road side of the horizontal levee to EL 13 feet NAVD. The berm will not provide additional flood protection as it is connecting to lower, existing berm elevations on either end. However, the berm allows for the placement of the trail atop it and inboard of the horizontal levee, and the berm also provides space for the irrigation supply line that will serve the distribution system for the ecotone.

The project scale would allow for construction to be targeted in 2023. It is anticipated that the future SAFER Bay/Shoreline Study levee would tie into the low berm during construction, and/or a portion of the low berm may be removed and reworked during construction of the larger flood control levee. To the extent possible, the horizontal levee elements (specifically, the treatment zone and associated infrastructure) will be designed and placed such that future construction impacts from the SAFER Bay/Shoreline Study levee are minimized. To support the adjacent treatment areas, the intent of the project is to construct the berm (materials, subgrade preparation, compaction, etc.) per geotechnical recommendations developed for levee fill following USACE guidance on stability and seepage. This approach could provide additional assurance that the effluent supply line for the irrigated ecotone will not require relocation due to construction impacts from the future flood protection levee. In later design phases, if the benefits of constructing the berm as a core for the future levee (fully complying with USACE specifications with the intent to remain) outweigh the added cost and replacement risk, that approach could be considered. These details will be refined in more advanced design levels.

Similar to Option 2, the City would bear all the costs associated with construction of the horizontal levee as the project would be ahead of the SAFER Bay/Shoreline Study levee; however, there is the potential for grant funding. This option may require mitigation of the environmental impact by the pilot, but it is anticipated to be self-mitigating given the area of new habitat created. Depending on the approach for construction of the future SAFER Bay/Shoreline Study levee, it is possible that mitigation may be required if flood protection levee construction impacts the upper margin of horizontal levee habitat.

Option 3 is currently preferred by the City due to its need for habitat restoration, ability to collect early data as a pilot, future connectivity potential to larger flood control levee improvement projects, and proximity to source of treated wastewater. It is possible during detailed design development that geotechnical guidance may steer the project toward Option 2 to address concerns related to differential subsurface conditions along the future SAFER Bay/Shoreline Study levee corridor. Therefore, the South Reach 30%-complete plan set and cost estimate presented in this report are based on this option. The City and Valley Water publically presented an update on sea level rise adaptation projects, including the SAFER Bay, Shoreline Study, and the South Reach PAHLPP option via a Webinar on September 9, 2020 and received supportive and excited feedback.

**Option 4 - Central Reach Horizontal and Flood Protection Levee**

This Option was developed to the 30% design level and presented in the earlier Preliminary Design Report (ESA, 2019). Similar to Option 2, Option 4 would construct the horizontal levee and adjacent portion (approximately 900 LF) of the flood protection levee as one system ahead of the SAFER Bay/Shoreline Study levee.

The primary differences from Option 2 are related to the larger project site with respect to the length along Embarcadero Road as well as the wider upland corridor between Embarcadero Road and the Harbor Marsh. The larger area would allow for a larger horizontal levee pilot with incrementally higher grades and flatter slopes that would offer improved habitat benefits. Option 4 can address the identified need for restoration in the large area of poor-quality upland habitat per the BCCP and Baylands Master Plan. Additionally, the closer proximity to the RWQCP would reduce the effluent supply pipe length for the horizontal levee irrigation.

As with all sites and options considered, due to the site's proximity to an operational airport, coordination and/or approval from the FAA and adherence to some or all applicable FAA guidelines related to creation of wetlands habitat is expected to be necessary. However, the permitting complications for this site are increased due to this site's location on City Airport lands, as documented during the previous preliminary design analysis. It is possible that this reach of horizontal levee could be constructed as part of a future SAFER Bay/Shoreline Study levee to provide for mitigation of impacts associated with the larger flood protection project that will traverse areas of tidal marsh habitat. However, this option was not chosen by the City to move forward for the pilot project.

**Option 5 - Harriet Mundy Marsh Sailing Station with Horizontal Levee**

This site is located bayward of Embarcadero Road connecting to the existing tidal marsh outboard of Harbor Marsh. Similar to Option 3, this option would include construction of up to 400-LF horizontal levee and irrigated ecotone specifically located away from the SAFER Bay/Shoreline Study area. This project would be designed and permitted as a stand-alone project that would be bayward of (and completely disconnected from) the future flood protection levee alignments currently being considered in the SAFER Bay/Shoreline Study processes. As with all sites and options considered, due to the site's proximity to an operational airport, coordination and/or approval from the FAA and adherence to some or all applicable FAA guidelines related to creation of wetlands habitat is expected to be necessary.

This location and approach would not result in any potential impacts to or from the SAFER Bay/Shoreline Study levee. However, the Option 5 project location would be disconnected from the future flood control levee network creating potential issues for long-term viability with respect to access to and maintenance of the horizontal levee for sea level rise. This location could become more viable if the City plans to maintain (raise) Embarcadero Road to keep pace with sea level rise. Additionally, this area was recently restored and no longer in need of habitat enhancements. Consequently, this option was not chosen by the City to move forward.

**Option 6 - Harbor Marsh Landfill Horizontal Levee**

This option includes construction of a 700-LF pilot horizontal levee and irrigated ecotone in Harbor Marsh adjacent to the landfill at the end of Embarcadero Road. Similar to Option 5, this option would be designed and permitted as a stand-alone project that is independent of the SAFER Bay/Shoreline Study flood protection levee. As with all sites and options considered, due to the site's proximity to an operational airport, coordination and/or approval from the FAA and adherence to some or all applicable FAA guidelines related to creation of wetlands habitat is expected to be necessary.

The USACE does not consider the landfill in need of flood protection, and there are no plans to construct a flood control levee to USACE specifications along this reach. Thus, there would be no federal cost share to support construction of a horizontal levee along the landfill. This option would require City funding augmented with potential grants.

Option 6 would allow for the pilot system to generate timely data to incorporate into design specifications for the SAFER Bay/Shoreline Study as well as inform on the horizontal levee performance. However, Option 6 is complicated by the narrow upland corridor along the landfill for a number of potential reasons. Primarily, the horizontal levee would need to be constructed almost entirely within the existing Harbor Marsh, requiring considerable fill (volume and area) within existing salt marsh and tidal channel. While regulatory agencies are in the process of amending their policies to allow for fill within existing salt marsh that provides for habitat benefits and sea level rise accommodation, these new/draft policies have not been tested. There could be unforeseen permitting issues associated with construction in existing tidal marsh, and the environmental impact of the horizontal levee construction may require mitigation. Additionally, the Harbor Marsh is relatively young, having formed within the dredged Palo Alto Yacht Harbor, so the sediments within this marsh area likely to be extremely weak, which would add to the construction costs and complexity. Finally, the landfill is likely to have a leachate collection system that could be sensitive to differential settlement potentially triggered by fill placement along the toe of the landfill in the adjacent marsh. Thus, significant geotechnical and engineering design challenges are anticipated with this location. Consequently, this option was not chosen by the City to move forward.

**Option 7 - Flood Basin Landfill Horizontal Levee**

Similar to Option 6 (but located in the Flood Basin), this option envisions construction of up to 1,900-LF of horizontal levee and irrigated ecotone along the Mayfield Slough adjacent to the landfill. Similar to Option 5, this option would be designed and permitted as a stand-alone project that is independent of the SAFER Bay/Shoreline Study flood protection levee. As with all sites and options considered, due to the site's proximity to an operational airport, coordination and/or approval from the FAA and adherence to some or all applicable FAA guidelines related to creation of wetlands habitat is expected to be necessary.

From a funding perspective, this option is also similar to Option 6 in that there would be no federal cost share, and the City would bear all the costs associated with construction of this option (potentially augmented with grant funding opportunities). From both a construction and permitting perspective, Option 7 is even more complex and challenging than Option 6 as it would require fill placement in the adjacent Mayfield Slough (open water) channel for the horizontal levee. Furthermore, the current Flood Basin configuration supports muted tidal action within the basin that could impact the effectiveness of the pilot horizontal levee. Consequently, this option was not chosen by the City to move forward.

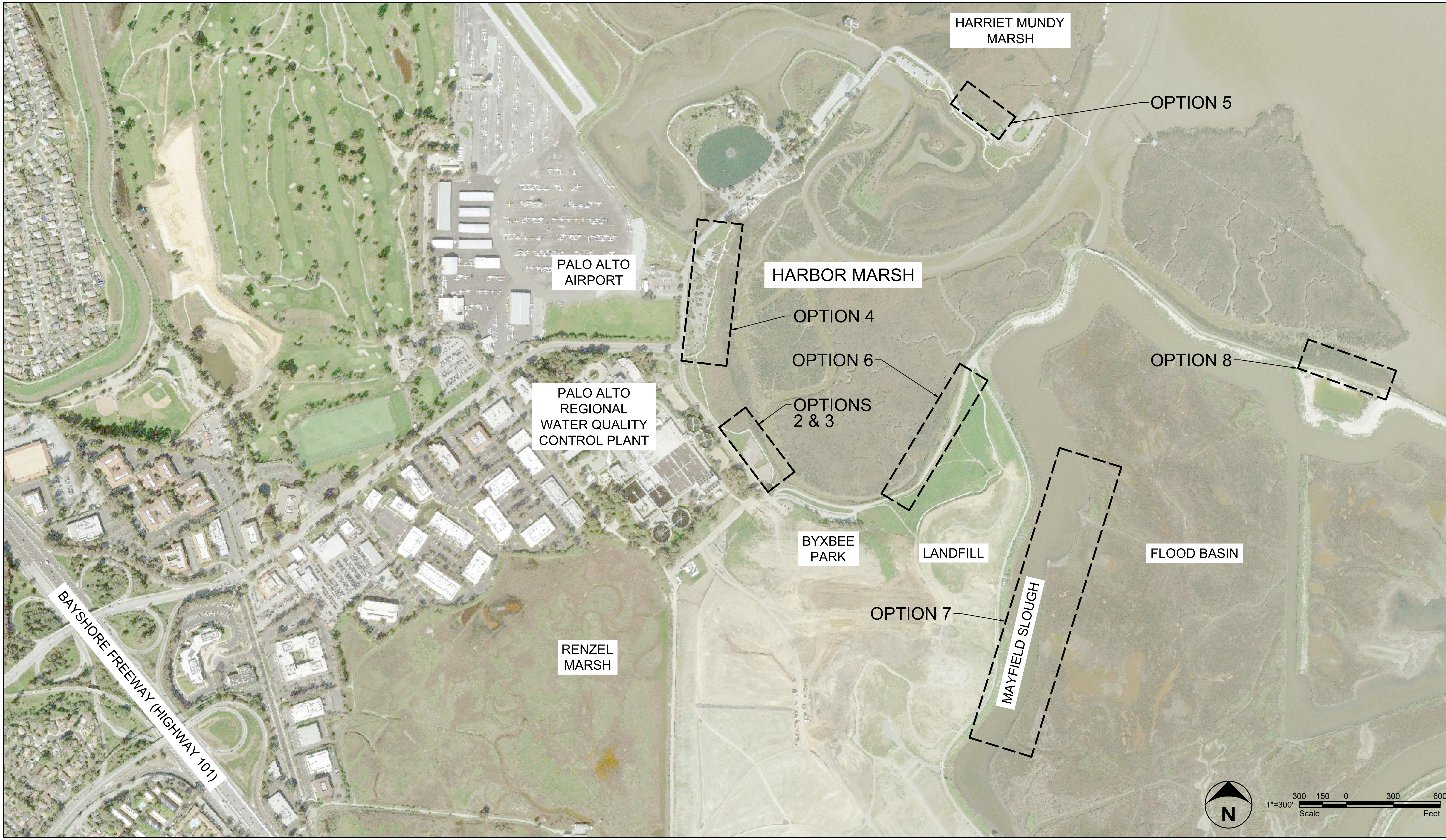
**Option 8 - Adobe Creek Bowl Horizontal Levee**

This option includes construction of a 450-LF horizontal levee and irrigated ecotone within the existing topographical "bowl" adjacent to the Flood Basin along the Adobe Creek Loop Trail. This option would be designed and permitted as a stand-alone project that is independent of the SAFER Bay/Shoreline

Study flood protection levee; however, depending on the ultimate alignment, it could be integrated into the SAFER Bay/Shoreline Study levee in the future. As with all sites and options considered, due to the site's proximity to an operational airport, coordination and/or approval from the FAA and adherence to some or all applicable FAA guidelines related to creation of wetlands habitat is expected to be necessary.

