South Bay Salt Ponds
Initial Stewardship Plan

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Submitted by:

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1.0 Project Overview

Through this plan, the South Bay Salt Ponds Initial Stewardship Plan (ISP), the California Department of Fish and Game (DFG) and U.S. Fish and Wildlife Service (USFWS) will operate and maintain the ponds prior to the development of the long-term plan. Detailed design studies involving technical specialists in water quality, hydrology, soils, engineering and biology/wetland ecology were used to prepare the ISP, which has the these objectives:

- Cease commercial salt operations
- Introduce tidal hydrology to ponds where feasible
- Maintain existing high quality open water and wetland wildlife habitat, including habitat for migratory and resident shorebirds and waterfowl
- Assure ponds are maintained in a restorable condition to facilitate future long-term restoration
- Minimize initial stewardship management costs
- Meet all regulatory requirements, especially discharge requirements to maintain water quality standards in the South Bay.

The ISP describes new water control structures, technical support for the desired changes, operational management of surface water and proposed discharge salinity levels, routine maintenance and monitoring protocol to direct adaptive management.

Changes to existing operations include:

- Circulating bay waters through reconfigured pond systems and releasing pond contents into the Bay. The plan will require installing new water control features, consisting of intake structures, outlet structures, and additional pumps to maintain existing shallow open water habitat.
- Managing a limited number of ponds as seasonal wetlands, to reduce management costs and optimize habitat for migratory shorebirds and waterfowl
- Managing different summer and winter water levels in a limited number of ponds to reduce management costs and optimize habitat for migratory shorebirds and waterfowl.
- Restoration of three ponds to muted tidal or full tidal influence.
- Managing several ponds in the Alviso Complex as “batch ponds,” where salinity levels would be allowed to rise in order to support specific wildlife populations.

1.1 Context

The San Francisco Bay has been called an ecological treasure. Its sweeping wetlands once served as a magnet for waterfowl and shorebirds. Shorebirds – some now on the verge of extinction – were common as coots. Historic pictures tell the story of the Bay producing thousands of wild salmon.

Today, the estuary is still home to a wide variety of wildlife species – over 250 species of birds, some 120 species of fish, 81 types of mammals, 30 kinds of reptiles and 14 species of amphibians. In addition to attracting wildlife, the estuary's wetlands play a critical role in preserving the water quality in the bay by filtering pollutants, preventing shoreline erosion and easing the impacts of periodic flooding. Some 40 percent of California's water flows into the estuary, which includes the Bay and the Sacramento-San Joaquin Delta.

The salt ponds that ring the South Bay are readily visible to commuters driving across bridges or visitors flying into local airports. These multicolored ponds often provide the first impression tourists have of the San Francisco Bay. The acquisition of the salt evaporation ponds represents an unprecedented opportunity to restore the degraded estuary.

Embarking on a once-in-a-lifetime opportunity, the DFG and USFWS recently acquired 16,500 acres of industrial solar salt ponds and associated salt-making rights in the bay from Cargill Salt. Approximately 15,100 acres of this is in the South Bay, and approximately 1,400 acres is in the North Bay. Purchase of the ponds represents a down payment on a multimillion-dollar commitment to restore, preserve and enhance former tidal salt marsh habitat for fish and wildlife in the South Bay. Acquisition and restoration of the ponds represents the largest tidal wetlands restoration project on the West Coast.

The Cargill solar salt production facilities cover some 26,000 acres, ringing the shoreline of southern San Francisco Bay. Prior to the sale, Cargill owned 14,760 acres and controlled the mineral rights to produce salt on the 11,430 acres of ponds owned by the U. S. Fish and Wildlife USFWS. With the sale, the DFG now owns 5,500 acres of "Baumberg Complex," located between the San Mateo Bridge and the Alameda Creek Flood Control Channel and 1,400 acres at the "Napa Plant Site" in the North Bay. (Note that the Napa ponds are not included in this ISP.) The USFWS owns and will manage the 1,600 acres of West Bay Complex, located on both sides of State Route (SR) 84 west of the Dumbarton Bridge and 8,000 acres of "Alviso Complex," located from Charleston Slough east around the South Bay to the Union Pacific Railroad (UPRR) line north of Mud Slough. Cargill will continue to operate the remaining commercial salt ponds in South San Francisco Bay.

The long term goal of the DFG and the USFWS is to restore the ponds into a mosaic of habitats, including tidal wetlands, saline ponds and seasonal ponds to benefit threatened and endangered and migratory and resident breeding species. Many of these ponds and the adjacent marsh have become important habitat for threatened and endangered wildlife, such as for the California Clapper Rail, Western Snowy Plover, California Least Tern and Salt Marsh Harvest Mouse. Planning and design for the long term restoration and operation is projected to take approximately five years and will require additional time to implement. The ISP will be in place during the period needed to plan and implement the long term restoration plan.

1.2 Location of Project

The Cargill Salt production facilities currently ring the shoreline of southern San Francisco Bay, on the margins of Alameda, Santa Clara and San Mateo counties. Cargill's South Bay facilities consist of five regional pond complexes: Baumberg, Newark #1, Newark #2, Alviso, and Redwood City. The ISP includes the Baumberg, Alviso (with the exception of Ponds A4 and A18), and West Bay complexes (See Figure 1-1). Cargill Salt will continue salt-making operations on the Newark #1 and Newark #2 complexes and at the Redwood City plant site and therefore are not included in the ISP.

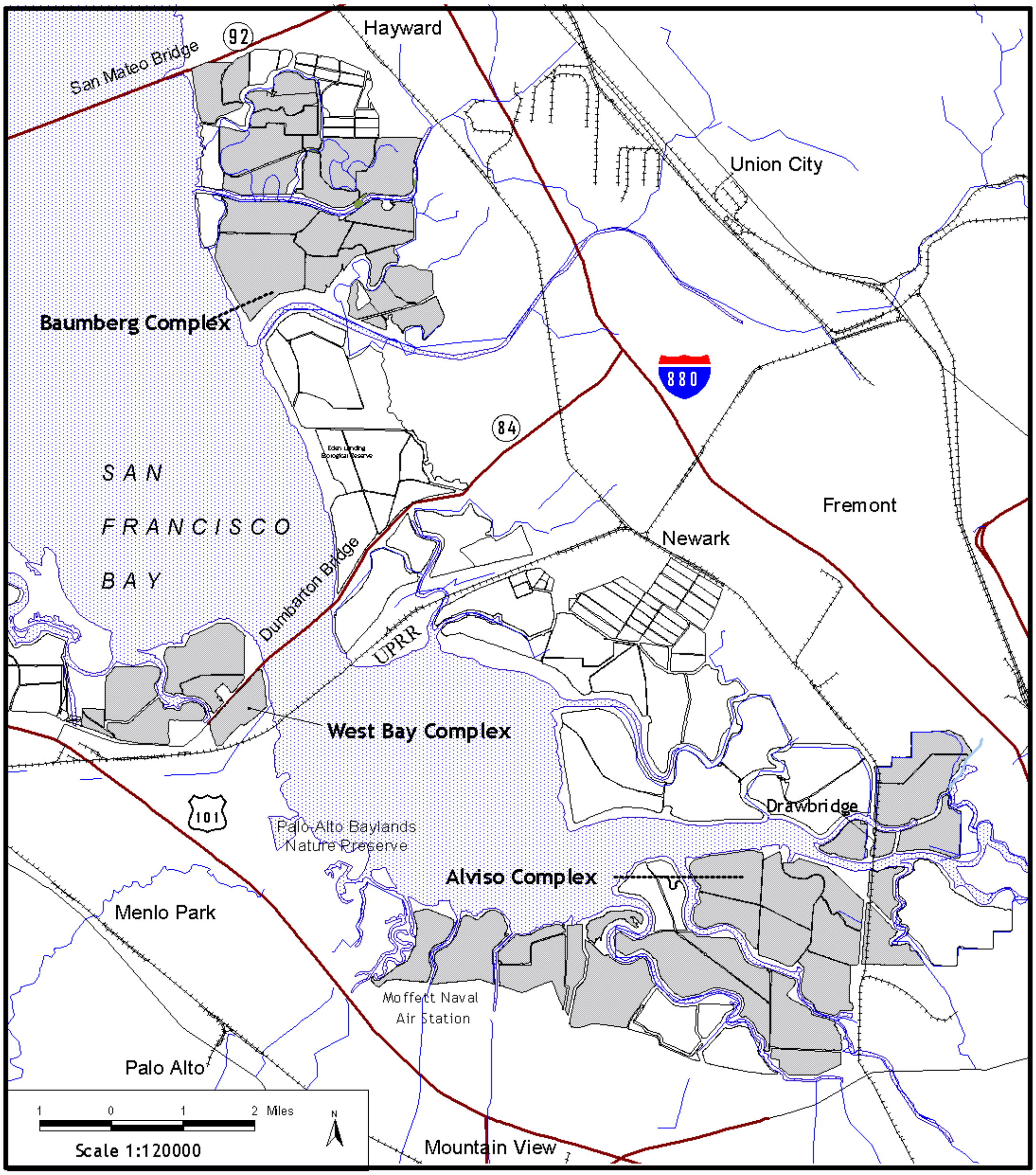


Figure 1-1
Map of Baumberg, Alviso, and West Bay Complexes

1.2.1 Baumberg Complex

The Baumberg ponds consists of a 5,500 acre complex of evaporator ponds (B1-B14 of Figure 1-2) in the East Bay west of Hayward and Union City in Alameda County. Since the complex contains only evaporators, brine historically has been pumped for final treatment to the Newark plant or to the Redwood City plant through a pipeline paralleling the Dumbarton Bridge. The approach to the San Mateo Bridge and the Eden Landing Ecological Reserve, formerly known as the “Baumberg Tract,” form the northern boundary of the complex. The reserve was established in May 1996 to restore former salt ponds and crystallizers to tidal salt marsh and seasonal wetlands. Alameda Creek Flood Control Channel (also known as Coyote Hills Slough) and the Coyote Hills form the southern boundary.

Major drainages that discharge into the San Francisco Bay within the complex include Mount Eden Creek and Old Alameda Creek and Alameda Creek Flood Control Channel. Alameda Creek Flood Control Channel diverges from Old Alameda Creek in Union City to provide bypass capacity during large floods. Several hundred acres of extant tidal marsh front the San Francisco Bay, known as the Whale’s Tail Marsh at the center of the complex. The marsh is located outboard of ponds 9, 8A, 2, and 1, where Mount Eden Creek discharges into the Bay. Prior to the acquisition, all ponds within this complex were under Cargill ownership and have now been transferred to the DFG.

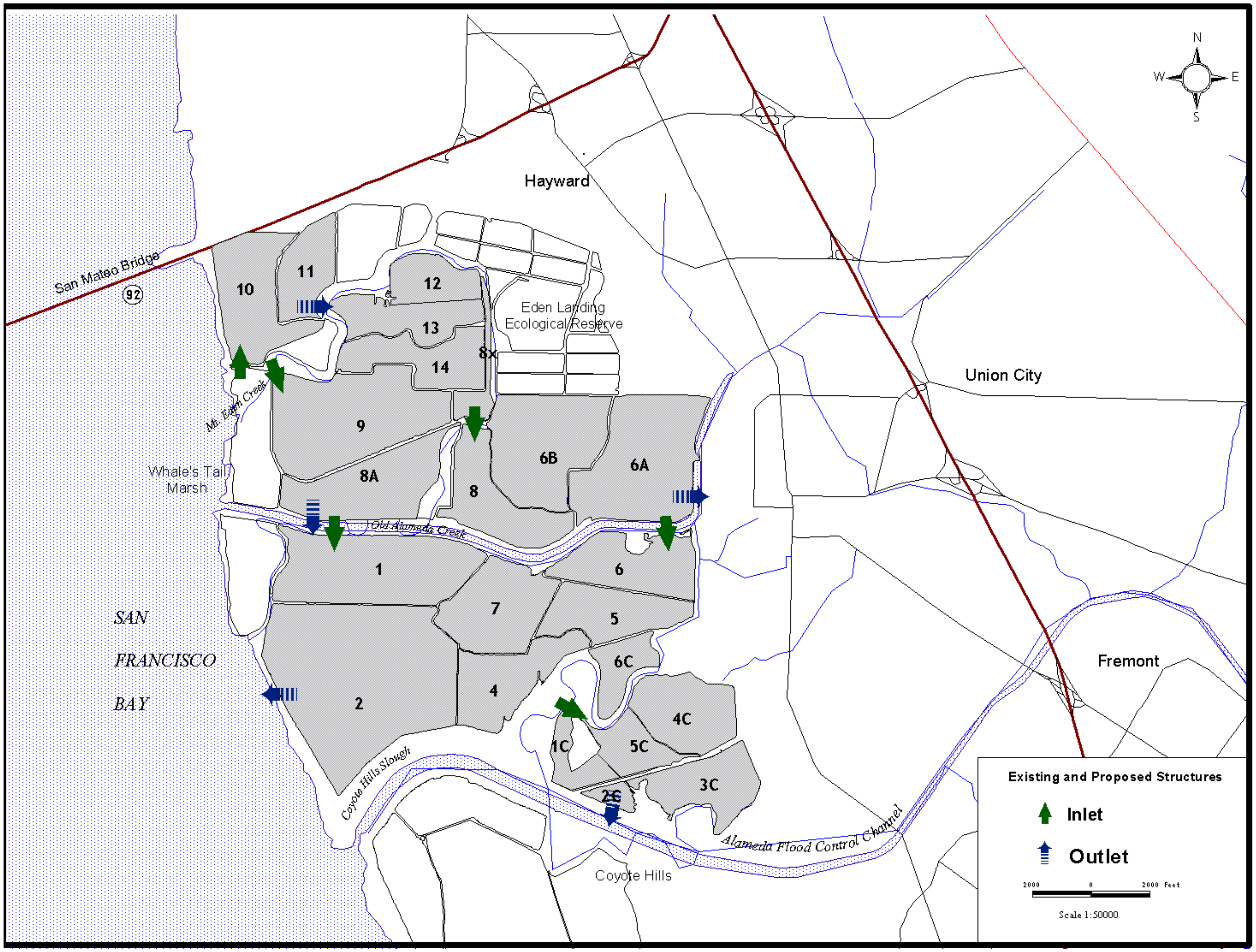


Figure 1-2
Map of Baumberg Complex

1.2.2 Alviso Complex, including Alviso Ponds

The Alviso complex is the largest complex in the South Bay, consisting of 8,000 acres of 25 ponds (A1-A23, B1 & 2 of Figure 1-3) at the Bay's southern extremity in Santa Clara and Alameda counties. Because the complex contains only evaporators, brine historically has been pumped northward to the Newark #2 site for crystallization and final processing. Ponds are located bayward of the cities of Fremont, San Jose, Sunnyvale and Mountain View. The complex area is flanked on the west by Palo Alto Baylands Nature Preserve and Charleston Slough, to the south by Moffet Naval Air Station, Sunnyvale Baylands Park and the east by Coyote Creek and Alviso and Fremont. Major drainages which discharge into San Francisco Bay within the complex area include Charleston Slough, Mountain View Slough, Stevens Creek, Guadalupe Slough, Alviso Slough (Guadalupe River), Artesian Slough, Mud Slough, and Coyote Creek. The Project does not include Ponds A18 and A4.

The USFWS acquired fee title to Ponds A1 to A8 (with the exception of Pond A4) and portions of A22 and A23. Cargill Salt is sold its reserved salt-making rights on Ponds A9 to A17, Ponds A19 to A21 and portions of Ponds A22 and A23. Pond A4 will be used by Santa Clara Valley Water District to restore wetlands to mitigate for losses resulting from construction of the Lower Guadalupe River Flood Protection Project. Cargill is negotiating with City of San Jose for the sale of pond A18 to the City.

The historic and abandoned town of Drawbridge, which still has standing hunting cabins and an active railroad line (UPRR), is located between ponds A20 and A21. Ponds 19, 20 and 21 are surrounded by Mud Slough to the east and Coyote Creek to the west and are collectively known as the “Island Ponds.” The bottom elevations of the Alviso ponds are generally lower than other complexes due to subsidence from historic groundwater withdrawals. Broad expanses of mudflats exposed at low tide are found at the confluence of Coyote and Alviso creeks, outboard of pond levees.

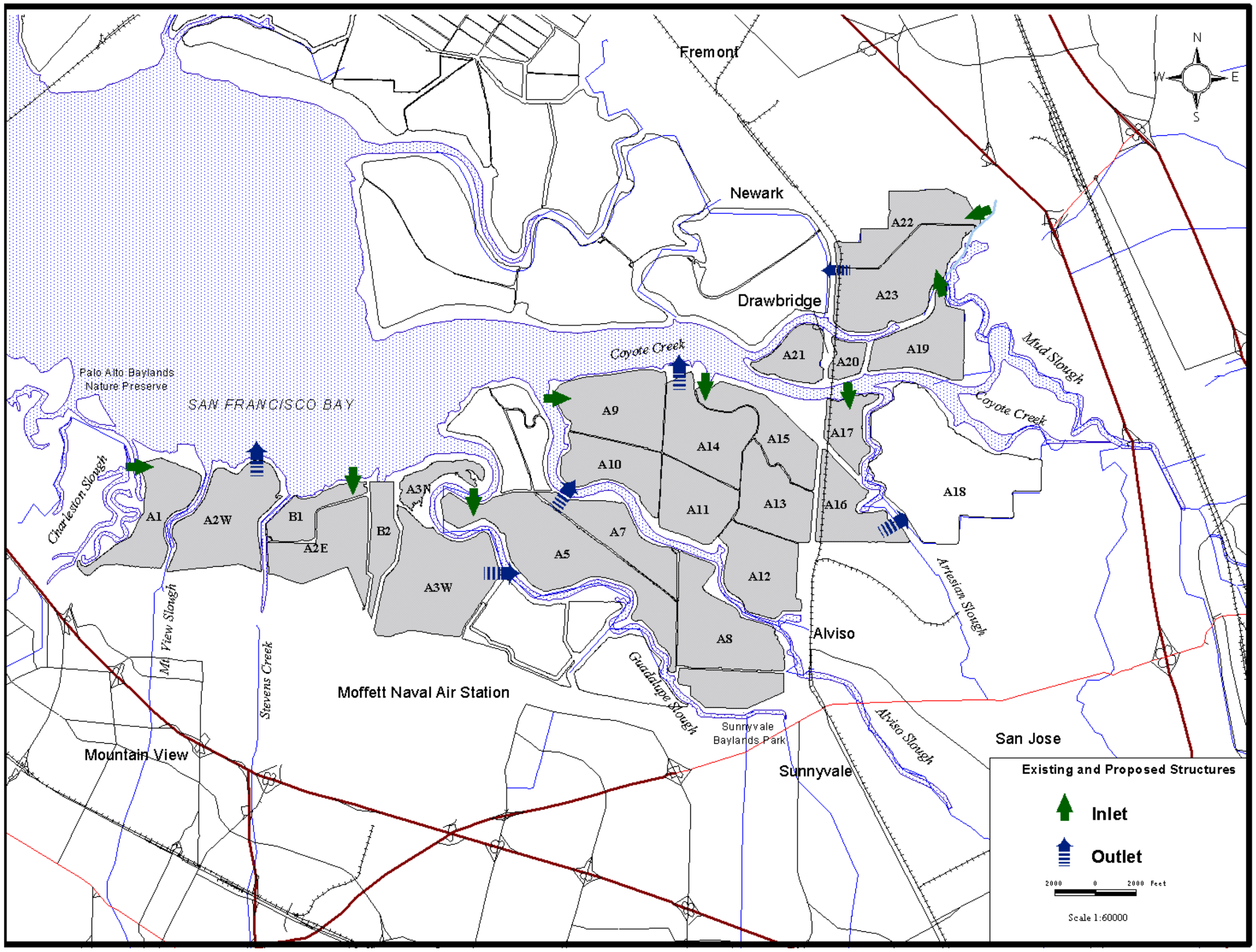


Figure 1-3
Map of Alviso Complex

1.2.3 West Bay Pond Complex

The West Bay Ponds consist of a 1,600 acre complex of 7 ponds (1-5, S5, & SF2 of Figure 1-4). The complex is located south of the Bay and the boundary between Menlo Park and Redwood City. The City of Menlo Park is located to the west, and the Dumbarton Bridge approach and the UPRR are located at its southern border. Ravenswood Slough discharges near the complex. Prior to the acquisition, Cargill owned all ponds in this complex with the exception of evaporator ponds 1 and 2 on which Cargill owned reserve salt-making rights. The USFWS acquired the West Bay ponds 3, 4, 5 and S5. Cargill is giving up salt making rights for ponds 1 and 2. Pond SF2 has not been acquired, but will be transferred later.

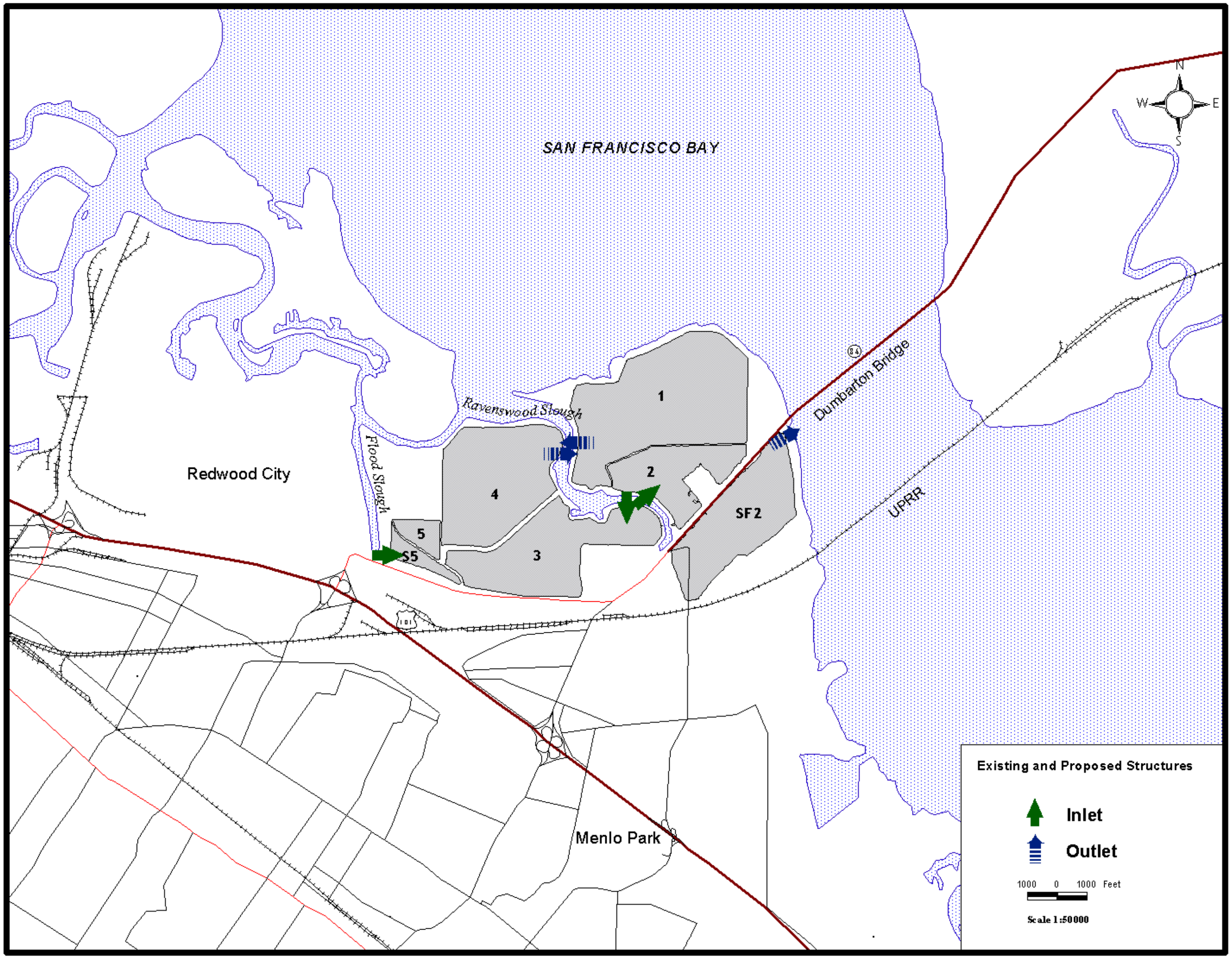


Figure 1-4
Map of West Bay Pond Complex

1.3 Site Background and History

The solar salt industry in San Francisco Bay began in the middle 1850s. The first operations were simple levees built around naturally occurring salt pans in Alameda County to increase their capacity. They were small family enterprises that used intensive hand labor for production and harvest. Nearly all of the salt produced in San Francisco Bay during this era was shipped to Nevada to be used for the processing of silver ore. By the late 1800s, an estimated 37 salt production facilities had been established throughout the South Bay. Most of these facilities were constructed by diking tidal marshes (BCDC, 1994, p. 19). The diked marshes were fitted with operator-controlled intake structures to capture seawater during high tides. The Baumberg ponds first came into production in the late 1800s. The Alviso ponds came into production in 1929.

