3.2 Hydrology, Flood Management, and Infrastructure

This section of the Draft Environmental Impact Statement/Report (EIS/R) characterizes the existing hydrology and flood management within the Eden Landing Phase 2 project area and analyzes whether implementation of the project would cause a substantial adverse effect on hydrological resources. The information presented is based on review of federal, state and local plans, and other pertinent regulations, which are presented in the regulatory framework setting section. Using this information as context, an analysis of the hydrology, flood management, and infrastructure environmental impacts of the project is presented for each alternative. Program-level mitigation measures described in Chapter 2, Alternatives, would be implemented as part of the project. Therefore, this section only includes additional mitigation measures as needed.

3.2.1 Physical Setting

Methodology

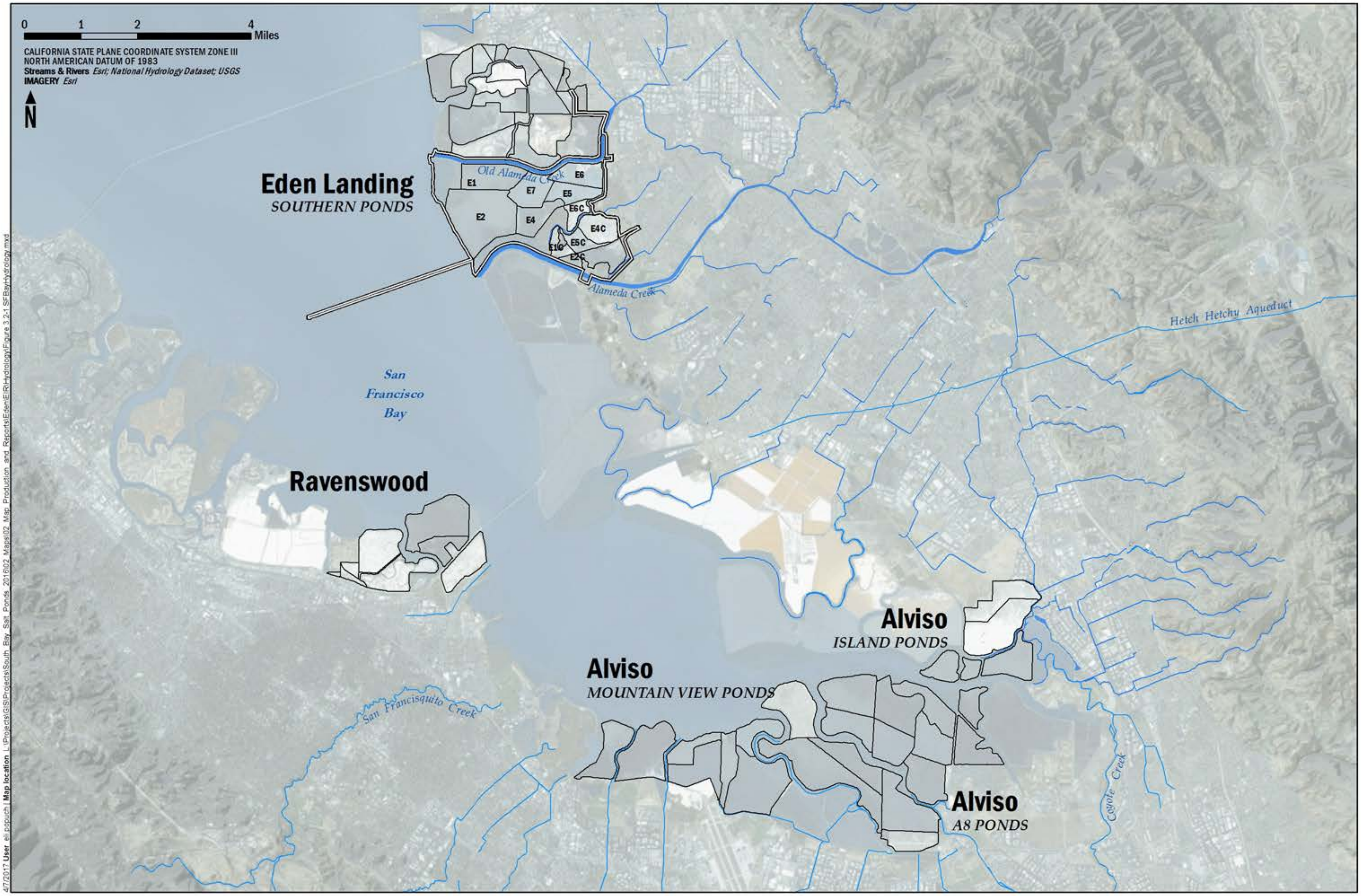
The development of the baseline conditions, significance criteria, and impact analysis is commensurate with and reliant on the analysis conducted in the 2007 South Bay Salt Pond (SBSP) Restoration Project Final Environmental Impact Statement/Report (2007 Final EIS/R). The baseline condition specific to the Eden Landing Phase 2 ponds is based on current conditions in these areas. The primary sources of data used to describe recent conditions include the *Eden Landing Ecological Reserve System E2 and E2C Operation Plan* (Operations Plan; California Department of Fish and Wildlife [CDFW] 2016) and the Self-Monitoring Reports (CDFG 2008, CDFW 2015).

Regional Setting

The regional setting provides information regarding the South San Francisco Bay (South Bay), the SBSP Restoration Project area, the Eden Landing pond complex, and upland watersheds (see Figure 3.2-1). The South Bay is defined as the portion of San Francisco Bay (or Bay) south of Coyote Point on the western shore and San Leandro Marina on the eastern shore. The South Bay is both a geographically and hydrodynamically complex system, with freshwater tributary inflows, tidal currents, and wind interacting with complex bathymetry (i.e., bed surface elevation below water).

Climate and Precipitation. The South Bay has a Mediterranean climate characterized by mild, wet winters and dry, warm summers. Air temperatures are mild due to proximity to the ocean. Winter weather is dominated by storms from the northern Pacific Ocean that produce nearly all the annual rainfall, while summer weather is dominated by sea breezes caused by differential heating between the hot interior valleys and the cooler coast. The South Bay typically receives about 90 percent of its precipitation in the fall and winter months (October through April), with the greatest average rainfall occurring in January. The average annual rainfall in the counties surrounding the South Bay is approximately 20 inches, although the actual rainfall can be highly variable due to the influence of local topography.

Hydrodynamics. The South Bay can be characterized as a large shallow basin, with a relatively deep main channel surrounded by broad shoals and mudflats. Tidal currents, wind, and freshwater tributary inflows interact with bathymetry to define the residual circulation patterns and residence time, and determine the level of vertical mixing and stratification. The most obvious hydrodynamic response is the daily rise and fall of the tides, although much slower residual circulation patterns also influence mixing and flushing processes within the South Bay.



LEGEND

River

Eden Landing Phase 2 Project Area

South Bay Salt Ponds

AECOM

South Bay Salt Pond Restoration Project

Figure 3.2-1

Rivers and Streams

The tides in San Francisco Bay are mixed semidiurnal tides (i.e., two high and two low tides of unequal heights each day). The tides exhibit strong spring-neap variability with the spring tides, which have a larger tidal range, occurring approximately every 2 weeks during the full and new moon. Neap tides, which have a smaller tidal range, occur approximately every 2 weeks during the moon's quarter phases. The tides also vary on an annual cycle, in which the strongest spring tides occur in late spring/early summer and late fall/early winter, and the weakest neap tides occur in spring and fall. The enclosed nature of the South Bay creates a mix of progressive and standing wave behavior, which causes tidal amplification as waves move southward (i.e., the tidal amplitude is increased by the harmonic addition of original waves plus reflected waves).

One of the most important factors influencing circulation patterns in the South Bay is bathymetry. Bathymetric variations create different flow patterns between the San Mateo Bridge and Dumbarton Bridge and in areas south of the Dumbarton Bridge. Circulation patterns also differ between the deep main channel and the shoals. Currents in the South Bay are driven predominantly by tidally and wind-forced flows and their interaction with the bathymetry. Typically, winds drive a surface flow, which then induces a return flow in the deeper channels (Walters et al. 1985). In terms of circulation, the most significant winds are onshore breezes that create a horizontal, clockwise circulation pattern during the spring and summer. Density-driven currents occur when adjacent water bodies have differing densities, such as differences in temperature and/or salinity. Although density-driven currents are generally uncommon in the South Bay, in years of heavy rainfall, fresh water can flow from the Delta through the Central Bay and into the South Bay. In such events, the freshwater flows southward along the surface, while the more saline South Bay water flows northward along the bottom (Walters et al. 1985).

Currents and circulation affect the tidal excursion – the horizontal distance a water particle travels during a single flood or ebb tide. The tidal excursion varies between 6.2 and 12.4 miles within the main channels, and it ranges between 1.9 and 4.8 miles within the subtidal shoals; much smaller excursions occur on the intertidal mudflats (Cheng et al. 1993; Fischer and Lawrence 1983; Walters et al. 1985). Tidal dispersion is the dominant form of transport in the South Bay and the primary mechanism that controls residence times. Residence time is usually characterized as the average length of time a water parcel spends in a given waterbody or region of interest (Monsen et al. 2002). It is typically shorter during the winter and early spring during wet years and considerably longer during summer and/or drought years (Powell et al. 1989; Walters et al. 1985). Residence time also varies with seasonal freshwater inflow and wind conditions.

The volume of water in the South Bay between mean low water and mean high water is the "tidal prism" of the South Bay. Tidal prism, in combination with bathymetry, determines the patterns and speed of tidal currents and subsequent sediment transport. The tidal prism for the South Bay is approximately 666,000 acre-feet, the majority of which is contained between the San Francisco-Oakland Bay Bridge and San Mateo Bridge (Schemel 1995). At mean lower low water, the volume of water in the far South Bay (south of the Dumbarton Bridge) is less than half the volume present at mean higher high water (MHHW). In addition, surface water area coverage at mean lower low water is less than half that at MHHW, indicating that over half of the far South Bay consists of shallow mudflats exposed at low tides (Schemel 1995).

Sea-Level Rise. Sea-level rise refers to an increase in mean sea level with respect to a land benchmark. Global sea-level rise can be a result of global warming from the expansion of sea water as the oceans warm or from the melting of ice over land. Local sea-level rise is affected by global sea-level rise plus tectonic land movements and subsidence (which can be of the same order as global sea-level rise.) Atmospheric pressure, ocean currents, and local ocean temperatures also affect local rates of sea-level rise.

Salinity. Salinity in the South Bay is governed by salinity in the Central Bay, exchange between the South Bay and Central Bay, freshwater tributary inflows to the South Bay, and evaporation. In general, the South Bay is vertically well mixed (i.e., there is little tidally averaged vertical salinity variation) with near oceanic salinities (33 parts per thousand [ppt]).