This location shares the proposed Shoreline Study levee alignment and one of the three proposed alignments for the SAFER Bay levee. The topographic bowl is relatively wide and would allow for a broad horizontal levee sloping toward the Bay from the proposed SAFER Bay/Shoreline Study levee. Thus, the project could be designed to allow for integration into the SAFER Bay/Shoreline Study levee during construction of the larger flood protection levee project in the future. This location is relatively far from the City's RWQCP, requiring one mile of additional pipeline to deliver treated wastewater to the site that would need to be removed and reconstructed during implementation of the future flood protection levee. Additionally, this distance from the plant and shared access with a public trail would add to the complexities for RWQCP staff to access, monitor, and maintain the horizontal levee system. Furthermore, because of this site's connection to the flood basin, coordination with and approval through Valley Water and other agencies would be required.

Depending on the configuration, the flood protection levee would be eligible for a federal cost share; however, the near-term construction of the horizontal levee would require City funding augmented with potential grants. This option allows for the pilot system to generate timely data to incorporate into design specifications for the SAFER Bay/Shoreline Study as well as inform on the horizontal levee performance. It is unknown if the horizontal levee would be self-mitigating given this wetland fill. Consequently, this option was not chosen by the City to move forward.




DWG: U:\Projects\SFO\18xxx\D181306.00 - Palo Alto Horizontal Levee\09 CAD\Dwgs\PDR FIGURE 5 - OPTIONS.dwg USER: Liane Ware PLOT DATE: 10/15/2020 10:05:00 PM

NOTE: AERIAL ORTHOIMAGERY FROM NORTHROP GRUMMAN (2015), AS DOWNLOADED FROM USGS EARTH EXPLORER DATABASE. IMAGERY WAS COLLECTED BY NORTHROP GRUMMAN BETWEEN FEBRUARY 20 TO FEBRUARY 24, 2015.

PALO ALTO HORIZONTAL LEVEE D181306.01

**FIGURE 2**

PROJECT OPTIONS LOCATION MAP

ESA

# Appendix J
## Phase Transition Memorandum

ESA

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Oakland, CA 94612
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www.esassoc.com

# memorandum

| | |
|---|---|
| date | December 17, 2020 |
| to | Samantha Engelage, P.E., Senior Engineer, Environmental Services Division, City of Palo Alto |
| cc | Heidi Nutters, San Francisco Estuary Partnership, Bay Area Metro Center |
| from | Liane Ware, Project Manager, Restoration Design Engineer |
| subject | Phase Transition from 30% to 60% Design – Palo Alto Horizontal Levee Pilot Project |

Dear Ms. Engelage and Ms. Nutters,

The purpose of this Phase Transition Memorandum is to capture and group the final 30% phase documentation and feedback that will be addressed in future phases of the Palo Alto Horizontal Levee Pilot Project ("PAHLPP"), including in the upcoming 60% design. This memorandum serves as the final document to be prepared (representing all final revisions on prior documents as complete) for the 30% design phase.

## Design Drawings

As part of the 30% design phase, ESA provided drawings of the project site and design. Palo Alto ("City") Engineering provided informative comments on the drawings on October 12, 2020. The extent to which some of the comments apply with respect to design phases exceed that of a standard 30% level. ESA revised the drawings based on an assessment of those comments that apply to 30% and associated scope (as confirmed by the City). Revised plans that were delivered to the City on October 21, 2020 are the final versions for this 30% phase. Comments that were not addressed will be carried forward for consideration and application within the future phases. ESA has tracked those comments as shown in Attachment 1. Additional coordination with the City is anticipated to ensure applicable comments are sufficiently addressed.

**BRRIT Presentation Feedback**

On November 4, 2020, the City, along with the San Francisco Estuary Partnership ("SFEP") and ESA, presented the 30% design to the Bay Restoration Regulatory Integration Team ("BRRIT"), and feedback was received both during the meeting as well as in written comment form on November 20, 2020. A copy of the comments is included in the updated Preliminary Design Report ("PDR") Appendix D, Permitting Strategy Memorandum ("memo"). The City, SFEP, and ESA met on December 4, 2020 to review the BRRIT comments and discuss the project approach moving forward based on incorporating that feedback. The Permitting Strategy Memo has been revised to reflect the discussion of that December 4th team meeting relative to the BRRIT feedback. The PDR has also been revised in relevant sections referencing the BRRIT meeting. A final, compiled PDR with the updated Permitting Strategy Memo appendix is being provided to the City and SFEP on December 18, 2020.

**Coastal Ecologist, Botanist Consultant Feedback**

ESA's subconsultant, Dr. Peter R. Baye, reviewed the 2020 comments provided by BRRIT following our November presentation. Dr. Baye provided a memo offering feedback regarding regulatory review and design with respect to the BRRIT comments. This feedback was briefly discussed in the aforementioned December 4th team meeting, and will inform on the 60% design and permitting in the upcoming phase. Dr. Baye's memo is provided in Attachment 2.

**Public Access**

Much of the feedback, both from BRRIT and Dr. Baye, includes discussion around the Bay Trail and public access. The scope of the upcoming phase is being prepared to include stakeholder outreach and engagement. That effort will include workshops as well as ongoing feedback from BRRIT and the agencies it comprises. The 60% design will incorporate the future input per coordination with the City, SFEP, and design team.

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# Attachment 1

## City Comments on 30% Drawings for Future Phase Incorporation

GLOBAL: RED-CLOUD, YELLOW-FILL COMMENTS TO BE ADDRESSED AFTER 30%

DRAFT 30% DESIGN DRAWINGS

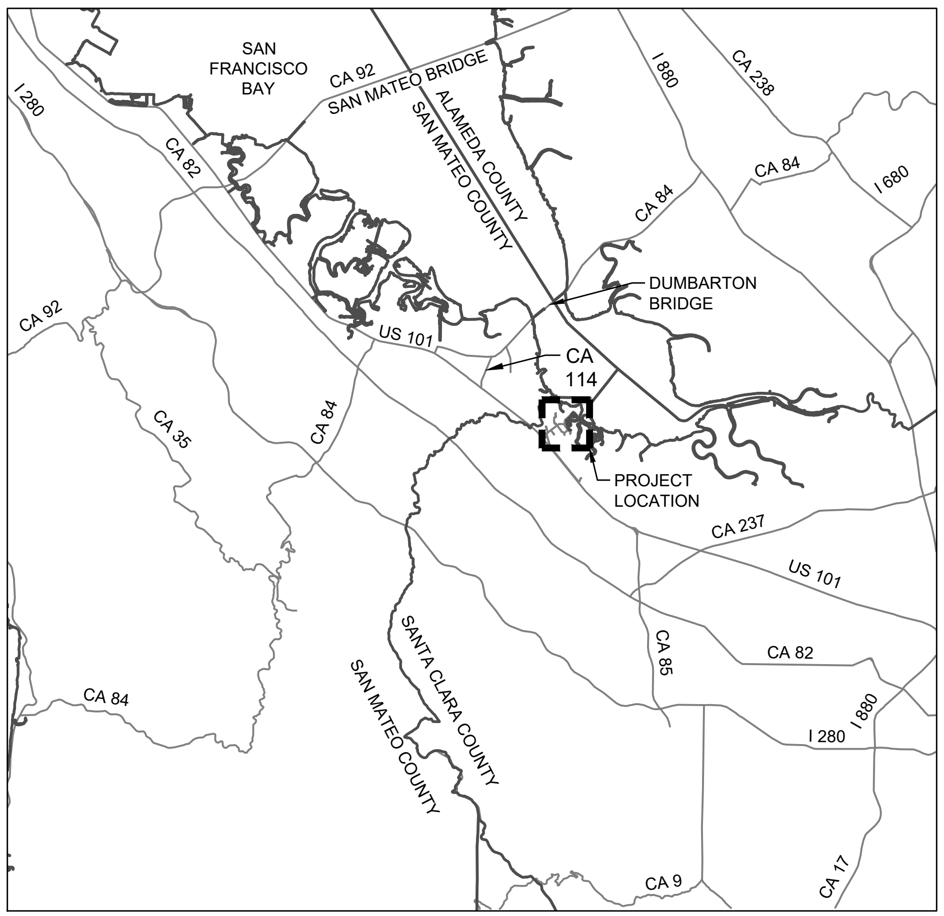
# PALO ALTO HORIZONTAL LEVEE PILOT PROJECT

SEPTEMBER 23, 2020

## DRAFT 30% DESIGN DRAWINGS

CITY OF PALO ALTO, CALIFORNIA

Add LEGEND

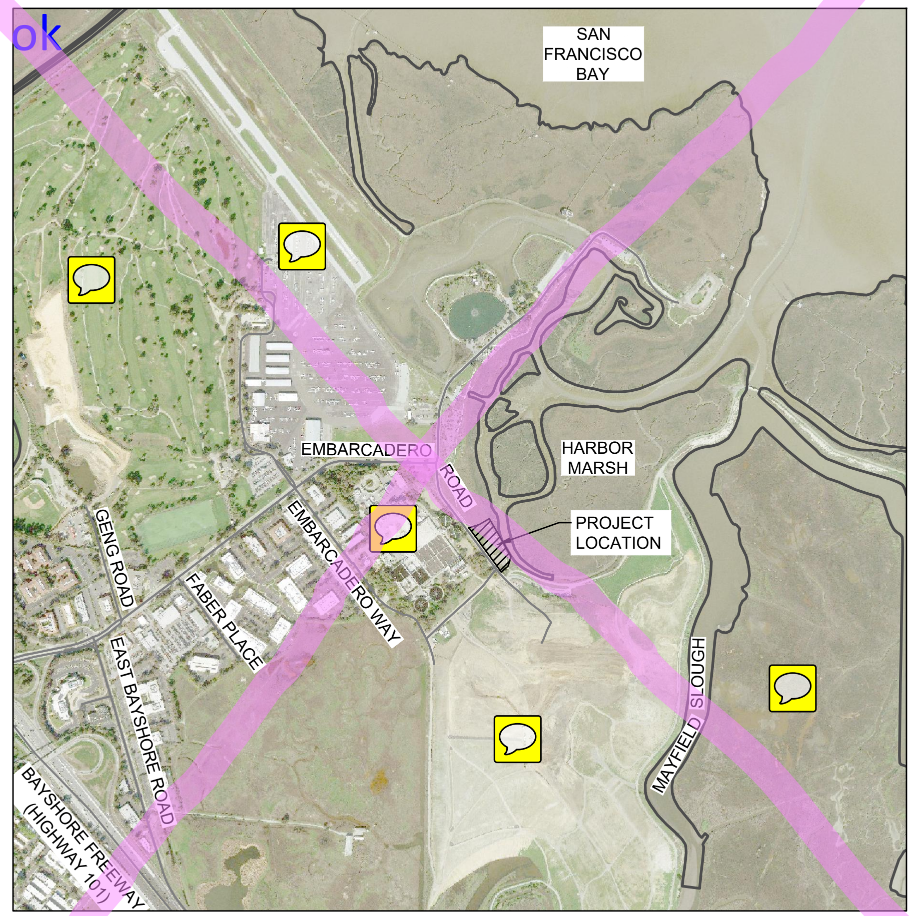



LOCATION MAP

CITY OF PALO ALTO

N

ok




VICINITY MAP

SCALE: 1" = 800'

N

Need to add General Construction Notes, for example work hours, protect existing utilities, USA marking requirements, what to do if encountering an unknown utility or design change

### SHEET INDEX

| PAGE NO. | SHEET NO. | SHEET TITLE |
|---|---|---|
| 1 | C-01 | TITLE |
| 2 | C-02 | OVERALL SITE PLAN |
| 3 | C-03 | EXISTING CONDITIONS AND DEMOLITION |
| 4 | C-04 | DETAILED PLAN |
| 5 | C-05 | UTILITY PLAN |
| 6 | C-06 | TYPICAL CROSS SECTIONS |
| 7 | C-07 | GRADING SECTIONS 1 |
| 8 | C-08 | GRADING SECTIONS 2 |
| 9 | C-09 | DETAILS |
| 10 | C-10 | PLANTING PLAN |
| 11 | C-11 | STORMWATER BMPS |
| 12 | M-01 | INSTRUMENTATION DIAGRAM (P&ID) |

add Stormwater BMPs sheet

### ABBREVIATIONS

| | |
|---|---|
| AC | ASPHALTIC CONCRETE |
| CONC | CONCRETE |
| D/S | DOWNSTREAM |
| (E) | EXISTING |
| EL | ELEVATION |
| EFF | EFFLUENT |
| F/L | FLOWLINE |
| G | GAS |
| HDPE | HIGH-DENSITY POLYETHYLENE |
| INV | INVERT |
| JP | JOINT SERVICE POLE |
| (N) | NEW |
| OVHD / OH | OVERHEAD UTILITIES |
| RCP | REINFORCED CONCRETE PIPE |
| RW | RECLAIMED WATER |
| SAFER | STRATEGY TO ADVANCE FLOOD PROTECTION, ECOSYSTEMS, AND RECREATION |
| SCP | SURVEY CONTROL POINT |
| SD | STORM DRAIN |
| SS | SANITARY SEWER |
| TYP | TYPICAL |
| U/S | UPSTREAM |
| W | WATER |
| WM | WATER METER |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STAMP

