3.2 Hydrology, Flood Management, and Infrastructure

This section of the Final Environmental Impact Statement/Report (referred to throughout as the Final EIS/R) characterizes the existing hydrology and flood management within the 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 Environmental Impact Statement/Report (2007 EIS/R). The baseline condition specific to the Phase 2 ponds is based on current conditions in these areas, which include Phase 1 actions and actions implemented under the Initial Stewardship Plan (ISP). The primary sources of data used to describe recent conditions include SBSP Self-Monitoring and Mitigation Monitoring Reports (SCVWD et al. 2010).

3.2.2 Regional Setting

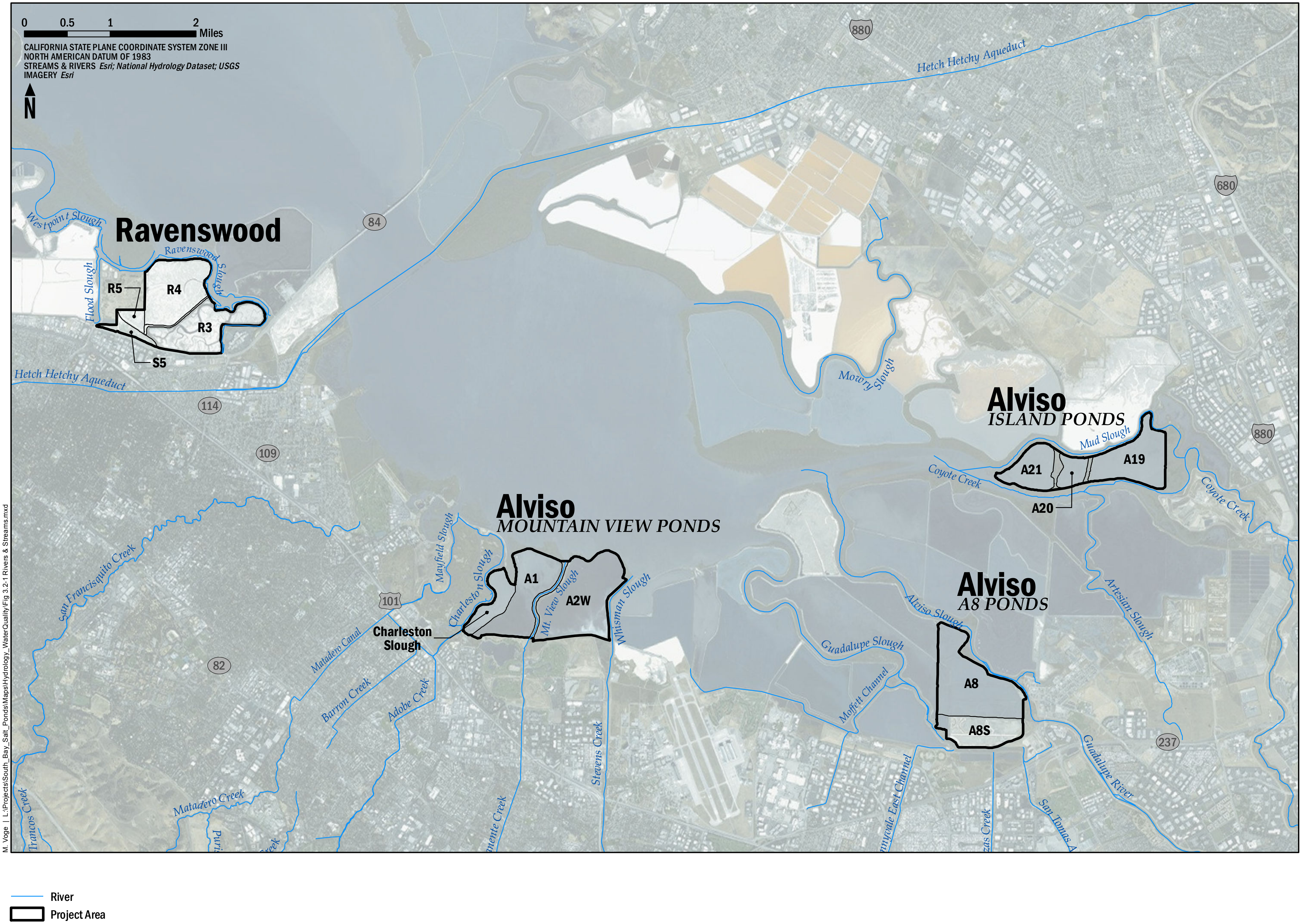
The regional setting provides information regarding the South San Francisco Bay (South Bay), the Alviso pond complex, the Ravenswood pond complex, and upland watersheds (see Figure 3.2-1).

South San Francisco Bay

The South Bay is defined as the portion of San Francisco 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, like much of California's Central Coast, experiences 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



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South Bay Salt Pond Restoration Project

Figure 3.2-1
Rivers & Streams

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.

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 expansive 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 (Walters et al. 1985). In such events, the freshwater flows southward along the surface, while the more saline South Bay water flows northward along the bottom.

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 and Huzzey 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]. Exceptions include areas within the far South Bay below the Dumbarton Bridge, which can remain brackish year-round due to wastewater treatment plant discharges.

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 (> 20 ppt) (PWA et al.

2005a). 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 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 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. Although the South Bay as a whole has undergone periods of net deposition and net erosion, the far South Bay below Dumbarton Bridge has remained largely depositional since bathymetric data collection began in 1857 (Foxgrover et al. 2004; Foxgrover et al. 2007; Krone 1996; Shellenbarger et al. 2013).

Suspended sediment concentrations 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 (Schoellhamer 1996). In the winter and early spring, the main sources of suspended sediments are local tributaries and the Central Bay. For example, extremely wet years candeliver 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. In recent, years, Shellenbarger et al (2014) have collected sediment flux data in the Alviso Slough. Their results show that winter storms and associated runoff have the greatest influence on sediment flux. Strong spring tides promote upstream sediment flux, and the weaker neap tides have a smaller net flux. During these neap tides, sediment transport during their weaker flood and ebb tides is suppressed by stratification of the water column, which dampens turbulence and limits sediment resuspension.

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 astronomical 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 incident 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 (USACE 1988). Note that, while the term "levee" is used to describe these features of the former salt production infrastructure throughout this Final 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.

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 Bay 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[2].

Tsunamis are another potential coastal flooding hazard in the South Bay. Borrero et al. (2006) evaluated historical and hypothetical tsunami-induced wave heights in San Francisco Bay, focusing on the Central

[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.
[2] For example, local flooding related to inadequate drainage systems regularly occurs at Redwood City's Bayfront Canal and Atherton Channel when Flood Slough is at high tide.

and 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. The modeling study did not extend to the far South Bay below the Dumbarton Bridge; however, previous relationships suggest that tsunami-induced wave heights in the far South Bay would be reduced to less than 10 percent of the wave heights at the Golden Gate Bridge.

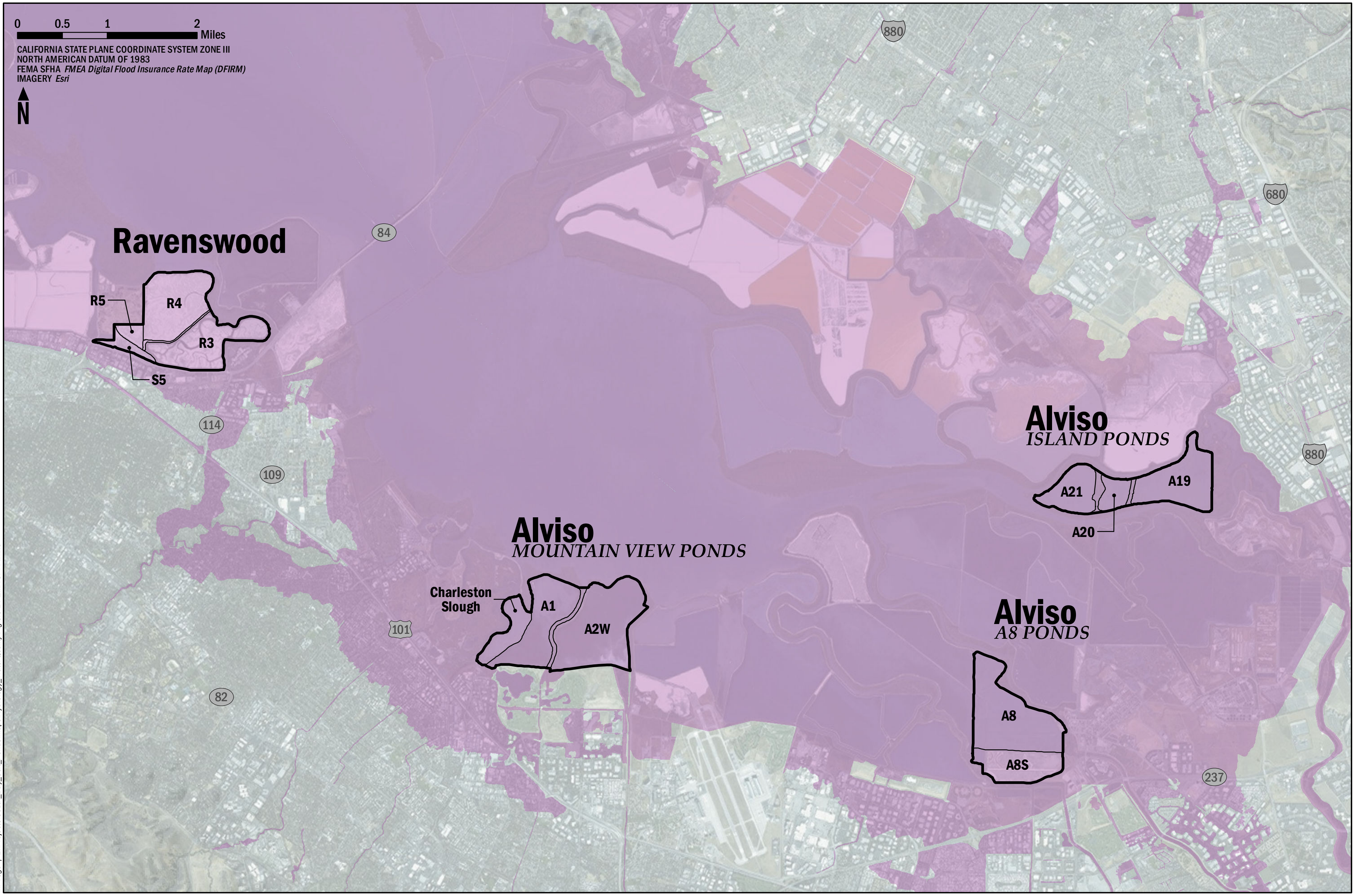
Levees. Levees in the far South Bay, and specifically levees in the SBSP Restoration Project area, were typically constructed with Bay mud (weak clays and silts) dredged from adjacent borrow ditches or pond areas. Soils were not compacted during levee construction, and levees have continued to settle 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 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 a measure of flood protection, and former salt ponds act as temporary storage during coastal flooding conditions. Waves break against outboard levees, which can be safely overtopped. As ponds fill, waves overtop internal levees sequentially, reducing flood-protection capabilities. If 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 as flood-protection mechanisms is substantially reduced. Although most of the shoreline in the South Bay consists of levees that do not meet the Federal Emergency Management Agency (FEMA) or the United States Army Corps of Engineers (USACE)

flood-protection standards, the absence of a history of significant tidal flooding indicates that these levees do provide some level of flood protection (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 (see Figure 3.2-2) 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 or seismic effects. 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 (Santa Clara and Alameda Counties) and 2012 (San Mateo County).