Seasonal variations in salinity are driven by variability in freshwater inflows. High freshwater inflows typically occur in winter and early spring in wet years when fresh water from the San Francisco Bay Delta (Delta) intrudes into the South Bay. For example, during wet years when Delta outflow exceeds approximately 200,000 cubic feet per second (cfs), fresh water from the Delta intrudes into the South Bay during the winter and spring months, pushing surface salinities below 10 ppt. During dry years, when Delta outflows are small, near surface salinity in the South Bay remains high (*i.e.*, greater than 20 ppt) (PWA et al. 2005). As Delta and tributary inflows decrease in late spring, salinity increases to near oceanic salinities. High freshwater inflows can result in circulation patterns driven by density gradients between the South Bay and Central Bay (Walters et al. 1985).

Sediment Characteristics. Bay habitats such as subtidal shoals, intertidal mudflats, and wetlands are directly influenced by sediment availability, transport, and fate, specifically the long-term patterns of deposition and erosion. The main losses of sediment from the South Bay are exports to the Central Bay and sediment capture within marsh areas and restored ponds. Sediments that are carried on flood tides into a marsh or restored pond are typically deposited, causing the marsh or mudflat area to increase in elevation. Sediments can also be carried out with ebb tides if cohesive sediment deposition is inhibited. The rate of sedimentation in a marsh or restored pond depends on the suspended sediment concentration (SSC) near the marsh or restored pond location, the elevation of the ground surface, and the degree of tidal exchange.

The capacity of many sloughs and channels in the South Bay has been gradually reduced by sediment deposition. Under natural conditions, channels adjacent to marsh lands experienced daily scouring from tidal flows. When these areas were diked off to create salt ponds, the scouring flows were reduced. Subsequent sedimentation has constricted channels, reducing cross-sectional areas and decreasing channel conveyance.

Historically, fringing marsh along the east shoreline has eroded, while marsh along the west shoreline has eroded and accreted (equating to no net change). The historical trend in marsh erosion suggests that more mudflat loss is expected along the higher-energy east shore than the west shore.

SSCs in the South Bay exhibit short-term variability, primarily in response to variations in tidally driven resuspension, wind-driven resuspension, and riverine input from local tributaries and sloughs. In the winter and early spring, the main sources of suspended sediments are local tributaries and the Central Bay. Extremely wet years can also deliver turbid plumes of sediment from the Delta into the South Bay. This influx of sediment enters the system and is continually reworked and transported as it is deposited and resuspended by tidal and wind-driven currents. There is typically little direct input of suspended sediment in the dryer summer months; however, SSCs are often high due to increased wind-wave resuspension and reworking of previously deposited sediments.

The transport and fate of suspended sediment has the potential to affect the transport and fate of contaminants, such as metals and pesticides, and the distribution of nutrients. Increasing SSCs are also directly correlated with increasing turbidity and decreasing light availability, thus affecting photosynthesis, primary productivity, and phytoplankton bloom dynamics.

Flood Hazards. Flood hazards in the South Bay result primarily from coastal flooding (tides, storm surge, and wind wave action) and fluvial flows (rainfall runoff) from the adjacent watersheds. Flooding can also be caused by backed-up storm drains or, much less commonly, by tsunamis or seiche waves.

Coastal flooding normally results from exceptionally high tides, increased by storm surge[1], climatic events, and wind-wave action. Coastal flooding can occur when high Bay water levels, in concert with wind waves, lead to erosion and/or overtopping of coastal barriers. The highest astronomic tides occur for a few days each summer and winter due to the relative positions of the earth, moon, and sun. The highest Bay water levels typically occur in the winter when storm surges are coincident with the higher astronomic tides. Salt ponds in the South Bay dissipate wind-wave action and act as large reservoirs to store overtopped waters. Floods resulting solely from coastal processes have been rare due to the de facto flood protection provided by existing pond levees (United States Army Corps of Engineers [USACE] 1988). Note that, while the term “levee” is used to describe these features of the former salt production infrastructure throughout this Draft EIS/R and in the SBSP Restoration Project as a whole, these features were never engineered or constructed to provide flood protection and are more like berms than true flood levees. Nevertheless, to be consistent with previous project documents, this Draft EIS/R retains the use of “levees” for these features.

Fluvial flooding occurs when rivers, creeks, and other natural or constructed channels are overtopped. Fluvial flooding has been the primary source of historical flood damage in developed areas adjacent to the South Bay. An extensive network of flood control levees has been constructed along various channel reaches to protect adjacent developed areas from channel overtopping. These leveed reaches are designed to convey large fluvial discharges during high Bay tides; however, the levees can be overtopped when high runoff conditions and high tides exceed the design capacity of the leveed channel. Out-of-bank flooding can also occur in areas adjacent to non-leveed channels when the runoff exceeds the carrying capacity of the channel. Flooding also results from local drainage that collects behind bayfront levees when discharges to the Bay (either by pumps or gravity flow) are inadequate.

Levees. Levees in the South Bay, and specifically levees in the SBSP Restoration Project area, were typically constructed with Bay mud (weak clays and silts) dredged from adjacent borrow ditches or pond areas. Soils were not compacted during levee construction, and levees have continued to settle and deform. These levees have been augmented from time to time with Bay mud fill to compensate for subsidence, consolidation of levee fill material, and weak underlying Bay mud deposits. In general, levees are low to moderate in height and have fairly flat, stable slopes. Some dikes were constructed from imported soil, riprap, broken concrete, and other predominantly inorganic debris, and these dikes typically have steeper slopes than the levees constructed of Bay mud.

Outboard levees (i.e., bayfront and slough/creek levees adjacent to tidal waters) were built to enclose evaporation ponds on former tidal marshes and mudflats and to protect the salt ponds from Bay inundation. Inboard levees (i.e., inland pond levees) are predominantly former salt pond levees that offer the last line of defense against flooding of low-lying inland areas. Internal levees separate the individual

[1] Storm surge is an increase in water level caused by atmospheric effects and strong winds over shallow areas, which combine to raise water elevations along the shore.

salt ponds from each other and are typically smaller than the outboard levees. Generally, pond levees were not designed, constructed, or maintained following well-defined standards (USACE 1988).

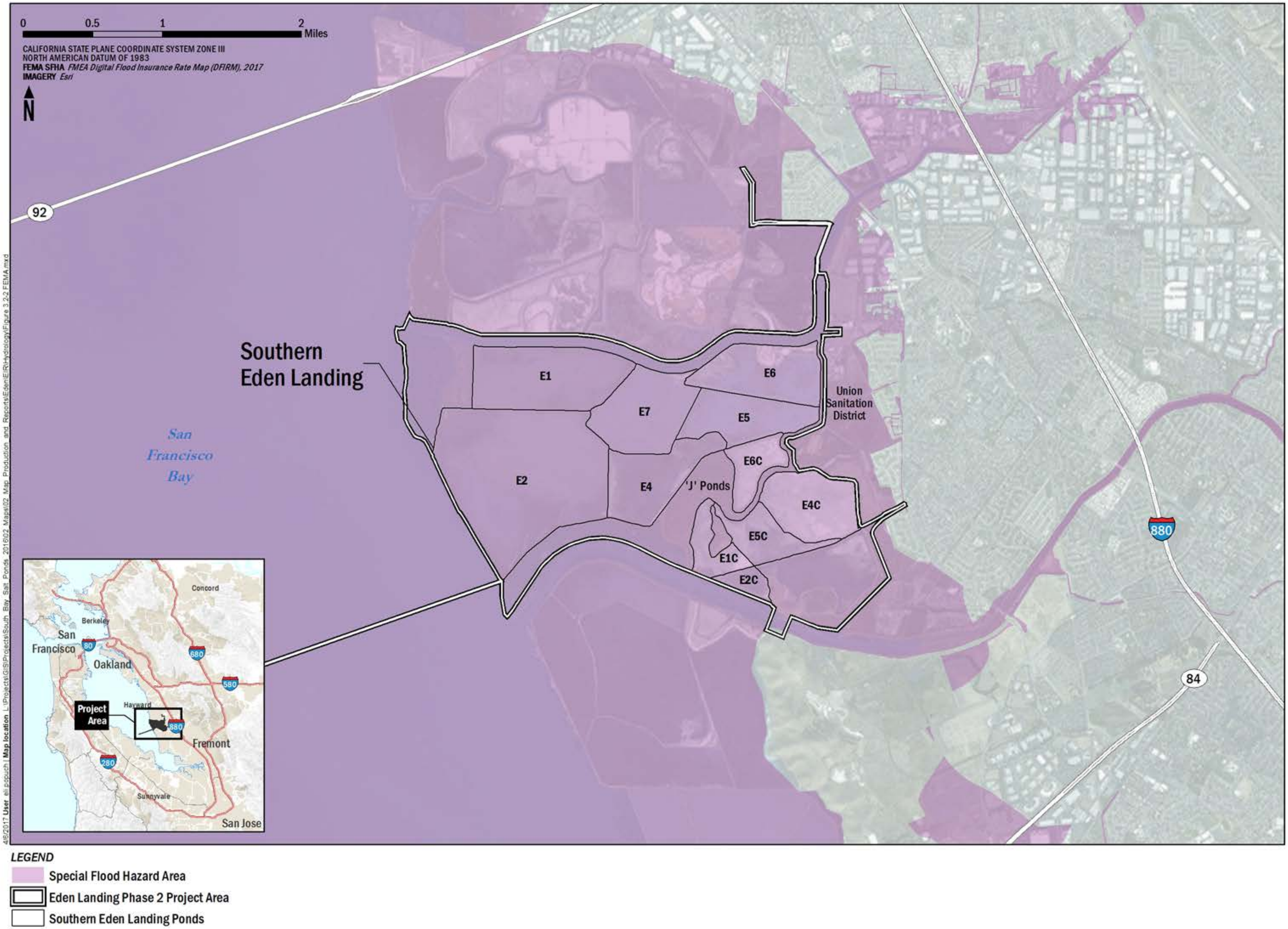
Existing levees provide flood risk management, and former salt ponds act as temporary storage during coastal flooding conditions. Waves break against outboard levees, which can be safely overtopped. If, however, there is an unexpected breach and ponds fill, waves could overtop internal levees, reducing flood-protection capabilities. When tidal action is introduced to the salt ponds, either through restoration or passively through deterioration of the levees, the effectiveness of the salt pond complexes acting as flood-protection mechanisms is reduced. Although most of the shoreline in the South Bay consists of levees that do not meet the Federal Emergency Management Agency (FEMA) or USACE flood protection standards, the absence of a history of significant tidal flooding indicates that these levees do provide flood risk management (USACE 1988).