PRELIMINARY - NOT FOR CONSTRUCTION

CONSULTANT

CITY OF PALO ALTO

PROJECT NAME

PALO ALTO HORIZONTAL LEVEE PILOT PROJECT

EMBARCADERO ROAD
PALO ALTO, CA 94303

REVISIONS

| # | DATE | DESCRIPTION |
|---|---|---|

| | |
|---|---|
| DESIGNED | ML |
| DRAWN | GW, BD |
| CHECKED | LW |
| IN CHARGE | M. LINDLEY 66701 |
| PROJECT NUMBER | D201801306.01 |
| ISSUE DATE | 09/23/2020 |

SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")

1"

DRAFT 30% DESIGN DRAWINGS

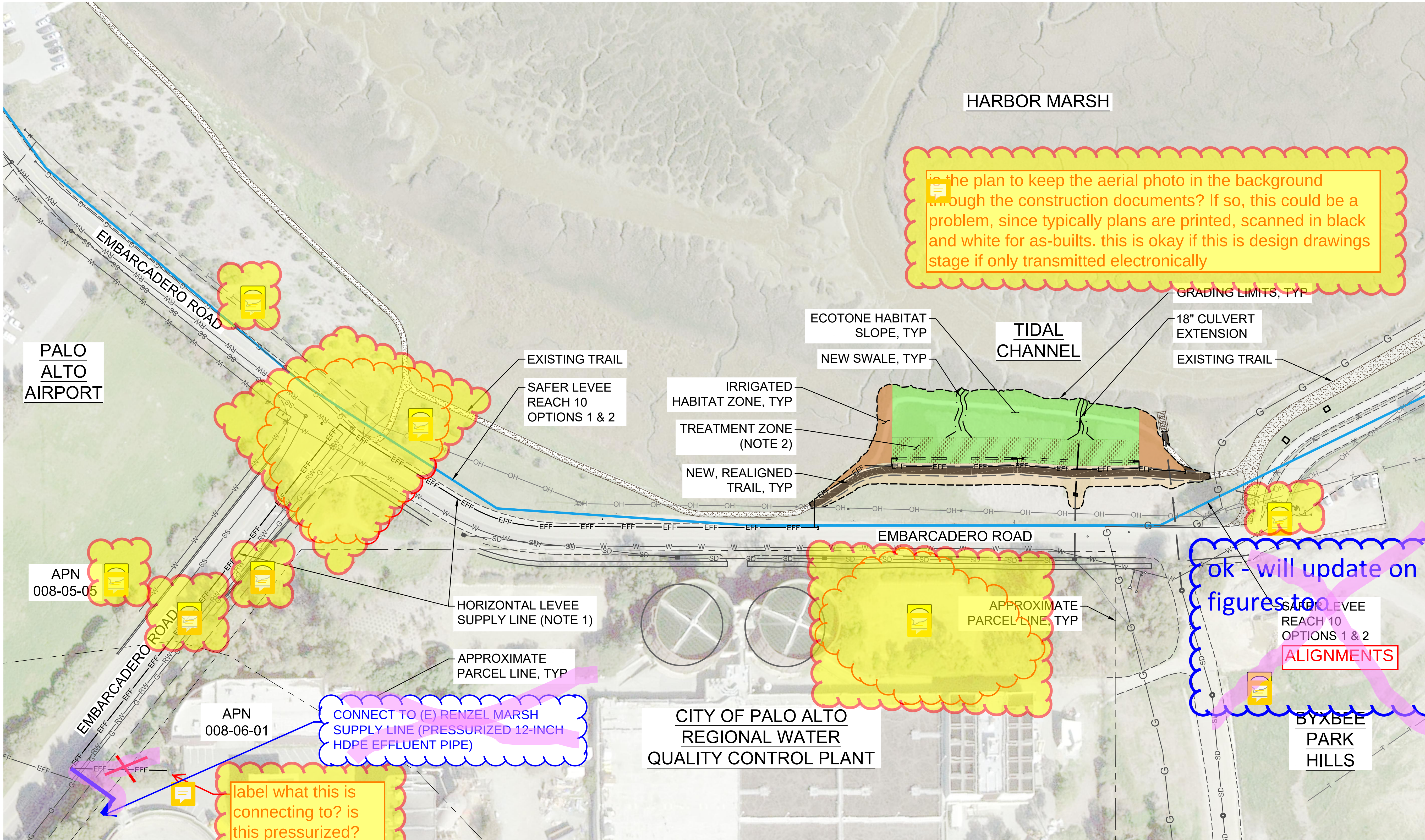
TITLE

SHEET NUMBER

C-01

SHEET 1 OF 11

FILE: U:\Projects\SFO\18xxxx\D181306.00 - Palo Alto Horizontal Levee\09 CAD\Dwgs\C-01 TITLE.dwg PLOT DATE: 9/25/2020 12:00:27 AM PLOTTED BY: LIANE WARE




OVERALL SITE PLAN

PLAN SCALE: 1" = 60'

NOTES

1. THIS PROJECT WILL ROUTE TREATED E... FROM THE PALO ALTO REGIONAL WATE... CONTROL PLANT TO THE PROPOSED H... LEVEE.
2. THE HORIZONTAL LEVEE WILL INCORPORATE A SUBSURFACE TREATMENT ZONE THAT DISCHARGES SURFACE WATER TO THE ECOTONE HABITAT SLOPE.

1"=60' 60 30 0 60 120 SCALE FEET

N

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SAN FRANCISCO, CA 94108
OFFICE - 415.896.5900
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CONSULTANT
CITY OF PALO ALTO

PROJECT NAME
PALO ALTO HORIZONTAL LEVEE PILOT PROJECT
EMBARCADERO ROAD PALO ALTO, CA 94303

REVISIONS

| # | DATE | DESCRIPTION |
|---|---|---|

| | |
|---|---|
| DESIGNED | ML |
| DRAWN | GW, BD |
| CHECKED | LW |
| IN CHARGE | M. LINDLEY 66701 |
| PROJECT NUMBER | D201801306.01 |
| ISSUE DATE | 09/23/2020 |

SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34") 1"

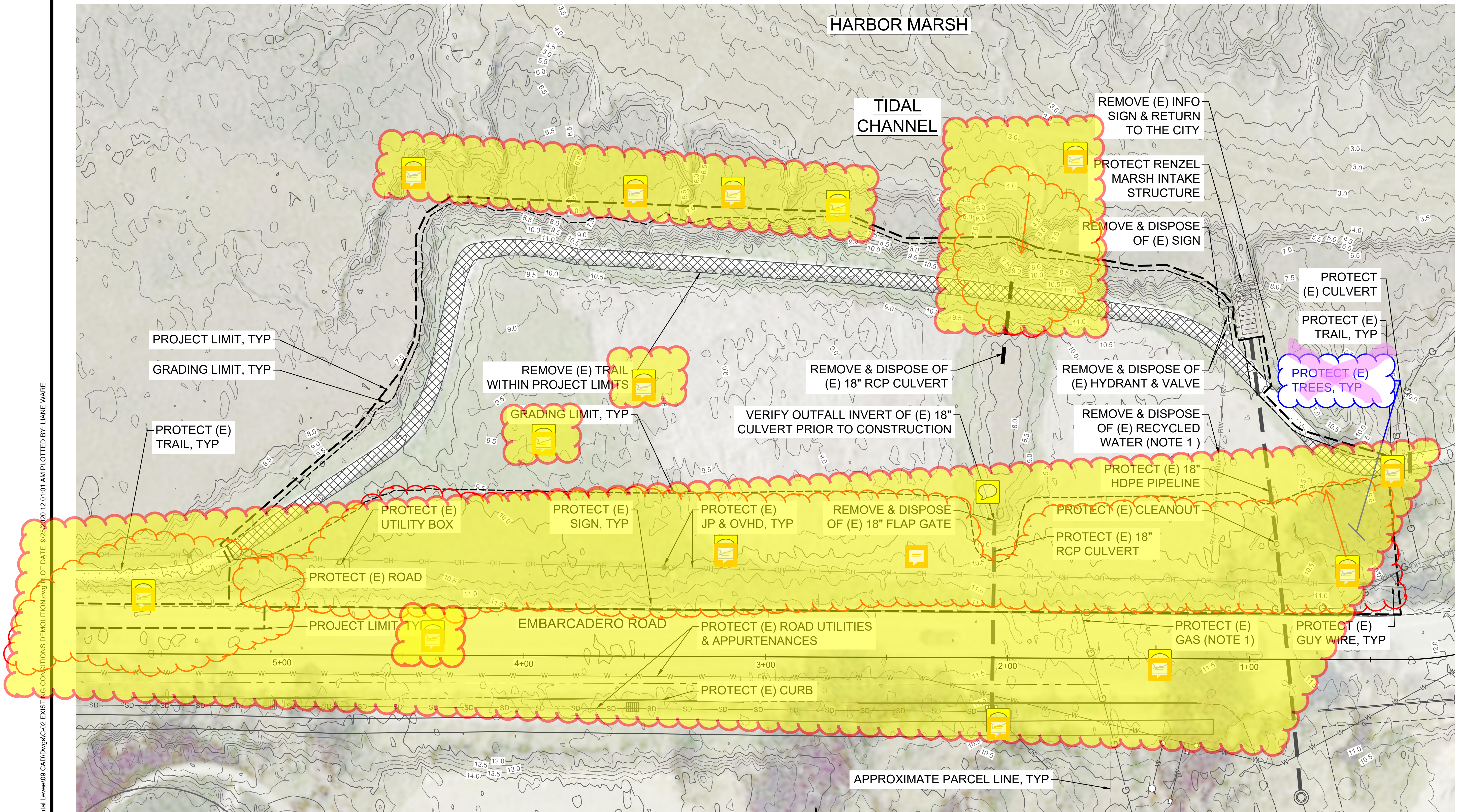
PHASE
30% CONSTRUCTION DOCUMENTS

SHEET TITLE
OVERALL SITE PLAN

SHEET NUMBER
C-02

SHEET 2 OF 11

FILE: U:\Projects\SFO\18xxxx\D181306.00 - Palo Alto Horizontal Levee\09 CAD\Dwgs\C-03 OVERVIEW PLAN.dwg PLOT DATE: 9/25/2020 12:00:41 AM PLOTTED BY: LIANE WARE




## EXISTING CONDITIONS AND DEMOLITION

PLAN

SCALE: 1" = 20'

## NOTES

1. RECYCLED WATER AND GAS UTILITY AS SHOWN IS PER RECORD INFORMATION THAT CANNOT BE VERIFIED. UTILITY MAY NOT HAVE BEEN INSTALLED, MAY HAVE BEEN REMOVED, OR MAY HAVE BEEN ABANDONED. TO BE CONFIRMED PRIOR TO CONSTRUCTION.
2. TOPOGRAPHIC SURVEY BASED ON USGS TOPOGRAPHIC LIDAR (USGS, 2010), AS DOWNLOADED FROM THE NOAA OFFICE FOR COASTAL MANAGEMENT.
3. AERIAL PHOTOGRAPH OBTAINED FROM USGS EARTH EXPLORER DATABASE, PREPARED BY NORTHROP GRUMMAN BETWEEN FEBRUARY 20 TO 24, 2015.
4. HORIZONTAL DATUM: NAD83 CA STATE PLANE ZONE 3.
5. VERTICAL DATUM: NAVD88.
6. UTILITY LOCATIONS SHOWN ARE PLOTTED FROM RECORD INFORMATION AND ARE APPROXIMATE ONLY. PRIOR TO CONSTRUCTION, CONTRACTOR SHALL POTHOLE AND VERIFY THE LOCATIONS OF ALL UTILITIES, AND NOTIFY THE ENGINEER IMMEDIATELY IF ANY CONFLICTS OR DISCREPANCIES ARE IDENTIFIED.
7. ALL EXISTING UTILITIES SIZING AND MATERIALS TO BE CONFIRMED PRIOR TO CONSTRUCTION.