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LEGEND

Special Flood Hazard Area

Project Area

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South Bay Salt Pond Restoration Project

Figure 3.2-2

FEMA Special Flood Hazard Areas

The USACE report for San Francisco Bay Shoreline Study: Southern Alameda and Santa Clara Counties, interim (USACE 1988) presents both a "worst-case" scenario and a "most likely" condition in defining the 100-year coastal floodplain. The "worst-case" scenario assumes that all low-lying areas that are not completely protected from tidal flooding would be flooded during extreme high tides to the elevation of the tide. The USACE "most likely" condition evaluated the extent of tidal flooding most likely to occur given the existence of the salt ponds, pond levees, high ground, and other non-engineered and engineered levees. (The Ravenswood pond complex was outside of the USACE study area and was not included by USACE in its 100-year coastal floodplains.)

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[3], 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. 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 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. The modeling study did not extend to the far South Bay below the Dumbarton Bridge; however, previous relationships suggest that tsunami-induced wave heights in the far South Bay would be reduced to less than 10 percent of the wave heights at the Golden Gate Bridge.

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.

Alviso Pond Complex

The Alviso pond complex consists of 25 ponds in the South Bay within Santa Clara and Alameda counties. The complex covers 8,000 acres and is owned and operated by the U.S. Fish and Wildlife Service (USFWS). The pond complex is bordered on the west by the Palo Alto Baylands Park and Nature Preserve and the City of Mountain View's Charleston Slough; on the south by commercial and industrial

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

land uses, Mountain View's Shoreline Park, the NASA Ames Research Center, and Sunnyvale Baylands Park; and on the east by Coyote Creek in San Jose and Cushing Parkway in Fremont.

Tributaries. Several tidal sloughs are located within the Alviso pond complex, including Mud Slough, Coyote Creek, Artesian Slough, Alviso Slough, Guadalupe Slough, Whisman Slough, Mountain View Slough, and Charleston Slough (see Figure 3.2-1). The tidal range within these sloughs is relatively large.

The largest tributary in the Alviso pond complex is Coyote Creek, which drains an area of 322 square miles towards the South Bay and conveys a substantial amount of fresh water during winter and spring. Tributaries that connect to Coyote Creek near the Bay include Laguna Creek, Mud Slough, Lower Penitencia Creek, Fremont Flood Control Channel, Artesian Slough, Alviso Slough, and the Coyote Creek bypass channel. Mud Slough and Artesian Slough connect to Coyote Creek near the Alviso-Island pond cluster (Ponds A19, A20, and A21). Mud Slough has a drainage area of about 29 square miles and receives limited freshwater input from Laguna Creek during all seasons. Artesian Slough receives discharges from the San Jose/Santa Clara Water Pollution Control Plant (WPCP).

The Guadalupe River is the second largest tributary in the Alviso pond complex in terms of drainage area and flow. The Guadalupe River receives runoff from a steep upper watershed and an urbanized lower watershed, with a total area of 170 square miles. In the lower reaches, the Guadalupe River enters the Bay through Alviso Slough. The Guadalupe River discharges to Alviso Slough near the A8 Ponds (Ponds A8 and A8S), which then drain to Coyote Creek and subsequently to the South Bay. The combination of low channel slope, low-flow velocity conditions, and availability of Bay sediments creates a depositional environment in Alviso Slough. In addition, construction of the salt ponds themselves reduced tidal prism and scour related to it in Alviso Slough. Following implementation of the Phase 1 actions, which made Pond A6 fully tidal and the A8 Ponds muted tidal, tidal flux in the slough has increased and so has its channel capacity. Channel capacity is maintained annually by the Santa Clara Valley Water District (SCVWD).

Guadalupe Slough drains an 85-square-mile watershed. Historically, the Guadalupe River drained through Guadalupe Slough to the Bay. However, the river was diverted to Alviso Slough in the early 1900s during construction of the salt ponds. Presently, Guadalupe Slough conveys flow from San Tomas Aquino Creek, Calabazas Creek, Sunnyvale East and West Channels, and pumped flow from the independent storm-drainage systems of the City of Sunnyvale (the Sunnyvale Stormwater Pump Station that pumps into Calabazas Creek, the Lockheed Stormwater Pump Station that pumps into Moffett Channel, and a small pump station operated by the Twin Creeks Sports Complex that pumps into the Sunnyvale East Channel). The Sunnyvale WPCP also discharges into Moffett Channel, which connects to Guadalupe Slough. The WPCP provides the primary source of fresh water during the summer and fall.

Tidal sloughs located near the Mountain View Ponds include Whisman Slough, Mountain View Slough, and Charleston Slough. These sloughs are relatively shallow and narrow, with limited freshwater inflows and small drainage areas. Stevens Creek discharges to Whisman Slough. Stevens Creek flows northerly from Mountain View and drains an area of 27 square miles. Much of the creek downstream of State Route (SR) 237 is channelized and armored for bank stabilization and flood protection (PWA et al. 2005b).

Permanente Creek, which discharges to Mountain View Slough, encompasses 28 square miles and includes portions of the cities of Los Altos, Mountain View, Cupertino, and Los Altos Hills.

San Francisquito Creek and Matadero Creek are located between the Alviso and Ravenswood pond complexes on the west side of the Bay. The far South Bay also receives water from the Palo Alto

Regional Water Quality Control Plant, which discharges water between the Ravenswood and Alviso pond complexes.

Sediment Characteristics. The sediment historically deposited within the Alviso pond complex is a mix of sand, silt, and clay. These grain-size distributions also show a marked difference from sloughs, where channels are composed primarily of silt. Sedimentation rates near the Alviso pond complex are generally higher than those near the Ravenswood pond complex due to higher levels of suspended sediment (sediment availability). In the Guadalupe River, SSC measurements indicate that SSCs are strongly correlated with flow rates, with higher SSCs found during times of higher flow. The rate of sedimentation in natural and restored marshes depends on the initial bed elevation, sediment supply in the water column, settling velocities, and the period of marsh inundation. Rates of sedimentation decrease over time as mudflats and marsh plains accrete and tidal inundation decreases. Work by Callaway et al. (2013) at has demonstrated this pattern of relatively rapid sediment accretion immediately following pond breaching, followed by a gradual decrease in accretion rates Ponds A6 and A21. The same report also concluded that the more subsided the ponds were initially, the greater the initial rate of accretion.

Flood Hazards. The 1988 San Francisco Bay Shoreline Study: Southern Alameda and Santa Clara Counties, interim (1998 Shoreline Study) (USACE 1988) determined that tidal flooding is a hazard in Alviso and its surrounding areas due to the potential for overtopping of the outboard pond levees near Alviso Slough and lower Coyote Creek (downstream of Artesian Slough). For the 100-year event, the 1988 Shoreline Study estimated that Alviso could incur up to 6 feet of flooding and that most of the flooding would be limited to the area north of SR 237. Tidal flooding also could occur at the Sunnyvale sewage treatment ponds, the northern portion of the NASA Ames Research Center, Moffett Federal Airfield, the Lockheed Missiles and Space Company Plant, and the industrial park area north of Java Drive and west of the Sunnyvale East Channel under extreme tide and wind conditions (USACE 1988).

FEMA has also published flood study results for the tributaries to the Alviso pond complex in community-specific flood insurance studies. These studies provide fluvial flood event discharges for various recurrence intervals. However, the FEMA discharge values may underestimate peak flows, which are now contained within the channel due to recent flood-protection projects.

Flooding due to overflow from the Guadalupe River, Alviso Slough, and Coyote Creek historically represents the most significant flood hazard to San Jose and the community of Alviso within it. Major flood-protection projects (such as the Lower Guadalupe River Flood Protection Project, discussed below in the project setting for the A8 Ponds) have been completed to reduce flood risk. Improvements include channel modifications, bank stabilization, and new levees. However, inadequate drainage in zones of low elevation remains a local problem.

Permanente Creek had a history of recurring floods in Los Altos and Mountain View. In response to these floods, SCVWD and other agencies have improved several sections of the creek. Improvements include channel lining and construction of the Permanente Diversion, as well as erosion control, structural repair, sediment reduction, and habitat restoration. SCVWD has begun work on additional projects to increase channel capacity in Permanente Creek.

Ravenswood Pond Complex

The Ravenswood pond complex (formerly the West Bay Complex) consists of seven ponds in San Mateo County. The pond complex covers 1,600 acres and is owned and operated by the USFWS. The pond complex is located on the bayside of the San Francisco Peninsula, both north and south of SR 84 west of the Dumbarton Bridge, and on the bayside of the developed areas of Menlo Park. Bayfront Park in Menlo Park is directly west of the pond complex, and a portion of SR 84 and the Dumbarton rail corridor are along its southern border.

Tributaries. Tidal sloughs near the Ravenswood pond complex include Ravenswood Slough and Flood Slough. Ravenswood Slough is located on the north-east border of the Ravenswood pond cluster (Ponds R3, R4, R5, and S5). Relatively little freshwater input is discharged from Ravenswood Slough into the Bay. Flood Slough is located west of the ponds. Flood Slough drains to the Bay through Westpoint Slough.

No major drainages flow directly to the Ravenswood pond complex, but sloughs receives local runoff from the adjacent areas. Local upstream drainage from portions of Redwood City, Menlo Park, Atherton, and unincorporated San Mateo County is generally conveyed to the Bayfront Canal, which outfalls to Flood Slough.

Sediment Characteristics. Because tributaries to the Ravenswood Slough discharge very little fresh water to the slough, sediments within the Ravenswood Slough and adjacent ponds originate primarily from the Bay and are sandier than those within the Alviso pond complex. Sediment deposition rates in marsh restoration areas near the Ravenswood pond complex are consistent with the regional sediment transport and availability patterns (PWA et al. 2005a).