Floodplains. FEMA and USACE have developed flood maps for the South Bay that include delineation of the 100-year floodplain. FEMA delineation of the coastal floodplain in the South Bay is based on the assessment that pond levees provide for a reduction of wave action but do not prevent inundation from high Bay water levels. Therefore, FEMA-designated 100-year base flood elevations are a function of the 100-year still-water elevations. The still-water flood elevation is defined by FEMA as the projected elevation that floodwaters would assume in the absence of waves resulting from wind. For fluvial systems, FEMA determines the 100-year base flood elevations by using the MHHW as the downstream tidal water surface elevation (tidal boundary) coupled with the 100-year flood for upstream flow conditions. The FEMA floodplain data shown on Figure 3.2-2 are from Flood Insurance Rate Maps (FIRMs) effective in 2009 (Alameda County). In general, pond levees would not meet FEMA criteria and are not certified as flood-protection facilities as defined in FEMA's certification requirements (FEMA 1998). This is because (1) levee failure comprised of overtopping, degradation, and breaching is likely to result in flooding of inland areas[2], and there are no calculations to show that they are designed for the 100-year event, and (2) maintenance records indicate frequent maintenance is required, but the required maintenance program for certification, including a commitment by a public entity, does not exist.

Tsunami and Seiche. Tsunamis are long-period, low-amplitude ocean waves that pose an inundation hazard to many coastal areas around the world. Tsunami waves are generated when the floor of an ocean, sea, bay, or large lake is rapidly displaced on a massive scale or when there is a large underwater landslide. While the wave height of a tsunami in the open ocean is generally low, the tsunami waves change shape as the seafloor ramps up near coastlines and water depth becomes shallow, trapping wave energy and potentially causing the wave height to increase dramatically. Tsunami waves at coastlines can range in size from barely perceptible on tide gauge recordings to heights upwards of 100 feet (30 meters). Upon reaching the coastline, the momentum of the tsunami waves may carry them inland for some distance, and they may run up on land to elevations greater than the wave height at the coast.

Borrero et al. (2006) evaluated historical and hypothetical tsunami-induced wave heights in San Francisco Bay, focusing on the Central Bay and the North Bay. The largest hypothetical tsunami-induced wave was caused by a very large earthquake (greater than 9.0 on the Richter scale) on the Alaska-Aleutian subduction zone. Modeling results predicted a 16.4-foot wave entering San Francisco Bay, but the wave height was quickly reduced to less than 3.2 feet as it passed under the San Francisco–Oakland Bay Bridge and was further reduced as it passed through the Central Bay.

[2] Analysis was conducted by USACE in the original San Francisco Bay Shoreline Study (USACE 1988, 1989).



AECOM
South Bay Salt Pond Restoration Project

Figure 3.2-2
FEMA Special Flood Hazard Areas

A seiche is a wave that oscillates in lakes, bays, or gulfs from a few minutes to a few hours as a result of seismic or atmospheric disturbances. The geometry of the basin and frequency of oscillation have the potential to amplify the waves. Tsunami waves can create seiches when they enter embayments. Geologic-induced seiche events have not been documented in the Bay and meteorological effects can be quickly dissipated due to the connection with the Pacific Ocean.

Project Setting

This section describes the physical setting of the Eden Landing Phase 2 area, located on the east shore of the Bay south of the San Mateo Bridge. Actions taken under the Phase 1 of the SBSP Restoration Project are included in the setting for Phase 2 actions.

The SBSP Restoration Project is a program to restore tidal marsh habitat, reconfigure and enhance managed pond habitat, maintain or improve current levels of flood risk management, and provide recreation opportunities and public access. The SBSP Restoration Project (described in the 2007 Final EIS/R) would restore a mosaic of tidal and managed pond habitats in the South Bay. A continuous band of tidal marsh (a “tidal marsh corridor”) along the edge of the Bay would provide connectivity of habitat for tidal marsh-dependent species. Tidal habitats would experience tidal inundation of Bay water, and marshes would be created through estuarine sedimentation and natural vegetative colonization. Habitat transition zones would be restored in some areas. Managed ponds would encompass a range of water depths and salinity regimes through the use of flow control structures, grading, and other means. The SBSP Restoration Project lands reflect the diversity of wildlife habitats that could be restored to tidal wetlands, brackish marsh, managed ponds, seasonal wetlands, riparian habitat, freshwater marshes and adjacent uplands.

Eden Landing Phase 1 actions included tidal salt marsh habitat restoration, managed pond reconfiguration and enhancement, recreation and public access features, and maintenance of the existing levels of de facto flood protection provided by the former salt-production levees. Full tidal action was restored to former Ponds E9, E8A and E8X in 2011. Ponds E12 and E13 were reconfigured to create 230 acres of high quality shallow water foraging areas at varying salinities and six constructed nesting islands. Pond E14 was enhanced for shorebird management.

Eden Landing Phase 2 of the SBSP Restoration Project is a direct outgrowth of the acquisition of the Eden Landing pond complex and of the continued implementation of the larger SBSP Restoration Project laid out in the 2007 Final EIS/R.

Eden Landing Pond Complex

The 5,500-acre Eden Landing (formerly Baumberg) pond complex, shown in Figure 2-3, is owned by the CDFW and is located on the eastern shore of the South Bay, between the San Mateo Bridge and the Alameda Creek Flood Control Channel (ACFCC).

Tributaries

The tidal sloughs located within the Eden Landing pond complex are the ACFCC, Old Alameda Creek (OAC), Mt. Eden Creek, and North Creek. Dry Creek is a tributary to Alameda Creek, located about 6 miles upstream of its mouth and 0.5 miles upstream of the confluence of Alameda Creek with the ACFCC and OAC. Ward Creek is a tributary to OAC.

The largest of the tidal sloughs is the ACFCC (formerly known as Coyote Hills Slough). The ACFCC receives flow from Alameda Creek, which drains an area of 633 square miles of land, stretching from Mt. Diablo in the north to Mt. Hamilton in the south, and east to Altamont Pass. The 12-mile-long ACFCC is the primary flood conveyance channel for the Alameda Creek watershed. The flood protection project was constructed from the west end of Niles Canyon and extends through the City of Fremont to the Bay. The ACFCC is enclosed with levees for most of its length and is tidally influenced in the vicinity of the SBSP Restoration Project area. It was originally constructed by the USACE to provide protection from the "Standard Project Flood." The Standard Project Flood is defined as a major flood that can be expected to occur from a severe combination of meteorological and hydrological conditions that is considered reasonably characteristic of the geographical area and is equivalent to a flood flow of 52,000 cfs downstream of Dry Creek. Due to significant sedimentation, channel capacity adjacent to the salt ponds has been reduced to approximately the 100-year flood. The ACFCC is currently owned and maintained by the Alameda County Flood Control and Water Conservation District (ACFCWCD).

Before Alameda Creek was diverted into the ACFCC, it entered the Bay through OAC, located in the central portion of Eden Landing to the north of the ACFCC. OAC is a tidal slough that drains a watershed area of about 22 square miles. The creek consists of two excavated channels, lined by outside levees with an interior marshplain "island." The creek conveys urban runoff from southern Hayward and the Alvarado district of Union City. On the landward side of the salt pond complex, approximately 3.4 miles upstream of the Bay, a large gated structure has been installed to prevent tidal waters from extending further upstream. The 20-tide gate structure allows upstream runoff to enter the lower reaches but prevent tidal water from reaching upstream. The current channel capacity is estimated at the 15-year flood (4,000 cfs), although effective conveyance is reduced during high flow events due to the gated structure. All tributary inflow connections to OAC are located upstream from the tidal gates.

Mt. Eden Creek drains a small area south of State Route (SR) 92 in the City of Hayward. The slough receives flood flows from only one local pump station. The North Creek tributary connects tidal ponds in northern Eden Landing to OAC. Tidal action was restored to both North Creek marsh and Mt. Eden Creek marsh along with several miles of sloughs that connect these marshes to the Bay. These SBSP Phase 1 tidal marsh restoration actions were completed in 2011.

Sediment Characteristics

Alameda Creek can have highly episodic sediment discharge to the Bay. In the most extreme case, in water year 2003, Alameda Creek transported 76 percent of its annual sediment load in one day and 83 percent in the seven-day period during the storm and on the recession limb of the hydrograph. This one-day and seven-day load constituted 35 percent and 38 percent respectively of the total measured 11-year suspended sediment load for water years 2000 to 2010 (McKee et al 2013).

Sediment from the Alameda Creek watershed historically deposited within the Eden Landing pond complex is a mix of sand, silt, and clay. Ponds within the Eden Landing pond complex are composed of 38 percent sand, 39 percent silt, and 23 percent clay and, on average, slough channels are composed of 13 percent sand, 54 percent silt, and 33 percent clay (United States Geological Survey [USGS] 2005).

Sediment accretion allows mudflat areas and pond bottoms to increase to elevations at which marsh vegetation can establish itself. The rate of estuarine sedimentation in natural and restored marshes depends on sediment supply, settling velocities, and the period of marsh inundation. Sediments are carried into a marsh and deposited during flood tides as currents slacken. The rate of sedimentation decreases as mudflats and marsh plains rise in elevation and the period of tidal inundation decreases. Colonizing vegetation on accreting mudflats increases the rate of sedimentation by enhancing sediment trapping and contributing organic material to the sediment. Sediment deposits consolidate over time and can reduce the rate of net accretion.

Pond bottoms in the Eden Landing pond complex are currently at relatively high topographic elevations compared with the Bay. The sediment accretion rate in the Eden Landing ponds are expected to be lower than sedimentation rates measured near the recent breaches in the Alviso pond complex in the far South Bay, which have been in the range of 0.4 to 8 inches per year (Borgnis et al. 2013).

Flood Hazards

The Eden Landing pond complex is exposed to wind wave action due to westerly and northwesterly winds crossing the Bay. Consequently, the outboard levees and exposed tidal marshes are prone to erosion and potential flooding. However, flood studies completed by the USACE in the 1980s found little risk of coastal flood damage in the vicinity of the Eden Landing pond complex due to the lack of adjacent development and the presumption that the levees would be maintained to facilitate salt production (USACE 1988).

The southern Eden Landing ponds lie within the Alameda Creek watershed. ACFCWCD has jurisdiction over the watershed and all drainage ways leading to the Eden Landing pond complex. FEMA has published flood study results for the tributaries to Eden Landing in the community specific Flood Insurance Studies. These studies provide fluvial flood event discharges for various recurrence intervals. The FEMA-designated 100-year floodplain extends landwards from the southern Eden Landing ponds to the Union Sanitary District (USD) Wastewater Treatment Plant and to some industrial and residential developments. Additional areas near the ACFCC and along Ward Creek (a tributary to OAC) are also within the FEMA-designated 100-year floodplain and can be affected by fluvial flows.