1"=20' 20 10 0 20 40 SCALE FEET

N

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PROJECT NAME
PALO ALTO HORIZONTAL LEVEE PILOT PROJECT
EMBARCADERO ROAD
PALO ALTO, CA 94303

REVISIONS

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|---|---|---|

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|---|---|
| DESIGNED | ML |
| DRAWN | GW, BD |
| CHECKED | LW |
| IN CHARGE | M. LINDLEY 66701 |
| PROJECT NUMBER | D201801306.01 |
| ISSUE DATE | 09/23/2020 |

SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")
1"

PHASE
30% CONSTRUCTION DOCUMENTS

SHEET TITLE
EXISTING CONDITIONS AND DEMOLITION

SHEET NUMBER
C-03

SHEET 3 OF 11

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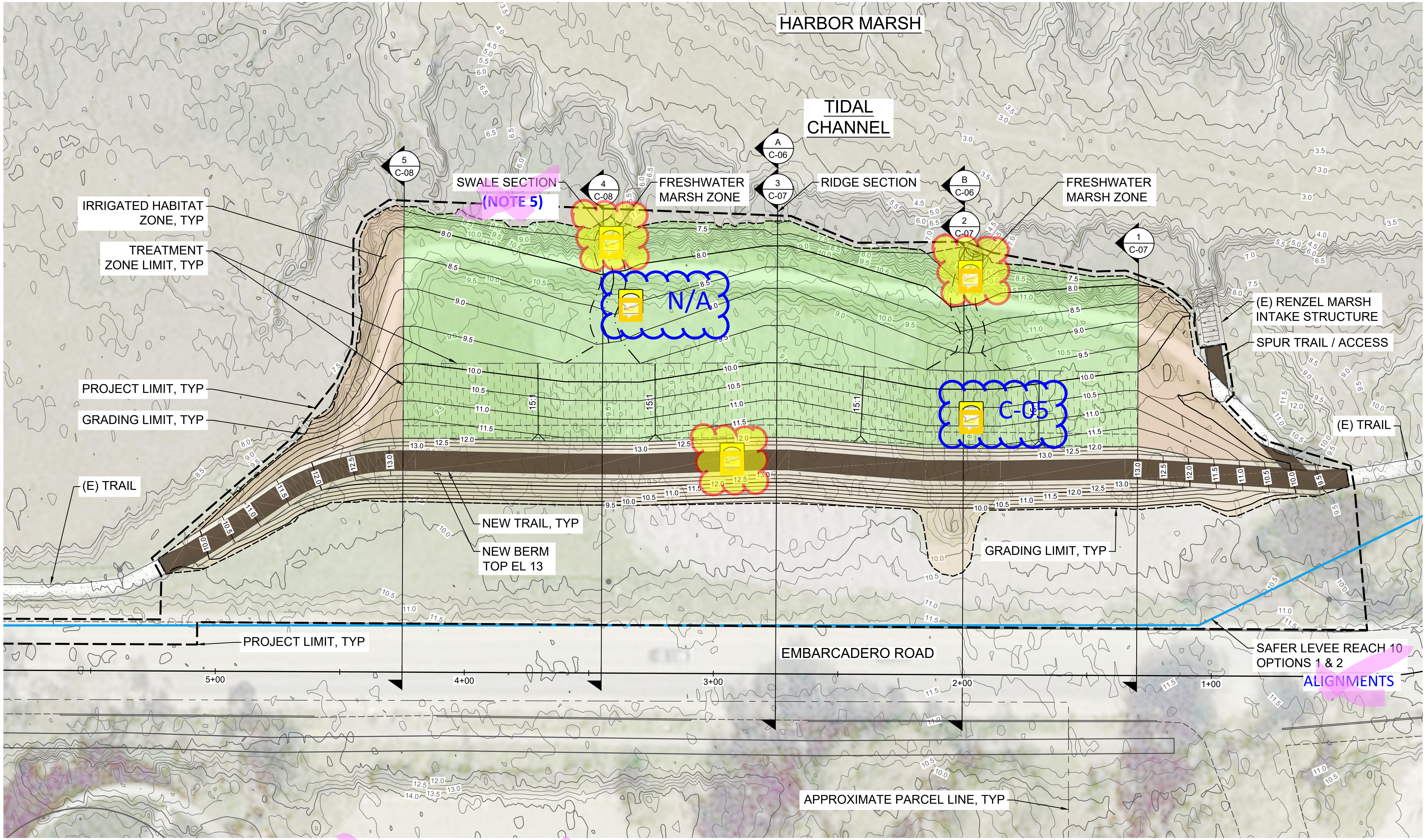


DETAILED PLAN

SCALE: 1" = 20'

NOTES

1. TOPOGRAPHIC SURVEY BASED ON USGS TOPOGRAPHIC LIDAR FROM THE NOAA OFFICE FOR COASTAL MANAGEMENT.
2. AERIAL PHOTOGRAPH OBTAINED FROM USGS EARTH EXPLORER NORTHROP GRUMMAN BETWEEN FEBRUARY 20 TO 24, 201
3. HORIZONTAL DATUM: NAD83 CA STATE PLANE ZONE 3.
4. VERTICAL DATUM: NAVD88.

5. PROPOSED SWALES ARE INTENDED TO ADD HABITAT COMPLEXITY. THEY ARE NOT DRAINAGE INFRASTRUCTURE ELEMENTS, AND THEIR SHAPE AND CONFIGURATION DO NOT REQUIRE MAINTENANCE (EXCEPT FOR THE CULVERT OUTFALL, WHICH SHALL BE MAINTAINED AS THE EXISTING ONE IS CURRENTLY).

1"=20' SCALE 20 10 0 20 40 FEET

N

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CONSULTANT

CITY OF PALO ALTO

PROJECT NAME

PALO ALTO HORIZONTAL LEVEE PILOT PROJECT

EMBARCADERO ROAD
PALO ALTO, CA 94303

REVISIONS

| # | DATE | DESCRIPTION |
|---|---|---|

| | |
|---|---|
| DESIGNED | ML |
| DRAWN | GW, BD |
| CHECKED | LW |
| IN CHARGE | M. LINDLEY 66701 |
| PROJECT NUMBER | D201801306.01 |
| ISSUE DATE | 09/23/2020 |

SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")

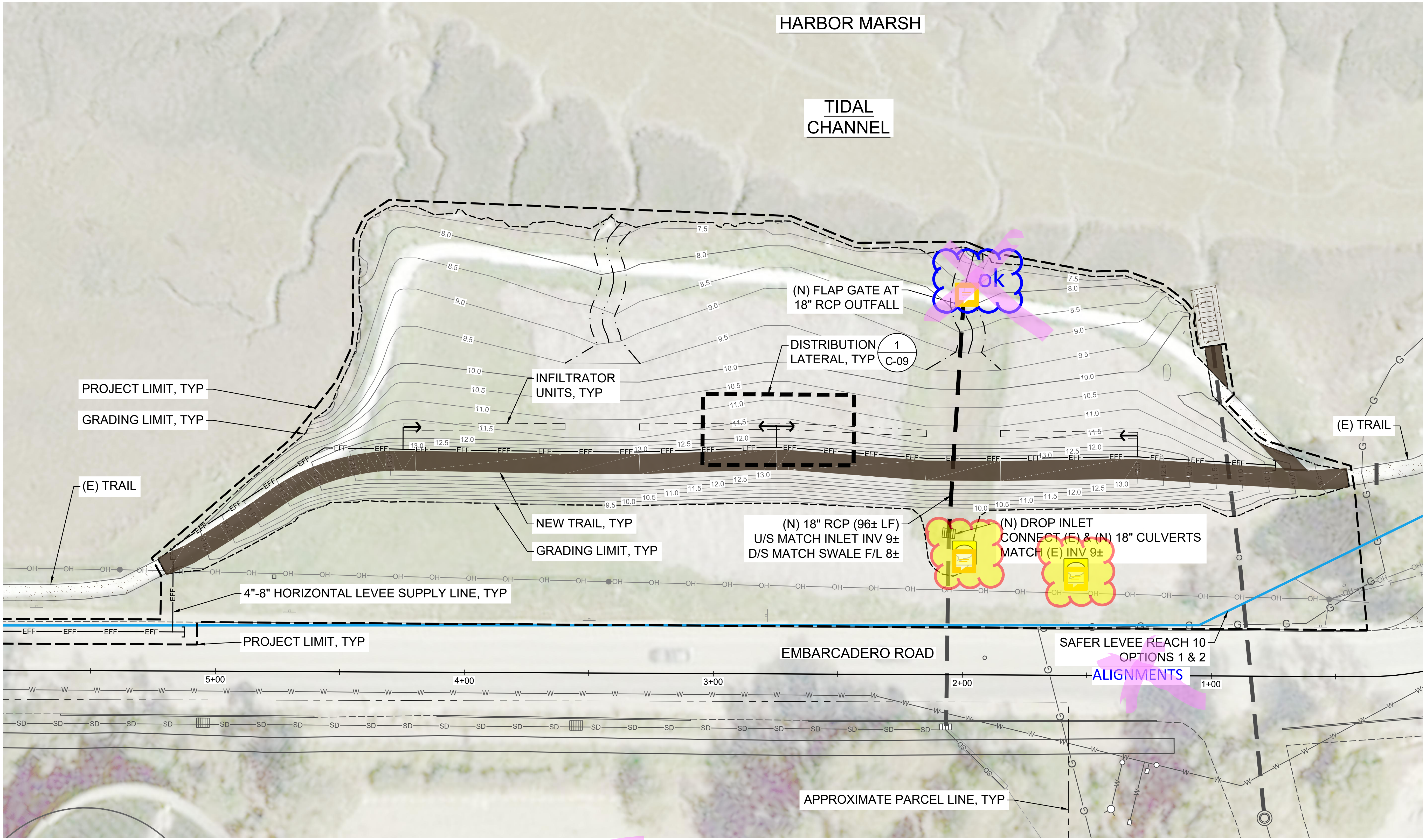
PHASE
30% CONSTRUCTION DOCUMENTS

SHEET TITLE
DETAILED PLAN

SHEET NUMBER
C-04



FILE: U:\Projects\SFO\18xxxx\D181306.00 - Palo Alto Horizontal Levee\09 CAD\Dwgs\C-04 DETAILED PLAN 1.dwg PLOT DATE: 9/25/2020 12:01:23 AM PLOTTED BY: LIANE WARE




PIPING PLAN

PLAN SCALE: 1" = 20'

NOTES

1. TOPOGRAPHIC SURVEY BASED ON USGS TOPOGRAPHIC LIDAR (USGS, 2010), AS DOWNLOADED FROM THE NOAA OFFICE FOR COASTAL MANAGEMENT.
2. AERIAL PHOTOGRAPH OBTAINED FROM USGS EARTH EXPLORER DATABASE, PREPARED BY NORTHROP GRUMMAN BETWEEN FEBRUARY 20 TO 24, 2015.
3. HORIZONTAL DATUM: NAD83 CA STATE PLANE ZONE 3.
4. VERTICAL DATUM: NAVD88.
5. EXISTING UTILITY LOCATIONS SHOWN ARE PLOTTED FROM RECORD INFORMATION AND ARE APPROXIMATE ONLY. PRIOR TO CONSTRUCTION, CONTRACTOR SHALL POTHOLE AND VERIFY THE LOCATIONS OF ALL UTILITIES, AND NOTIFY THE ENGINEER IMMEDIATELY IF ANY CONFLICTS OR DISCREPANCIES ARE IDENTIFIED.
6. ALL EXISTING UTILITIES SIZING AND MATERIALS TO BE CONFIRMED PRIOR TO CONSTRUCTION.