Flood Hazards. Flooding near the Ravenswood pond complex occurs when large storms coincide with high tides resulting in broad shallow street flooding and local ponding. Fluvial flooding in the Ravenswood region is largely due the inability of local drainage runoff to reach the Bay. Flows are restricted as a result of insufficient channel capacity along the Bayfront Canal and Atherton Channel. The salt pond perimeter levee may also be overtopped at extreme high tides, adding to the potential flood risks. Existing levees do not meet FEMA standards for flood protection and therefore, major urban areas are included in the tidal flood zone, including the Bohannon Industrial Park between SR 84 and U.S. Highway 101 and the Belle Haven neighborhood in Menlo Park. USACE currently has no coastal flood limit delineated for the Ravenswood pond complex. However, the entire area and inland areas are within the FEMA floodplain based on projections of the 100-year still water elevation.

The San Francisquito Creek Joint Powers Authority has initiated design, alignment selection, planning, and environmental planning on the Strategy to Advance Flood Protection, Ecosystems and Recreation along the Bay (SAFER Bay) project to address coastal flooding in the southern portion of San Mateo County. That project's primary alignment begins just west of Flood Slough and runs along the southern margins of Ponds S5 and R3 and other portions of the Ravenswood pond complex.

3.2.3 Project Setting

This section describes the physical setting of the Phase 2 area. Actions taken under the ISP and 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 managed pond habitat, maintain flood protection, and provide recreation opportunities and public access. The SBSP Restoration Project (described in the 2007 EIS/R) would restore a mosaic of tidal and managed pond habitats over an approximate 15,100-acre footprint within Don Edwards San Francisco Bay National Wildlife Refuge (Refuge). 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. 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.

Phase 2 of the SBSP Restoration Project is a direct outgrowth of the acquisition of the Alviso and Ravenswood pond complexes and of the continued implementation of the larger SBSP Restoration Project laid out in the 2007 EIS/R. Phase 2 project actions in the Alviso pond complex focus on three clusters of ponds (see Figure 3.2-1). Ponds A19, A20, and A21, referred to as the Island Ponds, are located between Coyote Creek and Mud Slough near the eastern end of the Alviso pond complex. Ponds A1 and A2W, referred to as the Mountain View Ponds, are on the western edge of the Alviso pond complex. The city of Mountain View lies immediately to the south of these ponds, and the Charleston Slough and the Palo Alto Flood Control Basin lie to the west. Ponds A8 and A8S are located in the southern central portion of the Alviso pond complex. They are west of the town of Alviso and north of Sunnyvale and SR 237. Phase 2 project actions in the Ravenswood pond complex are focused on the pond cluster of Ponds R3, R4, R5, and S5. These ponds are located in San Mateo County on the bayside of the San Francisco Peninsula, north of SR 84 and west of the Dumbarton Bridge.

Alviso-Island Ponds

The Alviso-Island Pond cluster, also referred to as the Island Ponds (Ponds A19, A20, and A21), are located at the southern extent of the Bay near Coyote Creek. The Island Ponds were middle-stage salt evaporator ponds with intermediate salinity levels. The levees surrounding the Island Ponds are outboard salt pond levees.

Tidal inundation was restored at the 475-acre Alviso-Island pond cluster in March 2006 as part of the tidal marsh restoration actions implemented under the ISP. Two breaches were cut in Pond A19, a single breach was cut in Pond A20, and two breaches were cut in Pond A21. The breaches were approximately 30 to 45 feet wide. The excavated breaches in the levees and outboard marshes were designed to have the same invert elevation (2.7 feet North American Vertical Datum of 1988 [NAVD88]). Since the original cuts, the breaches have widened and are now between 30 to 150 feet wide (SCVWD et al. 2010). The Island Ponds have been developing tidal marsh habitat since the ponds were breached. The five breaches cut along the south side of the ponds allow full tidal inundation. This restoration approach is a minimally engineered, passive design that relies on the natural sedimentation processes to restore the ponds to tidal marsh habitat. The overall restoration goal is to successfully reestablish vegetation, promote recolonization by benthic organisms, and provide habitat for various wildlife species.

Because the Island Ponds are subject to tidal inundation, these ponds can fill during flood events with a combination of tidal and fluvial flows. As the ponds fill during incoming tides, the ponds could provide temporary flood storage for Coyote Creek flows and may provide temporary relief to upstream flood-control facilities. (Flood-control facilities in the lower 7 miles of Coyote Creek include levee setbacks and overflow channels.) However, as the ponds drain during outgoing tides, water leaving the ponds would occupy the main channel, which would otherwise be used to convey flood flows. This could delay fluvial flood flows and prolong flooding in upstream areas.

Alviso-Mountain View Ponds

The Alviso-Mountain View pond cluster includes Pond A1, Pond A2W, and Charleston Slough. The pond cluster is located in the western portion of the Alviso pond complex. It is bracketed by Stevens Creek on the east and Charleston Slough on the west. Ponds A1 and A2W are separated by Mountain View Slough. Perimeter outboard salt pond levees, publicly maintained flood-control levees, and/or high ground surround Ponds A1 and A2W.

The Mountain View Ponds are currently operated for limited tidal circulation through Ponds A1 and A2W while maintaining discharge salinities to the Bay at less than 40 ppt (see Figure 3.2-3). The intake for the Mountain View Ponds' system is located at the northwest end of Pond A1 and includes one 48-inch gate from lower Charleston Slough near the Bay. Flow moves through the system from the intake at Pond A1 though the 72-inch siphon under Mountain View Slough to Pond A2W. The system outlet is located at the north end of Pond A2W, with one 48-inch gate to the Bay. The gates are iteratively adjusted as needed to find the correct equilibrium of water inflow and discharge to account for evaporation and salinity concentration during the summer. Operations of the Mountain View Ponds' system require little active management of gate openings to maintain appropriate flows. However, flows can be modified based on changes in dissolved oxygen levels.

The existing outboard salt pond levees at Ponds A1 and A2W provide some measure of flood protection to inland areas. As waves break against the outboard levees, the levees are overtopped, and the ponds fill during coastal flooding conditions. The landward sides of Ponds A1 and A2W are high ground atop the closed landfill under Shoreline Park. The levee to the west of Charleston Slough protects the Palo Alto Flood Basin. The southwestern corner of Charleston Slough has a relatively unprotected area between the high ground of Shoreline Park and the levee between the Palo Alto Flood Basin and Charleston Slough. This low-lying area includes the Coast Casey Forebay (a detention basin for runoff) and the similarly named levee separating the forebay from Charleston Slough.

Alviso-A8 Ponds

The Alviso-A8 pond cluster (also referred to as the A8 Ponds) is located within the Alviso pond complex between Alviso and Guadalupe Sloughs in the South Bay. Pond A8 was historically part of a larger tidal marsh that was diked in the mid-1900s for salt production. Perimeter levees separate the pond from Alviso Slough to the northeast and Guadalupe Slough to the southwest. Internal levees formerly separated Pond A8 from adjacent Ponds A5 and A7, and they also separate Pond A8 from Pond A8S. Portions of these internal levees still remain, many of which had levee roads on them, and there are pieces of concrete rubble and other roadbed materials left in place. Deeper borrow ditches surround the ponds along the inboard side of the levees (USFWS and USGS 2012).

During Phase 1 of the SBSP Restoration Project, levees were breached between Pond A8 and Ponds A8S, A5, and A7, and a reversible armored notch was installed (see Figure 3.2-4). The reversible notch was installed in the eastern levee to allow muted tidal exchange. The notch may be opened to various widths or closed as needed for water quality or fish migration purposes. Notch operations are anticipated to naturally widen and deepen Alviso Slough over a period of years through tidally induced scour, thus increasing the flow conveyance of Alviso Slough.

LEGEND

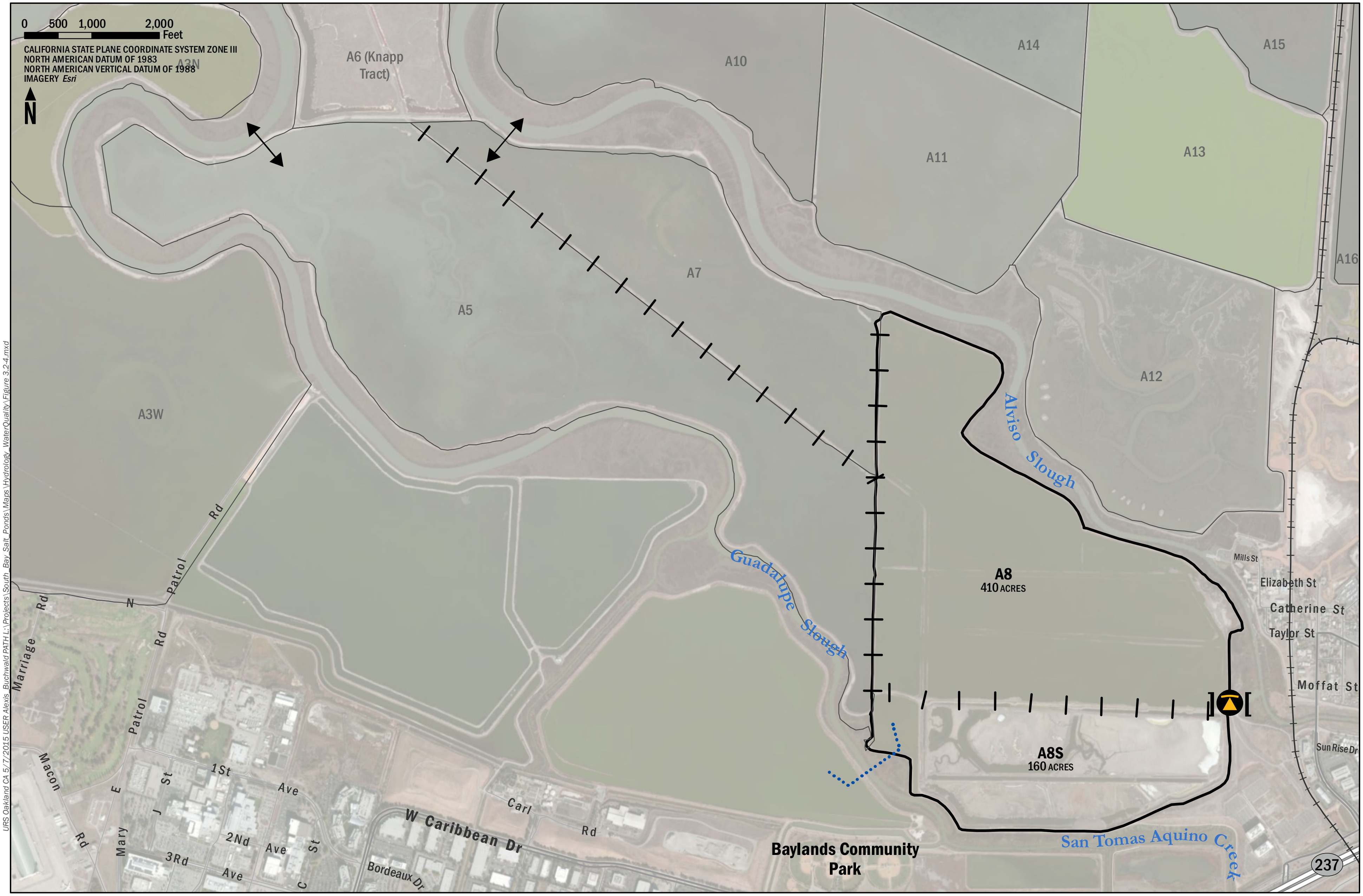
Existing control gate

Siphon

Pond boundary

URS
South Bay Salt Pond Restoration Project

Figure 3.2-3
Existing Circulation in the Mountain View Ponds



LEGEND

- Existing reversible armored notch
- Culvert
- Levee Cut
- Siphon
- Pond boundary

URS
South Bay Salt Pond Restoration Project

Figure 3.2-4
Existing Circulation in the A8 Ponds

As part of the Lower Guadalupe River Flood Protection Project, SCVWD constructed a series of floodwalls and levees along Guadalupe River and Alviso Slough. The west levee of Alviso Slough was reconfigured to act as a weir, allowing high flows in the Guadalupe River to exit Alviso Slough and enter Pond A8. The reconfigured west bank can divert up to 8,500 cfs to Pond A8 (of the 100-year flow, estimated at 18,300 cfs) and decrease water surface elevations in Alviso Slough downstream of the Union Pacific Railroad (UPRR). Flood flows would be conveyed into Ponds A5, A6, and A7. Flood waters would be held in the Pond A8 system and then pumped out (or conveyed via culverts with flap gates) over a period of time (about 1 month).