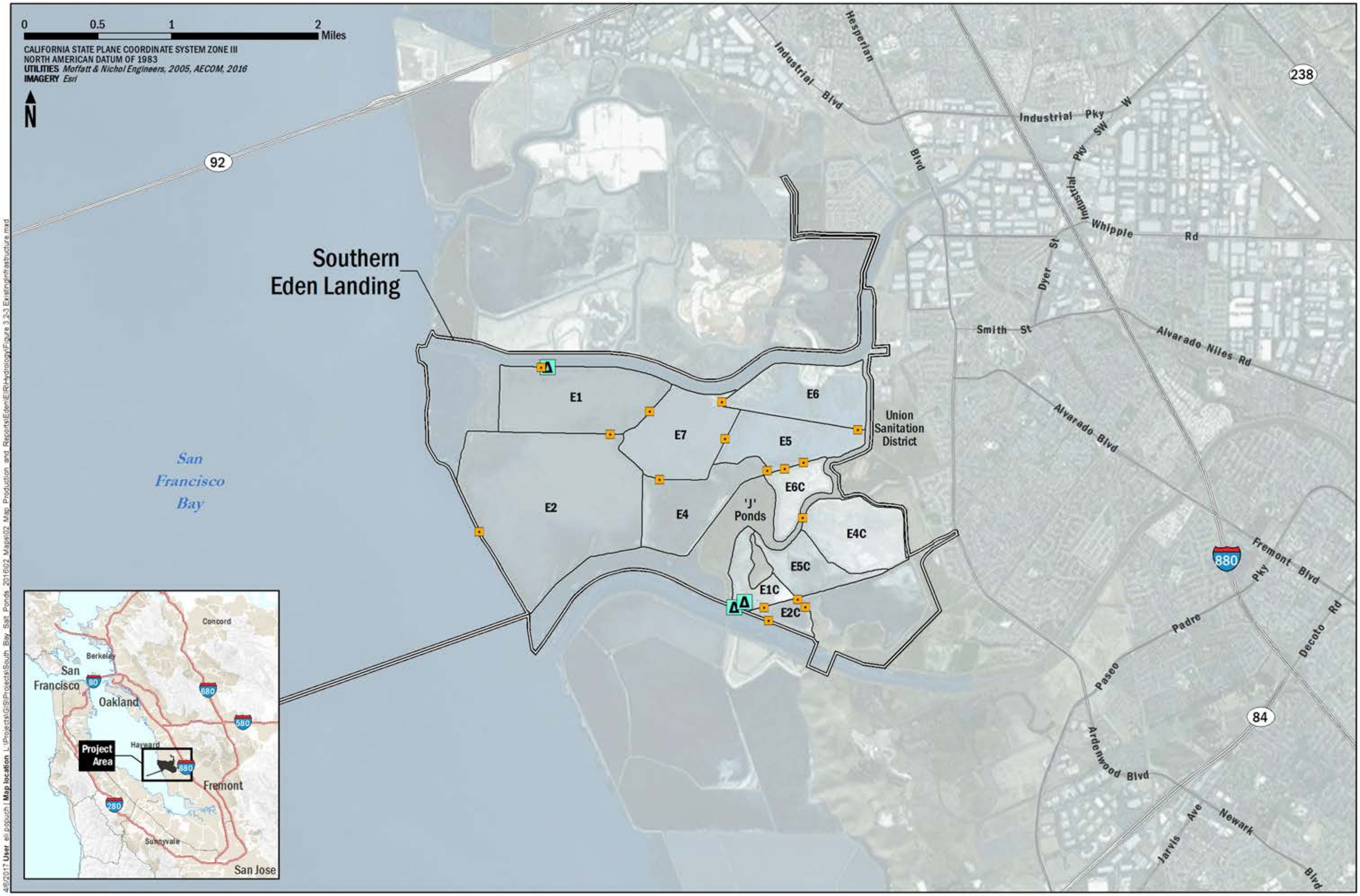
Eden Landing Phase 2 Ponds

Eden Landing Phase 2 actions consist of modifications to the entire southern half of the Eden Landing pond complex. At southern Eden Landing, there are 11 ponds that this document describes as being in three groups: the Bay Ponds, the Inland Ponds, and the Southern (or C-) Ponds. Existing infrastructure at these ponds are shown in Figure 3.2-3.

In general, water enters ponds directly from the Bay on high tides or through hydrologically linked sloughs, flows to one or more ponds through water control structure(s), and discharges at low tide. The ponds discharge at tide stages lower than pond water elevations. Discharge occurs for approximately 13 to16 hours per day (based on predicted tides and spring or neap tide cycle variation). Pond intake of Bay/slough water occurs at elevations above pond water levels (CDFW 2015).

Bay Ponds

The Bay Ponds (Ponds E1, E2, E4, and E7) are located on the south central portion of Eden Landing. The Bay Ponds are the four large ponds located closest to the Bay, bordered to the north by the OAC, and bordered to the south by Alameda County-owned wetlands and the ACFCC. Ponds E2 and E4 are connected to each other with two large breaches and a deteriorating levee while the other ponds are separated with intact levees and water control structures. The Bay Ponds are relatively large, 1,394 acres in size, and includes Ponds E1 (299 acres), E2 (687 acres), E4 (192 acres) and E7 (222 acres). The average bottom elevation of these ponds is about 4.5 feet (NAVD88).



LEGEND

- Water Control Structure
- Pump Station
- Eden Landing Phase 2 Project Area
- Southern Eden Landing Ponds

AECOM

South Bay Salt Pond Restoration Project

Figure 3.2-3

Existing Infrastructure at the Eden Landing Phase 2 Project

The Bay Ponds are currently operated as circulation ponds while maintaining discharge salinities to the Bay at less than 44 ppt (CDFW 2016). The intake pond E1 can receive water from OAC through four 48-inch gates and through a 30,000 gallon per minute (gpm) pump, although the pump is rarely used. Pond E2 discharges water to the Bay through two 48-inch gates.

Summer operations circulate flow through Pond E1 to Pond E2, while Ponds E7 and E4 are allowed to draw down. During the summer season, water is also transferred periodically from the Bay Ponds to the Inland Ponds to replace water lost from the Inland Ponds due to evaporation. Limited amounts of flow move from Pond E1 to E7 to E6 to E5 to E4 and finally to E2. Daily inflows through the tide gates at Pond E1 average 55 cfs.

During the winter, the Bay Ponds are used to circulate water through the Inland Ponds. Inflow from Pond E1 circulates through Ponds E7, E6, E5, E6C, and E4 to the discharge at Pond E2. Water from Pond E1 is diverted to Pond E7 to circulate through Ponds E6 and E5 (and E6C) to reduce salinity in those ponds. The higher salinity water in Ponds E6 and E5 (and E6C) is then recirculated and mixed in Pond E4 and discharged through Pond E2 to the Bay. The estimated average total winter circulation inflow is approximately 8 cfs. The winter operation period is normally November through April.

The existing outboard salt pond levee at Pond E2 provides some measure of de facto flood risk management to inland areas. The bayward-facing levee protects against high surface water elevations and waves. The bayward ponds provide storage and dissipate residual wave energy. Internal levees separate the individual salt ponds from each other. If the bayward ponds fill due to an unexpected breach, the internal salt pond levees then provide some level of flood risk management from high water levels and waves.

Inland Ponds

The Inland Ponds (Ponds E5, E6, and E6C) are somewhat smaller ponds located in the eastern portion of the pond complex. They are bordered to the north by OAC, to the east by Cargill owned property and by the USD wastewater treatment plant, and to the south by an Alameda County-owned freshwater outflow channel and diked marsh areas known as the "J-Ponds." Discharge pipes from the wastewater treatment plant run below the northeast corner of Pond E6. The Inland Ponds include Ponds E6 (202 acres), E5 (169 acres), E6C (85 acres). The average bottom elevation of these ponds is about 4.8 feet (NAVD88).

CDFW operates Ponds E6, E5, and E6C as batch ponds. This means that Ponds E6, E5, and E6C have low salinity in the spring and CDFW allows for evaporation to increase salinity during the summer months, similar to seasonal ponds. During the summer, these ponds are either allowed to draw down and dry, or are managed for mostly open water conditions with higher salinity (40 to 120 ppt) and no circulation flow. In the winter, the ponds are operated to have continuous circulation with low volume discharges to maintain higher water levels.

There is a section of higher ground on the landward side of the Pond E6 (*i.e.,* near the USD Wastewater Treatment Plant), but ACFCWCD's detention basin located east of the Inland Ponds is only partially protected by levees. The detention basin would inundate from the adjacent slough and from surrounding areas during flood events. Residential areas to the east are generally on higher ground.

Southern Ponds

The Southern Ponds (Ponds E1C, E2C, E4C, and E5C, which are sometimes referred to as the C- Ponds) are in the southeastern portion of the Eden Landing pond complex. They are separated from the Inland

Ponds and the Bay Ponds by the J-Ponds. The Southern Ponds include E4C (181 acres), E5C (102 acres), E1C (72 acres), and E2C (37 acres). Cargill Pond CP3C is not part of the Eden Landing Ecological Reserve (ELER, or Reserve) (i.e., it is not owned by CDFW), but is hydrologically linked to Pond E2C and by agreement with Cargill is operated as part of the Southern Ponds system. The average bottom elevation of these ponds is about 5.0 feet (NAVD88).

Ponds E1C, E4C, and E5C are seasonal ponds with open water in the winter, shallow water conditions in the fall and spring, and mostly dry conditions during the summer. Ponds E1C, E4C, and E5C are periodically filled from Pond E2C during the spring through fall and are operated as open water ponds in winter with water levels approximately 1-foot deep. These ponds can have increased salinity due to the high surface area and shallow water, which is then diluted prior to discharge via mixing in Pond E2C.

Ponds E2C and CP3C are operated as a separate continuous circulation system. CP3C's bottom is generally open water, while E2C's bottom is exposed during neap tides, though it remains wetted. The estimated circulation flow at Pond E2C is 26 cfs (daily average) during the summer and approximately 2 cfs during the winter.

Landward of the Pond E4C is an area of high ground, where a capped landfill is located on a private parcel. Residential areas to the east are also generally on higher ground.

3.2.2 Regulatory Setting

This section provides a description of the implementing agencies involved in flood management in the Eden Landing Phase 2 area and a brief summary of the regulatory setting: the primary laws and regulations related to flood management, hydrodynamics, and sediment transport in the region.