1"=20' SCALE 20 10 0 20 40 FEET

N

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CITY OF PALO ALTO

PROJECT NAME

PALO ALTO HORIZONTAL LEVEE PILOT PROJECT

EMBARCADERO ROAD
PALO ALTO, CA 94303

REVISIONS

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| | |
|---|---|
| DESIGNED | ML |
| DRAWN | GW, BD |
| CHECKED | LW |
| IN CHARGE | M. LINDLEY 66701 |
| PROJECT NUMBER | D201801306.01 |
| ISSUE DATE | 09/23/2020 |

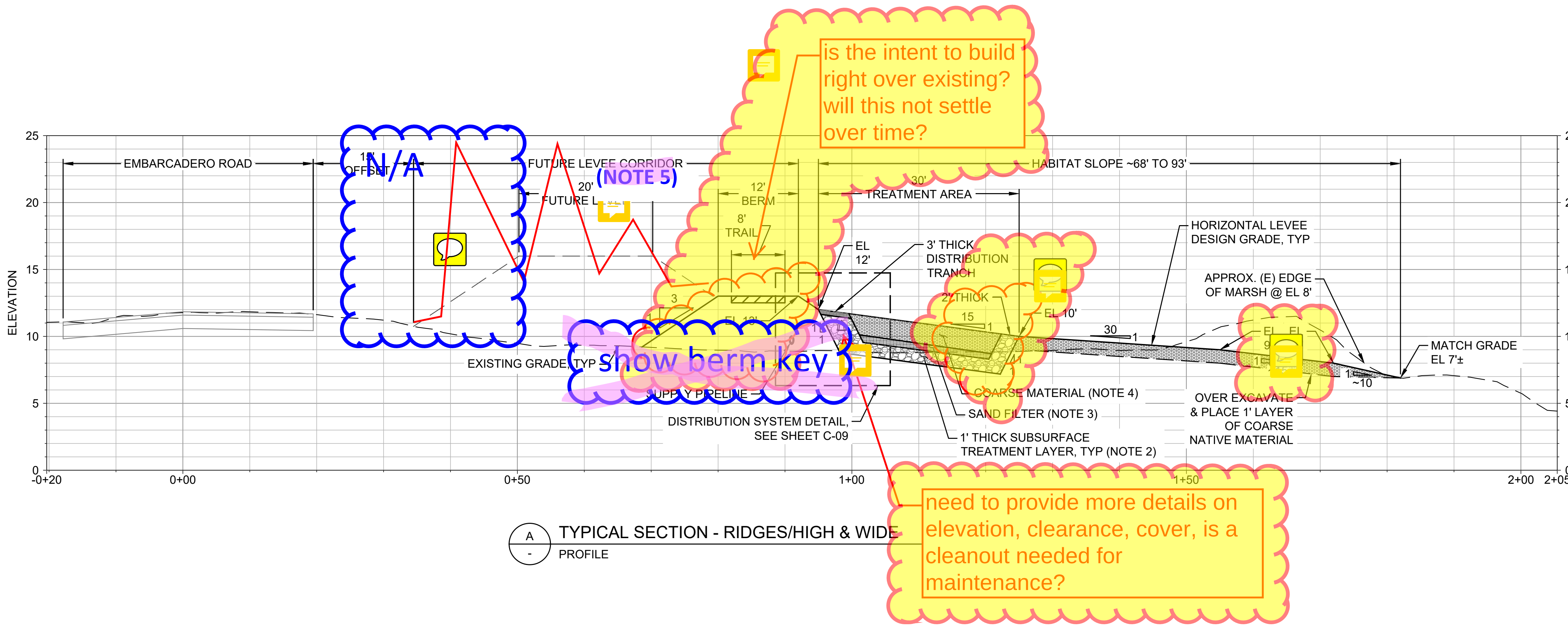
SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34") 1"

PHASE
30% CONSTRUCTION DOCUMENTS

SHEET TITLE
PIPING PLAN

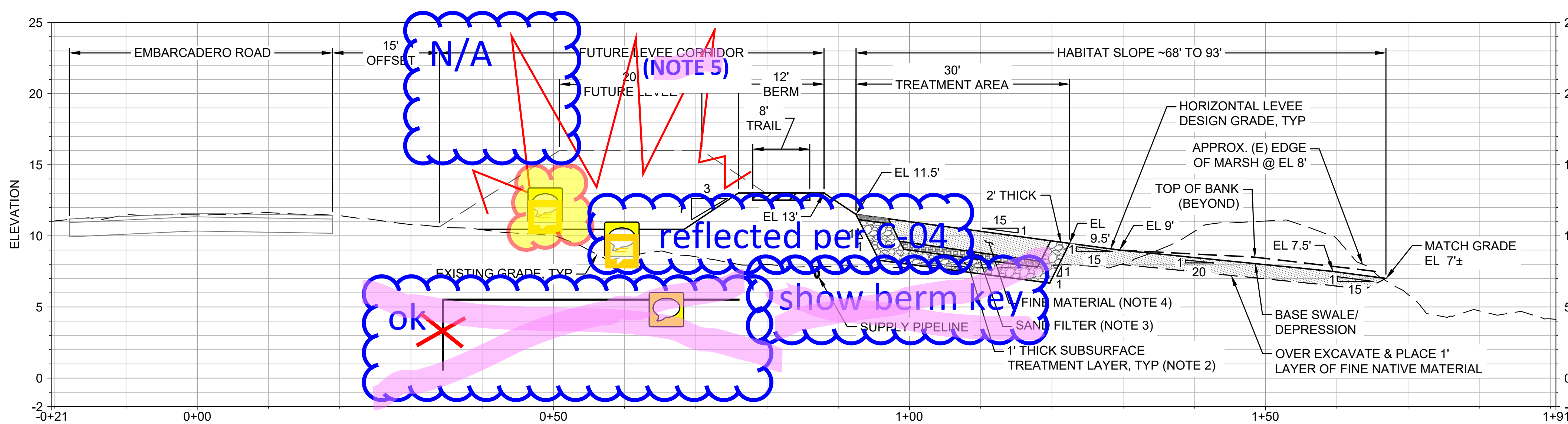
SHEET NUMBER
C-05

SHEET 5 OF 11




A - TYPICAL SECTION - RIDGES/HIGH & WIDE

PROFILE




B - TYPICAL SECTION - SWALES & DEPRESSIONS

PROFILE

SCALE: 1" = 10' H
1" = 5' V

## NOTES

1. SEGREGATE FINE AND COARSE MATERIAL ENCOUNTERED DURING EXCAVATION OF SITE TO SUBGRADE. DURING FILL OPERATIONS, PLACE COARSE MATERIAL ON THE RIDGES AND FINE MATERIALS IN THE SWALES.
2. SUBSURFACE TREATMENT LAYER COMPRISED OF A BLEND OF DRAIN ROCK AND COMPOSTED WOOD CHIPS.
3. SAND FILTER COMPRISED OF A BLEND OF SAND COMPRISED OF WOOD CHIPS
4. COARSE AND FINE MATERIAL INCLUDES A BLEND OF NATIVE MATERIAL WITH COMPOSTED WOOD FILLERS.
5. FUTURE FLOOD CONTROL LEVEE MAY OR MAY NOT BE CONSTRUCTED, BUT THIS LAYOUT PLANS FOR ITS POTENTIAL SPACE SHOULD IT BE CONSTRUCTED.

1"=10' SCALE 10 5 0 10 20 FEET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CITY OF PALO ALTO

PROJECT NAME
PALO ALTO HORIZONTAL LEVEE PILOT PROJECT
EMBARCADERO ROAD
PALO ALTO, CA 94303

REVISIONS

| # | DATE | DESCRIPTION |
|---|---|---|

| | |
|---|---|
| DESIGNED | ML |
| DRAWN | GW, BD |
| CHECKED | LW |
| IN CHARGE | M. LINDLEY 66701 |
| PROJECT NUMBER | D201801306.01 |
| ISSUE DATE | 09/23/2020 |

SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")

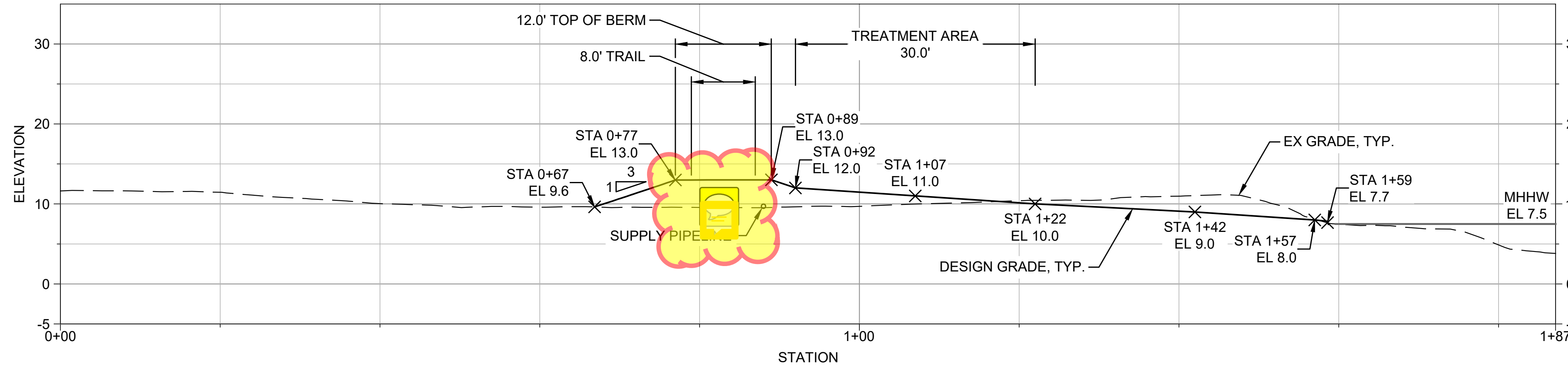
PHASE
30% CONSTRUCTION DOCUMENTS

SHEET TITLE
TYPICAL CROSS SECTIONS

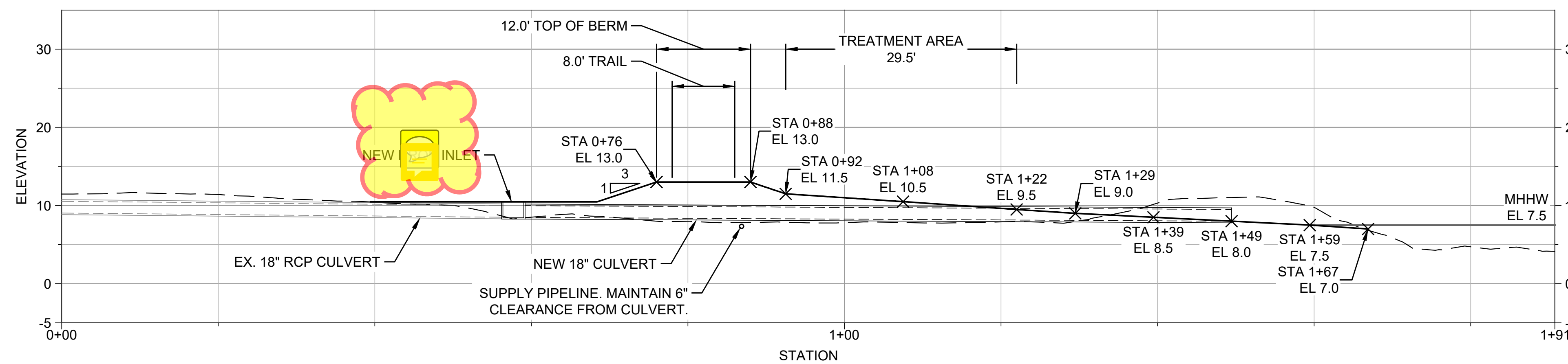
SHEET NUMBER
C-06

SHEET 6 OF 11

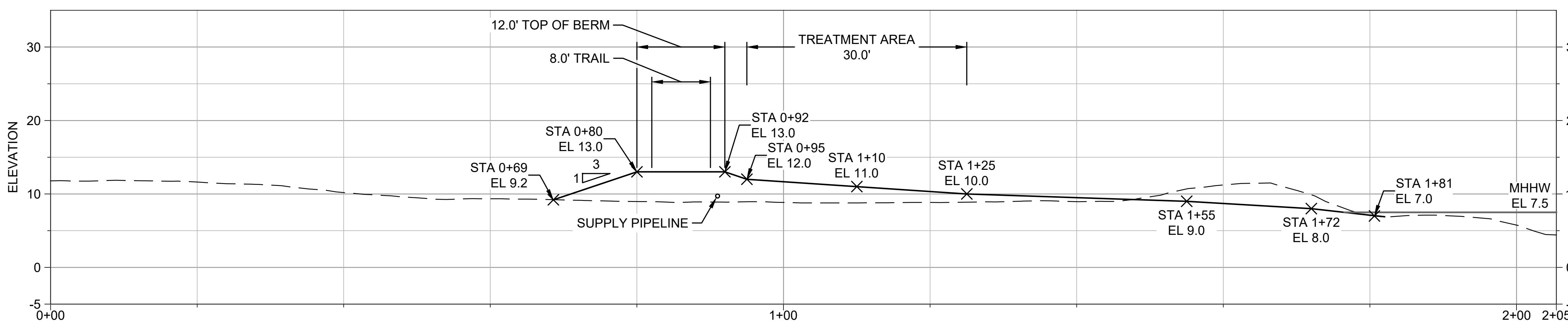
FILE: U:\Projects\SFO\18xxxx\D181306.00 - Palo Alto Horizontal Levee\09 CAD\Dwgs\C-07 CROSS SECTIONS.dwg PLOT DATE: 9/25/2020 12:01:59 AM PLOTTED BY: LIANE WARE