Existing Levees. Perimeter levees were originally constructed to protect Pond A8 from fluvial flooding, and therefore crest elevations are on average 12.3 feet NAVD88 (i.e., 4.8 feet above MHHW and 1.3 feet above the 100-year water level), except at the location of the engineered weir. The 1,000-foot-long overflow weir at Pond A8 allows high flood flows to exit Alviso Slough when water levels reach approximately 10.5 feet NAVD88. Due to the relatively low elevation of interior pond levees, flood water stored in Pond A8 would spill into Pond A8S (at 2.5 feet NAVD88), Pond A5 (at 3.25 feet NAVD88), Pond A7 (4.0 feet NAVD88), and eventually Pond A6 (at 10.0 feet NAVD88) (USFWS and USGS 2012).

Residual internal salt pond berms break up the topography of the A8 Ponds. Historic tidal marsh channels remain within the interior of Pond A8S (demarcated by the meandering shallow depressions that are visible on imagery taken during periods when the pond was dry), even though the entire bed has subsided. Borrow ditches were excavated along the entire perimeter of the pond and adjacent to the internal berms to obtain fill material for levee construction and maintenance. The depths of the borrow ditches are approximately 9 feet below the pond bed.

Existing Operations. As part of the Phase 1 actions, the Pond A8 system is operated to maintain muted tidal circulation through Ponds A5, A7, A8 and A8S, while maintaining discharge salinities to the Bay at less than 40 ppt. Phase 1 project actions allow for approximately 400 acres of muted tidal habitat in Pond 8 and approximately 1,000 additional acres of shallow water habitat with modified water depths in Ponds A5 and A7. Restoration of tidal action at Pond A8 was designed to be adaptable and reversible so that in the event that unacceptable environmental impacts begin to occur, tidal exchange to Pond A8 can be modified or eliminated to prevent long-term adverse impacts.

The Pond A8 system consists of a variety of elements that allow for a muted tidal connection from the adjacent slough to the A8 Ponds. Existing structures at the A8 Ponds include an armored notch between Pond A8 and upper Alviso Slough. Water exchange through the armored notch is limited, and the tidal range within the ponds is muted. With a fully open notch, water level fluctuations over a tidal cycle in the ponds are small (0.5 foot to 1 feet) compared to the range of tidal change in Alviso Slough (over 8 feet).

Ravenswood Ponds

The Phase 2 Ravenswood Ponds (Ponds R3, R4, R5, and S5) are operated as seasonal ponds. Seasonal ponds are passively managed as seasonal wetlands that receive direct precipitation, groundwater inflows, and minimal overland runoff during the wet season. During the dry season, seasonal ponds are allowed to dry out by seepage and evaporation. There is no gated or culverted hydraulic connection between the ponds that is actively managed or used. Operation or maintenance activities include inspection of berms and bird monitoring.

The outboard salt pond levees at Ponds R3 and R4 provide some flood protection to inland areas. As waves break against the bayward-facing levees, the levees are overtopped and the ponds fill. The ponds provide storage and dissipate wave energy.

Local flooding can occur in the neighborhoods behind Redwood City's Bayfront Canal and Menlo Park's Atherton Channel when large stormwater outflows coincide with high tides in Flood Slough. The Bayfront Canal is the stormwater transmission canal for Atherton Channel that discharges through Flood Slough and into the Bay. During storms that coincide with high tides, Bayfront Canal and Atherton Channel cannot discharge sufficient stormwater flows to the Bay, and depending on the intensity of the storm, Bayfront Canal and Atherton Channel do not have enough detention capacity to prevent flooding in low-lying areas.

3.2.4 Regulatory Setting

This section provides a description of the implementing agencies involved in flood management in the 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.

3.2.5 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 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 (RHA) of 1899 (often simply referred to as the Rivers and Harbors Act). 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 area of the SBSP Restoration Project, the relevant flood control districts include SCVWD for the Alviso pond complex and the County of San Mateo Public Works Department for the Ravenswood pond complex. SCVWD is a special district that oversees flood protection and watershed management in Santa Clara County, but is not part of the county government. 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.

3.2.6 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 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 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 USACE. If a proposed activity falls under the authority of RHA Section 10 and CWA Section 404, 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 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, 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

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 State of California Water Code, which sets the provisions for flood control. The State of 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 16016. In accordance with Sections 1601 to 1607 of the California Fish and Game Code, the California Department of Fish and Wildlife (CDFW) regulates projects that affect the channel, flow, or banks of rivers, lakes, or streams. Sections 1602 and 1603 require public agencies and private individuals to notify and enter into a streambed or lake alteration agreement with the CDFW before beginning construction that would:

- Change, divert, or obstruct the natural flow or the bed, bank, or channel of any river, lake, or stream;

- Use materials from a streambed; or
- Result in the deposition or disposal of debris, waste, or other material containing flaked, crumbled, or ground pavement where it can pass into any river, lake, or stream. Lake or streambed alteration agreements may impose conditions to protect water quality during construction.

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.

Local Regulations

Santa Clara Valley Water District Act. The Santa Clara Valley Water District Act of 1951 established SCVWD, giving it the authority to implement the following SCVWD purposes identified by the Act:

- To protect Santa Clara County from flood and stormwater;
- To provide comprehensive conservation and management of flood, storm, and recycled waters for all beneficial uses;
- To increase and prevent the waste of the water supply in the District; and
- To enhance, protect, and restore stream, riparian corridors, and natural resources in connection with other purposes of water supply and flood protection.

Under the Water Resources Protection Ordinance (Ordinance 06-1), the SCVWD requires encroachment permits for modifications on SCVWD facilities and/or SCVWD easements. Activities requiring a permit include: grading, removing, dredging, mining, or extraction of any materials; constructions, reconstruction, demolition or alteration of the size of any structure, including any facility of any private, public, or municipal utility; and the removal or installation of vegetation. Permits, if granted, may require mitigation for any disturbance to the health of the watercourse.

San Mateo County Flood Control District Act. The San Mateo County Flood Control District Act of 1959 establishes the San Mateo County Flood Control District (SMCFCD) in order to:

- Control and conserve stormwater and flood waters;
- Prevent waste or exportation of water;
- Retain drainage, storm, flood and other waters for beneficial use in the district; and
- Prevent pollution or diminution of water supply.

The SMCFCD is a special district created by the state legislature. While the SMCFCD has jurisdiction throughout all of San Mateo County, the cities within San Mateo County are not prohibited from undertaking flood control projects and regulating activities in the floodplain within their respective communities.

3.2.7 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 the existing conditions described in Section 3.2.2 above, and not the proposed 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. 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 Refuge management documents and practices.

3.2.8 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 Final 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, Phase 2 alternatives would not create or contribute runoff or place structures in flood hazard areas that would impede flood flows. These criteria are intended for evaluation of urban land uses and do not apply to the proposed project's 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 Final EIS/R are 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 National Environmental Policy Act (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.

3.2.9 Program-Level Evaluation Summary

Three programmatic-level alternatives were considered and evaluated in the 2007 EIS/R. This included (A) the No Action Alternative, (B) the Managed Pond Emphasis, and (C) the Tidal Habitat Emphasis. At the program level, the decision was made to select Alternative C and implement Phase 1 actions.

Therefore, a summary of the impacts for Programmatic Alternative C from the 2007 EIS/R are provided below.

The determination was made in the 2007 EIS/R that 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.

Under Alternative C, implementation of the AMP would maintain or improve levels of coastal and fluvial flood protection 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. 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 downstream flood control projects.

3.2.10 Project-Level Evaluation

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

Alviso-Island Ponds

Alternative Island A (No Action). No new activities would occur under Phase 2 and the pond cluster would continue to be monitored and managed through the activities described in the AMP and in accordance with current USFWS practices. The existing breached levees would continue to scour from hydraulic action and naturally degrade. Ongoing monitoring and studies to track the progress of these ponds toward tidal marsh restoration would be the principal component of the continued implementation of the AMP.

Under the No Action scenario, tidal inundation would cause existing breaches to widen and adjacent levee areas to continue to scour until equilibrium conditions are met. Over a 50-year horizon, tidally restored ponds are expected to develop into mature salt marsh. Sedimentation would raise pond-bottom elevations above vegetation-colonization elevations; vegetation would establish; and marsh channels would develop within the restored marsh. Mature salt marsh typically exists within the South Bay at an elevation near MHHW, so bottom elevations are assumed to eventually rise to this level. Because the Island Ponds are breached to tidal action, flow in adjacent sloughs has increased. Tidal scour would widen and deepen adjacent sloughs until equilibrium conditions are met. A possible exception is Coyote Creek, which may already be oversized and accreting sediment (see Appendix J of the 2007 EIS/R).

Although Ponds A19, A20, and A21 are surrounded by outboard salt pond levees, these levees would not provide coastal flood protection to landward areas from high water levels because the Island Ponds have full tidal inundation and because an existing wetland that connects to both Coyote Creek and Mud Slough is landward of the Island Ponds. Bayward levees may provide some level of protection from wave action because waves would break against these levees. Further unintentional breaching of these levees may cause waves to propagate into the ponds but would not change coastal flood conditions.

The ponds contribute to tidal flow in Coyote Creek as they drain. This could cause short-term effects on upstream fluvial flood conditions if the flow in the creek channel is constrained. However, Coyote Creek appears to be oversized relative to existing outflows and therefore any effects on fluvial flood conditions would likely be minimal. Furthermore, long-term marsh development within the ponds would decrease the tidal prism, potentially alleviating increased fluvial flood risk from the creek.