By the early 1900s, the quality of the salt produced in San Francisco Bay had increased significantly, and the market expanded to include fine or “table” salt. In 1936, the Leslie Salt Company was created from the consolidation of 19 small operations. Following this consolidation, only Leslie and Oliver salt companies remained. Oliver, located at the foot of the Hayward-San Mateo Bridge, ceased to operate in the 1970s. In 1979, Cargill bought Leslie and is now is the only solar salt producer in San Francisco Bay (BCDC, 1994, p. 19).

Salt production involves a sequence of ponds through which seawater is progressively cycled to concentrate and ultimately precipitate salt. Salt production takes approximately five years from the time that the water enters the system from San Francisco Bay until the salt is harvested. The salt production process begins as high tide brings baywater into the initial or intake pond, the first in a series of ponds called evaporator or concentrator ponds. Evaporator ponds range in size from less than 100 acres to more than 850 acres.

The ponds are separated by earthen levees – some constructed more than a century ago – and are interconnected with siphons and gates. Through natural evaporation, water is drawn out, creating increasingly saline brine. As brine flows to the next evaporator pond, it becomes increasingly concentrated with salt. When fully saturated, the brine is pumped into the pickle ponds for storage before it is crystallized and harvested. For the most part, Cargill Salt uses gravity to transfer brines from one pond to the next by taking advantage of differences in hydraulic head. When siphons or gates are open, differences of less than a few inches in surface elevation or “hydraulic head” between two ponds will result in a net flow of brine from one pond to the next until the water surfaces are equal in elevation. The pickle pond solution is then pumped into crystallizer beds to undergo final evaporation, resulting in the precipitation of salt crystals.

After a layer of salt approximately 5 to 8 inches thick has formed on the bottom of the crystallizer ponds, the remaining solution, called bittern is pumped into the desalting pond where additional sodium chloride is removed and then to the bittern pond for storage. Bittern contains highly concentrated magnesium, potassium, bromine and sulfate. Salts are mechanically harvested from the crystallizer beds and transported to the wash house by truck and then by conveyer to the salt stack. In the final stage of production, the raw salt will be sent to the refinery at Newark for further processing, packaging and shipping to customers. The Newark plant produces about 650,000 tons of salt per year. All of the ponds included in the ISP are concentrator ponds. No crystallizer ponds were included in the land transfer.

About 200 miles of pond levees separate the individual ponds and isolate salt production facilities from the bay. Levees require periodic maintenance to prevent failure from erosion, subsidence and consolidation. Currently approximately 10 miles of levees are maintained each year. Levee maintenance consists of excavating mud from salt pond borrow ditches and placing it on levees using a floating dredge.

2.0 Environmental Setting

This section describes the existing environmental setting for the South Bay Salt Ponds. Beginning with an overview of biological resources and concluding with a discussion of physical characteristics of the habitat. Information has been summarized from various reports on the San Francisco Bay and the salt pond communities.

2.1 Biological Resources

2.1.1 Vegetation

There are significant floristic differences between the San Francisco Bay and other similar regions along the central coast of California. These differences include some vegetation types unique to the ecosystem: the dominance of Pacific cordgrass (*Spartina foliosa*), the presence of disjunct populations of the rare species California sea-blite (*Suaeda californica)* and the presence of local endemic species such as soft bird's beak (*Cordylanthus mollis ssp. mollis*) and Suisun thistle (*Cirsium hydrophilum var. hydrophilum*) (Olofson, et. al., 2000, p. 11).

To describe the tidal wetlands, three elevation saltwater zones have been used to classify tidal marshes: the "low marsh zone" occurs from the mean sea level to the mean high water; the "middle marsh zone" occurs from approximately the mean high water to the mean higher water; and the "high marsh zone" occurs near and above mean higher water up to several meters above the extreme high water line. The "high marsh zone" is also known colloquially as the "upper marsh transition" or "upper salt marsh zone" (Peinado, et. al, 1994).

The native Pacific cordgrass generally dominates the low marsh zone, along tidal creek banks and the edges of tidal mudflats. In middle marsh zone, which makes up an extensive portion of the San Francisco Bay, younger marshes are characterized by vegetation dominated by pickleweed (*Salicornia virginica*) with some areas containing saltgrass (*Distichlis spicata*), salt marsh dodder (*Cuscuta salina*), alkali heath (*Frankenia salina*) and spearscale or fat hen (*Atriplex triangularis*). The low marsh and middle marsh zones are increasingly being impacted by an Atlantic species of invasive Spartina (*Spartina alterniflora*) and several species of other non-native pickleweed. Other invasive species in the middle marsh include brass buttons (*Cotula coronopifolia*) and Mediterranean saltwort (*Salsola soda*).

The high marsh zone commonly includes natives such as gumplant *(Grindelia stricta*) (often dominant in the zone), salt marsh dodder, pickleweed, alkali heath, sea lavender (*Limonium californicum*) and spearscale. Common non-native species in the high marsh zone include perennial pepperweed (*Lepidium latifolium*), bassia (*Bassia hyssopifolia*), saltwort (*Salsola soda*), wild beet (*Beta vulgaris*), annual iceplant (*Mesembryanthemum nodiflorum*), iceplant (*Corpobrotus edulis*), Australian saltbush (*Atriplex semibaccata*), ripgut brome (*Bromus diandrus*), sicklegrass (*Parapholis incurva*) and rabbit's-foot grass (*Polypogon monspeliensis*) (Monroe, et. al., 1999, pp. 12-13).

Tidal mudflats are expanses of barren muds, below the low marsh zone that are uncovered during low tides. According to one account, prior to filling and diking, flats were ubiquitous and as wide as two miles. In the South Bay, each day as the tide went out, almost 50,000 acres of tidal flats emerged along margins of bays and larger tidal creeks and sloughs. (Olofson, et. al., 2000). Currently, the South Bay supports approximately 30,000 acres of tidal mudflat (San Francisco Bay Conservation and Development Commission, 1994, p. 21). In areas where salt ponds have been constructed, mudflats are located outboard of the salt pond levees. Mudflats are habitat to algae, diatoms and invertebrates and when exposed, provide the major food source for shorebirds. During inundation periods at twice daily high tides, mudflats are feeding areas for fish.

2.1.1.2 Vegetation within Salt Ponds

Most salt pond complexes in the South Bay were built on tidal marsh. Salt ponds and dredge locks were constructed using bay mud for the levees around ponds.

Active salt ponds support a distinctive group of halophilic (salt-loving) biota made up of microalgae, photosynthetic bacteria and invertebrates. Vascular plants only exist along the edges of the pond levees. With presence varying by salinity, the dominant organism in these hypersaline ponds is the single-celled green algae (*Dunaliella salina*), halobacteria and purple sulfur-reducing bacteria. Ponds, such as those serving as intake areas with salt concentrations closer to sea levels, contain marine algae, such as sea-lettuce (*Ulva*), *Enteromorpha ssp., Cladophora ssp*., and sometimes *Fusus ssp*. and *Codium ssp*. in firmer substrate. These areas also include marine diatoms, dinoflagellates and cryptomonads (Monroe, et. al., 1999, p. 45).

Colors in salt ponds range from pale green to deep coral pink and indicate the salinity of the ponds. In low- to mid-salinity ponds (50-110 parts per thousand [ppt]), green algae proliferate, lending the water a green cast. The typical salinity of sea water is 32 ppt. As the salinity increases, *Dunaliella* out-competes the other microorganisms in the pond, and the color shifts to an even lighter shade of green. In mid-to high-salinity ponds (200-250 ppt), high salt concentrations actually cause the *Dunaliella* to produce a red pigment. Brine shrimp in mid-salinity ponds contribute an orange cast to the water. Halophilic bacteria such as *Stichococcus* and purple sulfur-reducing bacteria also contribute red and reddish purple tints to high-salinity brine (Monroe, et. al., 1999, p. 45).

Field observations made at the Department's Eden Landing Ecological Reserve, where salt production had ceased in 1972, indicate vegetation cover is generally limited to ponds with salinity levels lower than 30 ppt. Vegetated areas had a mean salinity of 22 ppt compared to non-vegetated areas with mean salinity of 65 ppt. At the reserve, the lower salinity ponds had characteristics of a San Francisco Bay salt marsh, with transitional pickleweed and saltgrass. In these ponds, there was a gradual succession from pickleweed stands to mixed stands of pickleweed and ruderal/hydrophytic grassland associations. Higher salinity muds were colonized on a seasonal basis by annual pickleweed (*Salicornia europa*). A correlation was also observed between percent vegetative cover greater than 50 percent and salinity less than 50 ppt. (Resource Management International, Inc., 1999, p. 10).

Salt pond dredge lock interiors are ponds primarily containing open water and mudflat habitat. With sufficient sedimentation in the lock, ponds will support Pacific cordgrass or alkali bulrush *(Scirpus robustus)* at lower salinity levels. While smooth cordgrass can be an invader of mudflat areas between mean sea level and mean high water, smooth cordgrass is not common in dredge locks (Wetland Research Associates, 2000).

Levees around salt ponds and dredge locks support both native and weedy species. At mean tide level, Pacific cordgrass and alkali bulrush are common while at higher zones, pickleweed is present. Monotypic stands of perennial pickleweed can be found along the margins and toe of slopes of levees. Salt bush and fleshy jaumea (*Jaumea carnosa*) can also be found along with pickleweed. Upland areas above the extreme high tide zone support alkali heath, salt grass, perennial pepperweed, and coyote brush. Perennial pepperweed is a common dominant species on many levee crowns and disturbed sites and can form monotypic stands on recently disturbed sites, displacing native marsh vegetation. While it can establish through seed, it spreads primarily by subsurface rhizomes, which sprout and form new plants when broken by tilling or excavation (Wetland Research Associates, 2000).

2.1.1.3 Vegetation along Sloughs and Creeks

Tidal salt marsh occurs in more saline conditions, while tidal brackish marsh occurs under fresher conditions generally where tributary streams discharge freshwater into the Bay. As the streams approach the Bay, plant associations change with the progression of salinity levels from freshwater to brackish to tidal. Upper reaches of the creeks and sloughs support predominantly alkali bulrush and/or peppergrass. Lower reaches support single species stands, or mixed stands of pickleweed and cordgrass depending on water depth. Pacific cordgrass occurs primarily in areas of persistent high salinity, alkali bulrush occurs in brackish water conditions, and California tule *(Scirpus californicus)* in freshwater conditions. Their distribution and abundance are related to their tolerance to water salinity and other factors, including tidal regime, disturbance, substrate type, marsh age, erosion and accretion patterns.

In a comparative study from 1989 to 1999 of marsh plant associations along lower Coyote Creek and Alviso and Guadalupe sloughs, H.T. Harvey & Associates documented the conversion of 127 acres of salt marsh to less saline brackish and freshwater habitat types. Freshwater discharge from South Bay wastewater treatment facilities has contributed to this conversion where California tule has replaced both Pacific cordgrass and alkali bulrush. However, the authors noted some areas of habitat conversion were at locations outside the influence by treatment facility discharges, and therefore, causes of conversion could not be solely attributed to the wastewater facilities. They also documented sedimentation of open water habitats from tributary streams has created new salt marsh within the study area (Harvey, 2001).

Vegetation in and adjacent to streams and sloughs around the South Bay salt ponds were mapped by Jones & Stokes for San Francisco International Airport to assess the potential of complexes for habitat mitigation (Jones & Stokes, 2001). Dominant communities of some of the major creeks and sloughs in the Initial Plan area are tabulated below in Table 2.1:

Table 2.1
Acreage of Slough and Creek Habitats

	Acres of Habitat			
	Mudflat	Salt Marsh	Brackish/ Freshwater	Open Water
Alviso Slough	58	57	118	83
Coyote Creek	293	116	306	258
Guadalupe Slough	37	60	156	122
Mt. View Slough	9	30	x	8
Mud Slough	x	29	112	38
Ravenswood Slough	57	8	x	17

As shown in the Table 2.1, broad areas of mudflat are located at the confluence of Alviso Slough and Coyote Creek.

2.1.2 Wildlife

Salt ponds provide important habitat for wildlife, the most visible of which are the resident and migratory waterfowl and shorebirds. The birds use the ponds and adjacent upland levees for feeding, roosting and as a place to rest during high tides. Pond depth also plays a key role in attracting certain water birds. Small and medium sized shorebirds dominate when the pond depth is shallow. During the rainy periods of the winter months, waterfowl use the deeper ponds extensively.

The ponds support an abundant source of food that attract birds to salt ponds, such as brine shrimp, salt marsh boatman and brine fly. Growing up to 10 millimeters, brine shrimp *(Artemia franciscana)* provide a major food source attracting birds to the salt ponds. Brine shrimp thrive in salt ponds where salinity measures 80 to 190 ppt (8 to 19 percent), where there is plenty of algae to eat and few predators and competitors. The tiny, egg-like cysts of brine shrimp are also sold as "Sea Monkey eggs" to hobbyists. Brine shrimp are commercially harvested from many of the salt ponds to supply the aquarium fish industry.

2.1.2.1 Waterfowl

During the winter, the San Francisco Estuary provides habitat for more than 300,000 ducks and geese (Accurso, 1992). The estuary provides habitat for the largest winter populations of canvasback *(Aythya valisineria)* on the Pacific Flyway. Winter surveys of salt ponds in the 1980s recorded more than 100,000 ducks (Harvey, et. al. 1988). Between 1988-90, the lower salinity (20-63 ppt.) South Bay ponds of moderate size (50-175 ha) supported 21-27 percent of waterfowl, including 90 percent of northern shovelers *(Anas clypeata)* (Harvey, et. al., 1992).

Species known to breed in or around the South Bay salt ponds include Canada geese *(Branta canadensis),* mallard *(Anas platyrhynchos),* gadwall *(Anas strepera),* northern pintail *(Anas acuta),* northern shoveler, cinnamon teal *(Anas cyanoptera),* and ruddy duck *(Oxyurajamaicensis).* Two waterfowl species that occur in the Estuary have special conservation status. The Aleutian Canada goose *(Branta canadensis leucopareia)* is federally threatened, and Barrow's Goldeneye *(Bucephela islandica)* is listed as a California Species of Special Concern. Both species are uncommon in the South Bay.

Waterfowl populations in the San Francisco Bay and Sacramento-San Joaquin Delta were assessed in a series of surveys taken in midwinter in years 1988 through 1990. More than 700,000 waterfowl were observed in the Bay and Delta, and more than 300,000 of these individuals were observed in open Bay areas and salt ponds (Accurso, 1992). These surveys showed that salt evaporation ponds supported 30-41 percent of the waterfowl in the San Francisco Estuary (Accurso, 1992). The South Bay salt ponds supported up to 76,000 (or 27 percent) of the estuary's total waterfowl population. This area has provided the largest haven for ruddy ducks in the region (up to 67 percent of the population), and supported 17 percent of the canvasbacks, 50 percent of the bufflehead and up to 86 percent of dabbling ducks, including the majority of shovelers. Waterfowl were concentrated in lower salinity (20-63 ppt) ponds, with few birds present in ponds above 154 ppt. Most waterfowl used ponds of moderate size, from 5 to 175 ha. The open water areas of the South Bay supported 9 to 11 percent (or 36,000) of the waterfowl in the Estuary, and were important for scaup (18 percent) and scoter (16 percent) (Monroe, et. al., 1999, pp. 310-311).

2.1.2.2 Shorebirds

With their cylindrical bills of different length and curvature, some 31 species of shorebirds inhabit the San Francisco Bay. These include birds of a wide range of sizes – from the sparrow-sized least sandpiper *(Calidris minutilla)* to the duck-sized long-billed curlew *(Numenius americanus).* They feed primarily on invertebrates obtained on tidal flats, salt ponds, managed wetlands and other habitats. Most tidal flat specialists are found concentrated in the North and South Bays. San Francisco Bay supports very high numbers of shorebirds of most species during migration and winter compared with other wetlands along the Pacific Coast (Page, et. al., 1991).

A federally listed threatened species, the western snowy plover (*Charadrius alexandrinus nivosus)* makes extensive use of the South Bay salt evaporation ponds. In addition, the red knot *(Calidris canutus)* has been found foraging and roosting in the South Bay salt ponds. The western sandpiper is the most abundant shorebird in the estuary. The Wilson's phalarope *(Phalaropus tricolor)* and the red-necked phalarope *(Pbalaropus lobatus)* are also most dependent on the salt ponds for foraging habitat, during spring and fall migration, while the others, including black-necked stilt and American avocet *(Recurvirostra americans),* are resident and nest primarily in South Bay salt ponds (Monroe, et. al., 1999, pp. 311-312).

2.1.2.3 Other Bird Species

Other birds that inhabit the South Bay salt ponds include:

Eared grebes *(Podiceps nigricollis)* are found through the estuary, but can be seen using the medium to high salinity salt evaporator ponds for resting or forage. They prefer the habitat of the medium or medium-high salinity ponds from late August through April or early May, a period when bird counts may include up to several thousand birds per pond. These ponds show high concentrations of brine shrimp *(Artemia salina)* and/or water boatmen *(Hemiptera: Corixidae),* which are prime prey for these small grebes. The grebes may also eat brine-fly (Diptera: E*pbydra* sp.) larvae and pupae which spend most of the time below the 1/4-meter depth, or even adult brine flies on the water surface (Olofson, 2000, pp. 317-318). They are also known to breed in salt ponds, building floating nest platforms anchored to salt pond substrate or algal mats from March to June (San Francisco Bay Conservation and Development Commission, 1994, p. E1).

American white pelican *(Pelecanus erythrorhynchoss)* is a State Species of Special Concern. They feed in several lowest salinity salt evaporators and around the Bay from July through October in considerable numbers. A few have been recorded to be present through June. Even in their peak period, local surveys of only one set of low-saline ponds may often reveal no white pelicans, while a few days later (or even later the same day) scores or hundreds may be present.

Double-crested cormorant (*Phalacrocorax auritus*) is a State Species of Special Concern. They can be found in large numbers in low salinity ponds all year, but can be found in other salt evaporation ponds in considerable numbers in the fall (San Francisco Bay Conservation and Development Commission, 2000. p. 324). The numbers of double-crested cormorants using salt ponds either for foraging and daytime resting or for nesting on structures within the ponds is probably rather small compared to the total number in or near the deeper parts of the Bay. In more recent years, they have increasingly taken to nesting on the platforms or sometimes at junctions of legs and braces of power line towers, e.g., many such south of the western part of San Mateo Bridge (Monroe, et. al., 1999, p. 396).

Snowy egret (*Egretta thula*), a member of the heron family, commonly inhabit fresh, salt and brackish water wetlands. They prefer mudflats and tidal areas for feeding, but have been found feeding and resting in low salinity ponds when prey items such as small fish, frogs, crustaceans and large insects are in abundance (Olofson, 2000. p. 327). High numbers of breeding pairs nest at the heron colony on Mallard Slough located between the Alviso ponds A17 and A18 (San Francisco Bay Conservation and Development Commission, 1994, p. E7).

Black-crowned night heron is *(Nycticorax nycticorax*is) a common resident of saltwater and brackish marshes throughout the San Francisco Bay Area. They use the low-salinity, fish-bearing salt ponds for foraging and prefer places where water moves past their perch, such as gates or siphon-flows between ponds. Partly because they do much of their feeding at night, less is known about their foraging habits. The usually roost during the day in small to fairly large flocks in the non-breeding season, typically in trees or within marsh growth, , e.g., in the primarily pickleweed marsh south of the outermost part of Alvarado Channel (old Alameda Creek) (Olofson, 2000, p. 396). As with the snowy egret, high numbers of breeding pairs nest at the heron colony on Mallard Slough. (San Francisco Bay Conservation and Development Commission, 1994, p. E3)

Northern harrier *(Circus cyaneus)* is a common year around resident raptor in the South Bay marshes. They are a State Species of Concern due to declines in both breeding and winter populations. They nest in salt marshes (upper portions, that are not flooded by tides in April or May), as well as in or near freshwater marshes or grassy flats inland. They feed on small mammals, birds, frogs, crustaceans, insects and occasionally on fish (BCDC, 1994, p. E34). In the non-breeding season, and in the breeding period within proximity to nest sites, they frequently forage over various marshes, fields, roadsides, dikes, and also those salt ponds that have numerous birds (Monroe, et. al., 1999, p. 397).

California brown pelican (*Pelecanus occidentalis*)is a state and federally listed endangered species. Weighing up to 17 kilograms, they are one of the largest piscivorous birds of coastal and estuarine waters of North America. They breed in colonies in southern coastal waters, and migrate north to winter in central California north to the Columbia River. Several hundred occur within the San Francisco Bay from July through November, where they can be found foraging in deeper waters including salt ponds, lagoons and mouths of the larger creeks. They feed on schooling fish, and favor deeper waters, which allow them to dive into water to catch fish (Monroe, et. al., 1999, p. 322). Modest size flocks have been observed to forage at times in the low-salinity South Bay ponds (Monroe, et. al., 1999, p. 394).

California clapper rail *(Rallas longirostris obsoletus)* is a state and federally listed endangered species that depends almost entirely on low intertidal salt marsh for foraging, retreat from danger, and for nesting marsh (San Francisco Bay Conservation and Development Commission, 1994, P. E10). (See discussion in Section 2.1.2.5 Special Status Species.)

California gull (*Larus californicus*) has been drawn to the San Francisco Bay by the availability of remote nesting locations in former salt ponds and abundant food sources in adjacent municipal landfills. In 1980, 12 nests were encountered in a salt pond near Alviso in Santa Clara County. Beginning in 1984, California gulls began breeding at other sites within the South Bay. In 1993, California gulls nested on an attached levee and a series of small dredge spoil islands near Mountain View in Santa Clara. Currently, approximately 10,000 California gulls nest in South Bay (Olofson, 2000, p. 350). California gulls are abundant in the San Francisco Bay in the winter, although no reliable estimates of wintering numbers exist (Harvey, et. al., 1992).

Caspian terns *(Sterna caspia)* are found around ocean shores, lakes, estuaries, and salt ponds, where they aerially search, hover and dive for small fish (Cogswell, 1977; Zeiner. et. al., 1990). They have nested on dikes or on barren islands within salt evaporators in the South Bay since at least 1922 in a colony that had 287 active nests in 1931 (DeGroot, 1931). Anderson (1970) discovered a thriving colony of Caspian terns on the southern part of the curving dike between ponds east of Albrae Slough (Monroe, et. al., 1999, pp. 398-399). Unfortunately, this colony has since been abandoned due to predators

Forster's tern *(Sterna forsteri)* is found mostly from May through September in or near salt pond habitats, when it is nesting or when the fledged young are still under intensive care by the adults. A few are present through the winter in favored locations around the Bay, but are seldom seen then on salt ponds. Nesting takes place at numerous locations, on pond levees and on small islands within the low- to medium-low salinity ponds (where fish are abundant, and where the newly fledged young may first try their own plunge-dives). Some colonies, however, are on islands within medium- high to high-salinity ponds, at the Newark #1 complex, just south of the eastern approach to Dumbarton Bridge and Newark Slough. There are no fish in those ponds, and foraging is entirely in the slough or the open Bay. However, where these are in salt ponds subject to spring or early summer draw-down by the pond operators, their success is jeopardized by the relatively easier access to the sites by predators (Monroe, et. al., 1999, p. 399).