Flood Management Implementing Agencies

Flood risk assessments and some flood-protection projects are conducted by federal agencies, including FEMA and USACE. The flood management agencies and cities implement the National Flood Insurance Program under the jurisdiction of FEMA and its Flood Insurance Administration. The FEMA-designated flood risk assigned to geographic areas along the Bay is illustrated on Flood Insurance Rate Maps (FIRMs). FEMA FIRMs show base flood elevations (which include predicted water surface elevations landward of shoreline and river barrier crests for the design event) and special flood hazard zones.

USACE also conducts studies on flood hazards and participates in flood management projects in which they have regulatory jurisdiction, as stated in Section 10 of the Rivers and Harbors Appropriation Act of 1899 (often simply referred to as the Rivers and Harbors Act or RHA). All significant USACE construction projects are subject to authorization by Congress pursuant to the Water Resources Development Act. Additionally, USACE is given authority to pursue projects in which Congress has determined a federal interest in joint flood protection/ ecosystem restoration (Executive Order 11988). USACE has developed principles and guidelines for designing and constructing flood-protection measures for coastal, estuarine, and river environments. USACE also has previously conducted studies on flood hazards and risks as part of the original San Francisco Bay Shoreline Study (USACE 1988, 1989, 1992).

Other agencies responsible for flood management include the local flood control districts and city public works departments. The local flood control districts have local jurisdiction for the development of flood-protection projects. The flood control districts' authority is derived from enabling legislation passed by the State of California. In the Eden Landing pond complex, the relevant flood control district is ACFCWCD. Local flood control districts are responsible for providing flood protection to the counties and cities in their jurisdiction and are the issuing agency for encroachment permits for storm drain outfalls into flood-protection channels.

Laws and Regulations

The SBSP Restoration Project falls under the jurisdiction of many federal, state, and local agencies with respect to specific aspects of planning, restoration, and management. The following section summarizes the primary laws and regulations affecting flood management, hydrodynamics, and sediment transport within the Eden Landing Phase 2 area.

Federal Regulations

Federal Clean Water Act. Section 404 of the Clean Water Act (CWA) regulates all activities resulting in the discharge of dredged or fill material into waters of the United States, which includes wetlands. Section 404 gives USACE the principal authority to regulate discharges of dredged or fill material, under oversight by the United States Environmental Protection Agency (USEPA). While the USACE is given authority to issue permits allowing such discharges, the USEPA is given the authority to veto permit decisions.

Rivers and Harbors Act. The RHA prohibits the unauthorized alternation or obstruction of any navigable waters of the United States. As defined by the RHA, navigable waters include all waters that are:

- Historically, presently, or potentially used for interstate or foreign commerce; and
- Subject to the ebb and flow of tides.

Regulations implementing Section 10 of the RHA are coordinated with regulations implementing CWA Section 404. The RHA specifically regulates construction of structures in, under, or over navigable waters; deposition or excavation of material in navigable waters; and all work affecting the location, condition, course, or capacity of navigable waters.

The RHA is administered by the USACE. If a proposed activity falls under the authority of RHA Section 10 and CWA Section 404, the USACE processes and issues a single permit. For activities regulated only under RHA Section 10, such as installation of a structure not requiring fill, permit conditions that protect water quality during construction may be identified in a letter of permission. A letter of permission is a type of individual permit issued by the USACE, through an abbreviated processing procedure, for certain activities subject to RHA Section 10.

Coastal Zone Management Act. The Coastal Zone Management Act of 1972 requires that federal actions be consistent with state coastal plans. The San Francisco Bay Conservation and Development Commission (BCDC) Bay Plan is approved under the Coastal Zone Management Act. To implement this provision, federal agencies make "consistency determinations" on their proposed activities, and applicants for federal permits, licenses, other authorization, or federal financial assistance make "consistency certifications." BCDC then has the opportunity to review the consistency determinations and certifications and to either concur with them or object to them.

Executive Order 11988–Floodplain Management. Executive Order 11988 requires federal agencies to recognize the values of floodplains and to consider the public benefits from restoring and preserving floodplains. Under this order, the USACE is required to take action and provide leadership to avoid development in the base floodplain; reduce the risk and hazard associated with floods; minimize the impact of floods on human health, welfare, and safety; and restore and preserve the beneficial and natural values of the base floodplain.

National Flood Insurance Acts. The National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973 were enacted to reduce the need for flood-protection structures and to limit disaster-relief costs by restricting development on floodplains. FEMA was created in 1979 to administer the National Flood Insurance Program and to develop standards for fluvial and coastal floodplain delineation.

State Regulations

Public Trust Doctrine. Public lands under the jurisdiction of the California State Lands Commission (CSLC) include fee lands owned by the State and easement interests in lands which are held in public trust. The CSLC has jurisdiction and management authority over all ungranted tidelands (*e.g.*, tidal sloughs), submerged lands, and the beds of navigable lakes and waterways. On tidal waterways, the State's sovereign fee ownership extends landward to the high tide line, except where there has been fill or artificial accretions or the boundary has been fixed by agreement or court decision. Use of public trust lands is generally limited to water dependent or related uses, including commerce, fisheries, and navigation, environmental preservation, and recreation. Public trust lands may also be kept in their natural state for habitat, wildlife refuges, scientific study, or use as open space.

McAteer-Petris Act. The McAteer-Petris Act of 1965 established the BCDC as a temporary state agency in charge of preparing the Bay Plan. In 1969, the act was amended to make the BCDC a permanent agency and to incorporate the policies of the Bay Plan into state law. Under the McAteer-Petris Act and the Bay Plan, any agency or individual proposing to place fill in, to extract materials from, or to substantially change the use of any water, land, or structure in BCDC's jurisdiction is required to secure a San Francisco Bay Permit. BCDC grants San Francisco Bay permits for projects that meet either of the following guidelines:

- The project is necessary to the safety, welfare, or health of the public in the entire Bay Area; or
- The project is consistent with the provisions of the implementing regulations and the Bay Plan.

The types of San Francisco Bay permits include region-wide, administrative, and major permits. The type of permit issued depends on the nature and scope of the proposed activities.

California Water Code. The California Water Code ensures that the water resources of California are put to beneficial use to the fullest extent of which they are capable and that the conservation of water is exercised in the interest of the people and for the public's welfare. All projects in California must abide by Division 5 of the California Water Code, which sets the provisions for flood control. The California Water Code includes a number of provisions that pertain to local and state flood management and flood protection. Section 8100 et seq. of the code contains guidelines for the construction of public works and improvements, including the protection and restoration of watersheds, levees or check dams to prevent overflow or flooding, conservation of the floodwaters, and the effects of construction projects on adjacent counties (especially upstream and downstream along a river). Section 12840 et seq. of the code contains provisions related to flood-prevention projects.

California Fish and Game Code Sections 1600 to 1616. In accordance with Sections 1601 to 1607 of the California Fish and Game Code, the CDFW regulates projects that affect the channel, flow, or banks of rivers, lakes, or streams. Section 1602 requires public agencies and private individuals to notify and enter into a streambed or lake alteration agreement with the CDFW before beginning construction that would:

- Substantially divert or obstruct the natural flow of any river, stream or lake;
- Substantially change or use any material from the bed, channel or bank of any river, stream, or lake; or
- Deposit debris, waste or other materials that could pass into any river, stream or lake.

Sections 1600 to 1616 may apply to any work undertaken within the 100-year floodplain of a body of water or its tributaries, including intermittent stream channels. In general, these sections are construed as applying to work within the active floodplain and/or associated riparian habitat of a stream, wash, or lake that provides benefits to wildlife and fish. Sections 1600 to 1616 typically do not apply to drainages that lack defined beds and banks, such as swales, or to very small bodies of water and wetlands. Lake or streambed alteration agreements may impose conditions to protect water quality during construction.

Local Regulations

Alameda County Flood Control and Water Conservation District Act. The Alameda County Flood Control and Water Conservation District Act created ACFCWCD in order to:

- Provide for control of flood and storm waters of the district and of streams which flow into the district;
- Conserve waters for beneficial and useful purposes by spreading, storing, retaining and causing the waters to percolate into the soil within or without the district, or to save or conserve the waters in any manner and protect the watercourses, watersheds, harbors, public highways, life and property in the district from such waters;
- Prevent waste of water or diminution of the supply in, or exportation from, the district;
- To obtain, retain and reclaim drainage, storm, flood and other waters for beneficial use in the district;
- To engage in incidental recreation activities; and
- Control and distribute any water including sewage water, and to acquire and operate facilities for collection and disposal of sewage, waste, and storm water.

The ACFCWCD Land Development Division reviews design documents and issues permits for developments that may disturb watercourses. Where appropriate, permits issued for development may require mitigation for disturbances.

3.2.3 Environmental Impacts and Mitigation Measures

Overview

This section describes environmental impacts and mitigation measures related to hydrology, flood management, and infrastructure. It includes a discussion of the criteria used to determine the significance of impacts. Potential impacts were characterized by evaluating direct, indirect, short-term (temporary), and long-term effects. Impact evaluations for the Action Alternatives are assessed based on hydrodynamic modeling of the southern Eden Landing ponds (provided in Attachment 1, Southern Eden Landing Restoration Preliminary Design: 1D and 2D Hydrodynamic Modeling, of Appendix D, Southern Eden Landing Preliminary Design Memorandum), the existing conditions described in Section 3.2.2 above, and the anticipated future conditions that would occur under the No Action Alternative. This approach is consistent with the California Environmental Quality Act (CEQA), which requires that project impacts be evaluated against existing conditions. This approach is also consistent with the National Environmental Policy Act (NEPA), where Action Alternatives are compared to the No Action Alternative and an environmental baseline for comparison that can be either the existing conditions or the future no-action conditions.[3] In this case, the No Action Alternative represents no change from current management direction or level of management intensity provided in the Adaptive Management Plan (AMP) and other Reserve management documents and practices.

Significance Criteria

Hydrology and flood risk were assessed by comparing expected conditions in the future under each alternative against the baseline conditions. For the purposes of this Draft EIS/R, the project is considered to have adverse impacts on hydrology or flooding if it would:

- Increase the risk of flooding that could cause injury, death, or substantial property loss;
- Alter existing drainage patterns in a manner which would result in substantial erosion or siltation on- or off-site;
- Create a safety hazard for people boating in the project area;
- Result in inundation by a seiche, tsunami, or mudflow;
- Create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems; or
- Place structures within the 100-year-flood hazard area that would impede or redirect flood flows.

The SBSP Restoration Project, Eden Landing Phase 2 alternatives would not create or contribute runoff. This criteria is intended for evaluation of urban land uses and does not apply to the proposed project's Eden Landing Phase 2 actions.