3.2.11 Alternative Island A Level of Significance: Less than Significant

Alternative Island B. Under Alternative Island B, Pond A19 would be breached to Mud Slough on the north side. Alternative Island B would also remove or lower the levees between Ponds A19 and A20 to support hydraulic connectivity, alter circulation and sedimentation patterns, and thus increase habitat complexity in Ponds A19 and A20. Any levee material that is moved would be used locally to fill borrow ditches and further speed revegetation. Increases in sediment accumulation and/or sediment distribution in the ponds could help achieve a future flood-protection goal of ensuring that the rate of sediment accretion and marsh development keeps pace with expected future sea-level rise.

Phase 2 actions would not change the total volume of water that fills and drains from the ponds immediately after construction activities. Because there would be new breaches to Mud Slough, tidal flow within Coyote Creek would decrease, and tidal flow within Mud Slough would increase. Tidal scour would likely widen and deepen Mud Slough until equilibrium conditions are met.

The Island Ponds do not and would not provide coastal flood protection to landward areas from high water levels because the Island Ponds are fully tidal and are surrounded by water on all sides. Bayward levees may provide some level of protection from wave action because waves would break against the levees. Lowering the levees on Pond A19 may allow waves to propagate into the pond, but these waves would dissipate or break on the inside levee. If the east side of the levee is overtopped, water that would enter into the adjacent wetland would have reduced energy and would spill into a brackish restoration area behind it.

Water from Ponds A19 and A20 would contribute to increased tidal flows in Mud Slough. Water that drains from the ponds into Mud Slough on the ebb tide could delay fluvial flood flows in Mud Slough from reaching the Bay. If flow in the channel is constrained, this could cause short-term effects on upstream fluvial flood conditions. However, breaching Pond A19 to Mud Slough would improve hydraulic connectivity and cause tidal scouring within the channel. This would improve tidal drainage and provide additional fluvial discharge capacity. Therefore, effects to upstream fluvial flood conditions are expected to be minimal.

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 for the above-mentioned reasons, and therefore impacts would be less than significant.

3.2.12 Alternative Island B Level of Significance: Less than Significant

Alternative Island C. Alternative Island C would include all of the components of Alternative Island B with the addition of levee breaches to Mud Slough on the north side of Ponds A20 and A21, pilot channels in Pond A19, and widened breaches on the southern levee of Pond A19. These additional components are intended to add additional habitat complexity and complexity in and between all of the ponds and their surrounding waterways. Any levee material that is moved would be used locally to fill borrow ditches and further speed revegetation. Increases in sediment accumulation and/or sediment distribution in the ponds would also help achieve a future flood-protection goal of ensuring that the rate of sediment accretion and marsh development keeps pace with expected future sea-level rise.

Phase 2 improvements would affect coastal and fluvial flooding in a similar manner as improvements under Alternative Island B. The Island Ponds would not provide coastal flood protection to landward areas from high water levels but would continue to provide some level of protection from waves. Tidal flow in Mud Slough would increase, and tidal flow in Coyote Creek would decrease. Breaching the Island Ponds to Mud Slough would improve hydraulic connectivity and cause tidal scouring within Mud Slough. 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.

3.2.13 Alternative Island C Level of Significance: Less than Significant

Alviso-Mountain View Ponds

Alternative Mountain View A (No Action). Under Alternative Mountain View A (No Action), no new activities would be implemented as part of Phase 2. The USFWS is maintaining the ponds as part of the Don Edwards San Francisco Bay National Wildlife Refuge System in accordance with the AMP and other Refuge management documents and practices. The pond cluster would continue to be managed through the activities described in the AMP, in accordance with current USFWS practices. The ponds would not be actively managed except for the current water-quality management, which involves circulating water as needed to control dissolved oxygen per the AMP. The current use of water in Charleston Slough to supply the Shoreline Park sailing lake's water system would also continue.

The levees around Ponds A1 and A2W are high-priority levees that are to be maintained for inland flood protection. These levees would be maintained (or repaired upon unexpected failure). Areas immediately south of the ponds are high ground atop the closed landfill under Shoreline Park. The levee to the west of Charleston Slough protects the Palo Alto Flood Basin. The southwestern corner of Charleston Slough has a relatively unprotected low-lying area between the high ground of Shoreline Park and levee between the Palo Alto Flood Basin and Charleston Slough. That area would be subject to tidal inundation if the levee between A1 and Charleston Slough were to be overtopped.

Under the No Action scenario, it is assumed that unanticipated breaches in the Mountain View Ponds would be repaired, so as to maintain current levels of flood protection. Therefore effects to coastal and fluvial flood risk would be minimal, and impacts would be less than significant.

3.2.14 Alternative Mountain View A Level of Significance: Less than Significant

Alternative Mountain View B. Alternative Mountain View B would increase tidal flows in Ponds A1 and A2W by breaching levees at several points (e.g., the northwest corner of Pond A1 would be breached to Charleston Slough, and Pond A2W would be breached at two locations to Mountain View Slough on the west and at two locations to Whisman Slough on the east). The breaches to Whisman Slough would be armored and bridged to allow bayward access along that levee by Pacific Gas and Electric Company (PG&E) for tower and power-line maintenance. Habitat transition zones and islands would be constructed to increase habitat complexity. The west levee at Pond A1 would be raised to provide additional flood-control protection.

The Mountain View Ponds are currently operated for very limited tidal circulation through Ponds A1 and A2W. Bay-facing levees would continue to provide some level of coastal flood protection from wave action as waves break against the levees. Levee breaches would allow full tidal inundation to the ponds, and the internal side of the salt pond levees would be subject to tidal flows. Existing flood control levees would also be breached. These actions would reduce the level of flood protection provided by these levees. However, the levee along the west side of Pond A1 would be raised such that the current level of flood protection would be maintained or exceeded by preventing tidal flows from Pond A1 from entering Charleston Slough and affecting currently low and unprotected areas at its southern end. Monitoring and adaptive management would be used to verify that the Phase 2 actions are performing as intended.

Therefore, impacts to flood protection would be less than significant.

3.2.15 Alternative Mountain View B Level of Significance: Less than Significant

Alternative Mountain View C. Alternative Mountain View C would breach levees and lower levee heights to increase tidal flows in Pond A1, Pond A2W, and Charleston Slough. Pond A1 would be breached at three locations, Pond A2W would be breached at four locations, and the existing levee across Charleston Slough would also be breached or have its tide gate removed. The southern and western levees of Charleston Slough would be raised. Habitat transition zones and islands would be introduced to increase habitat complexity.

Similar to the effects described above for Alternative Mountain View B, these Phase 2 actions would reduce the level of flood protection provided by Pond A1 and A2 levees. However, flood-control functions would be maintained and even increased with improvements to the western and southern levees around Charleston Slough. The flood-control functions would be increased relative to the baseline because the City of Mountain View (a project partner if Alternative C is selected) would assist in raising and improving the levees bordering Charleston Slough to levels beyond that required of the SBSP Restoration Project. Monitoring and adaptive management would be used to verify that the Phase 2 actions are performing as intended. Therefore, impacts would be less than significant and would be beneficial under NEPA.

3.2.16 Alternative Mountain View C Level of Significance: Less than Significant (CEQA); Beneficial (NEPA)

Alviso-A8 Ponds

Alternative A8 A (No Action). Under Alternative A8 A (No Action), the USFWS would continue to operate and maintain the A8 Ponds in accordance with the AMP and other ongoing management practices that have been in place since the implementation of Phase 1 actions. These management practices include inspections of pond infrastructure to ensure the pond is operating as intended and water quality requirements are being met, monitoring of restoration performance, summer water-level recording; and management of tidal exchange between Pond A8 and Alviso Slough during the wet season to avoid fish trapping and to maintain existing levels of flood protection. Because existing levels of flood protection would be maintained and adaptive management would be used to actively monitor and assess flood-protection measures, impacts to flood protection would be less than significant.

3.2.17 Alternative A8 A Level of Significance: Less than Significant

Alternative A8 B. In this alternative, habitat transition zones would be constructed in the southwest and southeast corners of Pond A8S. As in the Mountain View Ponds, the habitat transition zones would perform several functions: they would add some flood protection, buffer against sea-level rise, add transitional habitat, and protect the adjacent landfill. The habitat transition zones would be constructed of dredged material and/or upland fill material and would extend into the center of the pond at a slope of 30:1 or steeper.

Phase 2 actions would not change water levels in the A8 Ponds or interfere with flood-control functions. The habitat transition zones would consume some of the capacity of Pond A8S, which could provide temporary detention for high flood flows from Alviso Slough. However, internal levees at Ponds A8, A8S, A5, A7, and A6 would be overtopped at elevations less than the overflow weir at Alviso Slough, and therefore the capacity of the A8 system's ponds is much larger than the volume displaced by habitat transition zones. Because adaptive management would be used to actively monitor and assess flood-protection measures and existing levels of flood protection would be maintained, impacts to flood protection would be less than significant.

3.2.18 Alternative A8 B Level of Significance: Less than Significant

Ravenswood Ponds

Alternative Ravenswood A (No Action). Under Alternative Ravenswood A (No Action), no new activities would be implemented as part of Phase 2. The USFWS is maintaining the ponds as part of the Don Edwards San Francisco Bay National Wildlife Refuge System in accordance with the AMP and other Refuge management documents and practices. The Ravenswood pond cluster would continue to be managed through activities described in the AMP. Ponds R3, R4 and R5/S5 would function as seasonal ponds. Seasonal ponds are passively managed as seasonal wetlands that receive direct precipitation, groundwater inflows, and minimal overland runoff during the wet season. During the dry season, seasonal ponds are allowed to dry out by seepage and evaporation.

The outboard levees along Ponds R4 and R3 provide inland flood protection and would continue to be maintained or repaired as a component of the USACE 1995 operations and maintenance permit.

Bayward-facing levees would continue to provide some level of coastal flood protection from wave action as waves break against the levees. If waves overtop the outboard salt pond levees, the ponds would provide storage and dissipate wave energy. Under the No Action scenario, it is assumed that unanticipated breaches in the Ravenswood Ponds would be repaired so as to maintain current levels of flood protection.

Adaptive management would also be used to actively monitor and assess existing flood-protection measures. Therefore impacts to flood risk would be less than significant.

3.2.19 Alternative Ravenswood A Level of Significance: Less than Significant

Alternative Ravenswood B. Under Alternative Ravenswood B, Phase 2 actions would initiate the transition of Pond R4 from a seasonal pond to tidal marsh, while maintaining or improving the existing levees and the overall flood protection provided by the pond. Ponds R5 and S5 would be converted from seasonal ponds to managed ponds through the construction of water control structures and some earthmoving. Pond R3 would become an enhanced managed pond through a water-control structure would be installed on Pond R3's outer levee (adjacent to Ravenswood Slough) to improve forage habitat for the western snowy plover.