California least tern *(Sterna antillarium browm)* is a federally and state listed endangered species. It prefers open, sandy beaches in the vicinity of lagoons or estuaries (San Francisco Bay Conservation and Development Commission, 1994, p. E31). (See discussion in Section 2.1.2.5 Special Status Species.)

2.1.2.4 Fish

Some 15 species of fish can be found in the South Bay salt ponds. Of these, six reproduce in the ponds. Entering through the intakes to the Bay, these are primarily salt tolerant fishes, including topsmelt (*Atherinops affinis*), longjaw mudsucker (*Gillichthys mirabilis*) and staghorn sculpin (*Leptocottus armatus*). These species all tolerate salinities over 60 ppt (Lonzarich, 1989; WRA, 1994; Carpelan, 1957). According to Lonzarich (1989), fish species diversity decreases with salinity, but abundance does not always decrease with salinity. Fish are more abundant in ponds with low salinity. In the low salinity ponds, macro-invertebrates provide as essential resource for fish populations.

None of the fish resident in the South Bay ponds have special conservation status, but many of the small fish living in the salt ponds provide food for special status birds, such as American white pelicans, California brown pelicans, California gulls, and California least terns. While salt pond have a limited capacity to support fish, the sloughs, tidal marshes, mud flats, and estuaries provide important areas for foraging and escape cover for fish.

According to Moyle and Chechi (1982), fish that inhabit the estuaries can be classified into five types. *Nondependent marine* fishes are found near oceanic mouths of the estuaries and do not depend on the estuary for their life cycles. *Dependent marine* species need the estuary to complete at least one of their life stages. This could include spawning, rearing young or feeding as juveniles or adults. *True estuarine* species complete their entire life cycles in the estuary. The Delta smelt (*Hypomesus transpacificus*) is the only true estuarine species. *Diadromous* species use the estuary as a migratory corridor to travel to their spawning grounds. The most common of these species grow to maturity in the ocean and spawn in freshwater (anadromous). In the South Bay, these include the Chinook salmon, steelhead trout and striped bass (*Morone saxatilis*). Freshwater species are those that complete their entire life cycles in the upper reaches of tidal influenced estuary areas. An example of the freshwater species is the Sacramento splittail (*Pogonichthys macrolepidotus*). See section 2.1.2.8 Special Status Fish Species for a discussion of sensitive fish species within the project area.

In the estuary, the presence of fish species – the abundance and distribution – depends on physical and chemical factors such as temperature, salinity and oxygen levels. Most fish species use the estuary on a seasonal basis. In the estuaries adjacent to the South Bay salt ponds, the fluctuating salinity is a factor in presence of fishes using the waters.

In general, the South Bay normally would reflect more of a marine environment, because the reduced flows of fresh water result in relatively high salinity levels. However, outflows from water treatment plants have increased freshwater flows to the system. Several small freshwater creeks provide a source of food for fishes. These include San Leandro Creek, Alameda Creek, Coyote Creek, Upper Penitencia Creek, Alviso Slough, Stevens Creek, San Francisquito Creek, and San Lorenzo Creek.

2.1.2.5 Special Status Species

Special-status species are plants and animals that are legally protected under the state and federal endangered species acts or other regulations, and species that are considered rare by the scientific community. Special-status species are defined as follows:

- Plants and animals that are listed or proposed for listing as rare, threatened, or endangered under the California Endangered Species Act (Fish and Game Code 1992 Sections 2050 et seq.; 14 CCR Sections 670.1 et seq.) and/or the Federal Endangered Species Act (50 CFR 17.12 for plants; 50 CFR 17.11 for animals; various notices in the Federal Register [FR] for proposed species).

- Plants and animals that are Candidates (Category 1) for possible future listing as threatened or endangered under the Federal Endangered Species Act (50 CFR 17.12 for plants; 61 FR 7591, Feb. 28, 1996, for animals).

- Plants and animals that meet the definition of rare or endangered species under CEQA Guidelines Section 15380, which includes species not found on State or Federal Endangered Species lists.

- Plants occurring on Lists 1A, 1B, 2, 3, and 4 of the California Native Plant Society's (CNPS) Inventory of Rare and Endangered Vascular Plants of California (Skinner and Pavlik, 1994). The Department recognizes that Lists 1A, 1B, and 2 of the CNPS inventory contain plants that, in the majority of cases, would qualify for state listing, and the Department requests their inclusion in EIRs as necessary.

- Animals that are designated as "Species of Special Concern" by the Department (1994).
- Animal species that are "fully protected" in California Fish and Game Code, Sections 3511, 4700, 5050 and 5515).
- Animals that are designated as federal "Species of Concern" by the Service.

See Table 2.1.2.5 for a list of known occurrences of special status species.

Table 2.1.2.5
Known Occurrence (X) or Potential Habitat (H) for Federally-listed Species, Seabird Colony, Shorebird Roost Site, Heron Rookery and Harbor Seal Haul-out.
(Adapted from San Francisco Bay Conservation and Development Commission, 1994.)

Complex	System	Pond (Incl. Adjacent Marsh habitat)	Clapper Rail*	Salt Marsh Harvest Mouse*	California Least Tern	Western Snowy Plover	Seabird Colony	Shorebird roost site	Heron Rookery*	Harbor Seal Haul Out*
Alviso										
	A2W	A1	X	H	X		X			
		A2W	X		X					
	A3W	B1	X		X					
		A2E	X	X	X	X				
		B2	H	H	X	X	X			
		A3W	H	H				X		
		A3N	H	H	X			X		
	A7	A5				X	X	X		
		A7				X	X	X		
		A8				X	X	X		
	A14	A9	H	H	X			X		
		A10	H	H						
		A11			X		X			
		A14	X	X	X		X	X		
		A12		X						
		A13								
		A15	X	X						
	A16	A16		X			X		X	
		A17	X	X			X		X	X
	A18	A18	X	X			H		X	
	A23	A22	H	H		X				
		A23	H			X				

* Present only in bay or slough areas adjacent to salt ponds.

Table 2.1.2.5
Known Occurrence (X) or Potential Habitat (H) for Federally-listed Species, Seabird Colony, Shorebird Roost Site, Heron Rookery and Harbor Seal Haul-out.
(Continued)

Complex	System	Pond (Incl. Adjacent Marsh habitat)	Clapper Rail*	Salt Marsh Harvest Mouse*	California Least Tern	Western Snowy Plover	Seabird Colony	Shorebird roost site	Heron Rookery*	Harbor Seal Haul Out*
	Island ponds	A19	X	H						
		A20	X	H						X
		A21	H	H						X
	Lock A7		X	X						
	Lock A10/11			H						
	Lock A15		X	X	X					
	Lock A16								X	
	Lock A17		H	X			X			H
	Lock A18								X	
	Lock A19		H	H						
	Lock A20S		H	H						
	Lock A20N		H	H						
	Lock A21		H	H						
	Lock A23		H	H						
	Lock B1		X	H	X					
	Lock A1		X	H	X		X			

* Present only in bay or slough areas adjacent to salt ponds.

Table 2.1.2.5
Known Occurrence (X) or Potential Habitat (H) for Federally-listed Species, Seabird Colony, Shorebird Roost Site, Heron Rookery and Harbor Seal Haul-out.
(Continued)

Complex	System	Pond (Incl. Adjacent Marsh habitat)	Clapper Rail*	Salt Marsh Harvest Mouse*	California Least Tern	Western Snowy Plover	Seabird Colony	Shorebird roost site	Heron Rookery*	Harbor Seal Haul Out*
Baumberg	B2	1	X	H	X		X	X		
		2	X	H	X	X	H	X		
		7		H	X		H			
		4		X	X		X			
	B2C	6		H						
		5		H						
		6C		H	H					
		4C	No data	No data	No data	No data	No data	No data	No data	
		3C	No data	No data	No data	No data	No data	No data	No data	
		5C	No data	No data	No data	No data	No data	No data	No data	
		1C	No data	No data	No data	No data	No data	No data	No data	
	B6A	6A		H		X				
		6B		H		X	X			
	B8A	8A	X	X		H	X	X		
		8X								
		9	X	H	X	X				
		14		X	X	X	X	X		
		13		X	X	X		X		
		12		X	X	X		X		
		10		H	X	X	X			
	B10 or B11	11		H	X	X	X			
	Lock 2		X	X						
	Lock 8A		X	X						
	Lock 10			H						

Table 2.1.2.5
Known Occurrence (X) or Potential Habitat (H) for Federally-listed Species, Seabird Colony, Shorebird Roost Site, Heron Rookery and Harbor Seal Haul-out.
(Concluded)

Complex	System	Pond (Incl. Adjacent Marsh habitat)	Clapper Rail*	Salt Marsh Harvest Mouse*	California Least Tern	Western Snowy Plover	Seabird Colony	Shorebird roost site	Heron Rookery*	Harbor Seal Haul Out*
Redwood City	West Bay	1	H	H			X	X		
		2								
		3			X	X				
		4		H		X				
		5				X				
		S5								
		SF2	H	H				X		
		3			X	X				
		4		H		X				

* Present only in bay or slough areas adjacent to salt ponds.

Six listed species, the salt marsh harvest mouse (*Reithrodontomys raviventris*), the California clapper rail (*Rallus longitostris obsoletus*), western snowy plover (*Charadrius alexandrinus nivosus*), California least tern (*Sterna albifrons browni*), California black rail (*Laterallus jamaicensis coturniculus*), and the American Peregrine Falcon (*Falco peregrinus anatum*) use the South Bay salt ponds.

2.1.2.6 Listed Species

2.1.2.6.1 Salt Marsh Harvest Mouse (Reithrodontomys raviventris raviventris)

The salt marsh harvest mouse is endemic to the tidal marshes of the San Francisco Bay region. This species is similar to the western harvest mouse, *Reithrodotomys megalotis.* These two species are genetically isolated by a different chromosome number (Shellhammer, 1987). However, the salt marsh harvest mouse evolved from western harvest mouse some 8,000 to 25,000 years ago with the creation of the marshes in the San Francisco Bay (Service, 1984). Its historic range included the extensive marsh system bordering San Francisco, San Pablo, and Suisun Bays.

The salt marsh harvest mouse was listed as an endangered species by the U.S. Department of the Interior in 1970, and by the Department in 1971 (Shellhammer, 1982). The Service (1984) recovery plan identifies five reasons for decline of this species: habitat loss, fragmentation of remaining habitat, back filling of habitat, land subsidence, and vegetation changes. Approximately 80 percent of the historic tidal marshes in the Bay have been destroyed or modified (SFEP, 1991). Prior to mid nineteenth century, 734 square kilometers of tidal marsh existed around the Bay. Today only 152 square kilometers exist, much is fragmented or modified (Service, 1984).

Two sub-species of the salt marsh harvest mouse are recognized: *Reithrodontomys raviventris raviventris*, which is the southern sub-species, and *Reithrodontomys raviventris halicoetes*, the northern sub-species. There are a few populations of the southern sub-species in Marin and Point Richmond, but most of this sub-species occurs in southern half of South San Francisco Bay (SSFB). In the South Bay, the range of the species extends from San Leandro around to the Belmont area. The northern sub-species is found in the marshes along the San Pablo and Suisun Bays and along northern Contra Costa County coast. The pelage coloration on the belly of the southern sub-species is typically cinnamon, from which the scientific name of this species was derived; *Reithrodontomys raviventris* means "grooved-toothed mouse with a red belly."

The salt marsh harvest mouse exhibits physiological and behavioral adaptations, which allows this species to survive in the salt marsh and associated grassland (Shellhammer, 1987). These unique adaptations include excellent swimming abilities, tolerance of high salinities in its food and drink, and docile behavior. The *R. r. raviventris* can undergo daily torpidity. These adaptations appear to provide this species with a competitive advantage in the marsh environment (Fisler, 1965).

The habitat area commonly associated with this species is the mid-to-upper tidal salt marsh. It lives in dense pickleweed stands. Shellhammer (1982) concluded that pickleweed is "the preferred habitat of the salt marsh harvest mouse wherever it occurs, and that the taller, denser stands of pickleweed support the most salt marsh harvest mice." In the 1984 Service recovery plan, the best habitat for the salt marsh harvest mouse is characterized as having 100 percent cover, a cover depth of 30 to 50 cm at summer maximum, greater than 60 percent cover by pickleweed, and habitat complexity which includes saltbush, alkali heath or other halophytes. Wondolleck, et. al. (1976) and others have also found that in the South Bay, the species was most commonly associated with lush pickleweed, mixed with salt bush and alkali heath. In a study conducted by Johnson and Shellhammer (1988), it was determined that salt marsh harvest mice prefer pickleweed to grassland. They found that 86.8 percent of the salt marsh harvest mice captures occurred in pickleweed. Salt marsh harvest mice did intermittently utilize and move through grassland areas, however, they primarily remained in pickleweed areas. Use of grasslands increased in the springtime, when grasses sprout and provide increased cover in grassland (Johnson and Shellhammer, 1988). The use of adjoining grasslands as refugia was also documented by Fisler (1965) during the highest winter tides or flooding events.

In diked marsh systems, the use of grasslands may reflect the lower nutritional value of the pickleweed, which does not receive the daily nutrient input from tidal waters. The salt marsh harvest mouse may be required to seek a wider dietary selection in the grasslands, especially at the onset of the breeding season (Johnson and Shellhammer, 1988).

The salt marsh harvest mouse is not an obligate species to pickleweed habitat. It can also occur in other marsh vegetation communities composed of species such as fat hen and bulrush (*Scirpus robustus*), providing the vegetation offers appropriate multilayered structure. Zetterquist (1978) found that the salt marsh harvest mouse will use marginal habitats. At some of the sites examined by Zetterquist, the vegetation patterns were altered by diked conditions, and the dense cover was not always present. In other trapping studies of *R. r. halicoetes* conducted by the Department (Botti, et. al. 1986; WESCO, 1979 and 1982), salt marsh harvest mice were captured in habitats containing no little or no pickleweed. The vegetation composition of these areas typically consisted of fat hen, saltgrass, baltic rush (*Juncus baliticus*), alkali heath, and other grass species, and in one location on Suisun Bay, a dense stand of tule (*Scirpus spp*.). Although pickleweed is the preferred habitat for this species, they may be found in sub-optimal habitats depending on the season, environmental condition, and proximity of these areas to more typical habitat. Many locations of potential habitat and occupied habitat for the salt marsh harvest mice were found on vegetated levees dominated by pickleweed near each of pond complexes.

2.1.2.6.2 California Clapper Rail (*Rallus longirostris obsoletus*)

The California clapper rail, a federally and state-listed endangered species, has historically occurred in tidal salt marsh and brackish marshes along the northern and central California coastlines. However, the existing population of clapper rails is almost entirely limited to the San Francisco Bay area. As with the salt marsh harvest mouse, the overriding cause for listing the California clapper rail is the loss and fragmentation of suitable tidal marsh habitat, particularly the loss of large blocks (greater than 40 acre in size) of contiguous tidal marsh (Evans and Collins, 1992). The California clapper rail is almost exclusively associated with broad tidal marshes, which support an intricate network of slough channels, which provide feeding areas as well as escape corridors from predators (Harvey, 1988). Clapper rails feed on invertebrate species located in mud flats, creek banks, marsh vegetation, and shorelines at low tide. Clapper rails generally occupy habitat composed of mid and high marsh and typically nest in associated vegetation including cordgrass, pickleweed and gumplant.

California clapper rail populations have dropped alarmingly in the last two decades. The first intensive surveys were conducted in the early 1970's and by Gill (1979) who estimated the total population to be between 4,200 and 6,000 birds at that time. By the early 1990s, the population had declined to about 300 to 500 rails (Takekawa, 1992). This latter decline has been attributed to introduction and spread of the red fox (*Vulpes fulva*) in the marshes surrounding the Bay. Following implementation of red fox and other predator control programs on the San Francisco Bay National Wildlife Refuge and adjacent baylands, rail populations have rebounded to an estimated, wide population in the range of 1040 to 1,264 rails, of which an estimated 650 to 700 are located in the South Bay (C. Wilcox, personal communication, 2001).

Clapper rails were observed in the northern half of the Whale's Tail Marsh outboard of Baumberg pond 9 during census counts in 1984 and 1985 (Cole/Mills Associates, et. al., 1987). Non-protocol level surveys conducted in 1998 documented clapper rails in the same area, but none were identified at the mouth of Mt. Eden Slough or along the lower slough. The mudflats and tidal marsh outboard of Cargill's Newark #1 and Newark #2 complexes and the southern portion of Greco Island (across Ravenswood Slough from the Redwood City plant site) are noted as high use areas for the rail. High use areas within the Initial Stewardship Plan area include marsh zones along Charleston Slough, Mt. View Slough, and Stevens Creek surrounding Alviso ponds A1 and A2W (Wetland Research Associates, Inc., 2000).

2.1.2.6.3 Western Snowy Plover (*Charadrius alexandrinus nivosus*)

The western snowy plover is federally-listed as a threatened species. Studies indicate that San Francisco Bay is one of the most important breeding areas for snowy plovers along the Pacific Coast (Page et. al. 1991). Snowy plovers also winter in the Bay, making it one of the most important wintering locations for plovers along the Pacific Coast (Page, et. al., 1986).

Snowy plovers have nested at the salt ponds of South Bay since the late 1800s. Snowy plovers prefer barren, non-vegetated areas such as levee tops close to brine flies and other food sources in the salt ponds. They feed in shallow water or forage at the edge of water in ponds. Pond levees at the upper Baumberg area (ponds 2, 8, 9-11), the Newark #1 complex, Alviso Ponds A-22 and A-23 and the West Bay Ponds provide important nesting habitat (San Francisco Bay Conservation and Development Commission, 1994, p. E24).

2.1.2.6.4 California Least Tern (*Sterna albifrons browni*)

The California least tern, a federally and state-listed endangered species, requires coastal habitats during its breeding season. Nesting colonies are typically located in close proximity to shallow waters populated by small fish, the main source of food for the least tern, and consist of flat areas characterized by little or no vegetation, and loose, sandy, or mixed substrate. As a result of human disturbance of traditional breeding areas, the least tern, like the western snowy plover, has shifted its breeding activities to include nesting on salt pond dikes, bare flats, and sand fills.

Observations suggest that intake ponds can provide important habitat for fledgling least terns that need to develop the requisite foraging and feeding skills critical to successful migration (Feeney, 1988). High use areas for the tern include the Baumberg complex, the Alviso ponds A9-15 between Coyote Creek and Alviso Slough, pond A1 between Charleston and Mt. View Sloughs, and ponds B1, 2 and A2E east of Stevens Creek.

2.1.2.6.5 California Black Rail (*Laterallus jamaicensis coturniculus*)

The California black rail, a state-listed threatened species, inhabits freshwater, saltwater and brackish marshes. The California black rail is an elusive bird that is rarely observed. As a result, there is little reliable data concerning historical and present population densities. Black rails appear to prefer higher elevation tidal marshes comprised of dense vegetation. Although black rails have not been observed on or around the project site, suitable wintering and potential breeding habitat exists along the upper margins of the marsh at the lower end of Mt. Eden Creek (Thomas Reid Associates, 1989).

2.1.2.6.6 American Peregrine Falcon (*Falco peregrinus anatum*)

The American peregrine falcon a federal and state listed endangered species. Peregrine falcons typically nest in cliffs with good visibility; however, they can occasionally be found nesting in transmission towers, bridges, and tall buildings. The area that an individual falcon requires for foraging purposes can be quite large depending upon the availability of an adequate food supply. The peregrine falcon’s principal sources of food are passerine birds, waterfowl and shorebirds. Peregrine falcons are regularly observed foraging on the Eden Landing Ecological Reserve, adjacent to the Baumberg complex, and this use is assumed to include resident and migratory populations.

2.1.2.7 Non-listed Species

2.1.2.7.1 Salt Marsh Wandering Shrew (*Sorex vagrans halicoetes*)

The salt marsh wandering shrew is classified as a “Mammalian Species of Special Concern” within the state of California. Salt marsh wandering shrew habitat consists of middle elevation tidal salt marsh composed of dense stands of pickleweed, jaumea and occasional saltgrass. Shrews are typically found in areas of marsh that provide dense cover, an abundance of invertebrate animals for food, suitable nesting and resting sites, and fairly continuous ground moisture (WESCO, 1986). Although no shrews have been captured on the site, one shrew was observed during trapping activities conducted by WESCO during 1985 (Thomas Reid Associates, 1989).

2.1.2.8 Special Status Fish Species

The steelhead trout and chinook salmon have been reported to occur in the areas designated to receive the circulation of saline waters from the South Bay salt ponds and serve as intake points. In order to assess the potential for impacts to this species associated with such circulations, the distribution, abundance, and timing of these species in the vicinity of the proposed circulation locations was estimated based on a review of the scientific literature as well as interviews with staff of the interested resource agencies.

The results of this evaluation are summarized in Table 2.1.2.8.1 (which lists where these salmonids are found) and Table 2.1.2.8.2 (which describes when these species would likely be present in the circulation areas). More thorough review of the distribution, abundance, and life history characteristics of steelhead trout and chinook salmon are provided below.

2.1.2.8.1 Steelhead Trout

This species (*Oncorhynchus myskiss*) is native in tributaries to SSFB, using these streams for spawning and rearing of juveniles. Small runs of steelhead trout have been identified in Coyote Creek and Guadalupe River (which discharges into Alviso Slough), with each run numbering approximately 100 to 300 individuals annually (J. Abel, Santa Clara Water District; G. Stern, NMFS, personal communication, 2002). The steelhead do not spawn in those sections of Coyote Creek and Alviso Slough which could potentially receive any saline water circulated from the South Bay salt ponds, but would use these sections as migration corridors to upstream spawning and rearing sites. According to M. Roper (DFG, personal communication, 2001), there is an effort to develop a steelhead run in Alameda Creek. Apparently, this species has historically used Alameda Creek, but is unable to do so now due to man-made physical blockages, which prevent upstream migration. Efforts are being made to physically transport upstream migrating adult steelhead around these blockages so they can reach their spawning grounds.

Due to their life history strategy, steelhead trout are only present in the potential circulation areas during limited portions of the year. Generally, adult steelheads migrate from the ocean to the South Bay tributaries from late December through early April, with the greatest activity in January through March. It would be during this time frame that adult steelhead would be migrating through the potential circulation areas. Spawning occurs in the upper reaches of the Coyote Creek and Alviso Slough/Guadalupe River watersheds, well upstream of any elevated salinity plume. After either one or two years of rearing, juvenile steelheads migrate from their upstream rearing areas to the ocean. Most of this downstream migration of juveniles occurs between February and May, with the peak between March and April. It is during this period that the juveniles would pass through the potential circulation areas.

The steelheads remain in the ocean for 2 to 4 years until they reach reproductive condition. At that point, they migrate into the estuary and return to their South Bay tributaries to spawn. Once spawning has occurred, the adults swim downstream and return to the ocean. Each winter, for several successive years, these adults repeat their upstream migration to spawn and, subsequent, downstream migration to the ocean waters.