As explained in Section 3.1.2, while both Council on Environmental Quality (CEQ) Regulations for Implementing NEPA and the CEQA Guidelines were considered during the impact analysis, impacts identified in this Draft EIS/R are generally characterized using CEQA terminology. Please refer to Section 3.1.2 for a description of the terminology used to explain the severity of the impacts. For the purpose of this NEPA/CEQA impact assessment, the thresholds of significance are applied to changes from baseline conditions that result from factors within the control of the project proponents. Also note that the impacts and the thresholds of significance in this Draft EIS/R are similar to those evaluated in the 2007 Final EIS/R with an additional discussion of structures placed within the 100-year flood hazard area.

[3] More discussion of this topic is presented in Section 3.1 of this Draft EIS/R.

Program-Level Evaluation Summary

Three programmatic-level alternatives were considered and evaluated in the 2007 Final EIS/R. This included Programmatic Alternative A – the No Action Alternative, Programmatic Alternative B – the Managed Pond Emphasis, and Programmatic Alternative C – the Tidal Habitat Emphasis. At the program level, the decision was made to select Programmatic Alternative C and implement Phase 1 actions. Therefore, a summary of the impacts for Programmatic Alternative C from the 2007 Final EIS/R is provided below.

The determination was made in the 2007 Final EIS/R that Programmatic Alternative C would result in less than significant impacts for the following:

- Coastal flood risk landward of the area of the SBSP Restoration Project;
- Fluvial flood risk;
- Levee erosion along channel banks downstream of tidal breaches; and
- Potential interference with navigation.

Impacts from coastal flood risk due to regional changes in Bay bathymetry and hydrodynamics were considered potentially significant in areas outside the SBSP Restoration Project if levees were not adequately maintained.

Under Programmatic Alternative C, the Tidal Habitat Emphasis, implementation of the AMP would maintain or improve levels of coastal and fluvial flood protection[4] landward of the area of the SBSP Restoration Project. For example, salt pond levees would be inspected and regularly maintained and levees would be improved (e.g., raise, widen, or armor the levee) as needed, in accordance with the AMP. Programmatic Alternative C would also be designed such that levees downstream of breaches are either no longer required for flood protection, are adequately maintained, or are protected from erosion (e.g., by a band of marsh between the levee and the channel, setting the levee back from the eroding channel, or by armoring the levee). Therefore, the widening and deepening of sloughs would not substantially affect nearby flood control projects.

Project-Level Evaluation

Phase 2 Impact 3.2-1: Increased risk of flooding that could cause injury, death, or substantial property loss.

Alternative Eden A (No Action). The existing levees within the SBSP Restoration Project area were originally built to create ponds for commercial salt production. The pond levees were not constructed to provide flood protection, and were not engineered to conform to flood or other engineering standards. The levees and the salt ponds themselves, however, provide partial protection from coastal flooding as they are a barrier to waves and high tides from the Bay. The ponds also provide storage of water due to wave-

[4] The 2007 Final EIS/R and other SBSP Restoration Project documents used the term “flood protection” to describe its goals, but the conventional terminology has since changed to be “flood risk management”. Not only can this distinguish improvements to existing berm-like salt pond levees from engineered levees specifically designed for flood protection, but it also reflects a general shift in terminology used by our partner organizations. This document generally uses the former term to refer to overall Project goals that were established prior to this terminology change but uses the latter term for forward-looking statements and actions that would be taken in the future.

induced overtopping of bayfront levees. Salt pond levees need to be actively maintained to provide this partial flood risk management.

Under Alternative Eden A (No Action), no new activities would be implemented as part of Phase 2. The CDFW is maintaining the ponds at southern Eden Landing as part of the Reserve in accordance with the AMP and other Reserve management documents and practices. The ponds are currently managed as either seasonal ponds or circulation ponds to provide a variety of water depths during summer and winter seasons and for the current water quality management which involves circulating water, as needed, to control pond discharge salinity. These southern Eden Landing ponds would continue to be managed through the activities described in the AMP, and in accordance with CDFW practices.

The outboard salt pond levee at Pond E2 (the bayward-facing levee) would continue to provide partial coastal flood risk management from high water surface elevations and from waves. The outboard salt pond levee would be repaired, as needed, if there was an unexpected breach. The mudflats and fringing marsh near Pond E1 would continue to dissipate wave energy, causing fewer waves from the Bay to be transmitted shoreward.

Under the No Action Alternative, it is assumed that levees would be maintained and unanticipated breaches in the Eden Landing complex ponds would be repaired to maintain current levels of de facto flood risk management. Adaptive management would also be used to actively monitor and assess existing flood-protection measures. Therefore, effects to coastal and fluvial flood risk would be minimal, and impacts would be less than significant.

Alternative Eden A Level of Significance: Less than Significant

Alternative Eden B. Under Alternative Eden B, pond bottom elevations would be raised and tidal inundation would be introduced to the Bay and Inland Ponds. Minor levee improvements would occur at the Bay and Inland Ponds prior to placement of dredge materials (i.e., low-lying levees would be raised to 10 feet NAVD88 and some of the higher levees would be lowered). After placement of the dredge materials, levees along the northern margins of Ponds E1 and E6 would be breached to OAC and the levee on the southern edge of Pond E2 would be breached to the Alameda County wetlands, which in turn would be connected to the ACFCC via a water control structure (more detail on this below). Pilot channels would be excavated to connect these breaches to the rest of the Bay and Inland Ponds. Portions of the outer levees around the Bay Ponds would be lowered to MHHW (7 feet NAVD88) to provide more frequent levee overtopping, and internal levees would be breached to increase the hydraulic connectivity between channels and marshes, alter circulation and sedimentation patterns, and increase habitat complexity. Levee materials would be used locally to improve the landside levees (discussed below) or for habitat islands. Alternative Eden B also includes construction of four water control structures to manage flows from the ACFCC into the Bay Ponds and Southern Ponds. One of these would provide the aforementioned southern connection into the Bay Ponds; this is for fish habitat connectivity and, depending on gate operations, would provide a minor contribution to the filling and draining of the ponds. The other water control structures would allow muted tidal flows to the Southern Ponds.

Under Alternative Eden B, the Bay, Inland, and Southern Ponds would fill and drain on a daily basis. Without placement of dredge materials, the Bay Ponds and Inland Ponds would initially fill to water surface elevations between 5.0 and 5.6 feet NAVD88, inundating the majority of the pond bottoms during the highest tides. During the peak of the spring tide (the highest tide in a 2-week cycle), the ponds may not completely drain, and water could be ponded for several days. When these peak tides recede, the ponds would drain more fully. With placement of dredge materials, the Bay Ponds and Inland Ponds would fill with the highest tides of the day and drain during low tide.

The Southern Ponds would have muted tidal flow because of the water control structures. These ponds would initially fill to water surface elevations between 5.8 and 6.3 feet NAVD88, which would inundate most of the pond bottoms during the highest tides, except for Pond E4C where a large portion of the pond would remain dry. Low-flow channels and portions of Pond E2C are not expected to completely drain during even with the lowest tides.

Tidal scour is expected to widen and deepen OAC in the area between the levee breaches and the Bay until equilibrium conditions are met. Similarly, some scouring could occur in the ACFCC, between the water control structures and the Bay, due to the increased tidal prism; however, the effects to ACFCC are expected to be minor because of the relatively large capacity in the flood control channel.

Alternative Eden B includes raising the existing backside levees along the eastern edge of the Inland and Southern Ponds to an elevation of 12 feet NAVD88 (in particular, Ponds E6, E5, E6C, E4C, E5C, and E2C). In addition to these flood risk management measures, levees at Ponds E1C and E6C would also be raised for habitat separation and to extend the Bay Trail through Eden Landing. Other levee improvements would be made between Pond E1C and Pond E5C to provide Cargill access to Turk Island.

With the exception of the pilot channel through the Alameda County wetlands connecting the water control structure on the ACFCC to the levee breach on Pond E2, the existing hydraulic connections between the Alameda County wetlands, the J-Ponds, and the ACFCWCD's detention basin would be unchanged. Currently stormwater temporarily detained in the J-Ponds is pumped out, as these ponds do not drain to the Bay. There is a small levee separating the J-Ponds from the County wetlands. The County wetlands are also at a higher elevation than the J-Ponds.

With implementation of Alternative Eden B, levee breaches would allow tidal inundation in the Bay and Inland ponds and water control structures would provide muted tidal flows in the Southern Ponds. Because of these changes, the backside levees of the Inland Ponds and Southern Ponds would be subject to tidal flows with additional erosive forces. However, these backside levees would be raised and enhanced such that the current level of flood risk management would be improved or maintained.

Water from the Bay, Inland, and Southern Ponds would cause the tidal prism to change in OAC and in the ACFCC. Water that drains from the ponds into the channels on the ebb tide could delay fluvial flood flows in these channels from reaching the Bay. If flow in the channel is constrained, this would cause short-term effects on upstream fluvial flood conditions. However, breaching the Bay and Inland Ponds and increasing tidal flows in the Southern Ponds would improve hydraulic connectivity and cause tidal scouring in these channel. This would improve tidal drainage and provide additional fluvial discharge capacity. Lowering portions of the outer levees around the Bay Ponds would also allow fluvial flows that enter into the ponds to pass through the ponds and over the lowered sections to the Bay when tides are high. This would also improve drainage conditions during large fluvial flows. Therefore, effects to upstream fluvial flood conditions are expected to be minimal.

Monitoring and adaptive management would be used to verify that the Eden Landing Phase 2 actions are performing as intended. Changes to coastal and fluvial flood risk would be minimal for the above-mentioned reasons, and therefore impacts would be less than significant.

Alternative Eden B Level of Significance: Less than Significant

Alternative Eden C. Under Alternative Eden C, pond bottom elevations would be raised and tidal inundation would be introduced to the Bay Ponds, and the Inland and Southern Ponds would become enhanced managed ponds. Minor levee improvements would occur to the Bay Ponds prior to placement of dredge materials. When dredge material placement is complete, the northern levee at Pond E1 would be breached to OAC, the southern levee at Pond E4 would be breached to the Alameda County wetlands, and internal levees would also be breached. Portions of the outer levees around the Bay Ponds in areas away from the bayfront would be lowered to MHHW (7 feet NAVD88) and pilot channels would be excavated into the Bay Ponds to improve drainage and enhance tidal marsh formation. Water control structures would be installed in the Inland Ponds and Southern Ponds to manage water quality, depth, salinity, and other aspects of habitat for certain species, including those at the boundaries with OAC, the ACFCC, the J-Ponds, and the Alameda County wetlands.