Pond R4 would be breached to Ravenswood Slough to allow tidal flows within the pond. The Pond R4 levee adjacent to Greco Island would be lowered to provide habitat connectivity between Pond R4 and Greco Island. The southern levee for Pond R4 would be improved to provide flood protection for areas south of the Ravenswood Ponds. Other Phase 2 actions would create a habitat transition zone along the western edge of Pond R4, create and extend pilot channels at a slough trace, remove levees between Ponds R5 and S5 to increase pond connectivity, and improve recreation and access.

The breach in the Pond R4 levee would allow full tidal inundation, and the internal side of the R4 levees would therefore be subject to tidal flows. This would reduce the level of flood protection provided by these levees. However, the levee along the southern side of Pond R4 (at the All-American Canal [AAC]) would be raised such that the current level of flood protection provided to landward areas would be maintained or exceeded. Monitoring and adaptive management would be used to verify that the Phase 2 actions are performing as intended. Therefore impacts to flood protection would be less than significant.

3.2.20 Alternative: Ravenswood B Level of Significance: Less than Significant

Alternative Ravenswood C. Alternative Ravenswood C would have similar effects to those described above for Alternative Ravenswood B with the following exceptions: Pond R4 would also be breached to the channel between it and Greco Island, an additional habitat transition zone would be constructed, Ponds R5 and S5 would be converted to managed mudflats, a second water-control structure would be installed on Pond R3 (at its western border with Pond S5) to further improve forage habitat for the western snowy plover, and additional recreational and public access components would be constructed.

Similar to the effects described above for Alternative Ravenswood B, the breaches in the Pond R4 levee would allow full tidal inundation to Pond R4, and therefore the internal side of the Pond R4 levees would be subject to tidal flows. This would reduce the level of flood protection provided by these levees.

However, the levee along the southern side of Pond R4 (at the AAC) would be raised such that the current level of flood protection for landward areas would be maintained or exceeded. Monitoring and adaptive management would be used to verify that the Phase 2 actions are performing as intended. Therefore, impacts to flood protection would be less than significant.

3.2.21 Alternative Ravenswood C Level of Significance: Less than Significant

Alternative Ravenswood D. Alternative Ravenswood D would open Pond R4 to tidal flows, improve levees to provide additional flood protection, create habitat transition zones in Pond R4, install water control gates on Pond R3, remove levees within and between Ponds R5 and S5, convert Ponds R5 and S5 to enhanced managed ponds, allow stormwater outflow from Redwood City to Ponds R5 and S5, and improve recreation and public access.

Similar to the effects described above for Alternative Ravenswood B, the breaches in the Pond R4 levee would allow full tidal inundation to Pond R4, and therefore the internal side of the Pond R4 levees would be subject to tidal flows. This would reduce the level of flood protection provided by these levees.

However, the levee along the southern side of Pond R4 (at the AAC) would be raised such that the current level of flood protection provided to landward areas would be maintained or exceeded.

Currently, local flooding can occur at Redwood City’s Bayfront Canal and Atherton Channel when Flood Slough is at high tide because of inadequate drainage. Under Alternative Ravenswood D, peak flood flows could be redirected from the Bayfront Canal and Atherton Channel into Ponds R5 and S5, bypassing the Flood Slough tide gate. Ponds R5 and S5 would be used for temporary stormwater detention, which would reduce the amount of local flooding and provide additional flood protection.

Monitoring and adaptive management would be used to verify that the Phase 2 actions are performing as intended. Therefore, impacts to flood protection would be less than significant under CEQA and would be beneficial under NEPA.

3.2.22 Alternative Ravenswood D Level of Significance: Less than Significant (CEQA); Beneficial (NEPA)

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.

Alviso-Island Ponds

Alternative Island A (No Action). Under Alternative Island A (No Action) existing drainage patterns within the Island Ponds and adjacent sloughs would be maintained (i.e., the ponds would fill and drain with the tides). Tidal scour would continue to widen the pond breaches until equilibrium conditions are met. Marsh channels within the Alviso-Island pond cluster would continue to develop, increasing habitat complexity and allowing the ponds to drain quickly. Sediment accretion rates within the ponds would remain similar to existing conditions until the bottom elevations increase. Coyote Creek could experience some degree of tidal scour; however, effects to downstream pond levees would be minimal because the Coyote Creek channel is wide and has experienced tidal flows from the Island Ponds for several years.

Another potential effect of salt pond restoration is that breached ponds, acting as new sediment sinks, could shift sediment dynamics within the South Bay, increasing erosion in adjacent marshes and mudflats. Results from analyses of sediment dynamics in tidal channels adjacent to the Island Ponds have indicated that sedimentation at the Island Ponds did not come at the expense of adjacent mudflats and tidal-marsh habitats. For example, sediment accumulated relatively rapidly within Pond A21 following levee breachings (approximately twice as fast as typical marshes); concurrently, sediment continued to accumulate on adjacent mudflats on Coyote Creek and Mud Slough. Large-scale erosion of the adjacent mudflats and tidal marshes was not observed (Callaway et al. 2013). Under Alternative Island A, sediment would continue to accumulate within the Island Ponds until elevations are raised and accretion rates decrease. Local sediment input from the South Bay and from Coyote Creek would likely continue to meet sediment demand from the Island Ponds without substantial changes to nearby mudflats. Therefore, impacts would be less than significant.

3.2.23 Alternative Island A Level of Significance: Less than Significant

Alternative Island B. Under Alternative Island B, drainage patterns within Pond A19 and Mud Slough would change because Pond A19 would be breached to Mud Slough. Sediment accretion rates would increase in the northern side of Pond A19. Marsh channels in the northern portion of the pond would develop more rapidly, increasing habitat complexity. The new breaches and the Mud Slough channel would be affected by tidal scour. Levee breaches would increase tidal flows in Mud Slough downstream of the breach, widening and deepening the slough over time. Slough width and depths upstream of the breaches would be less affected by levee breaching. Widening and deepening Mud Slough could erode levees downstream of the breach, which may be a concern for the ponds on the north bank of Mud Slough. (Ponds A20 and A21 are already fully tidal, and therefore unexpected breaches would not substantially change habitat in these ponds.) These effects would be monitored through the AMP, and corrective actions could be implemented if downstream levees fail to meet performance standards.

Although sediment distribution within the ponds would change due to the northern breaches in Pond A19, total sediment demand from the ponds would not increase. Net accretion rates may increase somewhat, but additional accretion would be minor compared to the initial breaching of the ponds. Therefore, potential erosion to nearby mudflats is also expected to be minor. Impacts from changes in existing drainage patterns would be less than significant.

3.2.24 Alternative Island B Level of Significance: Less than Significant

Alternative Island C. Under Alternative Island C, all of the Island Ponds would be breached to Mud Slough. Effects from tidal scour would be similar to those effects described above under Alternative Island Pond B except that the northern side of Ponds A20 and A21 would also have increased sediment accretion rates and larger marsh channels. Net accretion rates may increase somewhat, but erosional effects to nearby mudflats would be minor. Therefore, impacts from changes in existing drainage patterns would be less than significant.

3.2.25 Alternative Island C Level of Significance: Less than Significant

Alviso-Mountain View Ponds

Alternative Mountain View A (No Action). Under Alternative Mountain View A (No Action), existing drainage patterns would be maintained. The Mountain View Ponds would continue to be managed for limited tidal circulation through gated control structures and siphons. The potential for sediment accretion within the ponds and erosion from circulating water within the ponds would be minimal because the ponds would not be subject to tidal inundation. Therefore, impacts would be less than significant.

3.2.26 Alternative Mountain View A Level of Significance: Less than Significant

Alternative Mountain View B. Under Mountain View B, Ponds A1 and A2W would be breached to tidal flows. Therefore, existing drainage patterns within the ponds and tidal flows in adjacent sloughs would be altered. 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. Marsh channels would form near the breaches, allowing the ponds to drain faster. As the pond elevation increases, vegetation would become established, stabilizing sediments and increasing habitat complexity.

Widening and deepening Mountain View Slough (below Permanente Creek) and Whisman Slough (below Stevens Creek) could erode adjacent levees. This may be of concern for the outboard salt pond levees in Ponds A2E and AB1 at Whisman Slough. These effects would be monitored through the AMP, and corrective actions could be implemented if downstream levees fail to meet performance standards.

Breaching Ponds A1 and A2W would enable sediment accretion within the ponds. This increased sediment demand could be met by local tributaries, sediment influx from Bay areas north of the Dumbarton Bridge, imported dredge materials, and/or from other nearby sediment sources. If naturally supplied sediment sources are exceeded, the breaching of the salt ponds has the potential to cause erosion in adjacent mudflats.

The long-term regional sediment supply in the far South Bay has been studied by Shellenbarger et al. (2013) for the area of the SBSP Restoration Project. It is estimated that between 29 and 45 million cubic meters of sediment would be required to raise all of the area of the SBSP Restoration Project to mean tidal level. Sediment influx from the South Bay (north of the Dumbarton Bridge) would supply this amount of sediment in about 90 to 600 years.[4] This estimate reflects the long-term regional sediment supply, assuming that there is no net loss of mudflats and marshes in the area and that the volume of sediment needed in the ponds does not change due to sea-level rise or construction. However, some of the subsided ponds would be maintained as managed ponds and not restored to tidal action, so Phase 2 of the SBSP Restoration Project may require less sediment than the estimate provided here. Furthermore, in order to meet the sediment deficit without scouring mudflats, restoration would either be phased over many decades to match sediment demand with the rate at which sediment naturally enters the far South Bay, or ponds would be partially filled with clean dredged sediments and/or upland material.

With respect to the breaching of Ponds A1 and A2W, sediment demand in these ponds is not expected to exceed naturally supplied sediment supply because the size of the ponds is small compared to the overall restoration area. Effects to nearby 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 to the ponds). Therefore impacts from erosion and accretion due to changes in existing drainage patterns would be less than significant.

[4] These data are based on using water year 2009 and 2010 sediment budget results. Also, the program-level Alterative C analyzed in the SBSP Restoration Project 2007 EIS/R had an upper range of 90 percent tidal restoration, not 100 percent tidal restoration.

3.2.27 Alternative Mountain View B Level of Significance: Less than Significant

Alternative Mountain View C. Under Alternative Mountain View C, ponds would be breached to Charleston Slough, Mountain View Slough, and Whisman Slough. The Pond A1 levee would be lowered at Charleston Slough, and the flood control levee on the west bank of Charleston Slough would be improved. These actions would allow sediment accretion in the ponds but would also increase tidal scour in the sloughs. Effects from tidal scour and sediment demand would be similar to the effects described above under Alternative Mountain View B, with the exception that Charleston Slough is expected to scour bayward of the breach location and import sediment from the Bay and lose sediment to Pond A1 landward of the breach location. These effects would be monitored through the AMP, and corrective actions could be implemented if performance standards were not met. Therefore impacts from changes in existing drainage patterns would be less than significant.