2.1.2.8.2 Chinook Salmon

This species (*Oncorhynchus tshawytscha*) is not native in tributaries to SSFB. Chinook salmon were first observed in South Bay tributaries in the early 1980s and, based on genetic analyses, are probably from Sacramento River hatchery stock (G. Stern, NMFS, personal communication, 2000). Small runs of this species have been identified in Coyote Creek and Guadalupe River (which discharges into Alviso Slough), with each run numbering approximately 100 to 200 individuals annually (J. Abel, Santa Clara Water District, personal communication, 2000). The Chinook salmon do not spawn in those sections of Coyote Creek and Alviso Slough which could potentially receive any saline water circulated from the South Bay salt ponds, but would use these sections as migration corridors to upstream spawning and rearing sites.

Due to their life history strategy, Chinook salmon are only present in the potential circulation areas during limited portions of the year. Generally, these fall-run adult Chinook salmon migrate from the ocean to the South Bay tributaries from late September through November. It would be during this time frame that adult fish would be migrating through the potential circulation areas. Spawning occurs in November through December in the upper reaches of the Coyote Creek and Alviso Slough/Guadalupe River watersheds, well upstream of any elevated salinity plume. After a few months of rearing, juvenile Chinook salmon generally migrate from their upstream rearing areas to the ocean. Most of this downstream migration occurs between mid-March and early May. However, during big winter storm events, these juvenile salmon could be carried downstream as early as January or February. It is during this period that the juveniles would pass through the potential circulation areas.

The Chinook salmon remain in the ocean for two to four years until they reach reproductive condition. At that point, they complete their life cycle by migrating into the estuary and returning to their South Bay tributaries to spawn. Unlike steelhead trout, the Chinook salmon adults spawn only once and die after their first and only upstream migration.

Table 2.1.2.8.1
The Presence of Salmonid Species in each of the Potential Circulation Sites.

Circulation Location	Species of Interest Present	Description of Presence in Potential Areas of Circulation
Coyote Creek		
	Steelhead Trout	Uses area as a migration corridor to upstream spawning areas
	Chinook Salmon	Uses area as a migration corridor to upstream spawning areas
Alviso Slough		
	Steelhead Trout	Uses area as a migration corridor to upstream spawning areas
	Chinook Salmon	Uses area as a migration corridor to upstream spawning areas
Alameda Creek		
	Steelhead Trout	Only with human intervention, uses area as a migration corridor to upstream spawning
Guadalupe Slough		Neither salmonid species reported to use area
Alameda Flood Cont. Channel		Neither salmonid species reported to use area

Table 2.1.2.8.2
Temporal Patterns in the Abundance of Salmonid Species at South Bay Circulation Sites.

Species of Interest	Presence During Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Steelhead Trout												
Upstream Migrating Adults	▓	▓	▓									
Downstream Migrating Juveniles			▓	▓	░							
Chinook Salmon												
Upstream Migrating Adults									░	▓	▓	
Downstream Migrating Juveniles			▓	▓	░	░						

2.2 Soils and Geology

U.S. Department of Agriculture (USDA) soil surveys classified the soil on the project site as either Reyes clay or Pescadero clay (USDA, 1975). The salt ponds are composed almost entirely of Reyes clay. The USDA describes Reyes clay as a "very deep, very poorly-drained soil that formed on alluvium that derived from mixed sources." Bay muds and related alluvial deposits on the project site, including silt and clay deposits, may have been altered by so many years of salt production. Soil salinities in most of the ponds are elevated above "natural " conditions, with surface salinities ranging from 30 to 150 ppt. Levees throughout the site consist of a mixture of bay mud and urban fill material (e.g. soil, rock, gravel, concrete) that vary greatly in depth and drainage capacity.

Fault lines surround the project sites. The San Andreas fault runs parallel to the West Bay Complex and the Hayward and Calaveras faults run parallel to the eastern border of the Baumberg Complex. The US Army Corps of Engineers (USACE) addressed the salt pond levee stability during seismic events in a 1988 paper titled *San Francisco Bay Shoreline Study*. In this paper the USACE concluded that Cargill's levees were "particularly susceptible to rapid settlement due to liquefaction or lateral spreading of their underlying soils." However, the same report notes that "there is no known historic record of shoreline levee failure in the study area due to earthquakes," and even the intense seismic activity associated with the Loma Prieta Earthquake only resulted in minor cracking and settling of the salt pond levees.

The areas surrounding the Alviso Complex have subsided significantly since the levees were first constructed. Consequently, the levees now provide flood protection for the subsided surrounding land. Land subsidence in the southern San Francisco Bay can be attributed to the over drafting of aquifers during the first half of the twentieth century. Some areas have subsided as much as 13 feet between 1912 and 1969 (USACE, 1988).

2.3 Sediment Quality

The following is a presentation and discussion of the findings of the chemical characteristics of contaminants associated with sediments in the pond complexes.

The Cargill ponds were constructed for salt making purposes starting in the early 1900s by building levees around existing marshes, mudflats, and open water areas. Some of the Alviso ponds (A1 through A7) were constructed in the late 1940s. The sediments in this area have historically been subject to significant sources of contamination from historical mining activities (especially for mercury) in the Coast Range and Guadalupe River watershed. These mining activities resulted in the mobilization of large amounts of mercury-rich sediment into these downstream, wetland areas. Since diking the areas into ponds for salt-making operations, the source of contaminant input into these areas has generally been restricted to what comes in with the intake water, including some suspended sediment. Some contamination may also originate from the large wastewater treatment plant located upstream from the salt ponds and from urban runoff from the heavily populated and industrialized watershed. Ponds A5, A7 and A8 are not fully isolated during rare flooding events in the Guadalupe River, and can receive suspended sediment in floodwaters. In Cargill's recorded history two events where over topping occurred were noted in pond A-8. Suspended sediment in the ponds can then be transferred between ponds by an array of weirs and culverts. Consequently, sediment in the ponds would be expected to have similar characteristics to ambient conditions in the vicinity of each pond system, including elevated concentrations of some inorganics (e.g mercury).

Available sediment data from the ponds throughout the systems generally support this premise. The concentrations of contaminants in the ponds taken as a whole are similar to San Francisco Bay ambient concentrations. In the Alviso ponds, near the Guadalupe River/Alviso Slough the concentrations of some inorganics (notably arsenic, mercury, and selenium) are elevated over some reported San Francisco Bay ambient concentrations, but are within the range of ambient concentrations found within the South Bay and associated watersheds, including the Guadalupe River (See Table B-1 in Appendix B)

Sediment samples for inorganics were collected from 19 of the 57 ponds that are included in the ISP. These ponds are generally representative of all the ponds addressed by the ISP because they reflect the range of water depths and salinities present throughout the ISP ponds. Sampled ponds ranged in average water depth between 0.7 feet and 4.1 feet; average salinities in sampled ponds range between 15 and 110 parts per thousand. By comparison, the range of average water depths for all ISP ponds is zero to 4.1 feet, and the range of average salinities in these ponds is 11 to 150 and up to 200 ppt on the Island Ponds. Most of the available data are from the Alviso ponds. The Alviso ponds are located near the mouths of Alviso Slough and Guadalupe Slough, and Coyote Creek. This area is more directly affected by contaminants associated with historic mercury mining in the Guadalupe River drainage, municipal and industrial wastewater discharge, and the outflow of contaminants from an urban watershed. The weighting of the data toward the ponds with the higher concentrations is environmentally conservative.

Samples for organic chemicals (i.e., petroleum-based chemicals, including PAHs, PCBs and pesticides) were collected at several sites. They were either not detected in pond sediments, or were detected at very low concentrations similar to ambient concentrations found in the cleanest parts of the Bay. Therefore, the organic contaminant data are not discussed here (See Table A-1 in Appendix A).

2.3.1 Evaluation of ISP Pond Sediments

2.3.1.1 Alviso Complex

Sediment data collected by USFWS from selected ISP ponds are shown in Table 2.3.2.1-1. A data set taken by Hydroscience from selected ISP ponds is shown in Table 2.3.2.1-2. In general, concentrations of inorganics were detected in Alviso Complex sediments at levels similar to San Francisco Bay ambient concentrations. Arsenic, selenium, and mercury were detected in some ponds at concentrations elevated above Bay ambient concentrations, but within the concentration ranges observed within the Guadalupe River watershed. The trend of the data from other non-ISP salt ponds or collected in previous studies presented in the Appendices is inclined to support this conclusion.

Table 2.3.2.1-1

Alviso Pond System Inorganic Sediments
Data Source: Fish and Wildlife Service

Units = ug/g dry weight

Pond No.	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Zinc
Pond A1	7.1	<0.20	115	46	29	0.3	89	<0.6	110
Pond A1	4.7	<0.20	133	50	30	0.34	100	<0.6	130
Pond A1	7.0	0.50	130	50	28	0.3	100	<0.6	120
Pond B1	16.0	0.50	136	44	34	0.59	110	<0.6	120
Pond B1	19.0	1.00	149	48	37	0.57	110	<0.6	140
Pond B1	10.0	1.00	136	48	37	0.53	120	0.7	130
Pond A5	15.0	1.50	87	29	34	0.76	94	0.7	89
Pond A5	17.0	1.50	84	29	32	0.34	95	0.5	93
Pond A5	11.0	1.50	77	26	38	0.20	74	0.5	81
Pond A9	8.9	<0.20	134	37	19	0.30	96	<0.6	87
Pond A9	7.0	0.99	115	46	31	0.53	110	<0.6	110
Pond A9	9.0	0.50	127	39	34	0.69	110	0.6	110
Pond A10	12.0	<0.20	138	44	27	1.20	120	0.7	100
Pond A10	8.8	0.50	129	45	30	0.79	110	2.1	120
Pond A10	6.9	1.00	113	44	29	0.82	110	<0.6	110
Pond A16	11.0	0.99	102	44	57	0.71	100	0.8	150
Pond A16	11.0	0.99	69	36	40	0.38	73	0.5	110
Pond A16	12.0	0.99	101	41	47	0.56	110	0.6	140

Maximum	19.00	1.50	149.00	50.00	57.00	1.20	120.00	2.10	150.00
Minimum	4.70	<0.20	69.00	26.00	19.00	0.20	73.00	0.50	81.00
Arithmetic Mean	10.74	0.77	115.28	41.44	34.06	0.55	101.72	0.77	113.89
Median	10.50	0.99	121.00	44.00	33.00	0.55	105.00	0.56	110.00
n	18	18	18	18	18	18	18	18	18

Table 2.3.2.1-2

Alviso Ponds Inorganic Sediments (Alviso Complex)
Data Source: Hydroscience

Units = mg/kg dry weight

Method No.	EPA 6020	EPA 6020	EPA 6020	EPA 6020	EPA 6020	EPA 7471	EPA 6020	EPA 6020	EPA 6020	EPA 6020
Pond No.	**Arsenic**	**Cadmium**	**Chromium**	**Copper**	**Lead**	**Mercury**	**Nickel**	**Selenium**	**Silver**	**Zinc**
A2W-A-S	5.85	ND	87.40	34.20	19	0.295	82.5	1.17	ND	74.2
A3W-A-S	17.5	ND	100.0	32.3	24.2	0.541	94.7	1.08	ND	77.9
A5-A-S	9.4	ND	85	35.8	33.5	1.32	83.7	0.713	0.252	94
A9-A-S	11.3	0.356	109	49.1	39	0.682	101	1.16	0.464	121
A15-A-S	11.8	0.329	88.7	40.2	48.3	0.791	81.3	0.829	0.82	103
A16-A-S	9.11	0.35	70.6	32.7	31	0.712	77.9	0.834	0.346	68.9
A17-A-S	10.2	ND	82.8	34.9	32.7	1.28	107	1.03	ND	92.9
Bay-A-S	14.5	ND	85.3	113.0	32.7	0.514	79.3	0.916	0.385	95.7

Maximum	17.50	0.35600	109.00	113.00	48.30	1.32	107.00	1.17	0.82	121.00
Minimum	5.85	0.32900	70.60	32.30	19.00	0.30	77.90	0.71	0.25	68.90
Mean	11.21	0.34500	88.60	46.53	32.55	0.77	88.43	0.97	0.45	90.95
Median	10.75	0.35000	86.35	35.35	32.70	0.70	83.10	0.97	0.39	93.45
n	8	3	8	8	8	8	8	8	5	8

Chromium, copper, lead, nickel, silver and zinc were detected in the Alviso Complex at relatively low concentrations. Mean concentrations of these chemicals were approximately half San Francisco Bay ambient concentrations. Maximum detected concentrations of these chemicals were only about 20% to 30% higher than San Francisco Bay ambient values. The distribution of these concentrations is heavily weighted toward the low end of their respective concentration ranges. This distribution combined with the fact that maximum concentrations are not highly elevated over Bay values (which are 85th percentiles) indicates that concentrations of these chemicals in the Alviso Complex are very similar to Bay ambient conditions.

The Island Pond system within the Alviso Complex was treated differently than the other sub-systems because the pond levees might be breached. Two composite samples are available for each of the three Island Ponds (A19, A20, and A21). One composite sample per pond represented surface sediments and one sample represents sediments at depth. Each composite sample was a compilation of the the three grab samples from around each pond. See Table 2.3.2.1-3. Mean concentrations of detected inorganics were well below San Francisco Bay ambient conditions. Maximum concentrations were also below ambient concentrations for all inorganics except mercury and selenium. The maximum detected concentrations for mercury and selenium were similar to ambient concentrations. The data indicate that the Island Pond sediments are similar to San Francisco Bay ambient concentrations and are unlikely to pose a risk to water quality or wildlife.

Table 2.3.2.1-3

Island Pond System Inorganic Sediments
Data Source: Hydroscience

Units = ug/g dry weight

Method No.	EPA 6020	EPA 6020	EPA 6020	EPA 6020	EPA 6020	EPA 7471	EPA 6020	EPA 6020	EPA 6020	EPA 6020
Pond No.	**Arsenic**	**Cadmium**	**Chromium**	**Copper**	**Lead**	**Mercury**	**Nickel**	**Selenium**	**Silver**	**Zinc**
A21 S*	4.34	<0.17	32.9	12.6	9.83	0.08	40.1	0.88	<0.17	31.1
A21 D*	9.91	<0.17	73.7	29	14.2	0.31	84.8	0.44	<.17	60.5
A20 S*	7.56	<0.21	59.9	25.4	13	0.23	74	0.52	<0.21	49.2
A20 D*	7.28	<0.19	48.7	23.1	12.7	0.48	65.3	0.36	<0.19	44.4
A19 D*	12.2	<0.25	100	39.1	22.1	0.3	125	0.84	<0.25	77.8
A19 S*	4.67	<0.17	54.3	19.7	9.02	0.046	63.7	0.45	<0.17	37.9

Maximum	12.20	<0.25	100.00	39.10	22.10	0.48	125.00	0.88	<0.25	77.80
Minimum	4.34	<0.17	32.90	12.60	9.02	0.05	40.10	0.36	<0.17	31.10
Arithmetic Mean	7.66	<0.1933	61.58	24.82	13.48	0.24	75.48	0.58	<0.1933	50.15
Median	7.42	<0.3733	57.10	24.25	12.85	0.27	69.65	0.49	<0.3733	46.80
n	6	6	6	6	6	6	6	6	6	6

S*-Surface sample (0-6 Inches) D* -at depth sample (6-12 inches)

2.3.1.1.1 Alviso Complex Hydrologic Changes

An understanding of water depths in the ponds is an important component of assessing the potential for the mobility and exposure of sediment-associated contaminants, and how the ISP may affect risks to wildlife and aquatic resources. For example, very shallow water depths or sediment exposure to air can result in oxidation of sulfides and organic matter that are known to bind inorganic contaminants very strongly. If the pH of the system stays near neutral (a characteristic that can easily be monitored), the release of heavy metals (e.g., mercury) from sulfides and organic matter can be immobilized through their adsorption by clays and iron hydroxides in the sediment and water column. However, should the pH drop into the acid range (e.g., below pH 6), heavy metal adsorption by those solid phases would be depressed and additional heavy metals could be released from the sediment. Under these conditions, mercury could be made more available for methylation reactions to the toxic methyl mercury. For arsenic and selenium, pH affects are different as these chemicals are typically adsorbed by solid phases more strongly at acid pH than alkaline pH. The potential for methylation of mercury could be increased under drying and wetting cycles where previously bound mercury was made available during a drying cycle and then methylated upon a wetting cycle. In general, shallower and changing water depths that produce some aeration of the surface sediment can create opportunities for wildlife exposure to contaminants in those sediments due to the wetting and drying cycles.

Hydrologic modeling has been conducted by Shaaf and Wheeler to predict water elevations under the ISP and compare those elevations to existing conditions. On average, water elevations in the ponds with elevated concentrations of inorganics in sediment (A2W, A3W, A5, A9, A10, A15, A16, and A17) will be within about one foot of existing average elevations. Water in these ponds will be one to three feet deep on average throughout the year. Actual water depths within the individual ponds and pond systems will depend on the management operations.

In summary, since water depths in most of the ponds will be 1 to 2 feet on average, most of these ponds currently have and will continue to have high potential for use by a wide range of foraging shorebirds and waterfowl. Since some drawdown may occur at the extreme low end of the water regime, there is some potential for oxidation and increased mobilization of inorganics, including increased availability of mercury for potential methylation in drying/wetting cycles. In comparison with existing conditions, ponds A2W, A3W and A5 will be deeper on average, and ponds A9, A10, A15, A16, and A17 will be 0.5 to 2.5 feet shallower on average. The actual pond depths will depend on management operations in the future. ISP management will be diligent during the low end of the water regime to avoid drying cycles.

To the extent that periodically lower water levels increase the frequency of wetting/drying cycles in these ponds, the potential for oxidation of sediment and mercury methylation may be increased. However, the ponds are currently subject to a greater degree of variation in water depths than will occur under the ISP (about 1 to 2 feet in variation). The current frequency and duration of wetting/drying cycles is unknown. The greater variability in water levels under existing conditions may counteract the higher average water levels that currently prevail. Therefore, the existing frequency and duration of drawdown may be similar to or greater than that expected under the ISP. A description of hydrologic changes in each pond is presented below.

Water in pond A2W will be about 0.4 feet deeper on average than the existing average depth. The average water depth will be about 1.9 feet in summer and 2.2 feet in winter. Modeling results indicate that water depths will vary by about 0.5 feet, so even the lowest water levels would be about 1.5 feet above the pond bottom

Water in pond A3W will be about 0.2 feet deeper on average than the existing average depth. The average water depth will be about 1.8 feet in summer and 2.1 feet in winter. Modeling results indicate that water depths will vary by about 0.5 feet, so even the lowest water levels would be about 1.5 feet above the pond bottom.

Pond A5 will be about 0.4 feet deeper on average than existing conditions. The average water depths will be about one foot in summer and about 1.2 feet in winter. Modeling results indicate that water depths will vary by about 0.5 feet, so water depths could at times be within about 0.75 feet of the pond bottom. Existing operations have drown down pond A5 to average depths as low as 0.1 feet. Due to the slope of the pond bottom this has exposed up to half of the pond bottom.

Pond A9 will be about 2.5 feet shallower on average than existing conditions. Average water depths will be about 2.2 feet in summer and 1.7 feet in winter. Modeling results indicate that water levels will vary by about 1.5 feet, so water levels could at times be within one foot of the pond bottom.

Pond A10 will be about one foot shallower than existing conditions. Average water depths will be 2.5 feet in summer and 2.2 feet in winter. Modeling results indicate that water levels will vary by about 0.5 feet, so water levels could at times be within a 1.5 feet of the pond bottom.

Pond A15 will be operated as a batch pond to store and release water for controlling salinity in nearby ponds. In batch ponds, large volumes of water may be transferred from pond to pond during relatively short periods of time Therefore, water elevations can vary significantly and rapidly depending on management operations. The proposed operations would not result in more drying of sediment within this pond than under present conditions.

Pond A16 will be about 0.5 feet shallower than existing conditions. Average water depths will be 1.7 feet in summer and 1.6 feet in winter. Modeling results indicate that water levels will vary by about 0.5 feet, so water levels could at times be just over a foot higher than the pond bottom.

Pond A17 will be about 0.5 feet shallower than existing conditions. Average water depths will be 1.15 feet in summer and 1.05 feet in winter. Modeling results indicate that water levels will vary by about 0.5 feet, so water levels could at times be within a few inches of the pond bottom.

The Island Ponds will likely be breached and allowed to return to full tidal action. This management decision will be made based on the results of the CEQA/NEPA review. If the ponds are restored to full tidal action, available hydrologic modeling indicates that they would be inundated on the higher high tides but would be above water at other times. Based on this inundation frequency, the Island Ponds would be expected to become high intertidal marsh habitat. If restoration is delayed much beyond the time management responsibility transfers to FWS, the ponds would become seasonal; dry in summer and wet in winter until restoration begins.

2.3.1.1.2 Alviso Complex Management and Monitoring:

The ISP is an interim effort whose modifications of hydrology and wildlife use are likely to be minimal. Interim operations may offer opportunities to minimize existing levels of contaminant exposure. In general, the ponds will be managed with the goal of maintaining at least one foot of water. Opportunities for management of water levels once the ISP is implemented include adjustments to water control structures, for example adding or removing weir boards. Adjustments to water regimes to minimize contaminant exposure to birds must be weighed against potential impacts, including possible entrainment of salmonids if water inflow is increased during the migration season. Monitoring will be conducted during the initial stewardship period (most intensively in the first year) to ensure that water quality objectives in the RWQCB permit are met. Some preliminary recommendations for management and monitoring for the ISP ponds are described below. Management and monitoring activities will be developed and evaluated through the CEQA/NEPA and permitting processes.

To the extent possible within the limits of ISP infrastructure, and provided that adjustments to water regimes do not result in secondary impacts, the water regimes in the ponds with elevated concentrations of mercury and selenium (A2W A3W, A5, A9, A10, A15, A16, and A17) should be managed to minimize the potential for mobilization of inorganics, mercury methylation, and wildlife exposure. Possible strategies to accomplish this include maintaining water depths to minimize shorebird and waterfowl exposure, and reducing variation in water levels to avoid drying out and potentially mobilizing contaminants. The ponds will be adaptively managed; any adjustments would be made based on the results of monitoring.

Future water quality monitoring should be conducted in these areas to detect any mobilization of inorganics into the water column. In some areas, further sediment sampling would be advisable to better characterize sediment quality. Monitoring for methylmercury will be conducted as described in EIR/EIS or other pertinent documents. Additional analyses for other metals would be conducted in conjunction with that monitoring, possibly including sampling of fish tissue, bird eggs, and invertebrates in the ponds. Sampling of tissue in offsite locations to provide a comparison with ambient conditions would be advisable. Ponds that will be seasonal and have no available data (A3N, A12, and A13) should be characterized if they are seasonal. Sampling of pond A8 for selenium is advisable given the past presence of snowy plovers in that area. The presence of selenium concentrations over 1 mg/kg in nearby ponds (e.g., A3W and A9) indicates that sampling with appropriate detection limits is advisable.

Available data indicate that inorganics are present in the Island Pond System sediments at low concentrations that are unlikely to cause adverse effects on water quality or wildlife. Therefore, no special management considerations appear necessary. Additional data needs may become clear during future design and impact assessment. Possible data needs could include further sampling at depth in the areas near breaches where deeper tidal channels are most likely to form.

2.3.1.2 Baumberg Complex

Available sediment data in the Baumberg Complex consist of four samples representing three of the 23 ponds in the Baumberg system. These are shown in Table 2.3.1.2. The ponds for which data are available are generally representative of the range of water depths and salinities that characterize the Baumberg Complex. In the sampled ponds, average existing water depths range from 0.67 to 1.34 feet, and average salinities range from 26 to 156 parts per thousand. In comparison, average existing water depths for all the Baumberg Complex range from zero to 2.7 feet; average salinities range from 26 to 156 ppt. In general, lower concentrations of contaminants are expected in the Baumberg Complex based on their greater distance from known sources such as the Guadalupe River drainage.