Alternative Eden C would have its primary source of coastal flood risk management maintained by an improved mid-complex levee system raised to an elevation of 12 feet NAVD88. The mid-complex levee would be constructed to separate the Inland Ponds and Southern Ponds from the tidal flows introduced to the Bay Ponds. It would also prevent the tidal flows from the Alameda County wetlands from entering into the Inland Ponds or Southern Ponds. In addition to these flood risk management measures (which also allow the necessary habitat separation), the bay-facing levee at Pond E2 would also be raised to an elevation of 12 feet NAVD88, where needed, for the purpose of habitat restoration. This levee is currently between 12 and 14 feet NAVD88 for almost all of its length, and therefore improvements to this levee are expected to be minor.

Phase 2 improvements would affect coastal and fluvial flooding in a manner similar to improvements under Alternative Eden B. The Bay Ponds would not provide coastal flood risk management to landward areas from high water levels because levees would be breached, but they would continue to provide some level of protection from waves. Tidal flow in OAC would increase, and to a lesser extent, tidal flow in the ACFCC could also increase (depending on water control structure operations at the Alameda County wetlands). Breaching the Bay Ponds would improve hydraulic connectivity and may cause tidal scouring in these channels, improving tidal drainage, and providing additional fluvial discharge capacity.

Monitoring and adaptive management would be used to verify that the Phase 2 actions are performing as intended. Changes to coastal and fluvial flood risk would be minimal, and therefore impacts on coastal and fluvial flooding would be less than significant.

Alternative Eden C Level of Significance: Less than Significant

Alternative Eden D. Under Alternative Eden D, pond bottom elevations would be raised in the Bay and Inland Ponds, tidal flows would be introduced to the Bay Ponds, and the Inland Ponds and the Southern Ponds would remain as managed ponds until tidal or muted tidal flow is introduced at some future point. Minor levee improvements would occur to the Bay and Inland Ponds prior to placement of dredge materials. The northern levee at Pond E1 would be breached to OAC, portions of the outer levees around the Bay Ponds would be lowered, and internal levees within the Bay Ponds would be breached. Water control structures would be constructed in the Inland Ponds and Southern Ponds to manage water quality, depth, salinity, and habitat. Pilot channels would be excavated in the Bay, Inland, and Southern Ponds to improve circulation or drainage, and in the case of the Bay Ponds, to enhance tidal marsh formation.

Alternative Eden D would construct a temporary mid-complex levee separating the Bay Ponds from the Inland Ponds, extending across the J-Ponds and the western end of the Southern Ponds to the ACFCC.

The mid-complex levee would allow the tidal marsh habitat in the Bay Ponds and the enhanced managed ponds in the Inland Ponds and Southern Ponds to be separately restored and managed. The levees on the landward side of the Inland Ponds and Southern Ponds would also be improved by raising levee elevations to 12 feet NAVD88. The landward levee would provide coastal flood risk management if, and when, tidal or muted tidal flows are introduced to the Inland Ponds and Southern Ponds. The combined effect of the temporary mid-complex levee and the improved backside levee would provide equal or better flood risk management, as compared to existing conditions.

With pond bottom elevations raised due to the placement of dredge materials, tidal marsh habitat is expected to develop in the Bay Ponds relatively quickly. Since mudflats and fringing marsh serve to dissipate wave energy, development of mudflats in the Bay Ponds would cause less wave energy from the Bay to be transmitted shoreward and would potentially decrease rates of erosion on landward levees. Decreased erosion may reduce the need for frequent levee maintenance by those entities responsible for maintaining these levees. Tidal or muted tidal flow would be introduced to the Inland and Southern Ponds at some future point. Tidal marsh habitat is also expected to develop relatively quickly after introduction of tidal flows to the Inland and Southern Ponds because pond bottom elevations would be relatively high due, in part, to placement of dredge materials in the Inland Ponds.

Phase 2 improvements would affect coastal and fluvial flooding in a manner similar to improvements under Alternative Eden B. Breaching the Bay Ponds would improve hydraulic connectivity and cause tidal scouring in OAC. This would improve tidal drainage and provide additional fluvial discharge capacity. Monitoring and adaptive management would be used to verify that Phase 2 actions are performing as intended. Changes to coastal and fluvial flood risk would be minimal for the above-mentioned reasons, and therefore impacts on coastal and fluvial flooding would be less than significant.

Alternative Eden D Level of Significance: Less than Significant

Phase 2 Impact 3.2-2: Alter existing drainage patterns in a manner which would result in substantial erosion or siltation on- or off-site.

Alternative Eden A (No Action). Under Alternative Eden A (No Action), existing pond operations and drainage patterns would be maintained. The ponds would continue to be managed as seasonal ponds or for limited circulation through gated control structures. Because the flows are limited, the potential for erosion from circulating water within the ponds and for sediment accretion within the ponds is minimal. Impacts would be less than significant.

Alternative Eden A Level of Significance: Less than Significant

Alternative Eden B. Under Alternative Eden B, pond elevations would be raised in the Bay and Island Ponds and some of the dredge material placement infrastructure, including the offloading facility and submerged pipelines, would be placed on mudflats or in open waters of the Bay. Although tidal inundation patterns would not change during project construction, the piles securing the offloading facility and the precast concrete pipe weights securing the submerged pipelines could cause minor amounts of localized erosion. Once dredge material placement is complete, the Bay Ponds and Inland Ponds would be breached to tidal flows; therefore, existing drainage patterns within the ponds and tidal flows in adjacent sloughs and channels would be altered. Water control structures would also be constructed in the Southern Ponds, allowing increased muted tidal flow with regular filling and draining. Tidal scour would widen pond breaches, and widen and deepen adjacent sloughs, until equilibrium conditions are met. Sediment from the incoming tide would settle out within the ponds as they fill and drain. Additional marsh channels would form near the breaches, allowing the ponds to drain faster. Vegetation would become established at high pond elevations, stabilizing sediments and increasing habitat complexity. Widening and deepening OAC and increasing scour in the ACFCC could increase erosion at the adjacent levees. These effects would be monitored through the AMP, and corrective actions could be implemented if downstream levees do not meet performance standards.

Breaching Ponds E1 and E6 would increase sediment accretion in the Bay Ponds and Inland Ponds. (Accretion rates are expected to be lower if pond bottom elevations were raised to 6.5 feet NAVD88, the same elevation as mean higher water [MHW]). Muted tidal flows through water control structures at the Southern Ponds could also increase sediment accretion rates. The increased sediment demand would be met by inflow from local tributaries, sediment influx from the Bay, or from nearby sediment deposits in sloughs, channels, mudflats, or marshes. In the South Bay, suspended sediment loads from local drainages are likely to deposit in slough and channels or pass through to the Bay margin where it could be available for wetland maintenance or restoration (Barnard et al. 2013). If naturally supplied sediment sources are exceeded, breaching the salt ponds has the potential to cause erosion in adjacent mudflats. However, ongoing monitoring of mudflats near breaches made as part of Phase 1 and the Initial Stewardship Plan has not detected increases in erosion in nearby mudflats.

The South Bay has experienced net accretion for several decades with deposition occurring in the deepest channels of the Bay (Jaffe and Foxgrover 2006). Strong winds cause significant wave generation, sediment resuspension, and basin-wide circulation. Bottom currents are seasonally reversing and non-tidal surface currents are generated by prevailing summer and winter storm winds and winter freshwater inflows. Sediment concentrations in South Bay are generally higher during flood tides as wind waves resuspend sediments, particularly when the westerly and northwesterly winds occur in the summer and fall. This results in a net sediment flux toward the southeast. Sediment concentrations in sloughs and channels peak during the lowest spring tides, when turbid water occurs at the shoals (Barnard et al. 2013).

In order to meet the sediment deficit without scouring mudflats, SBSP restoration efforts (as a whole) would either be phased over time to match sediment demands with the rate at which sediment naturally enters the South Bay, or ponds would be partially filled with clean dredged sediments and/or upland material. Alternative Eden B includes the option of raising pond bottom elevations through the import of dredge material during the construction phase of the project. The dredge material would be deposited in a slurry and sediments would have the opportunity to settle. After water from the slurry is decanted, sediments are more likely to become consolidated and remain in place when tidal flows are introduced to the Bay Ponds and Inland Ponds. Areas near the external levee breaches would scour, but sediments deposited within the deep interior of the ponds are likely to remain. If the sediments are not cohesive or do not have the opportunity to consolidate, additional sediment would be scoured from the ponds with the initial outgoing tides. This sediment would likely remain in the South Bay, move back and forth through the breached levee with the tides, and over time, be reworked and redeposited in the ponds or nearby mudflats.

Sediment demand in the Bay Ponds and Inland Ponds is not expected to exceed the rate at which sediment naturally enters the Bay because the size of the ponds is small compared to the size of the South Bay and because concurrent, nearby tidal marsh restoration efforts are limited. Effects to neighboring mudflats would be monitored through the AMP, and corrective actions would be implemented if performance metrics are not met (i.e., phasing future tidal restoration within the project vicinity or importing fill material during the tidal restoration efforts). Therefore, impacts from erosion and accretion due to changes in existing drainage patterns would be less than significant.

Alternative Eden B Level of Significance: Less than Significant

Alternative Eden C. Under Alternative Eden C, pond elevations in the Bay Ponds would be raised, and the Bay Ponds would be breached to OAC and to the Alameda County wetlands. Effects from tidal scour and sediment demand would be similar to the effects described above under Alternative Eden B, with the exception that the overall sediment demand from the restoration effort would be less because the Inland Ponds and Southern Ponds would remain as managed ponds. Effects to neighboring mudflats would be monitored through the AMP, with corrective actions implemented if performance standards are not met. Therefore, impacts from erosion and accretion due to changes in existing drainage patterns would be less than significant.

Alternative Eden C Level of Significance: Less than Significant

Alternative Eden D. Under Alternative Eden D, pond elevations in the Bay and Inland Ponds would be raised, the Bay Ponds would be breached to OAC and the Inland Ponds and Southern Ponds would initially remain managed ponds. Tidal or muted tidal flows would be introduced to the Inland Ponds and Southern Ponds during future restoration efforts by the removal of the water control structures and/or by leaving the structures open to allow complete filing and draining. Effects from tidal scour and sediment demand would be similar to the effects described above under Alternative Eden B, with the exception that the overall sediment demand from the restoration effort would phased over a period of decades instead of being implemented at once. Effects to neighboring mudflats would be monitored through the AMP, with corrective actions implemented if performance standards are not met. Therefore, impacts from erosion and accretion due to changes in existing drainage patterns would be less than significant.

Alternative Eden D Level of Significance: Less than Significant

Phase 2 Impact 3.2-3: Create a safety hazard for people boating in the project area.