3.2.28 Alternative Mountain View C Level of Significance: Less than Significant

Alviso-A8 Ponds

Alternative A8 A (No Action). Under Alternative A8 A (No Action), existing pond operations and drainage patterns would be maintained. The A8 ponds would be operated to allow muted tidal exchange with Alviso Slough and Guadalupe Slough. The potential for erosion from water circulating within the ponds and accretion rates within the ponds would be minimal because the ponds are not fully tidal and because flows are mediated through engineered control structures. Tidal scour in Alviso Slough associated with A8 notch operations would continue to widen and deepen the slough until equilibrium conditions are met. These effects are monitored through the AMP and corrective actions could be implemented if downstream levees fail to meet performance standards. Therefore impacts would be less than significant.

3.2.29 Alternative A8 A Level of Significance: Less than Significant

Alternative A8 B. Under Alternative A8 B, fill material would be used to create habitat transition zones in Pond A8S, but Phase 2 actions would not change existing drainage patterns. Pond accretion rates, pond circulation, and tidal scour from notch operations would continue to have effects similar to those described for Alternative A8 A. Therefore impacts would be less than significant.

3.2.30 Alternative A8 B Level of Significance: Less than Significant

Ravenswood Ponds

Alternative Ravenswood A (No Action). Under Alternative Ravenswood A (No Action), Ponds R3, R4, R5, and S5 would continue to be operated as seasonal ponds (i.e., they would be passively managed and allowed to dry out by evaporation during the dry season). No gated or culverted hydraulic connection between the ponds would be actively managed or used. Therefore, there would be no impact or change to the existing drainage patterns.

3.2.31 Alternative Ravenswood A Level of Significance: No impact

Alternative Ravenswood B. Under Alternative Ravenswood B, Pond R4 would be breached to tidal inundation. The Pond R4 levee adjacent to Greco Island would also be lowered to allow inundation above mean high water. Therefore, existing drainage patterns within Pond R4 and tidal flows in Ravenswood Slough would be altered. Tidal flows in sloughs between Pond R4 and Greco Island as well as within Greco Island would also be changed, but to a lesser degree. Tidal scour would widen the breach and widen and deepen Ravenswood Slough until equilibrium conditions are met. Marsh channels near the breach would increase in complexity. Sediment from the incoming tide would settle out within Pond R4 as it fills and drains.

Water control structures would also be constructed to connect Pond R4 to Pond R5 and Pond S5 to Flood Slough, allowing active control of water surface elevations in Ponds R5 and S5. Water surface elevations and circulation would be actively managed in these ponds, which would change existing drainage patterns. However, erosion and increased tidal scour in Flood Slough would likely be minimal because tidal flows would be restricted by the control structures. A separate water control structure would be added to Pond R3 at its eastern levee to connect it to Ravenswood Slough. This structure would enable management on pond water levels to improve forage habitat for western snowy plover.

Although sediment demand in the Ravenswood pond complex would increase, it is not expected that sediment demand in these ponds would exceed the naturally supplied sediment supply because the size of the ponds is small compared to the overall restoration area. Effects to nearby 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 to the ponds). Therefore, impacts would be less than significant.

3.2.32 Alternative Ravenswood B Level of Significance: Less than Significant

Alternative Ravenswood C. Under Alternative Ravenswood C, drainage patterns within the ponds and adjacent sloughs would be altered by levee breaches (and to a lesser extent by water control structures) in a manner similar to Alternative Ravenswood B, with the addition of a second water control structure to manage flows in Pond R3, increased tidal flows in the sloughs on the perimeter of Greco Island, and potentially managed flows in Ponds R5 and S5.

Pond R4 would be breached to tidal inundation towards Ravenswood Slough and Greco Island, and tidal flows in adjacent sloughs (including perimeter sloughs in and around Greco Island) would increase. Tidal scour would widen the pond breaches and widen and deepen adjacent sloughs until equilibrium conditions are met. Marsh channels near the breaches would increase in complexity. Sediment from the incoming tide would likely settle out within Pond R4 as it fills and drains.

Water control structures would be used to increase flows in Pond R3 and to control water surface elevations in Ponds R5 and S5 to maintain mudflat elevations. Operation of the water control structures would not cause substantial erosion or siltation. Accretion rates within these ponds could slightly increase, and marsh channels located near control structures could increase in complexity. Flows would be restricted by the control structures, and therefore tidal scour in adjacent sloughs near the control structures would likely be minimal.

Although sediment demand in the Ravenswood pond complex would increase, it is not expected that sediment demand in these ponds would exceed the naturally supplied sediment supply because the size of the ponds is small compared to the overall restoration area. Effects to nearby 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 to the ponds). Therefore, impacts would be less than significant.

3.2.33 Alternative Ravenswood C Level of Significance: Less than Significant

Alternative Ravenswood D. Under Alternative Ravenswood D, drainage patterns within the Ravenswood Ponds and adjacent sloughs would be altered by a levee breach and by water control structures. Levee breaches would increase tidal scour in Ravenswood Slough, potentially widening and deepening the slough over time. Sediment from the incoming tide would likely settle out within Pond R4 as it fills and drains.

Water control structures would be used to manage water levels in Ponds R3, R5, and S5. Operation of the water control structures would not cause substantial erosion or siltation. Accretion rates within these ponds could slightly increase due to settling of suspended sediments from incoming flows. Flows would be restricted by the control structures and therefore tidal scour in adjacent sloughs near the control structures would likely be minimal. Local drainage from the Bayfront Canal and Atherton Channel would be redirected to Ponds R5 and S5, and these ponds would be used to detain local flows. Temporary detention of the peak flows may decrease fluvial scour in Flood Slough.

Although sediment demand in the Ravenswood pond complex would increase, it is not expected that sediment demand in these ponds would exceed the naturally supplied sediment supply because the size of the ponds is small compared to the overall restoration area. Effects to nearby 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 to the ponds). Impacts would be less than significant.

3.2.34 Alternative Ravenswood D Level of Significance: Less than Significant

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

Alviso-Island Ponds

Alternative Island A (No Action). The Phase 2 area of the SBSP Restoration Project currently contains few navigable sloughs and waterways – 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. Unless explicitly allowed pursuant to a compatibility determination, navigation within restored ponds would not be allowed. As part of the compatibility determination, the USFWS and 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).

Under Alternative Island A (No Action), tidal inundation would continue to cause the levees previously breached to Coyote Creek to scour and widen. Coyote Creek could also experience some degree of tidal scour; however, effects would be minimal because the Coyote Creek channel is wide and has experienced tidal flows from the Island Ponds for several years. Therefore potential benefits to navigation under Alternative Island A would be minor. Impacts would be less than significant.

3.2.35 Alternative Island A Level of Significance: Less than Significant

Alternative Island B. Under Alternative Island B, Pond A19 would be breached to Mud Slough. Breaching levees to Mud Slough would widen and deepen the slough, improving navigation. Immediately after breaching, tidal currents through the breaches and in the sloughs downstream of the breaches would be stronger. High current velocities (e.g., peak values of approximately 5 to 7 fps) and turbulent flow may occur in the immediate vicinity of the breach. This may limit safe navigation of small watercraft to certain periods of the tide cycle (near slack tide). Navigation in the immediate vicinity of the breaches could be dangerous until the channel scoured sufficiently. USFWS would restrict navigation in the vicinity of the breaches in the short term, if needed, for safety.

Due to the limited amount of boating expected in Mud Slough, Phase 2 actions would not result in significant adverse impacts to navigation. Over a period of years, Mud Slough is expected to scour, increasing channel dimensions. 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.

3.2.36 Alternative Island B Level of Significance: Less than Significant

Alternative Island C. Under Alternative Island C, short-term impacts and long-term benefits to navigation would be similar to the impacts discussed under Alternative Island B except that tidal flow may be greater in Mud Slough because of additional levee breaches. Due to the limited amount of boating expected in Mud Slough, Phase 2 actions would not result in significant adverse impacts to navigation. Over a period of years, Mud Slough is expected to scour, increasing channel dimensions. 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.

3.2.37 Alternative Island C Level of Significance: Less than Significant

Alviso-Mountain View Ponds

Alternative Mountain View A (No Action). Levees would not be breached under Alternative Mountain View A, and existing operations and pond circulation patterns would be maintained. Sloughs adjacent to the ponds are likely depositional, with unconsolidated sediment being transported during winter storm events. These sloughs would continue to be shallow, with reduced navigability. Impacts would be less than significant.

3.2.38 Alternative Mountain View A Level of Significance: Less than Significant

Alternative Mountain View B. Under Alternative Mountain View B, Ponds A1 and A2W would be breached to Charleston Slough, Mountain View Slough, and/or Whisman Slough. Unless explicitly allowed pursuant to a compatibility determination, navigation within the restored ponds would not be allowed. As part of the compatibility determination, the USFWS 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). The PG&E boardwalks added and raised under this alternative would be physical barriers to inadvertent boat access into the sloughs and the ponds. The bridges over armored breaches on the east side of Pond A2W would similarly prevent boat entry into this pond.

Breaching levees to adjacent sloughs would widen and deepen the sloughs. However, immediately after breaching, tidal currents through the breaches and in the sloughs downstream of the breaches would be stronger. High current velocities (e.g., peak values of approximately 5 to 7 fps) and turbulent flow may occur in the immediate ***vicinity*** of the breaches. These flows may limit safe navigation of small watercraft within the sloughs 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. USFWS would restrict navigation in the vicinity of the breaches in the short term, if needed, for safety.

Due to the restrictions on boating and the creation of several physical barriers to boat entry in theMountain View Ponds ***and*** surrounding sloughs, Phase 2 actions would not result in significant adverse impacts to navigation. Over a period of years, Whisman Slough, Mountain View Slough, and Charleston Slough (downstream of the control structure) are expected to scour, increasing channel dimensions.

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.

3.2.39 Alternative Mountain View B Level of Significance: Less than Significant

Alternative Mountain View C. Under Alternative Mountain View C, short-term potential impacts and the physical barriers and regulatory prohibitions to navigation would be similar to those discussed under Alternative Mountain View B. The Phase 2 actions would not result in significant adverse impacts to navigation.

3.2.40 Alternative Mountain View C Level of Significance: Less than Significant

Alviso-A8 Ponds

Alternative A8 A (No Action). The Alviso Marina is located on the eastern side of Alviso Slough adjacent to the community of Alviso. The marina and boat dock is located downstream of the A8 notch. The UPRR bridge, located approximately 1,000 feet upstream of the Alviso Marina, limits boat passage, and therefore, there is little upstream traffic within the vicinity of the A8 notch.

Under Alternative A8 A, pond operations and tidal flows would not change in comparison to existing conditions. Long-term operation of the notch would continue to widen and deepen downstream portions of Alviso Slough, improving navigation. However, flows through the notch are muted and continued tidal scour is likely minimal. Therefore, potential benefits to navigation under Alternative A are expected to be minor. Impacts would be less than significant.