Table 2.3.1.2

Baumberg Complex Inorganic Sediments
Data Source: Hydroscience

Units = mg/kg dry weight

Method No.	EPA 6020	EPA 6020	EPA 6020	EPA 6020	EPA 6020	EPA 7471	EPA 6020	EPA 6020	EPA 6020	EPA 6020
Pond No.	**Arsenic**	**Cadmium**	**Chromium**	**Copper**	**Lead**	**Mercury**	**Nickel**	**Selenium**	**Silver**	**Zinc**
10-B-S	6.05	0.217	65.80	27.60	23.2	0.241	61.9	0.757	0.193	73.2
8A-B-S	1.01	ND	12.9	5.9	6.52	0.0736	13.5	0.868	ND	14
2C-B-S	11.6	ND	88.30	41.20	27.4	0.233	110	0.825	ND	86.5
2C-B-S (DUP)	6.8	ND	57.80	24.00	35.2	0.191	64.2	0.594	ND	64.9
Bay-B-S	5.41	ND	71.0	22.5	9.46	0.137	69.5	0.678	ND	58.1

Maximum	11.600	0.217	88.300	41.20	35.20	0.2410	110.00	0.8680	0.193	86.50
Minimum	1.010	0.217	12.900	5.89	6.52	0.0736	13.50	0.5940	0.193	14.00
Arithmetic Mean	6.174	0.217	59.160	24.24	20.36	0.1751	63.82	0.7444	0.193	59.34
Median	6.050	0.217	65.800	24.00	23.20	0.1910	64.20	0.7570	0.193	64.90
n	5	1	5	5	5	5	5	5	1	5

With the exception of selenium, which was detected at slightly above ambient concentration, inorganics were detected in the Baumberg Complex at concentrations below San Francisco Bay ambient concentrations. Mean and maximum detected concentrations of arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc were below ambient values and wetland cover criteria. Mean concentrations of arsenic, cadmium, chromium, copper, lead, silver, and zinc were below ER-Ls. Maximum concentrations of silver and zinc were also below ER-Ls.

2.3.1.2.1 Baumberg Complex Hydrologic Changes

The Baumberg Complex and their pond bottom sediments are currently at relatively high topographic elevations compared with the Bay, so more drying of these sediments is expected than at the Alviso Complex. Hydrologic modeling conducted for the ISP indicates that 2C system (ponds 6, 5, 6C, 4C, 3C, 5C, 1C, and 2C) will have average water depths about 0.1 to 1 foot higher than existing conditions, although some of those ponds (1C and 5C) will still be seasonal. The remaining ponds will have average water depths about 0.5 to 2 feet lower than existing conditions. Average water depths in the Baumberg Complex will range from zero to about 2.5 feet in summer, and about one to 2.5 feet in winter. Hydrologic modeling results indicate that water levels will vary by about 0.5 feet due to weather and tides. Water levels under the ISP are therefore likely to expose the pond bottom for some portion of the year.

Since the water regime of the Baumberg Complex will vary from exposed mud to about 3 feet of water, the ponds are likely to be used by a wide range of foraging shorebirds and waterfowl. Given the generally high sediment elevations, some amount of drying and aeration of sediment can be expected in summer and on weak tide cycles. The ISP will result in shallower ponds. While there is some potential for oxidation, methylation and increased mobilization of inorganics due to this hydrologic regime, available data indicate that inorganics are present in sediment at concentrations at or below ambient conditions. Therefore, the risk of adverse effects on water quality and wildlife is unlikely to be greater than that posed by ambient bay sediment.

2.3.1.2.2 Baumberg Complex Management and Monitoring:

Some preliminary recommendations for management and monitoring are described in Chapter 4. Management and monitoring activities will be developed and evaluated through the CEQA/NEPA and permitting processes.

2.3.1.3 West Bay Complex

Assessment of sediment quality in the West Bay Complex has a high degree of uncertainty due to the fact that only one sample is available. See Table 2.3.1.3. However, concentrations of all inorganics in that sample were well below San Francisco Bay ambient conditions and RWQCB cover criteria. With the exception of nickel, which exists naturally in the Bay at concentrations above its Low Effects Range (ER-L), the detected concentrations were also below ER-Ls. While it is not possible to characterize sediment definitively on the basis of a single sample, the available data indicate that inorganics are present in the West Bay Complex at concentrations below background conditions and are unlikely to adversely affect water quality or wildlife.

Table 2.3.1.3

West Bay Complex Inorganic Sediments
Data Source: Hydroscience

Units = mg/kg dry weight

Method No.	EPA 6020	EPA 6020	EPA 6020	EPA 6020	EPA 6020	EPA 7471	EPA 6020	EPA 6020	EPA 6020	EPA 6020
Pond No.	**Arsenic**	**Cadmium**	**Chromium**	**Copper**	**Lead**	**Mercury**	**Nickel**	**Selenium**	**Silver**	**Zinc**
1-RC-S	6.63	0.226	53.6	19.2	7.77	0.0911	55.7	0.533	ND	50.1

2.3.1.3.1 West Bay Complex Hydrologic Changes

The hydrologic modeling results are presented in Section 4.2.13 of Chapter 4. These results indicate that the ponds will continue to be operated as continuous circulation ponds with water depths of at least one foot. Some ponds may be converted to muted tidal action.

2.3.1.3.2 West Bay Complex Management and Monitoring

Based on available data, concentrations of inorganics in the West Bay Complex are below Bay ambient conditions, and no special management considerations are advisable. Further sediment characterization is advisable to confirm the results of initial sampling. Based on the results of this sampling, limited future water quality monitoring should be conducted in this area to confirm that water quality is not affected.

2.4 Hydrology and Water Quality

Water quality in the ISP was characterized based on available surface water analytical data. Inorganics data were as collected from a representative subset of 11 ponds in the Alviso, Baumberg, and the Cargill Plant at Newark. Ponds were selected for sampling based on their salinity (See Table 2.4.1-1)). Seven of the 11 sampled ponds will actually discharge saline water during the initial stewardship period. However, pond selection was not primarily based on whether the selected ponds would be part of the actual circulation pattern. Rather, the selected ponds, exhibiting a range of salinities, were intended to serve as surrogates for the full complement of ponds in the planned circulation system. The objective was to determine concentrations of inorganics in a group of ponds that exhibited the range of salinities that might be circulated to the Bay and adjoining sloughs during the initial stewardship period. Since salinity increases with greater distance from water intake points, selection of a subgroup of ponds with a representative range of salinity is also approximates the likely variability in chemical concentrations due to proximity to Bay sources and potential concentration of metals.

Table 2.4-1

Concentrations of Inorganics in ISP Ponds[a]

		Dissolved Concentration									
Pond No.	**Salinity**	**Arsenic**	**Cadmium**	**Chromium**	**Copper**	**Lead**	**Mercury**	**Nickel**	**Selenium**	**Silver**	**Zinc**
	(g/L)	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**
A2W	31.6	6.27	0.049	1.22	1.06	0.264	0.00126	8.05	0.199	0.012	1.21
A3W	42.0	10.7	0.044	1.22	1.10	0.307	0.00126	7.45	0.128	0.010	0.65
B2C	54.6	1.14	0.054	1.24	1.29	0.280	0.00036	4.96	0.055	0.016	1.18
A15	89.4	14.0	0.077	1.12	0.86	0.313	0.00138	10.8	0.094	0.021	1.29
A51	89.8	14.5	0.067	1.16	0.89	0.330	0.00128	10.6	0.124	0.027	1.83
A14	92.6	18.3	0.039	1.35	0.97	0.309	0.00221	11.0	0.111	0.055	1.15
A16	109	14.4	0.053	1.27	1.07	0.446	0.00398	12.8	0.141	0.040	2.25
A18	146	48.3	0.899[b]	1.35	1.92	0.748	0.00114	19.7	0.224	0.023	2.88
I-3	194	3.52	0.096	1.16	0.57	0.572	0.00056	10.8	0.304	0.015	2.87
I-3B	224	3.14	0.124	1.47	2.64	1.33	0.00069	13.3	0.142	0.039	4.02
B9	279	30.9	0.423	1.34	2.21	7.18	0.00041	14.5	0.140	0.028	3.80

WQO – Alviso Complex (California Toxics Rule)										
Continuous	36	9.3	50	9[c]	8.1	-	8.2	-	1.9	81
Maximum	69	42	1100	5.3[c]	210	-	74	-	-	90
WQO – Baumberg Complex (Basin Plan)										
4-hour Average	36	9.3	50	6.9[d]	5.6	-	11.9	-	1.9	58
1-hour Average	69	43	1100	10.8[d]	140	-	62.4	-	-	170

Table 2.4-1

Concentrations of Inorganics in ISP Ponds[a]

(Continued)

		Total Recoverable Concentration									
Pond No.	**Salinity**	**Arsenic**	**Cadmium**	**Chromium**	**Copper**	**Lead**	**Mercury**	**Nickel**	**Selenium**	**Silver**	**Zinc**
	(g/L)	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**	**(µg/L)**
A2W	31.6	6.36	0.063	2.36	2.15	0.843	0.012	11.8	0.274	0.022	1.80
A3W	42.0	11.9	0.045	0.67	1.24	0.324	0.0048	8.42	0.173	0.015	0.79
B2C	54.6	1.00	0.050	0.67	1.59	0.392	0.0034	7.09	0.092	0.013	1.28
A15	89.4	15.1	0.054	0.83	1.37	0.351	0.032	14.3	0.160	0.030	1.82
A51	89.8	15.7	0.054	1.07	1.59	0.371	0.032	15.7	0.135	0.020	3.07
A14	92.6	20.1	0.053	1.17	2.04	0.395	0.044	13.5	0.220	0.063	3.16
A16	109	17.1	0.062	1.23	2.01	0.619	0.039	18.1	0.159	0.150	3.38
A18	146	56.2	0.119	1.30	3.39	1.37	0.050	21.8	0.310	0.045	4.49
I-3	194	4.28	0.119	1.47	2.07	0.892	0.036	9.73	0.295	0.128	6.77
I-3B	224	5.18	0.136	1.38	2.45	1.15	0.041	12.3	0.352	0.044	7.22
B9	279	33.1	0.123	1.12	2.61	6.48	0.030	15.1	0.143	0.416	4.28

WQO – Alviso Complex										
Continuous	-	-	-	-	-	0.051	-	5	-	-
Maximum	-	-	-	-	-	-	-	-	-	-
WQO – Baumberg Complex										
4-hour Average	-	-	-	-	-	0.025	-	5	-	-
1-hour Average	-	-	-	-	-	-	-	-	-	-

Table 2.4-1

Concentrations of Inorganics in ISP Ponds[a]

(Concluded)

Notes: [a] Source: Frontier Geosciences (November 11, 2002). Samples collected October 26, 2002

[b] Possible contamination suspected

[c] Values shown are site-specific criteria obtained from the RWQCB

[d] Values shown are site-specific criteria for the South Bay adopted on May 22, 2002 as an amendment to the Bay Plan

▨ = Exceedence of applicable water quality objective
WQO = Water Quality Objective
µg/L = Micrograms per Liter

Existing concentrations of organic compounds in the South Bay salt ponds were evaluated based on available surface water quality data from the Alviso, Baumberg, and West Bay Complexes (See Appendix A). Available organics data for surface water include petroleum hydrocarbons, dioxins/furans, and SVOCs. These chemicals were detected in surface water at concentrations similar to ambient conditions in uncontaminated areas of San Francisco Bay. Based on these results and the low concentrations of these and other organics (including semi-volatile organic compounds and polynuclear aromatic hydrocarbons) observed in groundwater samples collected for the ISP and by others (see Appendix A), organics are unlikely to be present in ISP ponds in excess of background conditions or applicable water quality objectives (WQOs). Therefore, the organic contaminant data are not discussed in detail.

Analytical results for inorganics are presented in Table 2.4-1. The salinity of each sample is presented along with the dissolved and total recoverable concentrations of each of the ten metals of interest. Table 2.4-1 also provides applicable water quality objectives for the Alviso and Baumberg Complexes. Water quality objectives applicable to the Baumberg Complex are listed in the most recent version of the Water Quality Control Plan. San Francisco Bay Basin (Region 2) (RWQCB, 1995), including a May 22, 2002 amendment adopting site-specific WQOs for the South Bay. Objectives applicable to the Alviso Complex are listed in the Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Rule. Federal Register Volume 65, No. 97. May 18 (40 CFR Part 131) (U.S. EPA, 2000) and are specified as dissolved concentrations, except for mercury and selenium, which are specified as total recoverable concentrations.

In order to assess the water quality a comparison was made between the detected concentrations of each of the metals of concern in the sampled ponds and the WQOs applicable to each area. All detected concentrations of arsenic, cadmium, chromium, copper, selenium, silver and zinc were well below applicable WQOs. Only nickel and mercury were detected at concentrations exceeding WQOs.

Concentrations of nickel in eight of the sampled ponds exceeded applicable water quality criteria. The lowest concentrations were detected in the lower salinity Alviso ponds (A2W, A3W, and B2C); nickel was detected in these ponds at concentrations from 4.96 to 8.05 µg/L; these values are below the CTR limit of 8.2 µg/L. Concentrations of nickel detected in the remaining Alviso ponds exceeded the CTR limit; those concentrations ranged from 10.6 µg/L (slightly above the CTR limit) to 19.7 µg/L (more than twice the CTR limit). Nickel concentrations may be correlated with salinity. At higher salinities (89.4 to 279 ppt) detected concentrations of nickel were generally higher (10.6 to 19.7 µg/L), while in lower salinity ponds (31.6 to 54.6 ppt) nickel concentrations were lower (4.96 to 8.05 µg/L).

Detected concentrations of total mercury ranged from 0.0034 to 0.050 µg/L. Detected concentrations in the Alviso Complex were below the CTR limit of 0.051 µg/L. In ponds I-3, I-3B, and the Baumberg Complex, detected concentrations of mercury slightly exceeded the Water Quality Control Plan San Francisco Bay Basin (Region 2) Board (RWQCB, 1955,) limit of 0.021 µg/L. Concentrations of mercury may be correlated with salinity. Detected concentrations in the ponds with lower salinity (31.6 to 54.6 ppt) ranged from 0.0034 to 0.12 µg/L, close to an order of magnitude lower than concentrations detected in ponds with salinities of 89.4 ppt and greater (0.032 to 0.050 µg/L).

In summary, available data indicate that concentrations of all inorganics except nickel and mercury are present in the ISP ponds at concentrations well below applicable WQOs. The elevated detections of mercury and nickel indicate that these metals may be present in the ISP ponds at concentrations exceeding applicable WQOs.

2.5 Hydraulic Setting

2.5.1 Physical Setting of South San Francisco Bay and Associated Tidal Sloughs

South San Francisco Bay (SSFB) is defined as the portion of San Francisco Bay south of the Oakland Bay Bridge. The length of SSFB from the Oakland Bay Bridge to the southern end at Coyote Creek is approximately 50 kilometers. The width of SSFB varies from less than 2 kilometers near the Dumbarton Bridge to approximately 20 km north of the San Mateo Bridge. SSFB consists of broad shoals and a deep relict river channel (Walters, 1982). The mean depth of SSFB is less than 4 meters while the channel is typically 10-15 meters deep. Intertidal areas typically contain a system of small branching channels that effectively drain these areas at low water.

2.5.1.1 South San Francisco Bay

SSFB is a complex and dynamic estuarine system influenced by ocean tides, winds and freshwater flows from tributaries to SSFB. For this reason the hydrodynamic properties of SSFB vary strongly in space and in time.

2.5.1.1.1 Hydrodynamics

The hydrodynamics of SSFB are fairly well understood due to extensive data collection (e.g., Cheng & Gartner, 1984) and modeling efforts (e.g., Cheng et. al., 1993 and Gross et. al., 1999a). Currents in SSFB are dominantly tidally driven, while wind and density-driven currents are relatively much less important (e.g., Walters et. al., 1985). Tidal amplitude increases as tides propagate from Central SSFB. The mean tidal range at the Golden Gate Bridge is 1.25 meters, the tidal range at Alameda is 1.45 meters and the tidal range at the Dumbarton Bridge is 2.00 meters (NOAA, 2003). The tides in SSFB are “mixed semidiurnal” meaning that high water occurs twice daily and that the daily higher high water elevation can be significantly higher than the daily lower high water elevation. As an example, measured water surface elevation at the Dumbarton Bridge shown during a two-week period at the beginning of 1980 on Figure 2-1. The diurnal inequality in the tides is apparent in this data, as well as the fortnightly spring-neap cycle.

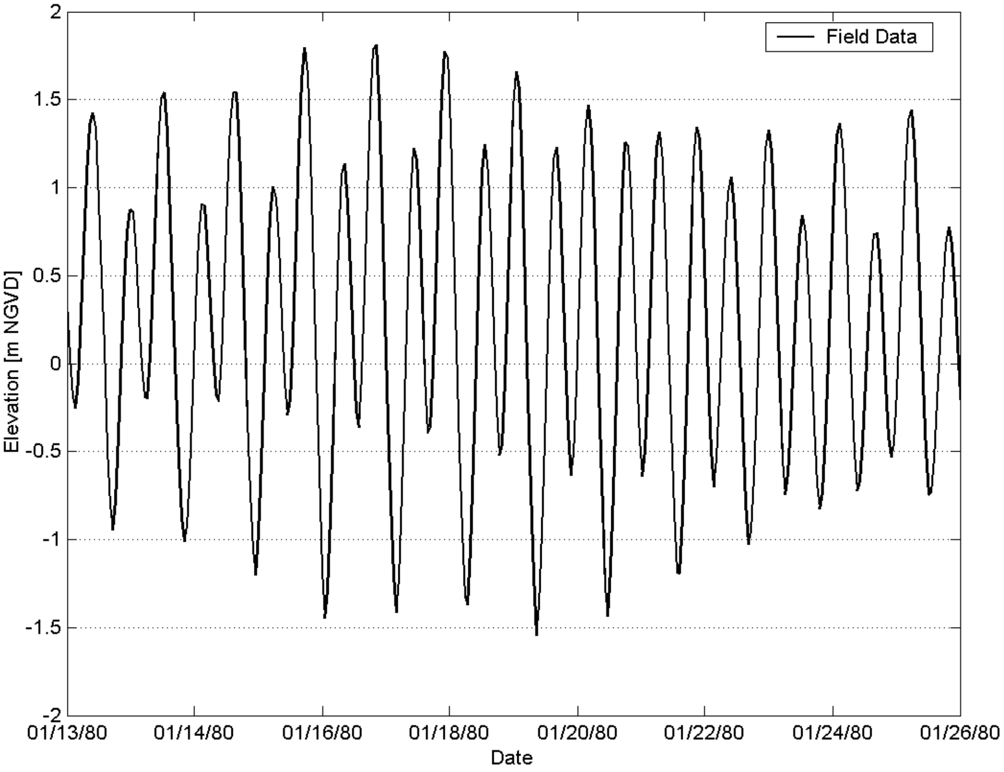


Figure 2-1
Observed Water Surface Elevation at NOAA Station 9414509, Located at the Dumbarton Bridge

Tidal currents are stronger in the channel than in the shoals (Walters et. al., 1985) and slack water generally occurs in the shoal regions before the channel. Table 2.5.1.1.1shows the root mean square (RMS) speed and depth for different stations and Figure 2-2 shows the variability of RMS speed with depth using the data in Table 2.5.1.1.1 (Cheng & Gartner, 1984). Tidal currents also show significant diurnal inequality and temporal variability on the fortnightly spring-neap cycle as shown for United States Geological Service (USGS) station C13, located near the Dumbarton Bridge (Cheng and Gartner, 1984), on Figure 2-3.

Table 2.5.1.1.1

Water depth, RMS Speed and Other Information Regarding Mechanical Current Meter Data Collected in South San Francisco Bay

Station	Meter Depth (meters)	Water Depth (meters)	RMS Speed (cm/s)	Start of Record	End of Record
c9	4.5	7.6	36.4	6/21/80	7/23/80
c307	3.0	4.6	20.0	8/6/80	8/23/80
gs27	3.3	9.4	43.4	2/4/81	3/5/81
gs28	2.7	8.8	38.1	4/21/83	6/1/83
c10	0.6	2.1	28.4	8/19/80	9/4/80
3sw84	1.5	2.6	21.6	8/9/84	9/6/84
gs29	7.0	13.1	40.0	1/27/82	2/21/82
c312	6.1	14.3	46.6	6/6/80	6/25/80
gs30	6.7	12.1	43.9	3/16/83	4/14/83
c313	1.2	2.1	20.9	6/26/80	7/11/80
c12	5.8	14.3	54.3	5/21/80	6/6/80
gs31	4.5	12.1	49.1	3/16/83	4/21/83
gs9	5.1	9.1	46.9	2/1/79	2/28/79
c13	7.6	13.7	43.7	7/10/80	8/9/80
c14	4.9	6.4	33.4	5/28/80	6/13/80

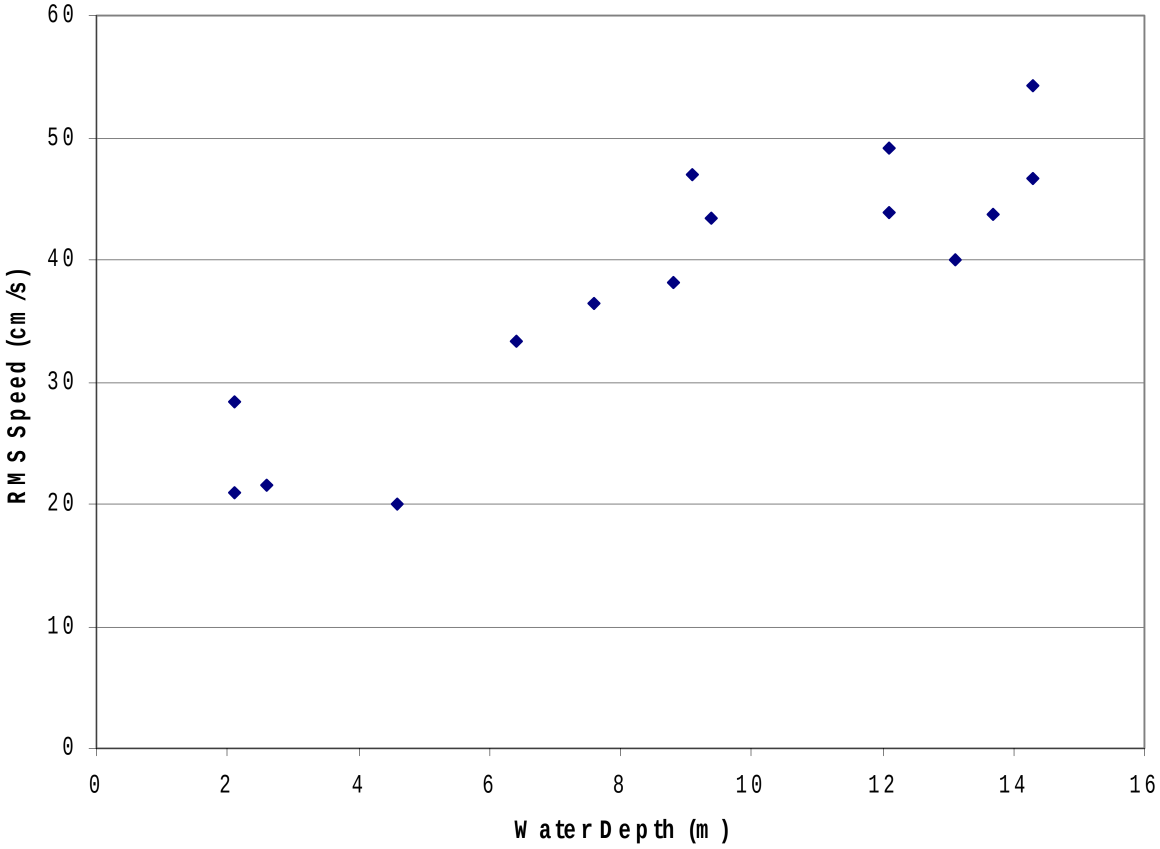


Figure 2-2
RMS Speed Versus Water Depth for South San Francisco Bay Current Meter Data