1 - RIDGE AT ROAD STA 1+30
SECTION SCALE: 1" = 10' H
1" = 10' V




2 - SWALE AT ROAD STA 2+00
SECTION SCALE: 1" = 10' H
1" = 10' V




3 - RIDGE AT ROAD STA 2+75
SECTION SCALE: 1" = 10' H
1" = 10' V

1"=10' 10 5 0 10 20
SCALE FEET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PROJECT NAME
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EMBARCADERO ROAD
PALO ALTO, CA 94303

REVISIONS

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|---|---|---|

| | |
|---|---|
| DESIGNED | ML |
| DRAWN | GW |
| CHECKED | LW |
| IN CHARGE | M. LINDLEY 66701 |
| PROJECT NUMBER | D201801306.01 |
| ISSUE DATE | 09/23/2020 |

SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")

PHASE
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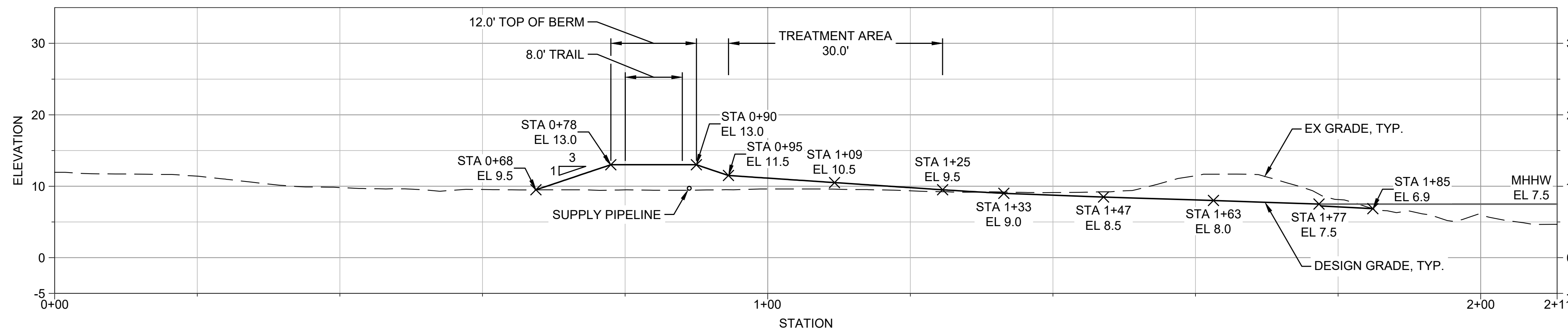
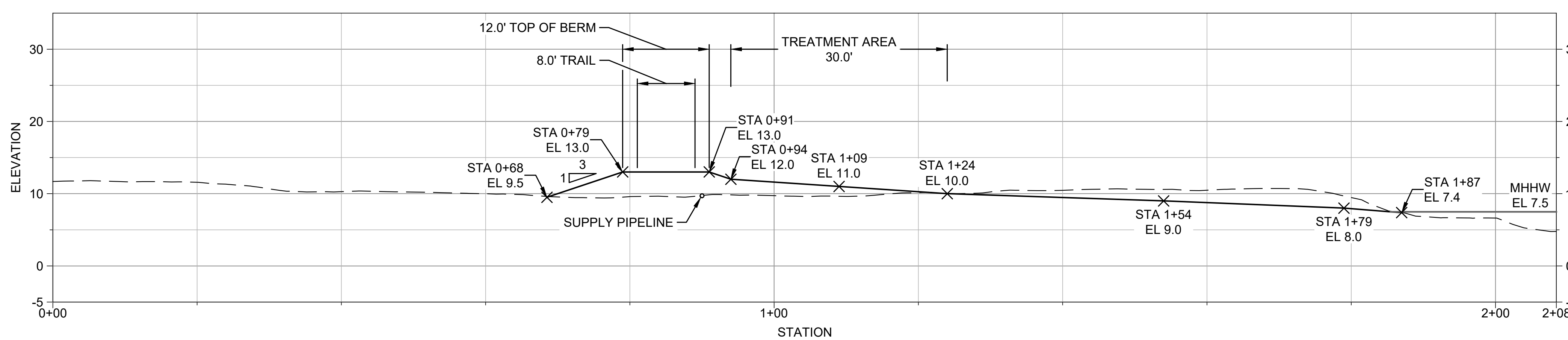
SHEET TITLE
GRADING SECTIONS 1

SHEET NUMBER
C-07




4 SWALE AT ROAD STA 3+45

SECTION SCALE: 1" = 10' H
1" = 10' V




5 RIDGE AT ROAD STA 4+25

SECTION SCALE: 1" = 10' H
1" = 10' V

1"=10' 10 5 0 10 20
SCALE FEET

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CITY OF PALO ALTO

PROJECT NAME
PALO ALTO HORIZONTAL LEVEE PILOT PROJECT
EMBARCADERO ROAD
PALO ALTO, CA 94303

REVISIONS

| # | DATE | DESCRIPTION |
|---|---|---|

| | |
|---|---|
| DESIGNED | ML |
| DRAWN | GW |
| CHECKED | LW |
| IN CHARGE | M. LINDLEY 66701 |
| PROJECT NUMBER | D201801306.01 |
| ISSUE DATE | 09/23/2020 |

SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")

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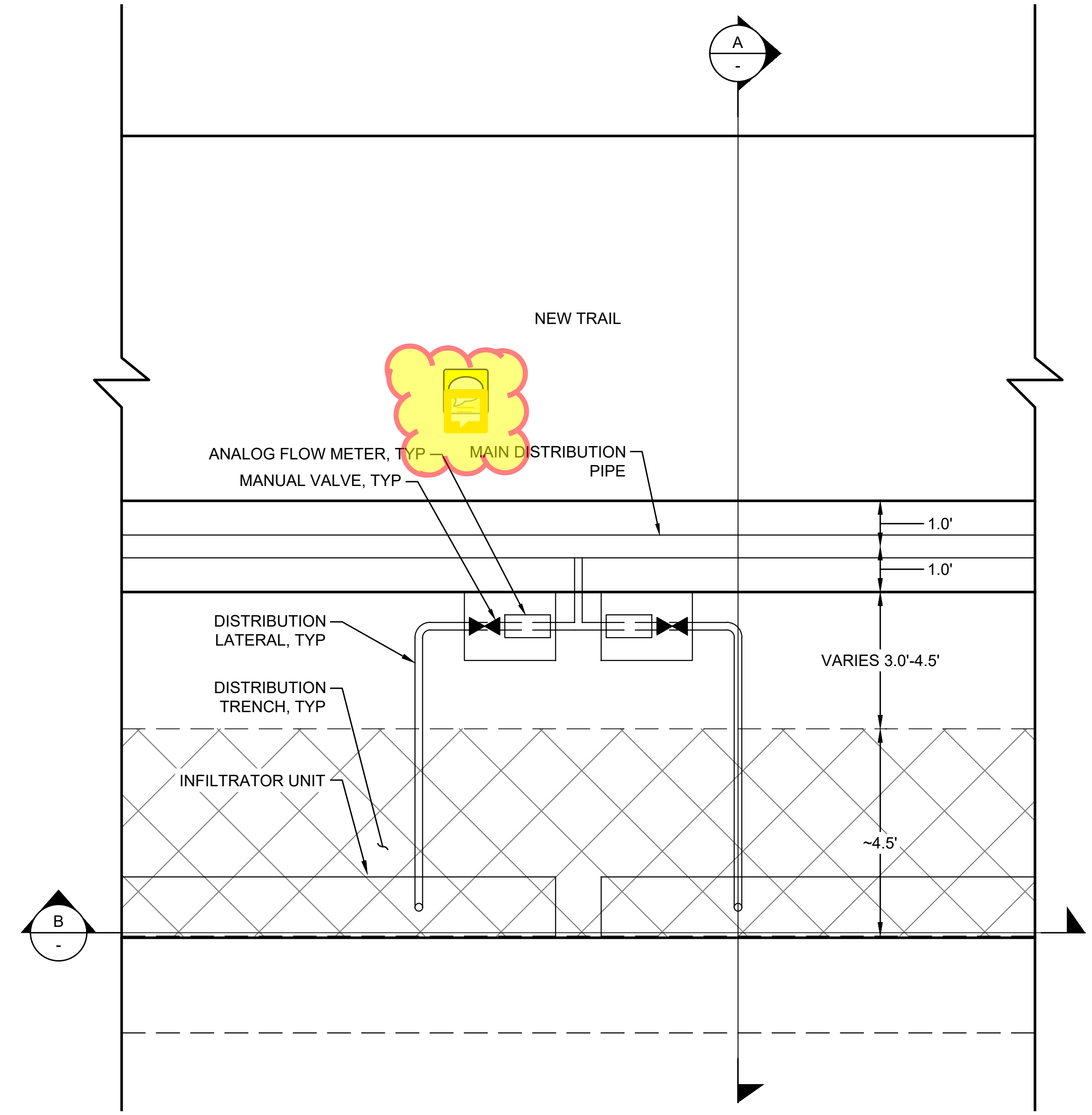
SHEET TITLE
GRADING SECTIONS 2

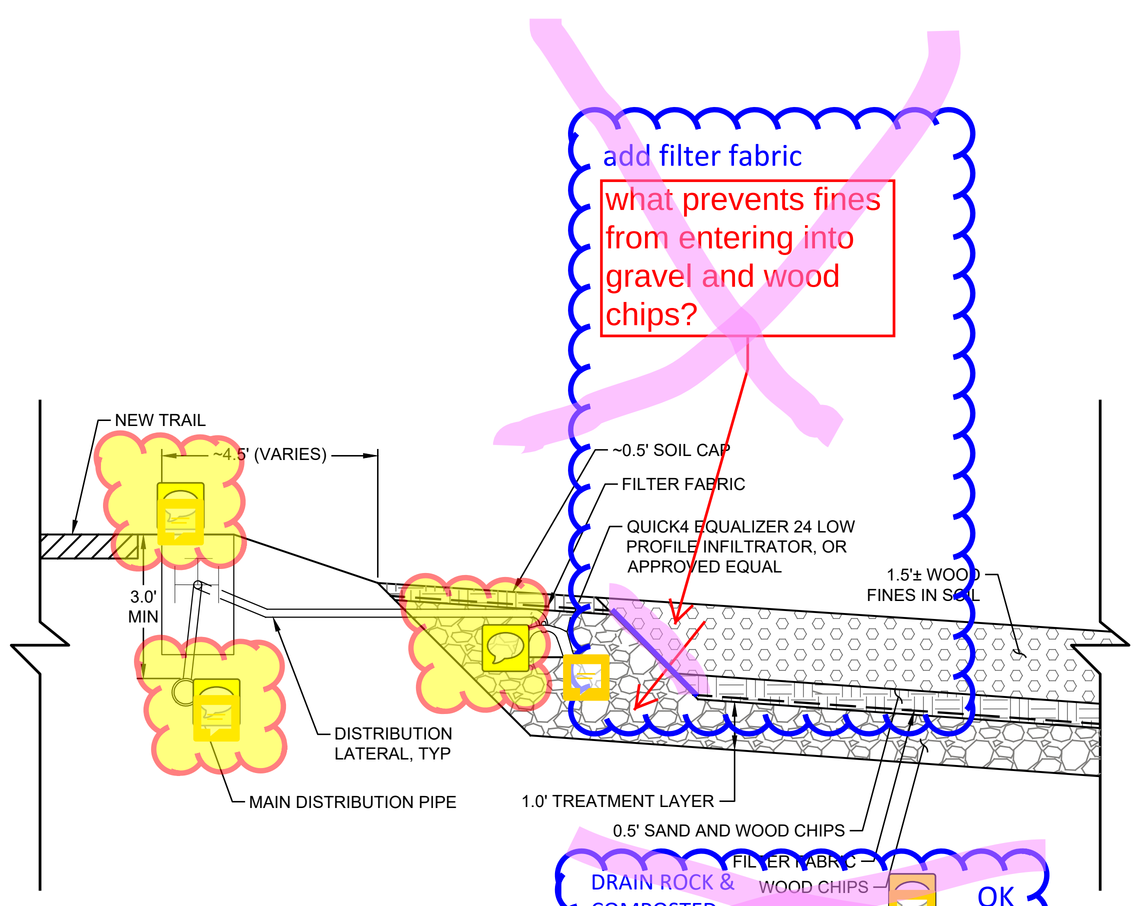
SHEET NUMBER
C-08



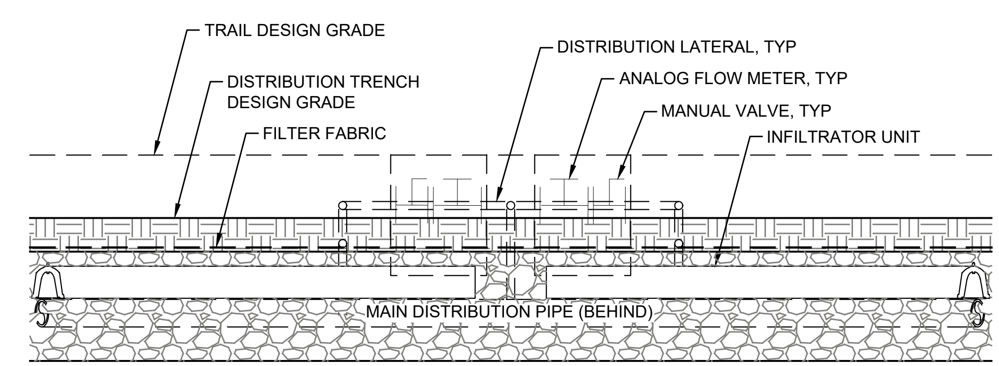
FILE: U:\Projects\SFO\18xxxx\D181306.00 - Palo Alto Horizontal Levee\09 CAD\Dwgs\C-07 CROSS SECTIONS.dwg PLOT DATE: 9/25/2020 12:02:19 AM PLOTTED BY: LIANE WARE