3.2.41 Alternative A8 A Level of Significance: Less than Significant

Alternative A8 B. Phase 2 actions under Alternative A8 B are limited to habitat transition zone construction, which would not change existing pond operations. Pond circulation and tidal scour from notch operations would continue to have effects similar to those described under Alternative A8 A. Therefore, impacts would be less than significant.

3.2.42 Alternative A8 B Level of Significance: Less than Significant

Ravenswood Ponds

Alternative Ravenswood A (No Action). Levees would not be breached under Alternative Ravenswood A, and Ponds R3, R4, R5, and S5 would continue to be operated as seasonal ponds – no gated or culverted hydraulic connections would be actively managed or used. Sloughs adjacent to the ponds are likely depositional, with unconsolidated sediment being transported during winter storm events. These sloughs would continue to be shallow, with reduced navigability. Impacts to navigation would be less than significant.

3.2.43 Alternative Ravenswood A Level of Significance: Less than Significant

Alternative Ravenswood B. Under Alternative Ravenswood B, Pond R4 would be breached to Ravenswood Slough. Ponds R3 and S5 would be connected to Ravenswood Slough and Flood Slough, respectively, through water control structures. Levees adjacent to Greco Island would also be lowered to allow inundation above mean high water. Unless explicitly allowed pursuant to a compatibility determination, navigation within the restored ponds would not be allowed. Furthermore, bottom elevations within this pond are relatively high, limiting potential boating.

Breaching the Pond R4 levee to Ravenswood Slough would widen and deepen the slough, eventually improving navigation. However, immediately after breaching, tidal currents through the breach and in the slough downstream of the breach would be stronger. High current velocities (e.g., peak values of approximately 5 to 7 fps) and turbulent flow may occur in the immediate vicinity of the breach. These flows may limit safe navigation of small watercraft in 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. The USFWS would restrict navigation in the vicinity of the breaches in the short term, if needed, for safety.

Due to the limited amount of boating expected in the area, Phase 2 actions would not result in significant adverse impacts to navigation. Over a period of years, Ravenswood Slough is expected to scour, increasing channel dimensions. Larger channel cross-sectional areas would reduce the short-term velocity increases associated with the breach and provide improved navigation in the long term. Therefore impacts to navigation would be less than significant.

3.2.44 Alternative Ravenswood B Level of Significance: Less than Significant

Alternative Ravenswood C. Pond R4 would be breached to Ravenswood Slough and to a slough near Greco Island under Alternative Ravenswood C. Several water control structures would also be constructed to connect Ponds R3, R5, and S5 to adjacent sloughs. Tidal flows within Ravenswood Slough and Greco Island sloughs would be affected by the breaches. To a lesser extent, flow through the water control structures would also affect downstream areas.

Under Alternative Ravenswood C, short-term impacts and long-term benefits to navigation would be similar to the impacts discussed under Alternative Ravenswood B. Tidal flows in sloughs between Pond R4 and Greco Island as well as within Greco Island would also be changed. High current velocities and turbulent flow may occur in the immediate vicinity of the breach. The USFWS would restrict navigation in the vicinity of the breaches in the short term, if needed for safety. Signage would be posted regarding potential safety hazards notifying kayakers and other users of small craft of possible risks. Over a period of years, adjacent sloughs are expected to scour, increasing channel dimensions. 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.

3.2.45 Alternative Ravenswood C Level of Significance: Less than Significant

Alternative Ravenswood D. Pond R4 would be breached to Ravenswood Slough under Alternative Ravenswood D. Several water control structures would also be constructed to connect Ponds R3, R5, and S5 to adjacent sloughs. Tidal flows through breaches, and to a lesser extent, flow through the water control structures would affect adjacent sloughs.

Under Alternative Ravenswood D, short-term impacts and long-term benefits to navigation would be similar to the impacts discussed under Alternative Ravenswood B and Alternative Ravenswood C. Due to the limited amount of boating expected in nearby sloughs, Phase 2 actions would not result in significant adverse impacts to navigation. Over a period of years, adjacent sloughs are expected to scour, increasing channel dimensions. 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.

3.2.46 Alternative Ravenswood D Level of Significance: Less than Significant

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

Alviso-Island Ponds

Alternative Island A (No Action). The Alviso-Island pond cluster is subject to tsunami and/or seiche events. Under Alternative Island A, no new improvements to existing levees would occur. Existing levees that protect the existing UPRR rail line between ponds A21 and A20 would be maintained. This alternative would allow the existing breached levees to continue to be scoured from hydraulic action and to naturally degrade over time. As such, no maintenance to repair or improve portions of levees for increased performance during a tsunami and/or seiche would occur under Alternative Island A. However, because Alternative Island A would not construct habitable structures and warning systems would allow for evacuation of the shoreline in the event of a tsunami, inundation by a tsunami would not expose people to potential injury or death. Therefore, impacts to the existing environmental conditions of a tsunami and/or seiche would be less than significant.

3.2.47 Alternative Island A (No Action) Level of Significance: Less than Significant

Alternative Island B. Impacts resulting from Alternative Island B would be the same as those described under Alternative Island A. Therefore, impacts to existing or proposed conditions resulting from tsunami and/or seiche would be less than significant.

3.2.48 Alternative Island B Level of Significance: Less than Significant

Alternative Island C. Impacts described under Alternative Island C would be the same as those described under Alternative Island A.

3.2.49 Alternative Island C Level of Significance: Less than Significant

Alviso-Mountain View Ponds

Alternative Mountain View A (No Action). The Alviso-Mountain View pond cluster is subject to a tsunami/seiche event. Under Alternative Mountain View A, the high-priority levees around Ponds A1 and A2W would be maintained for inland flood protection. These outboard levees would also be repaired upon failure; however, no direct improvements that might improve their performance during a tsunami and/or seiche are proposed as part of regular maintenance.

In areas where a tsunami could overtop a 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.

3.2.50 Alternative Mountain View A Level of Significance: Less than Significant

Alternative Mountain View B. Under Alternative Mountain View B, the northern perimeter levee and the northern portion of the western perimeter levee at Pond A1, the eastern levee of Pond A1, and the western levee of Pond A2W would not be maintained. The proposed new or improved and raised levee between Charleston Slough and Pond A1 would be designed for increased performance during a tsunami and/or seiche. Because Alternative Mountain View B would allow the northern perimeter levee and the northern portion of the western perimeter levee at Pond A1, the eastern levee of Pond A1, and the western levee of Pond A2W to degrade over time, the minimal flood protection these levees provide now would degrade over time. However, as that occurs, the transition of Ponds A1 and A2W to tidal marsh over time and the addition of habitat transition zones would provide a new measure of flood protection against tsunamis and/or seiches.

This alternative would not include construction of habitable structures. Additionally, 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 under this alternative resulting from a tsunami and/or seiche would be less than significant.

3.2.51 Alternative Mountain View B Level of Significance: Less than Significant

Alternative Mountain View C. Impacts resulting from a tsunami and/or seiche under Mountain View C would be the same as those described under Mountain View B; however, the levee separating the Palo Alto Flood Basin from Charleston Slough would be improved and the levee separating Charleston Slough and Pond A1 would be lowered. 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 under this alternative resulting from a tsunami and/or seiche would be less than significant.

3.2.52 Alternative Mountain View C Level of Significance: Less than Significant

Alviso-A8 Ponds

Alternative A8 A (No Action). Under Alternative A8 A, there would be no maintenance to repair or improve portions of levees for increased performance during a tsunami and/or seiche. In areas where a tsunami overtops levees, ponds and adjacent areas may be flooded and erosion of levee slopes may be accelerated. Because warning systems would allow for evacuation of the shoreline in such an event, inundation by a tsunami would not expose people to potential injury or death.

3.2.53 Alternative A8 A Level of Significance: Less than Significant

Alternative A8 B. Under Alternative A8 B, up to two habitat transition zones would be constructed in the southern corners of Pond A8S, but the A8 Ponds would remain under muted tidal control. Because of this, these activities would not change the potential for adverse effects from tsunami or seiche waves in or around these ponds relative to the baseline conditions. Impacts resulting from a tsunami and/or seiche under Alternative A8 B would be the same as those described under Alternative A8 A.

3.2.54 Alternative A8 B Level of Significance: Less than Significant

Ravenswood Ponds

Alternative Ravenswood A (No Action)**.** The Ravenswood pond cluster is subject to tsunami and/or seiche events. Under Ravenswood Alternative A, the high-priority levees on the bayward side of Ponds R3 and R4 would be maintained for inland flood protection. These outboard levees would also be repaired upon failure; however, no direct improvements that might improve their ability to mitigate the effects of a tsunami and/or seiche are proposed.

In areas where a tsunami could overtop a levee, ponds and adjacent areas may be flooded and erosion of levee slopes may be accelerated. However, warning systems would allow for evacuation of the shoreline in such an event, so inundation by a tsunami would not expose people to potential injury or death.

Therefore, impacts to existing conditions resulting from a tsunami and/or seiche would be less than significant under Alternative Ravenswood A.

3.2.55 Alternative Ravenswood A Level of Significance: Less than Significant

Alternative Ravenswood B. Under Alternative Ravenswood B, the project would maintain the existing outward levee at Pond R3, and the levee between Pond R3 and R4 along the AAC would be designed to maintain or increase the current levels of performance during a tsunami and/or seiche.

The proposed project would not include construction of habitable structures. Additionally, 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 a tsunami and/or seiche would be less than significant.

3.2.56 Alternative Ravenswood B Level of Significance: Less than Significant

Alternative Ravenswood C. Impacts resulting from a tsunami and/or seiche under Alternative Ravenswood C would be the same as those described under Alternative Ravenswood B.

3.2.57 Alternative Ravenswood C Level of Significance: Less than Significant

Alternative Ravenswood D. Impacts resulting from a tsunami and/or seiche under Alternative Ravenswood D would be the same as those described under Alternative Ravenswood B.

3.2.58 Alternative Ravenswood 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 Refuge 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											
	ISLAND			MOUNTAIN VIEW			A8		RAVENSWOOD			
	A	B	C	A	B	C	A	B	A	B	C	D
Phase 2 Impact 3.2-1: Increased risk of flooding that could cause injury, death, or substantial property loss.	LTS	LTS	LTS	LTS	LTS	LTS/ B	LTS	LTS	LTS	LTS	LTS	LTS/ B
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	LTS	LTS	LTS	LTS	NI	LTS	LTS	LTS
Phase 2 Impact 3.2-3: Create a safety hazard for people boating in the project area.	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
Phase 2 Impact 3.2-4: Potential effects from a tsunami and/or seiche.	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS

Notes:
Alternative A at each pond cluster is the No Action (No Project Alternative under
CEQA). B = Beneficial
LTS = Less than
Significant NI = No Impact