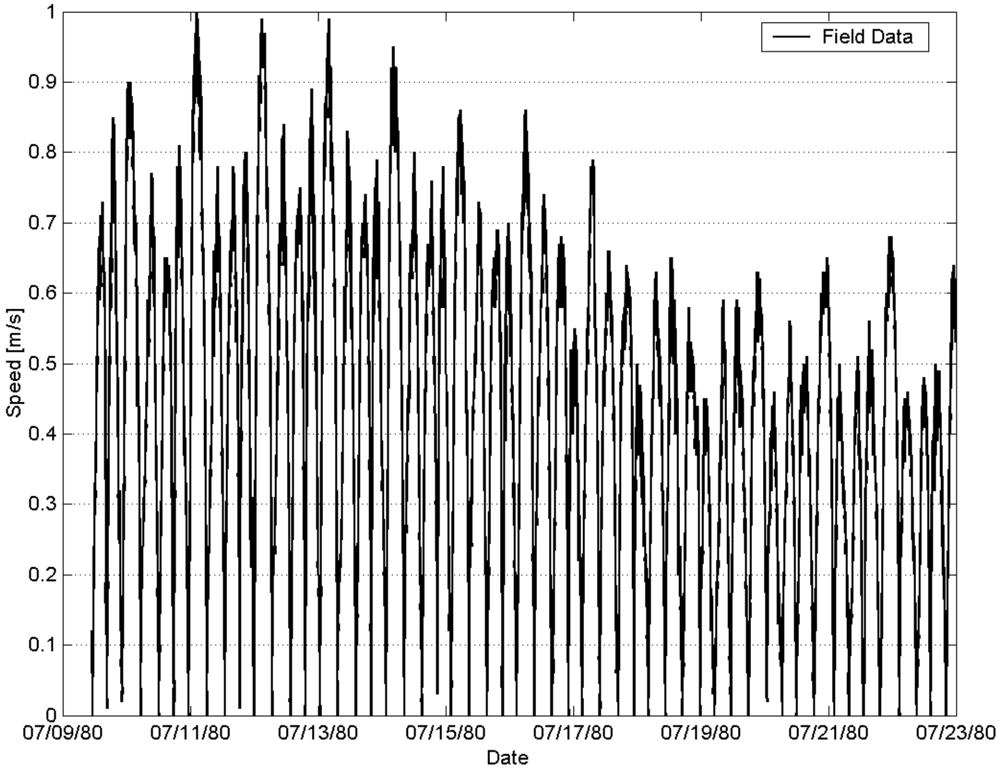


Figure 2-3
Observed Current Speed at Station C13, Located near the Dumbarton Bridge

Most freshwater inflow enters SSFB during the winter and spring. During summer there is little freshwater inflow to SSFB and most of this freshwater inflow is effluent from municipal wastewater treatment plants. The largest tributaries to SSFB are Alameda Creek, which flows into Alameda Flood Control Channel, Guadalupe River, which flows into Alviso Slough and Coyote Creek, which becomes a tidal slough and connects to SSFB. Streamflow is both highly variable during the year and among years. For example, the average gauged flow at USGS station #11179000 (Alameda Creek near Niles) during February is 12.5 cms, while the average gauged flow during October is 0.4 cms. During February of 1994 the average gauged flow at this location was 3.7 cms while during February of 1998 the average was 105.2 cms (USGS, 2003). The flows entering Alameda Flood Control Channel from Alameda Creek during 1994 and 1995 are shown on Figure 2-4. This period shows the dynamic nature of inflows, with low summer flows and much larger flows during the winter of 1995 (a relatively wet year) than during the winter of 1994 (a relatively dry year). Other tributaries also show orders of magnitude variability in flow on seasonal and annual time scales.

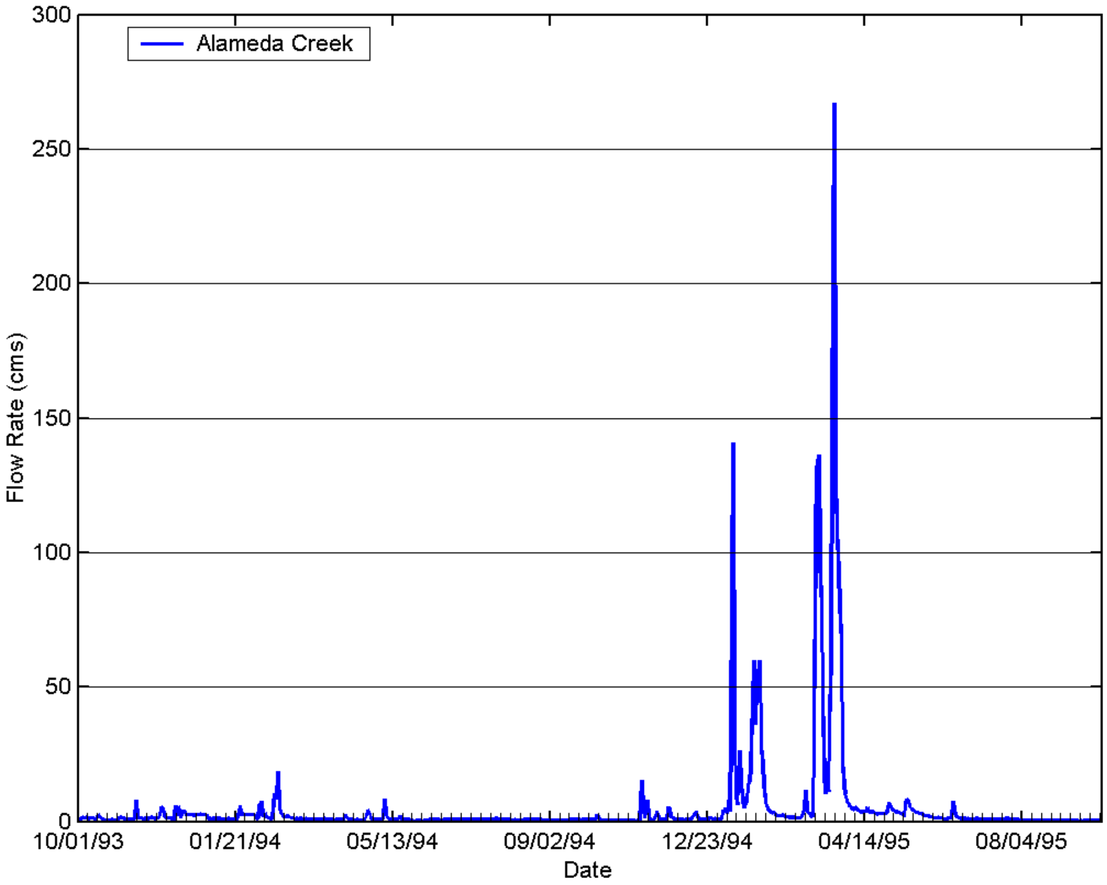


Figure 2-4
Flow rate from Alameda Creek to Alameda Flood Control Channel

2.5.2 South San Francisco Bay Salinity

Salinity in SSFB is dependent on:

- Salinity in Central Bay and exchange between SSFB and Central Bay
- Freshwater input to SSFB
- Evaporation.

Seasonal and yearly variations in salinity are driven primarily by variability in freshwater flow. During periods of high freshwater inflow salinity can vary substantially in SSFB resulting in dynamic three-dimensional circulation patterns (McCulloch, 1970). A key feature of these circulation patterns is density-driven exchange between SSFB and Central Bay (Walters et. al., 1985). Therefore, winter salinity conditions in SSFB are dynamic, characterized by unsteady inflows, variable salinity and periodic vertical stratification. When freshwater flows decrease, generally in late spring, the salinity of SSFB gradually increases as water of oceanic salinity mixes into SSFB from the ocean (via Central Bay). During summer the largest sources of freshwater input to SSFB are wastewater treatment plants and their flows are the same order of magnitude as evaporation in SSFB (Denton and Hunt, 1986). Therefore, salinity is relatively uniform and typically near oceanic (33 ppt) during late summer and fall.

Continuous observations of salinity are made by the USGS at station 162700, located at the west end of the Oakland Bay Bridge, and station 162765, located at the San Mateo Bridge on the east side of the ship channel. At both stations, salinity is measured continuously by two sensors: a “top” sensor and a “bottom” sensor. Data at the Oakland Bay Bridge is collected 2.7 m below mean lower low water (MLLW) and 12.0 m below MLLW. Data from the San Mateo Bridge is collected 1.7 m below MLLW and 13.9 m below MLLW. USGS salinity data are also available near the Dumbarton Bridge (on the east span of the old Dumbarton Bridge) at a single sensor located 2 m from the bed (Schemel, 1998). Figure 2-5 shows salinity measured at the bottom sensor at the San Mateo Bridge salinity station from February 1994 through August 1995. Observed salinity at this location is strongly inversely related to freshwater inflow and varies from over 30 ppt during the summer of 1994 to less than 10 ppt during March of 1995. A similar trend is shown at the Dumbarton Bridge station, where salinity observed between November 1994 and August 1995 varies from less than 1 ppt to more than 31 ppt, as shown on Figure 2-6. In addition, the salinity at this location also varies substantially over the tidal cycle, as indicated on Figure 2-7.

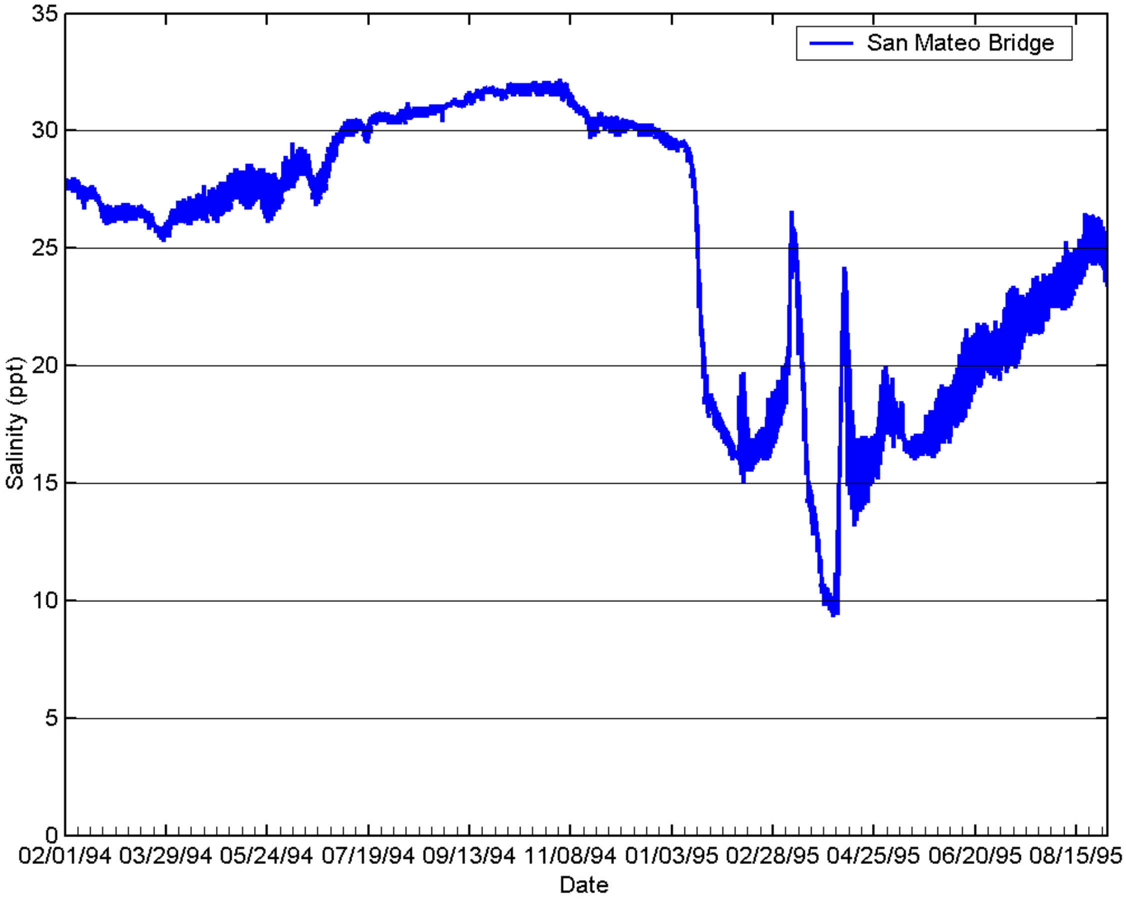


Figure 2-5
Observed Bottom Sensor Salinity at USGS Station 162765, Located at the San Mateo Bridge

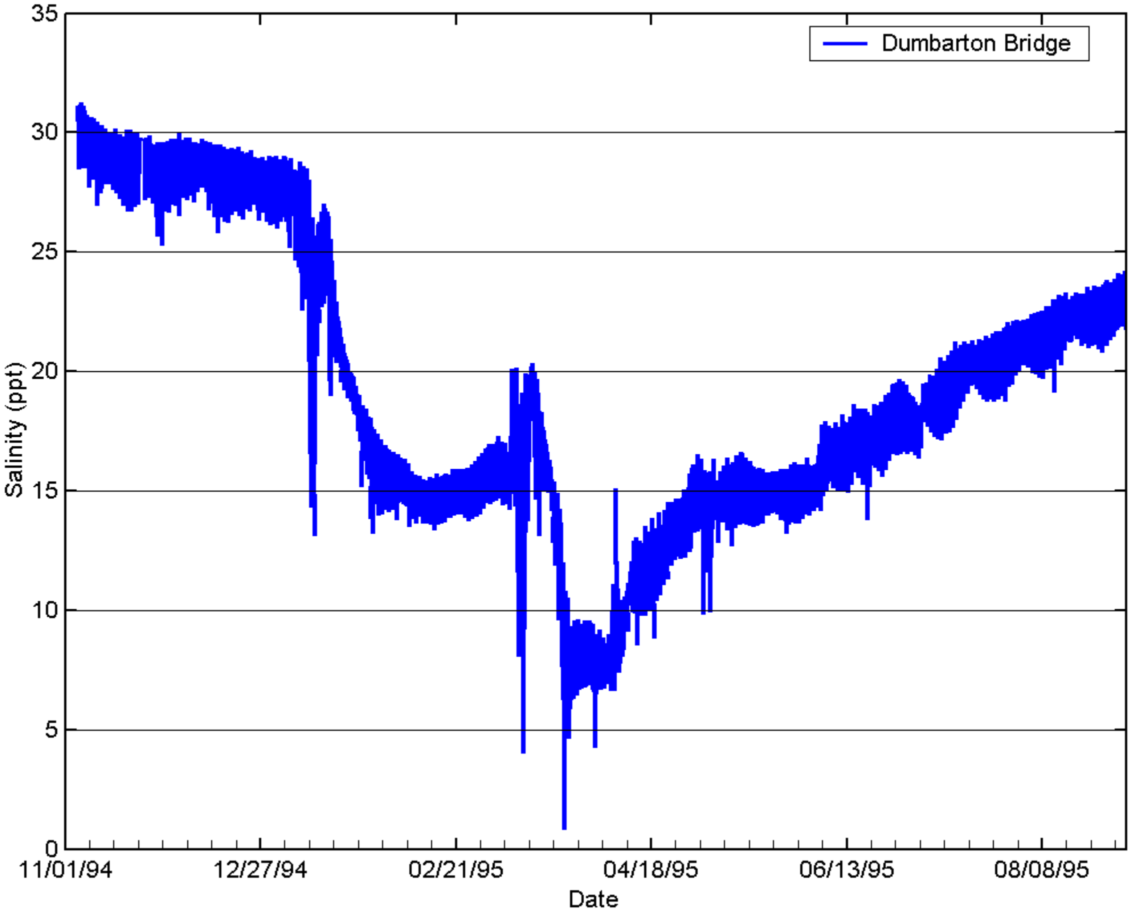


Figure 2-6
Observed salinity near the Dumbarton Bridge.

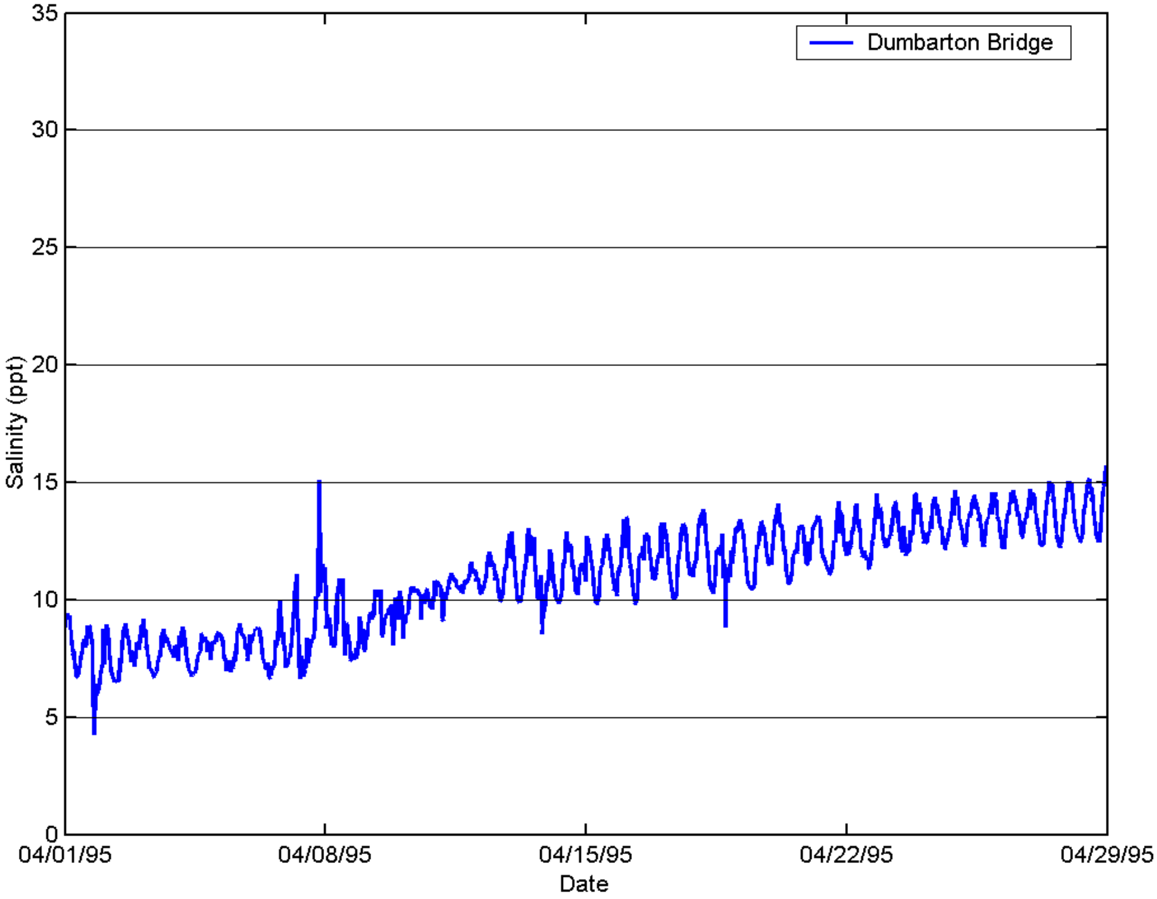


Figure 2-7
Observed Salinity near the Dumbarton Bridge during April 1995

The USGS has collected detailed salinity data in San Francisco Bay since 1969 as part of the pilot Regional Monitoring Program (e.g., Edmunds et. al., 1995). These data are collected at least once a month at a maximum of 17 stations in the channel of SSFB extending from the Oakland Bay Bridge to the mouth of Coyote Creek. Since 1988 this data has been reported in 1 meter vertical intervals. This data (from 1988 to 2000) has been analyzed to indicate the temporal variability of salinity in SSFB. In Figure 2-8, the variability of observed salinity at station 30, located in the main channel of SSFB directly west of the Baumberg System, is shown for all data collected during February between 1988 and 2000. Salinity values ranging from 8 ppt to 31 ppt, have been measured during winter and spring. A large range of salinity has also been observed at Station 36, located in the main channel of SSFB near the Alviso System. At this location, the minimum salinity recorded during February was 4 ppt, while the maximum salinity was 26, as shown in Figure 2-9.

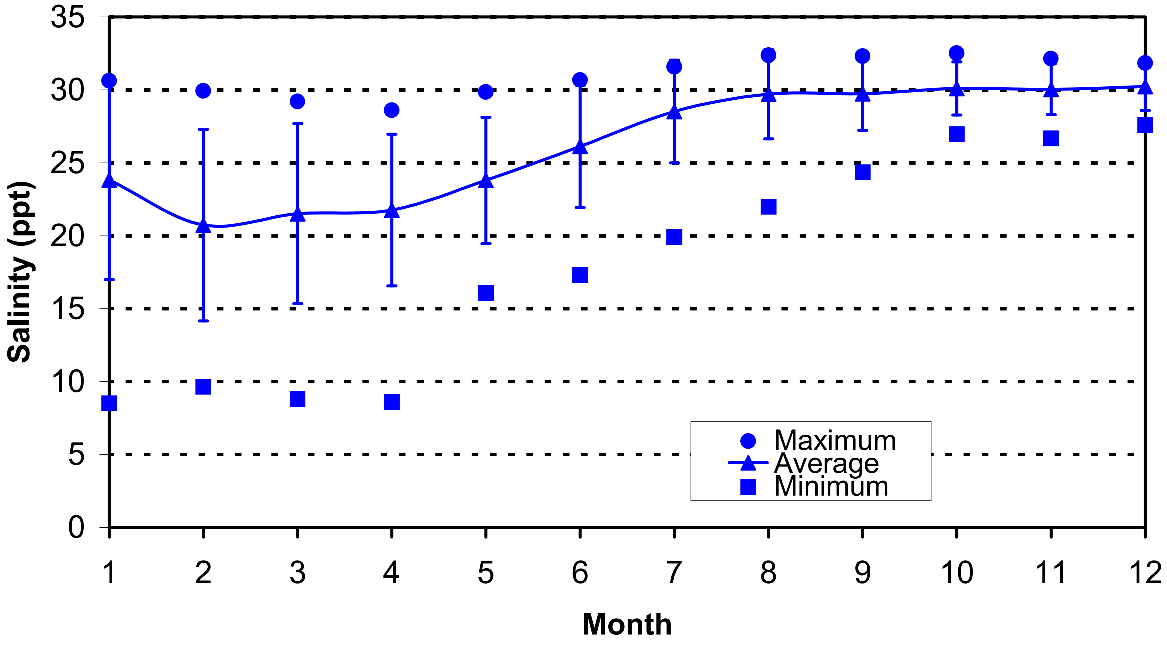


Figure 2-8
Variability of Observed Salinity at Pilot RMP Station 30

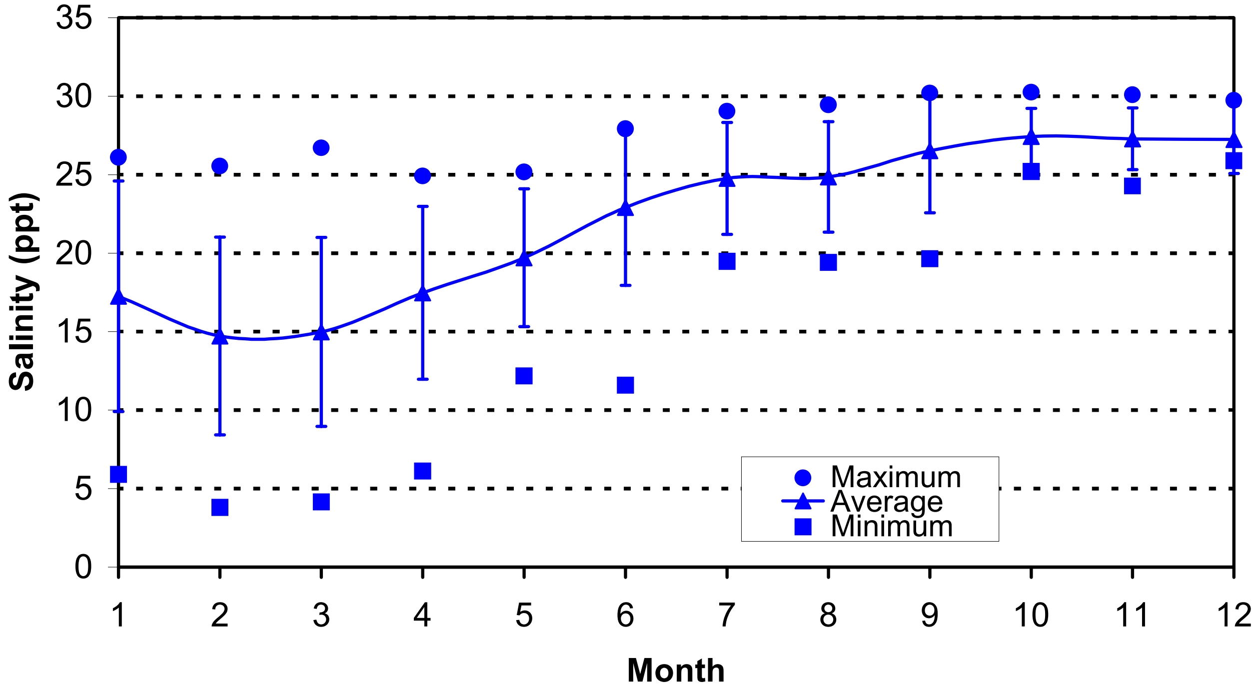


Figure 2-9
Variability of Observed Salinity at Pilot RMP Station 36

2.5.3 South San Francisco Bay Tidal Sloughs

2.5.3.1 Tidal Sloughs near the Alviso System

The Alviso System is located in Lower South Bay, defined as the portion of SSFB location landward (south) of the Dumbarton Bridge. Lower South Bay is a relatively shallow subembayment with an average depth of 2.6 m at mean tide. Tides in this region are particularly strong due to amplification of tidal energy with distance landward in SSFB. Because of the strong tides and small depths, "the area covered by water in Lower South Bay at mean lower low water (MLLW) is less than half the surface area at mean higher high water (MHHW) indicated that over half of Lower South Bay consists of shallow mudflats that are exposed at low tides" (Schemel, 1998). Furthermore the volume of water in Lower South Bay at MLLW is less than half of the volume of water at MHHW, indicating that more than half of the water volume present in Lower South Bay at high water can pass through the Dumbarton Bridge during a single ebb tide (Schemel, 1998). Near bottom salinity measured continuously by the USGS at the Dumbarton Bridge from 1995 to 1998 was highly correlated with freshwater flows and varied from approximately 5 ppt to 32 ppt (Schemel, 1998). The daily range of measured salinity at the Dumbarton Bridge can also be large, particularly during winter, when the daily range is typically 5 ppt.