1 DISTRIBUTION HEAD
DETAIL SCALE: 1" = 2'




A DISTRIBUTION CONNECTION AND TREATMENT ZONE MATERIAL
SECTION SCALE: 1" = 2'




B DISTRIBUTION TRENCH
SECTION SCALE: 1" = 2'

1"=2' 2 1 0 2 4
SCALE FEET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CONSULTANT
CITY OF PALO ALTO

PROJECT NAME
PALO ALTO HORIZONTAL LEVEE PILOT PROJECT
EMBARCADERO ROAD
PALO ALTO, CA 94303

REVISIONS

| # | DATE | DESCRIPTION |
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|---|---|
| DESIGNED | ML |
| DRAWN | GW |
| CHECKED | LW |
| IN CHARGE | M. LINDLEY 66701 |
| PROJECT NUMBER | D201801306.01 |
| ISSUE DATE | 09/23/2020 |

SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")

PHASE
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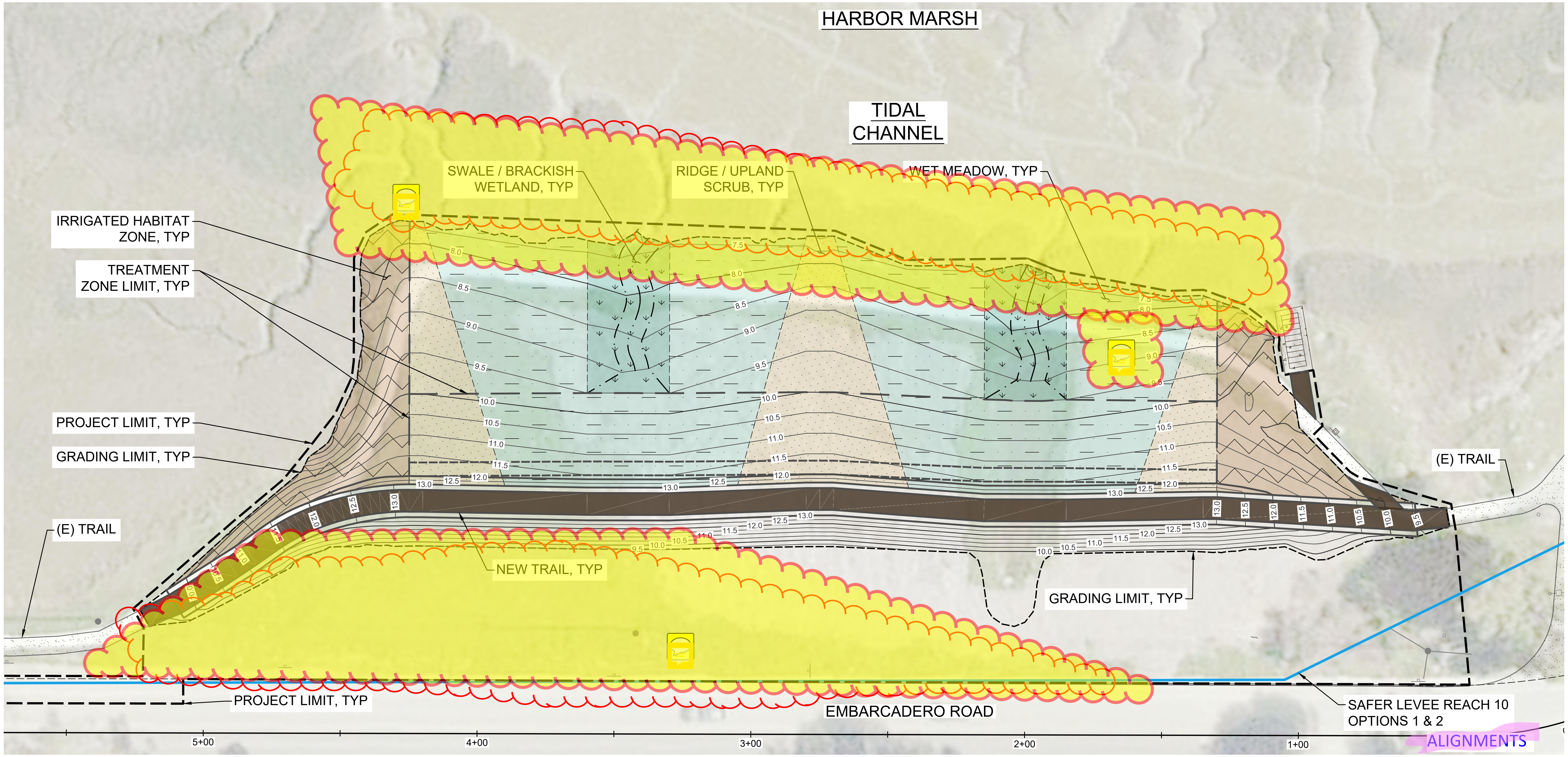
SHEET TITLE
DETAILS

SHEET NUMBER
C-09

SHEET 9 OF 11




PLANTING PLAN

PLAN SCALE: 1" = 20'

## LEGEND

- IRRIGATED HABITAT ZONE
- RIDGE/UPLAND SCRUB
- WET MEADOW
- SWALE/BRACKISH WETLAND

## PLANTING TABLES

### IRRIGATED HABITAT ZONE PLANT ASSEMBLAGE

| | |
|---|---|
| CALIFORNIA ROSE | Rosa californica |
| BLACK ELDER | Sambucus nigra |
| ARROYO WILLOW | Salix lasiolepis |
| RED WILLOW | Salix laevigata |
| WESTERN RAGWEED | Ambrosia psilostachya |
| WESTERN GOLDENROD | Euthamia occidentalis |
| PACIFIC ASTER | Symphyotrichum chilense |
| SUISUN MARSH ASTER | Symphyotrichum lentum |
| CALIFORNIA SUNFLOWER | Helianthus californicus |
| CREEPING WILDRYES | Elymus triticoides, E. x gouldii |
| VALLEY SEDGE | Carex barbarae |
| FIELD SEDGE | Carex praegracilis |
| BALTIC RUSH | Juncus arcticus |

### RIDGE/UPLAND SCRUB PLANT ASSEMBLAGE

| | |
|---|---|
| CALIFORNIA ROSE | Rosa californica |
| WESTERN RAGWEED | Ambrosia psilostachya |
| WESTERN GOLDENROD | Euthamia occidentalis |
| PACIFIC ASTER | Symphyotrichum chilense |
| SUISUN MARSH ASTER | Symphyotrichum lentum |
| CALIFORNIA SUNFLOWER | Helianthus californicus |
| CREEPING WILDRYES | Elymus triticoides, E. x gouldii |
| VALLEY SEDGE | Carex barbarae |
| FIELD SEDGE | Carex praegracilis |

### WET MEADOW AND SWALE/BRACKISH WETLAND PLANT ASSEMBLAGE

| | |
|---|---|
| COMMON SPIKERUSH | Eleocharis macrostachya |
| THREESQUARE BULRUSH | Schoenoplectus americanus |
| SMARTWEEDS | Persicaria punctata, spp. |
| BROADLEAF CATTAIL | Typha latifolia |
| SOUTHERN CATTAIL | Typha doimingensis |
| COMMON TULE | Schoenoplectus acutus |
| GIANT BULRUSH | Schoenoplectus californicus |
| SLENDER CLUBRUSH | Isolepis cernua |
| CREEPING WILDRYES | Elymus triticoides, E. x gouldii |
| VALLEY SEDGE | Carex barbarae |
| FIELD SEDGE | Carex praegracilis |
| SALTGRASS | Distichlis spicata |
| BALTIC RUSH | Juncus arcticus |

1"=20' 20 10 0 20 40 SCALE FEET

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CITY OF PALO ALTO

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PALO ALTO, CA 94303

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| DRAWN | GW, BD |
| CHECKED | LW |
| IN CHARGE | M. LINDLEY 66701 |
| PROJECT NUMBER | D201801306.01 |
| ISSUE DATE | 09/23/2020 |

SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")
1"

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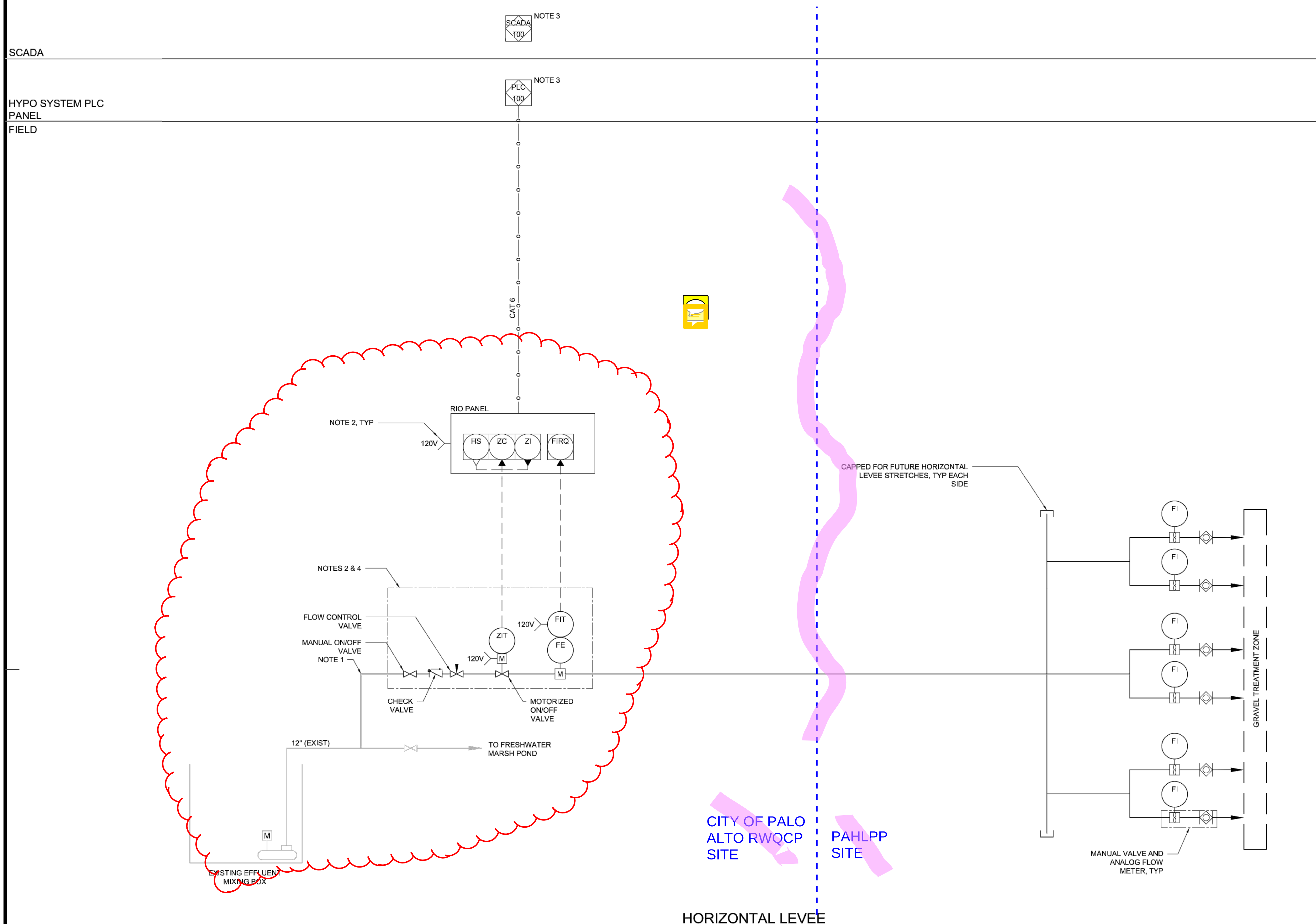
SHEET TITLE
PLANTING PLAN

SHEET NUMBER
C-10



FILE: U:\Projects\SFO\18xxxx\D181306.00 - Palo Alto Horizontal Levee\09 CAD\Dwgs\C-09 PLANTING PLAN.dwg PLOT DATE: 9/25/2020 12:02:40 AM PLOTTED BY: LIANE WARE




## NOTES:

1. PIPE SIZE TO HORIZONTAL LEVEE TO BE BETWEEN 4" AND 8". FINAL SIZING TO BE DETERMINED DURING DETAILED DESIGN.
2. 120V POWER TO COME FROM 120V PANELBOARD LOCATED NEAR THE UV SYSTEM MCC.
3. DATA CONNECTION FOR REMOTE I/O PANEL TO COME FROM THE CHLORINE SYSTEM PLC PANEL. FLOWMETER AND VALVE TO BE CONTROLLED AND MONITORED BY SCADA.
4. PIPE HEADER AND RIO PANEL TO BE LOCATED NEAR EXISTING EFFLUENT BOX ON THE WWTP SITE.