Alternative Eden A (No Action). With the exception of the deep water channel in the center of the Bay, the project vicinity currently contains few navigable sloughs and waterways that are not actively dredged – major sloughs have silted in over a period of decades, reducing navigability. At low tide, navigation into or out of shallow sloughs can be problematic. Small craft (e.g., kayaks) are more amenable to the shallow water environments and are more likely to navigate tidal sloughs than larger watercraft.

Under Alternative Eden A (No Action), existing operations and pond circulation patterns would be maintained. Sloughs and channels adjacent to the ponds have unconsolidated sediment transported during winter storm events. These sloughs and channels would continue to be shallow, with reduced navigability, unless actively dredged. Maintaining existing management practices would not increase safety hazards for boating. Impacts would be less than significant.

Alternative Eden A Level of Significance: Less than Significant

Alternative Eden B. Under Alternative Eden B, pond bottom elevations would be raised in the Bay and Island Ponds and some of the dredge material placement infrastructure, including the offloading facility and submerged pipelines, would be placed on mudflats or in open waters of the Bay. Submerged pipelines would be anchored to the Bay floor with precast concrete pipe weights, reducing potential navigation hazards. The offloading facility and associated equipment, and the floating pipeline would contain the appropriate signage and navigation lighting as per United States Coast Guard guidelines. This would include displaying lights at night and in periods of restricted visibility on the floating pipeline. Lights would be spaced sufficiently in number to clearly show the pipeline's length and course.

The Bay and Inland Ponds would be breached to tidal flows. Unless explicitly allowed pursuant to a change of CDFW policy and a compatibility determination, navigation within the restored ponds would not be allowed. As part of the compatibility determination, the CDFW could restrict navigation according to season (e.g., no access during breeding season), by type of access (e.g., non-motorized versus motorized), or type of use (e.g., waterfowl hunting only). Water control structures would also be constructed in the Southern Ponds to allow muted tidal flow; these structures would act as physical barriers and prevent boat entry into the Southern Ponds.

Breaching levees to OAC would widen and deepen this slough. However, immediately after breaching, tidal currents through the breaches and in the slough downstream of the breaches would be stronger. High current velocities (e.g., peak values of approximately 5 to 7 feet per second [fps]) and turbulent flow may occur in the immediate vicinity of the breaches. These flows may limit safe navigation of small watercraft within the slough to certain periods of the tide cycle (e.g., near slack tide). Navigation in the immediate vicinity of the breaches could be dangerous until the channel scoured sufficiently. CDFW would restrict navigation in the vicinity of the breaches in the short term, as needed, for safety.

Due to compliance with signage and navigation lighting on construction equipment, restrictions on boating in restored ponds, and due to the creation of physical barriers to boat entry in the Southern Ponds, the Phase 2 actions would not result in significant adverse impacts to navigation. Larger channel cross-sectional areas would reduce the short-term velocity increases associated with the breaches and provide improved navigation in the long term. Therefore, impacts would be less than significant.

Alternative Eden B Level of Significance: Less than Significant

Alternative Eden C. Under Alternative Eden C, short-term potential impacts and the physical barriers and regulatory prohibitions to navigation would be similar to those discussed under Alternative Eden B. Project actions would not result in significant adverse impacts to navigation.

Alternative Eden C Level of Significance: Less than Significant

Alternative Eden D. Under Alternative Eden D, short-term potential impacts and the physical barriers and regulatory prohibitions to navigation would be similar to those discussed under Alternative Eden B. Project actions would not result in significant adverse impacts to navigation.

Alternative Eden D Level of Significance: Less than Significant

Phase 2 Impact 3.2-4: Potential effects from tsunami and/or seiche.

Alternative Eden A (No Action). Eden Landing is subject to tsunami and/or seiche events, although tsunamis in the South Bay are expected to be both very rare and very small. Under Alternative Eden A, it is assumed that levees would be maintained and unanticipated breaches in the southern Eden Landing ponds would be repaired to maintain current levels of flood risk management; however, no direct improvements would occur as part of regular maintenance that would improve levee performance during a tsunami and/or seiche.

Although unlikely, if a tsunami were to overtop a bay-facing levee, ponds and adjacent areas may be flooded and erosion of levee slopes may be accelerated. Existing warning systems would allow for evacuation of the shoreline in the event of a tsunami, so inundation by a tsunami would not expose people to potential injury or death. Therefore, impacts to the existing environmental conditions or proposed conditions of a tsunami and/or seiche would be less than significant.

Alternative Eden A Level of Significance: Less than Significant

Alternative Eden B. Under Alternative Eden B, selected perimeter levees around the Bay Ponds would be breached and lowered and these levees would be allowed to degrade over time, potentially decreasing performance during a tsunami and/or seiche. However, the backside levees of the Inland Ponds and Southern Ponds would be raised to provide increase flood risk management from these levees and this activity would also increase levee performance during a tsunami and/or seiche. The Bay Ponds and Inland Ponds would also transition to tidal marsh, over time, and the addition of habitat transition zones in the Inland Ponds would provide additional protection against tsunamis and/or seiches.

This alternative would not include construction of habitable structures. Warning systems would allow for evacuation of the shoreline in the event of a tsunami, so inundation by a tsunami would not expose people to potential injury or death. Therefore, impacts to existing or proposed conditions resulting from tsunami and/or seiche would be less than significant.

Alternative Eden B Level of Significance: Less than Significant

Alternative Eden C. Impacts resulting from Alternative Eden C would be the same as those described under Alternative Eden B, with the exception that only the Bay Ponds would be restored to tidal marsh habitat, habitat transition zones would be built in the Bay Ponds, and the mid-complex levee would provide the necessary additional flood risk management. Impacts to existing or proposed conditions resulting from tsunami and/or seiche would be less than significant.

Alternative Eden C Level of Significance: Less than Significant

Alternative Eden D. Impacts resulting from Alternative Eden D would be the same as those described under Alternative Eden B, with the exception that habitat transition zones would be built in the Bay Ponds and the mid-complex levee would provide the additional flood risk management, until marsh develops in the Bay Ponds and tidal and/or muted tidal flows are subsequently introduced to the Inland Ponds and/or Southern Ponds. Impacts to existing or proposed conditions resulting from tsunami and/or seiche would be less than significant.

Alternative Eden D Level of Significance: Less than Significant

Phase 2 Impact 3.2-5: Place structures within the 100-year-flood hazard area that would impede or redirect flood flows.

Alternative Eden A (No Action). Under Alternative Eden A (No Action), new activities would not be implemented as part of Phase 2 and new structures would not be placed in 100-year flood hazard areas that would impede or redirect flood flow. There would be no change compared to existing conditions, and therefore there would be no impacts when compared to existing conditions.

Alternative Eden A Level of Significance: No Impact

Alternative Eden B. Under Alternative Eden B, two new bridges would be constructed between the Inland and Southern ponds to extend the Bay Trail through Eden Landing. These bridges would be open to pedestrian and bicycle use but would also be driveable by maintenance or emergency vehicles. These bridges would span the connection between the J-Ponds and ACFCWCD's detention basin and would be constructed to allow for Alameda County equipment access under the bridge, if necessary. These crossings would require bridge abutments on the channel banks and may also require support piers in the water channel. These bridge components could obstruct the ability of the channel to convey peak flows by reducing its channel capacity and possibly by raising flood elevations locally.

However, these bridges would be designed to allow the same volume of water to pass along the same flow path. The cross-sectional area of the bridge support piers would be small (possibly 4-foot diameter piers), when compared to width of the channel (200 to 300 feet). Therefore, the amount of flow that would be redirected around the piers would be minimal and would not raise water surface elevations at the bridge crossing in a manner that would cause flooding in new areas. This ACFCWCD channel is only used for temporary detention of very large fluvial outflows, and the ACFCWCD has control over the rate and timing of flows into and out of this channel to and from the J-Ponds.

Although pier construction methods have not been determined, it is possible that these crossings would require in-water work for pier construction. Design of these bridge crossings would include measures to minimize the effects of placing piers in a flood hazard area (e.g., the shape and alignment of the piers would be designed to minimize adverse hydraulic effects such as local scouring and backwater effects). Because the existing flow conveyance capacity at each crossing would be maintained and effects from pier construction techniques would be minimized, impacts would be less than significant.

Alternative Eden B Level of Significance: Less than Significant

Alternative Eden C. Impacts described under Alternative Eden C would be the same as those described under Alternative Eden B, with the exception that additional pedestrian and bicycle (not vehicle-accessible) bridges would also be constructed to span OAC and the ACFCC. These additional bridges would allow for the 100-year flood event to pass underneath the bridges with sufficient freeboard. Floating structures (such as maintenance dredging and Coast Guard equipment) would also be able to pass under the bridge over the ACFCC at MHHW tide.

Because the existing flow conveyance capacity at each crossing would be maintained and effects from pier construction techniques would be minimized, impacts would be less than significant.

Alternative Eden C Level of Significance: Less than Significant

Alternative Eden D. Impacts described under Alternative Eden C would be the same as those described under Alternative Eden B. Because the existing flow conveyance capacity at each crossing would be maintained and effects from pier construction techniques would be minimized, impacts would be less than significant.

Alternative Eden D Level of Significance: Less than Significant

Impact Summary Table

Phase 2 impacts and levels of significance are summarized in Table 3.2-1. The levels of significance are those remaining after implementation of program-level mitigation measures, project-level design features, the AMP, and other Reserve management documents and practices. The hydrology, flood management, and infrastructure analysis required no project-level mitigation measures in order to reduce the impacts to a level that was less than significant.

Table 3.2-1 Phase 2 Summary of Impacts – Hydrology, Flood Management, and Infrastructure

IMPACT	ALTERNATIVE EDEN A	ALTERNATIVE EDEN B	ALTERNATIVE EDEN C	ALTERNATIVE EDEN D
Phase 2 Impact 3.2-1: Increased risk of flooding that could cause injury, death, or substantial property loss.	LTS	LTS	LTS	LTS
Phase 2 Impact 3.2-2: Alter existing drainage patterns in a manner which would result in substantial erosion or siltation on- or off-site.	LTS	LTS	LTS	LTS
Phase 2 Impact 3.2-3: Create a safety hazard for people boating in the project area.	LTS	LTS	LTS	LTS
Phase 2 Impact 3.2-4: Potential effects from a tsunami and/or seiche.	LTS	LTS	LTS	LTS
Phase 2 Impact 3.2-5: Place structures within the 100-year-flood hazard area that would impede or redirect flood flows	NI	LTS	LTS	LTS

Notes:

Alternative Eden A is the No Action (No Project Alternative under CEQA).

LTS = Less than Significant

NI = No Impact

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