The tidal sloughs that border the Alviso salt ponds are Coyote Creek, Mud Slough, Artesian Slough, Alviso Slough, Guadalupe Slough, Stevens Creek, Mountain View Slough and Charleston Slough. (See Figure 1-3 in Chapter 1.)

The largest tidal slough is Coyote Creek, which meets SSFB at Calaveras Point. Coyote Creek is a substantial source of freshwater during winter and spring. Salt marsh regions are present in several parts of Coyote Creek, particularly bordering salt ponds. The bottom elevation of the main channel of Coyote Creek ranges from -1 to -4 m NGVD. The tidal range in Coyote Creek, reported as 2.2 m at NOAA Station 9414575 (NOAA, 2003), is particularly large.

Artesian Slough borders ponds Alviso A16 and Alviso A17 and is a tributary to Coyote Creek. The discharge from the City of San Jose municipal wastewater treatment plant enters the upstream end or Artesian Slough with a flow of approximately 133 megagallons per day (mgd) (Davis et. al., 2000). For this reason, Artesian Slough generally has relatively low salinity (Kinnetic Labs, 1987).

Strong salinity gradients are present in both Coyote Creek and Artesian Slough (Kinnetic Labs, 1987) and frequently result in vertical salinity stratification (Simons, 2000). Observations of salinity suggest that, during winter Coyote Creek is periodically stratified while Artesian Slough is persistently stratified (Simons, 2000). The daily range of salinity in Coyote Creek can be quite large. In a one week duration data set collected in late January and early February 2000, measured salinity typically ranged from approximately 3 ppt to over 20 ppt during most days (Simons, 2000), as shown in Figure 2-10. Salinity is also highly variable seasonally, with lower salinity during winter and spring, in Coyote Creek and Artesian Slough (Kinnetic Labs, 1987)

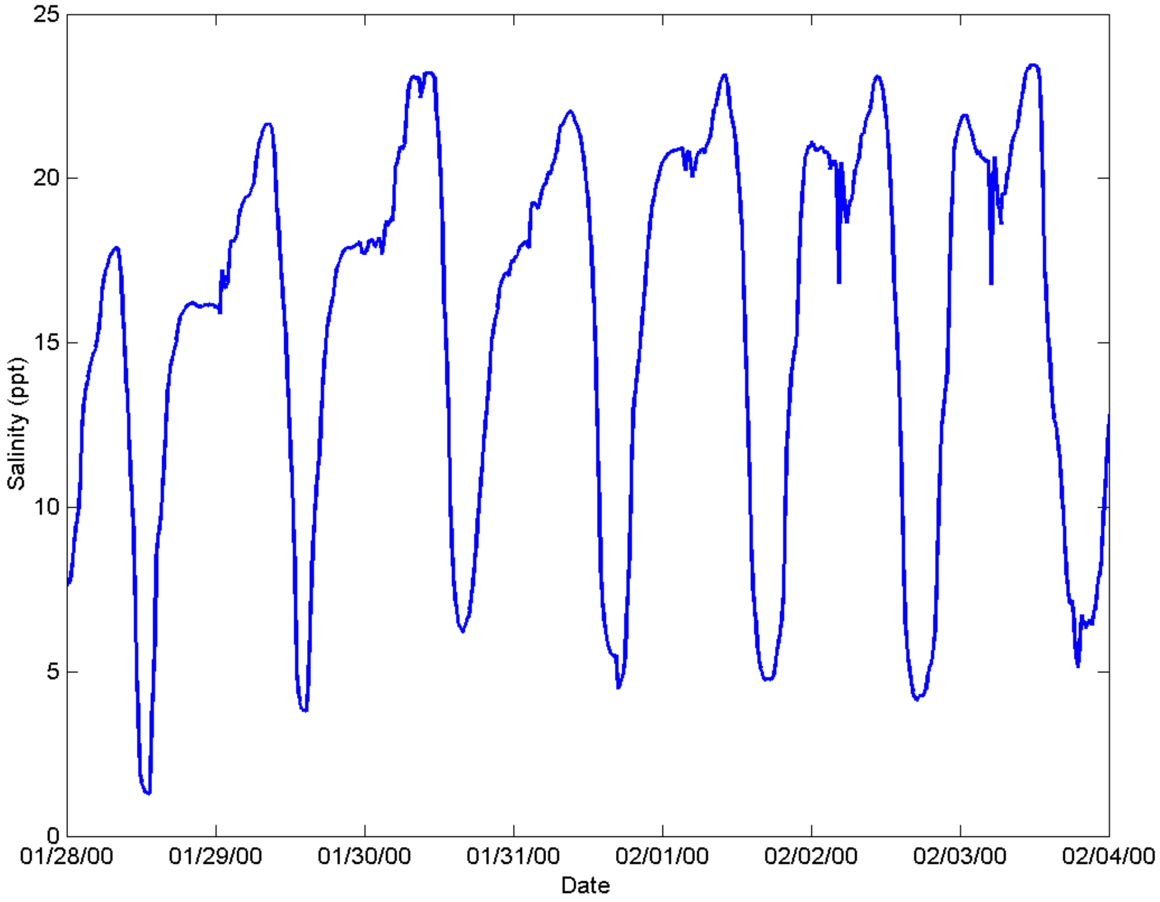


Figure 2-10
Observed Bottom Sensor Salinity in Coyote Creek, near Mud Slough

At the western end of pond Alviso A21, Mud Slough splits off from Coyote Creek and, bordering ponds Alviso A21, A20 and A19, continues landward to connect with Warm Springs marsh restoration area. Mud Slough is a shallow tidal slough, which receives minimal freshwater input during all seasons.

Alviso Slough borders ponds Alviso A7, A8, A9, A10, A11 and A12. Guadalupe River, the second largest tributary to SSFB in terms of drainage area and flow after Alameda Creek, discharges to Alviso Slough. The bottom elevation of Alviso Slough ranges from -1 to -3 m NGVD. The tidal range in Alviso Slough is particularly large with measured high water approximately a factor of 1.6 higher (relative to mean tide) than high water at the Golden Gate Bridge (NOAA, 2003). Given the combination of strong tides and shallow depths in Alviso Slough it is clear that most of the volume present in Alviso Slough at high water drains to Coyote Creek (and subsequently SSFB) during ebb tide. Therefore this slough, as well as Coyote Creek and Guadalupe Slough, actively exchanges water with SSFB due to tidal motions. Salinity is highly variable in Alviso Slough. Salinity observed near high water by Cargill at the mouth of Alviso Slough (measured by Cargill at the Alviso A9 intake) is generally similar to salinity measured at Dumbarton Bridge.

Guadalupe Slough borders ponds Alviso A3W, A4 and A5. Guadalupe Slough receives flow from Calabazas Creek and San Tomas Creek. The Sunnyvale municipal wastewater treatment plant also discharges to Guadalupe Slough (approximately 18 mgd) and is the primary source of freshwater to Guadalupe Slough during summer and fall. The bottom elevation of Guadalupe Slough ranges from -1 to -4 m NGVD. The tidal range in Guadalupe Slough is similar to the tidal range in Alviso Slough (NOAA, 2003). Measured salinity in Guadalupe Slough varies from 0 ppt to approximately 25 ppt (Kinnetic Labs, 1987). A strong salinity gradient along Guadalupe Slough during summer and fall conditions with salinity of approximately zero near the Sunnyvale WWTP discharge and measured salinity typically in the range of 10 to 20 ppt at the mouth of Guadalupe Slough (Kinnetics Labs, 1987).

Stevens Creek, Mountain View Slough and Charleston Slough are relatively shallow and narrow tidal sloughs, which contribute little freshwater flow to SSFB and drain relatively small areas.

2.5.3.2 Tidal Sloughs near the Baumberg System

The Baumberg System borders the eastern shore of SSFB and extends from Alameda Flood Control Channel on the south to San Mateo Bridge on the north. Relevant tidal sloughs flanking the Baumberg salt ponds are Alameda Flood Control Channel (AFCC), also known as Coyote Hills Slough, Old Alameda Creek, Mount Eden Creek and North Creek. (See Figure 1-2 in Chapter 1.) The region near the eastern shore of SSFB is a large mudflat.

The largest and most ecologically important slough in this region is Alameda Flood Control Channel (AFCC), also known as Coyote Hills Slough. Alameda Creek flows into AFCC. Alameda Creek, which drains an area of 633 square miles upstream of Niles (USGS, 2003), is the largest tributary to SSFB. The Army Corps of Engineers designed AFCC. The deepest part of the channel has bottom elevation of approximately -1.5 m NGVD near the mouth of AFCC and slopes gently up with distance upstream. The portion of AFCC that adjoins the salt ponds is tidal with high tide elevation slightly lower than the high tide elevation at San Mateo Bridge and low tide elevation considerably higher than low tide elevation at San Mateo Bridge (NOAA, 1933). Therefore the tidal range in AFCC is quite substantial but less than the tidal range in nearby portion of SSFB. Depths in the channel of AFCC typically range from 2 to 3 m at high water while, at low water, depths can be less than 1 m in the deepest part of AFCC. In addition, AFCC contains a large intertidal area that is only covered with water near high water and is drained during ebb tides. Therefore a large portion of the water volume that is present in AFCC at high water drains into SSFB during ebb tides. Salinity generally varies from bay salinity at the mouth of AFCC to freshwater arriving from Alameda Creek. During periods of high flow, freshwater can displace the bay water in AFCC and the salinity can be depressed significantly in SSFB near the mouth of AFCC (Huzzey et. al., 1990). However, the opposite pattern has also been noted, with higher salinity in the shoals than the channel, during periods of high Delta flow and relatively low local inflow in which less saline water enters SSFB from Central Bay primarily in the channel (Huzzey et. al., 1990).

The next tidal slough to the north of AFCC is Old Alameda Creek. Before Alameda Creek was diverted into Alameda Flood Control Channel, it drained into what is now known as Old Alameda Creek. Currently Old Alameda Creek receives minimal freshwater input. Currently Old Alameda Creek is comprised of two distinct channels, a narrow northern channel and a wider southern channel divided by a vegetated bar that is only submerged at higher high water during strong (spring) tides. A small amount of water level elevation data available in Old Alameda Creek indicates that high water elevations measured about 2 kilometers from the mouth of Old Alameda Creek as high are as 1.8 m NGVD and low water is typically near the bed elevation of -.5 m NGVD (Kamman Hydrology, 2000). Observed salinity in this slough, measured at a Cargill intake location, is generally similar to observed SSFB salinity.

Additional tidal sloughs are currently under construction in the Baumberg System. These sloughs are part of an ongoing tidal restoration project and are under construction using the Cargill dredge. When this restoration project is complete, Mount Eden Creek and North Creek will connect the Eden Landing Ecological Preserve to San Francisco Bay. North Creek will connect directly to Old Alameda Creek approximately 2 km from SSFB and Mount Eden Creek will enter the Bay approximately 2 km north of the mouth of Old Alameda Creek. These sloughs will not receive substantial freshwater flows and it is expected that salinity in these sloughs will be similar to bay salinity.

2.5.3.3 Tidal Sloughs near the West Bay System

The West Bay System is located on the western side of the Dumbarton Bridge. The Dumbarton Strait, with a width of approximately 2-km, is the narrowest part of SSFB. The mean tidal range in the Bay at this location is 2.0 m (NOAA, 2003) and the salinity is similar to the salinity measured by the USGS at the Dumbarton Bridge, shown on Figure 2-6 Observed velocities in this region, for example currents measured at USGS/NOAA station C13 (shown on Figure 2-3), are relatively large due to the strong tides and narrow cross-section of the Dumbarton Strait.

The largest tidal slough located near the West Bay System is Ravenswood Slough. (See Figure 1-4 in Chapter 1.) Local freshwater input to this slough is relatively low and salinity in the Bay and sloughs bordering the West Bay System is typically similar to salinity measured at the Dumbarton Bridge, shown in Figures 2-6 and 2-10 above.

3.0 Development of the Management Plan

3.1 Goals and Objectives

The goal of the ISP is to operate and maintain the South Bay Salt Ponds in an environmentally sound and cost effective manner while long-term restoration plans are developed and implemented.

The specific objectives of the ISP include:

- Cease salt production
- Circulate bay water through the ponds and introduce tidal hydrology to ponds where feasible
- Maintain existing open water and wetland habitat for the benefit of wildlife, including habitat for migratory shorebirds and waterfowl and resident breeding species
- Maintain ponds in a restorable condition to facilitate future long term restoration
- Meet all regulatory requirements, especially discharge requirements to maintain water quality standards in the South Bay.

In order to meet these objectives Bay water will be circulated through the pond system with sufficient volume to maintain pond salinities near Bay water salinity. This circulation allows salt production to stop, minimizes changes to existing pond water levels and habitat values, and maintains the ponds for future restoration. Several conditions exist that need to be considered in developing a cost-effective management philosophy and design.

Existing infrastructure limits flows through the existing pond system, because the system was constructed to maintain sufficient residence times in the ponds to increase the pond salinities. Therefore an interim operation similar to existing salt operations for the Alviso complex from A1 to A17, for example, would result in a high salinity discharge to Coyote Creek (near 150 ppt). This would not meet water quality objectives. In addition, the sale of pond A4 segments the Alviso system. Similarly, existing salt operations in Baumberg would result in a high salinity discharge to AFCC at pond 2C.

Therefore, the proposed project would segment the overall pond complexes into smaller systems where water would circulate from the Bay through a smaller number of ponds and discharge back to the Bay or slough. This approach has additional benefits for on-going operations and future restoration. The smaller systems mean the pond salinities are less dependent on the overall system operation, and allow a greater degree of control of water levels and salinity. This approach would also allow more flexibility in future restoration since one or more ponds could begin restoration without disrupting the operation of the entire complex.

The system segments were established based on logical physical groupings of ponds within the existing complexes. In particular, system separations were established at creek or slough crossings where siphons under the sloughs connect various ponds. The slough connections are generally the lowest capacity infrastructure in each complex, and are generally associated with a pump to force flow through the siphon. The slough locations are also points where a gravity outlet to the slough could be constructed.
The proposed new systems utilize most of the existing commercial salt operation infrastructure and general flow patterns. Therefore, most ponds include inflow and outflow locations at opposite ends of the pond. This improves mixing within the individual ponds.

Several systems include individual ponds or sub systems that are separate from the normal circulation patterns of the rest of the system. These ponds can be operated separately as batch ponds or seasonal ponds. The batch ponds can be operated to maintain longer residence times and higher pond salinities. The batch ponds do not discharge to a stream or slough, but outlet to another pond within the system to dilute any high salinity brines prior to any discharge to a stream or slough. These batch ponds could also be operated as seasonal ponds to be filled with Bay water or rainwater during the winter and drained or allowed to dry out during the summer.

3.2 Opportunities, Constraints, and Costs

The opportunities that the project will take advantage of are:

- Existing intakes. These conduits, gates, and channels have been in place for decades and are well understood by operational engineers.
- Existing connection infrastructure. Various structures between and among the ponds have been used for years to allow waters in various salinity conditions to flow between ponds in a controlled manner.
- Accessible Bay water for circulation. Each of the complexes described in the ISP has multiple potential access points for waters from San Francisco Bay to be admitted to control the water features of the ponds.
- Multiple locations for outlets. Each complex also has multiple exit points for water to be let back into the Bay. The inputs and outputs from the Bay maintain the salt ponds at acceptable water levels, salinity levels, habitat values, and potential restoration conditions.

The stewardship opportunities presented above also introduce constraints and associated project costs. Each of these constraints was evaluated during project planning and will continue to be monitored during the implementation of the ISP. The operations will be adjusted in near real time to produce the objectives.

These constraints are:

- Direction of water flow. Ponds generally have a singular flow direction and sequence established by existing pond bottom elevations and operational infrastructure.
- Existing salt pond levees. These levees, unless modified, may limit pond elevations.
- Existing pond connections. The maximum flow capacity of existing pond connections is limited by the structure size and the available water surface difference between ponds, although in some cases the connection may be replaced in order to establish greater flow potential.
- Flood control levees. The flood control levees have been built as part of public flood control projects. Construction and future pond operations must be consistent with the purposes and maintenance requirments of the flood control levees.
- Bottom elevations within ponds. High pond bottoms require high water surface elevations thereby reducing gravity inflow. In turn, low pond bottoms require low water surface elevations to minimize erosion from wave action. This also can reduce gravity outflows.
- Infrastructure effects. Because of the generally passive nature of the infrastructure, variations are induced in pond water levels during weak or strong tidal cycles and after rainfall events.

- Seasonal conditions. The high summer evaporation increases the need for circulation to minimize salinity increases. The low evaporation and rainfall during winter decreases the need for circulation of Bay water.

- Water Quality Objectives. WQO may limit long-term pond discharge salinities. The long term ISP operation must not degrade water quality to impact existing benefical uses in the receiving waters.

- Slough conditions. Because of the relative lack of water movement in sloughs discharges to sloughs are more sensitive to water quality concerns and will have to be monitored closely. In addition, salmonid migrations in specific creeks need to be protected.

The sum effect also means that the process of adapting the system operations may take several years to reach its final end state of system homeostasis.

The management cost of the South Bay Salt Ponds project, Initial Stewardship phase, will be minimized by taking advantage of the following:

- Existing infrastructure. By using and modifying the existing pond structures, the engineering and construction costs will be held to a minimum.

- Pumping. Pumping will be minimized by managing certain ponds seasonally to reduce the need for pumping.

- Monitoring. Monitoring, done by contractors, team participants, government agencies, or volunteer organizations will be early, extensive, and flexible. This will ensure that appropriate action can take place while costs for that action are their lowest.

- Operational Experience. The management team will examine, incorporate, and sustain existing operational experience in the management of the SSFB Salt Ponds. This management approach will simplify the ongoing transition of the salt ponds to wetlands.

3.3 Salinity Simulations

The key feature of the ISP is the circulation of Bay water through the ponds and release of this water to the receiving water sloughs and channels in South Bay. During the first period of circulation through the ponds, which will be referred to as the Initial Release period, the water currently in the ponds will be discharged to the Bay and replaced with Bay water brought into the ponds at the intakes. This will be a period of relatively rapid desalination. After the salinity is reduced to be similar to Bay salinity, it will be maintained by circulation of Bay water through the ponds. This circulation is different than the existing salt making operations because the pond systems will circulate water back to the Bay and because the flow rate through the ponds will be increased relative to existing flows. Following discharge into the receiving water bodies, there will be additional dilution of salinity due to the dynamic mixing forces within the South Bay environment.

Computer models were applied to estimate the water surface elevations, velocities and salinity within the ponds and receiving water bodies during the Initial Stewardship period. The pond model estimates inflows to the ponds from the Bay, flows between ponds, volume of water evaporated from the ponds, volume of water added to the ponds by precipitation and flow rates from the ponds to the Bay and sloughs. A three dimensional hydrodynamic model was used to estimate conditions in the Bay and sloughs.

This section provides a description of the pond modeling performed to evaluate the existing and proposed ISP pond conditions for elevation, flow, and salinity. The results of the pond modeling are described in

Chapter 4. The detailed description and simulation results of the hydrodynamic model are included in a separate report.

The initial release has been proposed to occur in April. April was selected to balance water quality and habitat concerns. The initial release of the higher salinity discharges during the late winter would have the least impact on maximum salinity values in the receiving waters. During the late winter the bay and slough salinities are generally low, and lower intake salinities would reduce the pond salinities more rapidly. Similarly, the lower bay and slough salinities would reduce the potential maximum salinities in the receiving water for a given discharge flow and salinity. Therefore, initial release during the winter would decrease the potential extent and duration of high salinities in the bays and sloughs due to the initial release.

However, the winter season from December to March is the period of the upstream migration of adult steelhead. The initial release salinity could affect the upstream migration of the adult salmon. The period from December to April is also period for the downstream migration of juvenile salmonids, including Chinook salmon and steelhead. In addition, March and April is the period with few bay shrimp in the bay and sloughs. April was proposed for most of the initial releases to avoid the adult steelhead migration, to be near the end of the juvenile salmonid migration period, and to be during the period with few bay shrimp.

Two additional initial release scenarios were modeled to include the permitted discharge salinity levels. The permitted discharge salinities are higher than the April 2002 recorded values. The additional initial release scenarios are described in Section 4.1.1.4.

3.3.1 Pond Model

In the ISP, the ponds are operated as a number of distinct pond systems each of which will contain one or more intake pond, which receives water from the Bay, and one or more release pond, which releases the water back to the Bay. Most of the pond systems contain a single intake pond and a single outlet pond and a single flow path through the ponds from the intake pond to the outlet pond.