HDR

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CITY OF
PALO
ALTO

PROJECT NAME

PALO ALTO HORIZONTAL LEVEE PILOT PROJECT

EMBARCADERO ROAD
PALO ALTO, CA 94303

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| | |
|---|---|
| DESIGNED | R. NATOLI |
| DRAWN | R. MCCOMB |
| CHECKED | ---- |
| IN CHARGE | ---- |
| | ---- |
| PROJECT NUMBER | D201801306.01 |
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SCALE IS AS SHOWN WHEN PLOTTED TO FULL SIZE (22"x34")

PHASE
30% CONSTRUCTION DOCUMENTS

SHEET TITLE
PIPING PROCESS AND INSTRUMENTATION DIAGRAM (P&ID)

SHEET NUMBER
M-01

SHEET 11 OF 11

FILE: U:\Projects\SFO\18xxxx\D181306.00 - Palo Alto Horizontal Levee\09 CAD\Dwgs\M-01 PIPING PROCESS INST DIA.dwg PLOT DATE: 9/25/2020 12:02:45 AM PLOTTED BY: LIANE WARE

180 Grand Avenue
Suite 1050
Oakland, CA 94612
510.839.5066 phone
510.839.5825 fax



# Attachment 2

## Palo Alto Horizontal Levee Bay Restoration BRRIT Meeting Responses and Comments Memorandum

**Peter R. Baye**, Ph.D.
*Coastal Ecologist, Botanist*
**33660 Annapolis Road**
**Annapolis, California 95412**

(415) 310-5109
botanybaye@gmail.com

# M E M O R A N D U M

To: Liane Ware, LWare[@]esassoc.com, Mark Lindley, MLindley[@]esassoc.com, Christie Beeman, CBeeman[@]esassoc.com,
Cc: Priya Finnemore, PFinnemore[@]esassoc.com
Date: November 27, 2020
SUBJECT: Palo Alto Horizontal Levee Bay Restoration BRRIT (Bay Restoration Regulatory Integration Team) meeting responses and comments

Liane, Mark, Christie:

I reviewed the BRRIT pre-application meeting notes dated November 20 that Liane forwarded, with a request for review and feedback. I have some selected comments to help move regulatory review and design forward.

1. **Public trail location (USFWS, BCDC): wildlife and recreational scenic trail use implications of HL seepage-influenced wetland vegetation.** The recommendation to set the trail back as landward ("inner edge) as possible, recommended by USFWS, CDFW, and BCDC, is typical for levee trail and bayward levee slope habitats along salt marshes, where levee slopes are usually around 5:1 to 3:1, and non-wetland vegetation height most or all of the year is lower than the height of a person (or dog, where they are prohibited or not).

I don't disagree with the norm, but the height of freshwater marsh or riparian scrub on the upper slope is likely to exceed 1.5-2.0 m, and density of slope marsh or willow wetland canopies is likely to be very high (combined standing litter and live shoots, year-round), very similar to slough-margin emergent tule marsh in upper Suisun Slough or Montezuma Slough in Suisun Marsh. It's the inverse of salt marsh, where the tallest vegetation is in the high marsh, and the low marsh vegetation canopy is actually lower than gumplant in the high marsh. Tules, cattails, and bulrushes (freshwater marsh and fresh-brackish marsh dominants) in low marsh have taller canopies than high marsh, and they are likely to dominate saturated soils on the seepage slope, where they would visually obscure the view of the marsh (unless they are brush-cut), and also thoroughly obscure visual cues of human trail use to marsh wildlife.

In addition, the freshwater-influenced (seep) fringe of alkali bulrush marsh in the high tidal marsh zone (near MHHW) would be even higher density, and probably maintain a year-round canopy height of about 1.0-1.5 m, even when the shoots are senescent in winter (upright, stiff, tough "straw", or standing litter). The relevant point is that the vegetation of the high tidal marsh influenced by freshwater seepage, and the HL slope itself, would also be very likely to completely obscure visual cues from the marsh to the trail, and the trail to the marsh all year, after the vegetation establishes. That establishment, as we all observed at Oro Loma, is likely to happen quickly – in about 2 years, and certainly no more than 3 years. So there would be redundant tall visual barriers between marsh and trail at two levels, high marsh alkali bulrush, and HL freshwater marsh.

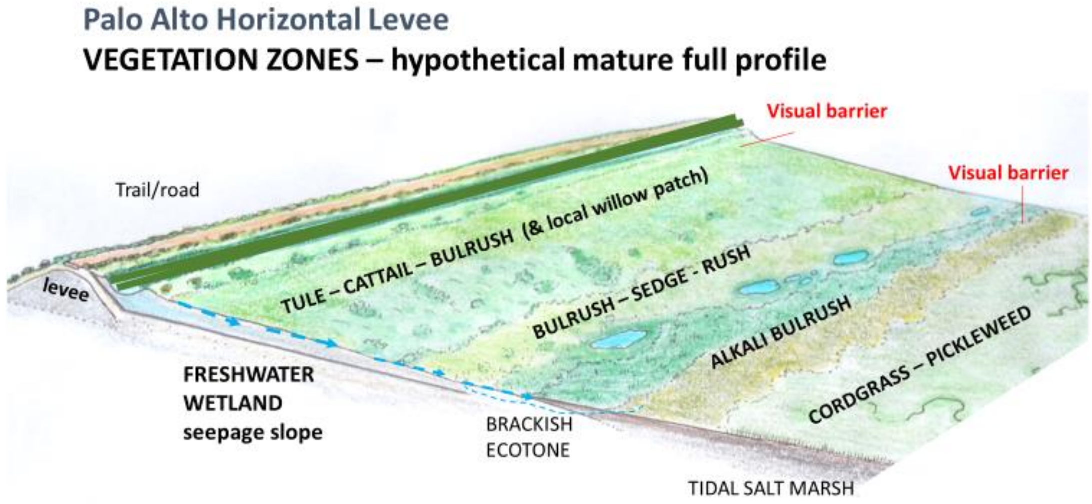
Even the less saturated alternative freshwater wetland vegetation, wet meadow (with several consecutive weeks of soil drainage on the HL slope in summer), would be dominated by tall, dense freshwater seep-influenced (vigorous) stands of creeping wildrye, Baltic rush, soft rush, sedges, Asteraceae tall forbs (goldenrod, aster) and probably bulrushes, close to 1.0-1.5 m high, in a zone above the same wide, taller, denser “hedge” of alkali bulrush in the high marsh zone. Here again the alkali bulrush zone will be stimulated by seepage at the toe of the levee, similar to the hedge-like stand bordering the seasonal stream mouth at southern China Camp Marsh. It’s quite likely that the alkali bulrush zone of the HL toe will expand laterally both downslope (to the fringing marsh plain) and upslope (to the toe of the HL) over time. The relevant point here is that even if the HL is hydrologically managed for alternating saturated and episodically summer-drained moist “wet meadow”, it would still be visually obscured from marsh to trail, and vice versa, by dense, tall bulrush and tall wet meadow.

For long-term management, to reconcile BCDC public access trail interest in scenic bay views, and USFWS/CDFW interest in having vegetation act as a blind (visual barrier), maybe a few vista points could be selectively maintained by mowing small open-view patches to the bay.

October 17, 2017

Oro Loma freshwater marsh vegetation on horizontal levee, end of second growing season.

Vigorous, tall (1-2 m) growth and dominance of native freshwater wetland vegetation obscures view of top of levee slope (background) from toe (foreground)




2. **Nationwide permits**: For what it's worth, I agree that they are not worth pursuing because like all General Permits, they presume minimal indirect, direct and cumulative impacts, which an unprecedented demonstration project (bordering endangered species habitat) is not in a good position to demonstrate. The first project bears the burden of an individual permit until a basis for presuming minimal indirect impacts are established.

3. **Type conversion framework**: I don't have the details of this draft policy, but the vegtation "type conversions" applicable here are:

- Non-jurisdictional wetland upland ruderal grassland conversion to perennial freshwater slope marsh and wet meadow supported by artificial hydrology (wetland jurisdiction to be determined by RWQCB, USACE, EPA).
- Jurisdictional tidal salt marsh conversion to tidal brackish marsh (at least to tidal channel edge), within-type tidal marsh habitat (higher order), but between-type tidal marsh vegetation conversion (change in dominant species and structure, habitat function).

4. **Monitoring and Adaptive Management**: Prediction of vegetation species composition, relative abundance, and structure over at least 5 years would probably be needed for a "Monitoring and Adaptive Management Plan that, describes monitoring metrics, methods, duration, and frequency; includes performance criteria to evaluate the Project's progress towards meeting goals and objectives". I don't know what phase of the design would provide this, but we can work on a first cut if needed.

Regarding "…adaptive management that may be implemented if performance criteria are not met; and includes long-term management and maintenance", I covered this in part in my last memo to John Bourgeois (Oct 6: Section 4. Potential adaptive management actions), but I could expand it to a more specific freshwater wetland vegetation and hydrology management scheme (or outline) for the slope, if needed.

5. **Vegetation conversion (salt to brackish marsh) thresholds (USFWS).** The USFWS request for performance criteria (thresholds for salt to brackish marsh conversion) was the ultimate aim of

my Oct 6 memo, requested by John Bourgeois. Ultimately, it's an effects threshold based on wildlife response for which we won't have an empirical basis ahead of the HL operation. We could set some arbitrary "not to exceed" thresholds of spatial distribution and size of alkali bulrush marsh patches, and cumulative area. The caveat is that once they establish a long-lived perennial "bud bank" (corm bank), alkali-bulrush will lag behind changes in (increased) salinity that inhibit above-ground growth. So there are only gradual changes (adaptations) possible.

6. **California sea-blite (*Suaeda californica*).** There is certainly no California sea-blite at the site. Natural populations became extirpated in SF Bay around 1960, and the only existing populations are experimentally established plantings (approved and coordinated with USFWS) at Emeryville, Tiburon, San Francisco (and possibly Richmond soon). I prepared the USFWS reintroduction plan and most of the recovery plan for the species, and worked with SFSU (Boyer Lab) on the experimental sites.

7. **Salt marsh harvest mouse exclusion and upland impact avoidance**. Rather than try to fine-tune mowing of upland vegetation (which is probably the least efficient and least effective way to manage upland habitat to avoid SMHM impacts), I would suggest an alternative approach that would temporarily eliminate the "attractive nuisance" of upland grassland that may be subject to springtime (green grass foraging) upland movements of SMHM. The upland annual grasses and forbs at the site are intolerant of elevated soil salinity, especially at the seedling stage in winter. Salinizing the soil in fall and early winter, during annual grass seedling emergence and establishment, would inhibit all existing upland vegetation. Slower-growing perennial salt-tolerant vegetation, like saltgrass and pickleweed, would minimally establish during the dry season when drained salinized upland become harsh and hypersaline, like salt pan margins that are normally barren or support extremely low, sparse cover (unattractive to SMHM). Soil salinization can be done with a screened intake from the nearest slough or ditch at high tide, a gas-powered pump, and PVC irrigation pipe and corrosion-resistant irrigation sprinklers (high-pressure plastic). It just has to be done at the right time, for the right duration and rate (slow) to ensure infiltration of saline water in the soil.

8. **Other sensitive species**. Most of the concerns from CDFW staff are just pro forma, but I would check on the possibility of burrowing owls at the adjacent capped landfill park, where ground squirrels could provide potential habitat – however unlikely, given regional decline of burrowing owls.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