The pond hydraulic computer model estimates inflows from the Bay, flows from the ponds to the Bay, evaporation from the ponds and rainfall on the ponds. However, in order to make pond hydraulic modeling feasible, some simplifying assumptions have been made. The following simplifying assumptions were made in formulating the pond hydraulic model:

- Each pond is considered to be well mixed.
- Each pond is treated as having a uniform bottom elevation.
- The flow through each pond system is assumed to be unidirectional from the intake pond to the outlet pond.

The model treats each pond as a single well-mixed volume and therefore does not estimate salinity variability within each pond. Data collected in the ponds under the existing operations indicates that they are generally well mixed.

The bottom elevation in each pond is specified as the average of available elevation data (Fremont Engineers, 1999) inside the pond. This data excludes borrow ditch areas, and levees.

The flow through each pond system is assumed to be unidirectional. Some of the ponds are connected by gaps in levees. Due to wind or density differences, flow may occasionally reverse direction through the gaps. The flow direction in the pond hydraulic model is assumed to be always from the intake pond to the outlet pond.

3.3.1.1 Hydraulic Information

Intake and outlet structures connecting the ponds to the Bay/sloughs will utilize gates to insure that flow is unidirectional through each structure. Outlet structures may also include weirs to maintain water elevations in the ponds. During Initial Stewardship, water will enter the ponds by gravity and/or pumping and be discharged by gravity.

The flow rates will vary over the tidal cycle depending on the difference in water level in the ponds and water level in the South Bay and associated sloughs where the culverts are located.

The infrastructure proposed in the ISP was selected to allow adequate flow rates to maintain discharge salinity close to Bay salinity during a dry year. The flows through the pond systems are substantially larger than flow rates for the existing commercial salt production operations. Increased flow rates result in decreased pond salinity by decreasing the average time required for water to travel from the inlet to the outlet allowing less time for evaporation. The hydraulic residence time (HRT) is defined as the average time required for water to circulate through a pond system. The HRTs corresponding to the ISP vary as tidal conditions vary, but are typically in the range of 15 to 50 days.

The relevant hydraulic information for each control structure is represented in the pond hydraulic computer model. The model accounts for the size and number of culverts at each inlet, outlet and at each connection between ponds. It also accounts for the length and elevation of any weir in the system. Flow per unit length over each weir is computed based on a rating curve for a sharp-crested weir (e.g., Chow, 1959). Flow through the culverts is based on rating curves developed using HEC-RAS (Hydrologic Engineering Center-River Analysis System).

Intake pumps are also accounted for in the pond hydraulic computer model. When salinities increase to undesirable levels in the ponds, pumping will increase circulation through the ponds and decrease salinity. The pump criteria used in the model were proposed to ensure that the predicted discharge salinity remains close to Bay salinity. The amount of pumping required depends on the Bay salinity, gravity inflow rates and the net evaporation from the ponds.

3.3.2 South San Francisco Bay Model

This section describes the computer modeling simulation of salinity in the South Bay and associated tidal sloughs. The simulations were performed using a state-of-the-art three-dimensional hydrodynamic model. In order to provide confidence that the three-dimensional hydrodynamic model reliably estimates salinity during existing conditions and during the proposed Initial Stewardship period, a substantial model calibration/validation was performed. First the model was calibrated to accurately simulate observed currents and water surface elevation. After the model was calibrated, it was applied to simulate existing salinity conditions without adjustment of any model parameters. The model results are shown to match available salinity data closely.

In order to estimate salinity increases in tidal slough regions, higher resolution in the Tidal, Residual, Intertidal and Mudflat (TRIM) model is required in the tidal sloughs. Two regions, the Alameda Flood Control Channel and the Alviso Region, which includes Coyote Creek, Guadalupe Slough and Alviso Slough, have been selected by representatives of state and federal agencies as regions of particular interest. As described below, salinity in these regions is simulated on high-resolution grids to provide additional detail and improved accuracy.

The results of the pond model simulation were used as an input to the hydrodynamic models to evaluate potential project impacts on the receiving waters. The description of the hydrodynamic modeling and the results of the models are contained in separate reports and are not included in the ISP.

3.3.3 Simulation Period

The pond hydraulic simulations and hydrodynamic simulations for the South San Francisco Bay and slough areas use tide and weather data as part of the model simulations as described in the previous sections. The exact meteorological and Bay salinity conditions that will exist during Initial Stewardship cannot be predicted. However, the estimated initial release salinity from the ponds is likely to be higher than receiving water salinity due to the existing salinity levels in the ponds and the evaporation expected to occur within the ponds during the Initial Stewardship operations.

To evaluate the proposed ISP operation plan and plan alternatives, the pond and receiving water conditions were modeled for a simulation period of 19 months, to include two summer periods and one winter period. The selected period was from April 1994 through October 1995. The particular period was selected to include a relatively recent period where Bay tidal and salinity profile information was available, and to include a range of meteorological conditions.

The 1994 period was considered suitable because it represents a relatively dry year, with above average salinity in the South Bay. This was considered important to evaluate initial release conditions where local salinity conditions could potentially reach or exceed the maximum salinity tolerance of existing flora and fauna in the Bay or sloughs. The intent was to evaluate initial release and summer operational salinities for a year with above average Bay salinities to identify maximum salinities that may occur. Analysis of the impact of salinity upon the aquatic species was conducted. The results of this evaluation indicate that during the period of the Initial Stewardship, salinities in segments of the Bay and its tributaries are predicted to be elevated, but significant impacts to aquatic life would be unlikely.

Figure 3-1 compares measured average monthly South Bay salinity during 1994 to average South Bay salinity (from 1988 to 2000). Data from the USGS "pilot RMP" station 30 (near the San Mateo Bridge area, close to the existing Baumberg intake). The plot shows the average salinity for each month (triangles) and one standard deviation from the average (error bar). One standard deviation represents a statistical value for the variation from the average value. Approximately 67 percent of all years would fall within one standard deviation, within the error bar on the graph. Approximately 84 percent of all years would have a lower salinity than the top of the error bar. The 1994 monthly salinity values (circles) at station 30 are consistently near the top of the error bar during the spring and summer. Therefore the 1994 year was well above average salinity, and represents a conservative period for the evaluation of maximum salinities in the Bay and sloughs. Figure 3-2 shows similar results for station 36 (near the Dumbarton Bridge area).

The high Bay salinities affect both the salinity levels in the receiving waters, and the operation of the ISP pond systems since the high intake salinities affect the circulation salinities in the ponds and the resulting discharge salinities. This affects both the summer operation conditions in dry years and the potential for initial release during a dry year. If the initial release occurs in a dry year, the higher intake salinities would take longer to dilute the existing higher salinity water in the ponds. The 1994 year was used to evaluate initial release condition for all initial release scenarios.

Figures 3-1 and 3-2 also show the measured salinities for 1995 (squares). The winter of 1995 was a particularly wet winter and the Bay salinities are lower than average. By March, the Bay salinity at station 30 was at the lower end of the error bar. This means that approximately 16 percent of years would have lower average monthly salinities in March. For the remainder of the summer, the 1995 average salinity is below the lower end of the error bar.

The 1995 period was used to model and to evaluate long term ISP operation during wet years with low average salinity in the Bay and sloughs. This was considered to evaluate potential increases in salinity during periods of low salinity. The 1995 period was also included to evaluate operation of the pond systems during wet winters where flood conditions could occur in the ponds. This was included to evaluate whether the ponds could be operated with high rainfalls and not affect the stability or erosion of the existing levees.

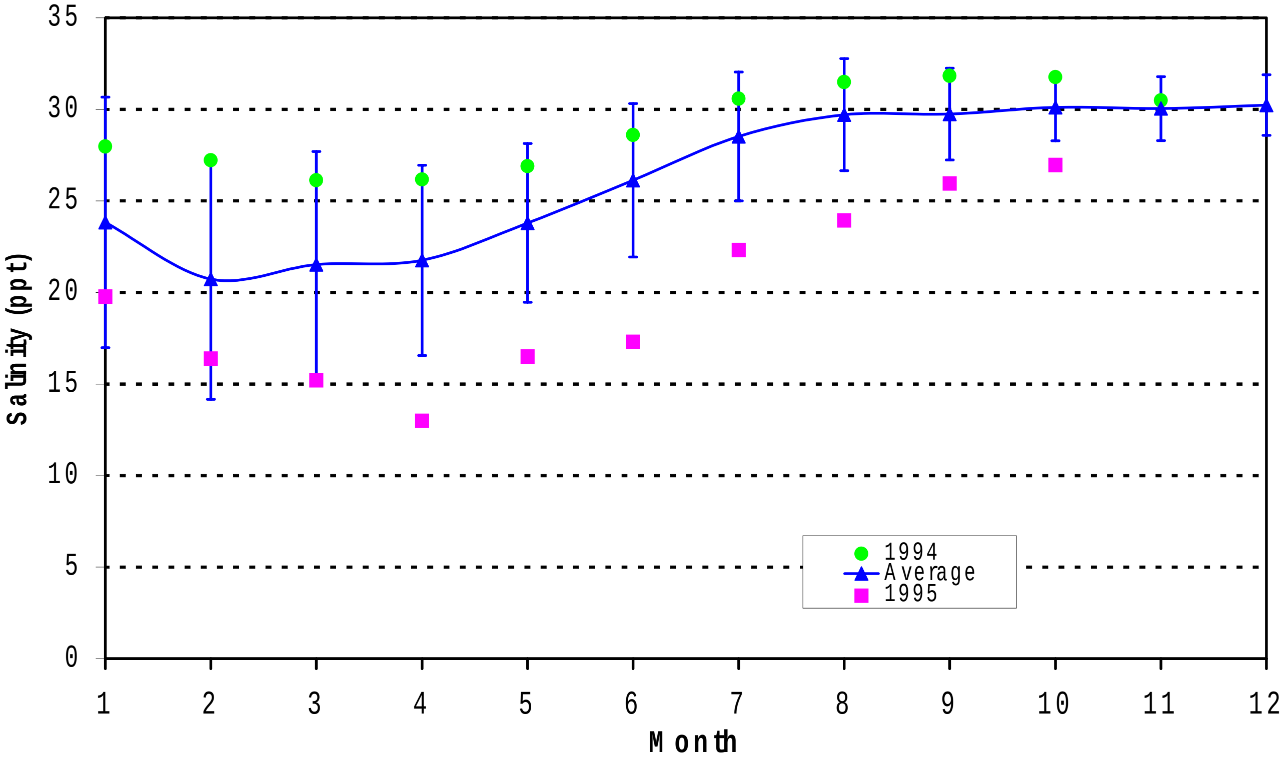


Figure 3-1
Monthly Salinity Averages from Station 30 near the San Mateo Bridge

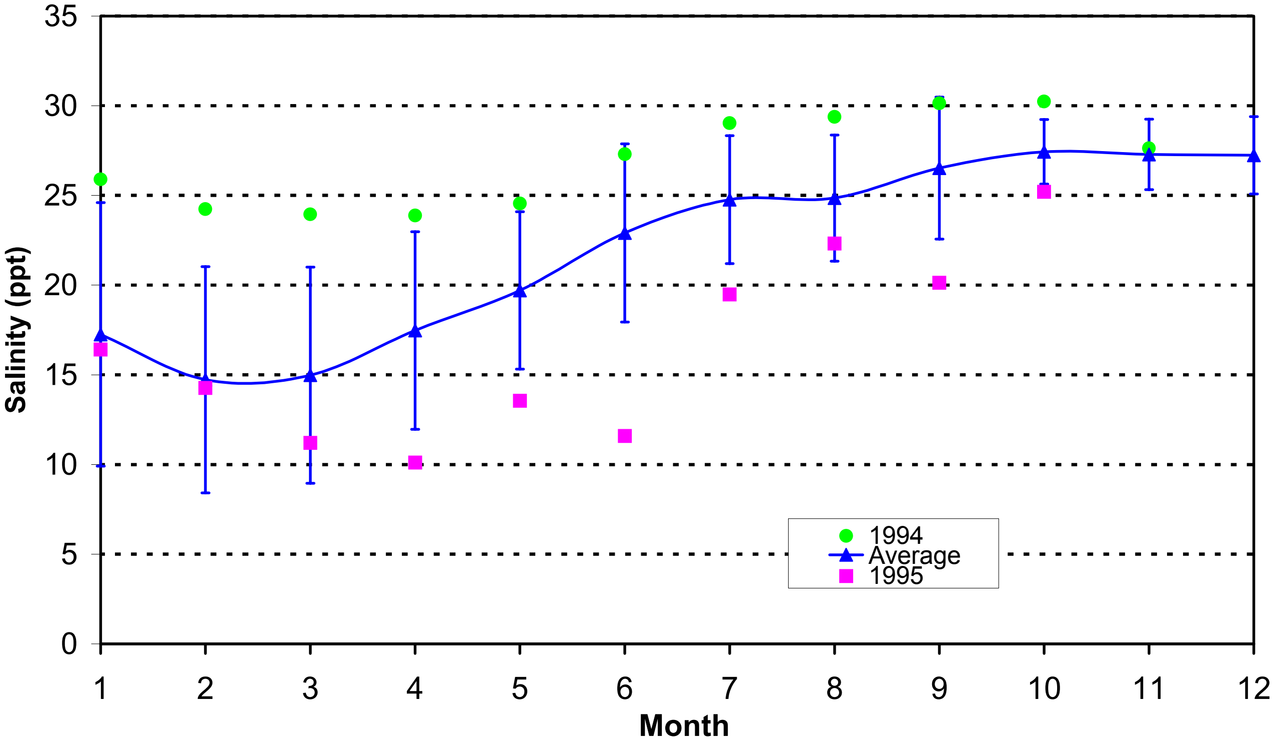


Figure 3-2
Monthly Salinity Averages from Station 36 near the Dumbarton Bridge

3.4 History of Project Design (Alternatives)

This section describes the project alternatives considered in the development of the ISP. These are as follows:

- No Action Alternative
- Maintain Infrastructure Only
- Culvert Structures for Island Ponds A19, A20 and A21
- Seasonal Pond Operations
- Flexibility in Time Period of Initial Release
- Individual System Alternatives

3.4.1 No Action

Under the No Action alternative, there would be no flow circulation through the pond systems. No additional water control structures would be installed, no release of pond contents or management of water and salinity levels would occur, and the existing infrastructure would not be maintained. The contents of the ponds would be allowed to evaporate leaving behind salt-crusted flats and in deeper areas, residual pools of concentrated brine. Ponds would take 1 to 2 years to dry. The deepest portions of the ponds would be seasonally wet during winter, filling with water after rain events. Under the No Action alternative, most of the existing open water habitats currently used by wildlife would be eliminated. Without maintenance pond levees and control structures would be prone to failure, increasing risk of uncontrolled intake and release of flows from/to the Bay. This alternative minimizes additional inputs of salinity and does not require a permit to discharge pond contents into the Bay. Long-term pond drying may result in hyper-saline soil conditions. This may cause the chemistry of the soil to be affected in a manner that would likely increase the cost and level of effort of future restoration.

3.4.2 Maintain Infrastructure Only

This alternative is the same as the No Action alternative except that the levees and water control structures would be maintained and repaired as needed. The ponds would be managed as seasonal ponds until the final restoration plan has been completed. Under this scenario the pond contents would be removed or allowed to evaporate. During the summer, they would be maintained as dry to minimize construction and management costs. During winter they would fill during precipitation events but contents would not be discharged. Maintenance of the levees and water control structures would prevent their deterioration that could cause the accidental breaching of the ponds and release of pond contents to the Bay. Under this alternative, most of the existing open water habitats currently used by wildlife would be eliminated, significantly changing the character of the South Bay salt ponds.

This alternative minimizes additional inputs of salinity and does not require a permit to discharge pond contents into the Bay. As with the No Action alternative, long-term pond drying may result in hyper-saline soil conditions. This may cause the chemistry of the soil to be affected in a manner that would likely increase the cost and level of effort of future restoration.

3.4.3 Culvert Structures for Island Ponds

Under the proposed ISP, the Island Ponds (A19, A20, and A21) would be breeched on the Coyote Creek side to establish full tidal conditions in the ponds. The island ponds ISP conditions are described in Section 4.2. A project alternative for the island ponds would be construct culvert inlet/outlet structures to manage the separate inlet/outlet structure; one for each pond. The ponds would be managed to maintain water levels in the ponds approximately one foot above the average bottom elevation. The culverts would be constructed to connect to either Mud Slough or Coyote Creek. Since the barge access to A19 and A20 would be from Mud Slough, the preferred location would be along Mud Slough. Due to their location between Lower Coyote Creek and Mud Slough, the Island Ponds are fairly inaccessible, and therefore, difficult to actively manage. Also, construction would be both difficult and expensive.

3.4.4 Seasonal Pond Operations

Under the proposed ISP, several pond systems consisting of numerous ponds include one or more pond(s) serving as batch ponds. Due to their location within the systems or due to the pond bottom elevations, the batch ponds were not included in the continuous tidal circulation systems. They would not have a direct hydrologic connection to the Bay or tidal sloughs and creeks, but rely on a neighboring pond for delivery of inflows and release of outflows. The volume and frequency of the intake and release from/to a neighboring pond can be used to control the batch pond salinity and water levels. Bottoms of batch ponds may be high, generally requiring pumping to fill the ponds (Baumberg 12, 13, and 14). For other batch ponds, the pond bottoms may be low, generally requiring pumping to remove water from the ponds (Alviso A8, A12, and A13). Batch ponds can easily be managed for high salinity in the range of 120-150 ppt. to favor brine shrimp and brine fly production, an important food source to certain migratory birds. Batch ponds may be operated as seasonal ponds and filled during the winter and drained during the summer.

Seasonal ponds differ from batch ponds in that their contents would be drained. Seasonal ponds will fill from high groundwater or rain during winter and be allowed to dry-down through the summer. The pond salinity would not be controlled, but would fluctuate due to residual salt in the pond, rainwater inflows, and seasonal evaporation. The major benefits of a seasonal operation are the habitat provided for certain species and the elimination of costly pumping to water to maintain water levels.

3.4.5 Flexibility in Time Period of Initial Release

Under the proposed ISP, structures would be installed in when site constraints allow and initial discharge of the existing pond contents would begin the following March/April when salinities within the ponds and receiving waters are the lowest. Allowing initial release of pond contents into the Bay at other times during the year may be desirable as a contingency if all necessary water control structures cannot be installed prior to March/April release date. Concerns regarding this alternative include the ability to meet regulatory requirements for the initial discharge of pond contents and effects of elevated salinity at discharge locations to salmonids and bay shrimp. Salmonid migration would not be a concern in July or August.

The proposed Phased Release scenario would include initial release of a limited number of ponds in July, with other pond systems to follow in subsequent years. This could allow for a limited number of structures to be constructed in the spring. The phased release scenario is described in more detail in Section 4.3.

3.4.6 Individual System Alternative

Several of the individual systems described in Section 4 have been revised during the development of the ISP. Some of the system alternatives are described below. Note that the systems are named for the pond containing the outflow structure.

3.4.6.1 Alviso A3W System

In the Alviso A3W system, an alternative intake location was considered for the additional intake to pond B1. The alternative location was close to the northern end of the pond near Stevens Creek. The alternative location would avoid existing marsh areas along the Bay levee and was close to the deeper channel maintained by flows from Stevens Creek. The existing intake location has marsh elevations outside the intake which limit inflow to only high tide periods. After consultation with NMFS, Stevens Creek was identified as potential steelhead habitat. The alternative intake location was not included in the ISP to avoid potential conflicts with steelhead migration to and from Stevens Creek.

3.4.6.2 Alviso A7 System

An alternative intake location was considered for the Alviso A7 system intake. The alternative was to intake at the A7 outfall location, and discharge at the A5 intake location. Under the alternative, the system would flow in the reverse direction from the ISP direction. The alternative would avoid potential intake of fresh water from Guadalupe Slough which contains effluent from the Sunnyvale WWTP. The alternative intake location was not included in the ISP to avoid potential conflicts with steelhead migration in Alviso Slough. After consultation with NMFS, Alviso Slough was identified as Chinook salmon and steelhead habitat. Detailed modeling of the Guadalupe Slough conditions has shown that the slough at the A5 intake location would be predominantly higher salinity Bay water at high tide. The gravity intake would flow at high tide.

3.4.6.3 Alviso A14 System

The Alviso A14 system included two separate alternatives which would include continuous circulation through all of the ponds. The ISP includes ponds A12, A13 and A15 as batch ponds.

The first alternative included four separate sub systems. A9 and A14 would be one sub system with flow from A9 to A14. A10 and A11 would be intake/outlet sub systems with tidal inflow and outflow to and from Alviso Slough into each pond. A15, A13 and A12 would be the last sub system with flow from A15 to A12. The alternative included potential issues with multiple discharges to Alviso Slough during initial release. The spring or summer freshwater flow in Alviso Slough may not be sufficient to carry the salinity from the pond discharges out to the Bay during the initial release. In addition, the flow from A15 to A12 would transfer Coyote Creek water to Alviso Slough and could represent a distracting trace flow to upstream migrating salmonids which may follow chemical clues from Coyote Creek.

The second alternative would include all of the ponds in the Alviso A14 system, without sub systems. The inflow would be at A15, the highest pond in the system. The flow would be from A15, through ponds A14, A13, A12, A11, A10 and discharge at A9 to lower Alviso Slough. The alternative would allow gravity flow without the use of the existing pump from A13 up to A15. However, the alternative would reverse the flow of the entire system and would increase operating water levels in ponds A14, A13, and A12, and decrease operating water levels in ponds A9 and A10. The higher water levels in ponds several ponds would require raising several internal levees and the levee along the railroad southeast of ponds A12 and A13.

3.4.6.4 Alviso A16 System

Two alternatives were considered for the Alviso A16 system. The first alternative would reverse the ISP direction of flow to intake from Artesian Slough and discharge to Coyote Creek. The intake from Artesian

Slough would avoid potential entrainment of migrating salmonids in Coyote Creek. However, the intake from Artesian Slough would contain low salinity water from the San Jose WWTP, and the entire system could operate at much lower salinities. The lower pond salinities could increase the risk of avian botulism in the ponds.

The second alternative for the Alviso A16 system would operate ponds A16 and A17 as batch ponds at higher salinities similar to ponds A12, A13 and A15 in the A14 system. This alternative would require a high salinity discharge to either Coyote Creek or Artesian Slough. Evaluation of the predicted pond discharge shows that the high salinity discharge may not meet receiving water quality objectives on a long term basis.

3.4.6.5 Baumberg 2 System

An alternative operation was considered for Baumber 2 system to maintain the water levels in all four ponds on a year around basis. This would require additional pumping at the pond 1 intake and construction of additional pumping capacity. This was not the preferred alternative due to the high cost of pumping during the summer peak evaporation season.

3.4.6.6 Baumberg 2C System

An alternative flow operation was considered for Baumberg 2C system to maintain the existing direction of flow from pond 4C to 5C to 1C. This was not the preferred alternative because the existing Coyote intake pump would be available to supplement the flow from the pond 6 intake pump, and to maintain future flexibility in the system.

3.4.6.7 Baumberg 8A System

An alternative operation was considered for Baumberg 8A system to maintain the water levels in all four ponds on a year around basis. This would require construction of an intake pump into the system. The intake pump was proposed at pond 8A to flow through to pond 9 and discharge at pond 9 to Mount Eden Creek. The flow from 8A to 9 was proposed to follow the existing pond bottom elevations to maintain similar pond depths in the two ponds. This was not the preferred alternative due to the high cost of pumping during the summer peak evaporation season.

3.4.6.8 Baumberg 6A System

An alternative operation was considered for Baumberg 6A system to maintain the water levels in all three ponds on a year around basis. This would require construction of an intake culvert or pump into the pond 8 and a discharge from pond 6A. This was not the preferred alternative due to the potential for higher salinities in Old Alameda Creek during the summer high evaporation season, and the potential for recycling of the discharge from pond 6A to the intakes at ponds 6 and 1. Old Alameda Creek has a limited drainage area with low flow rates in the summer to carry the pond 6A discharge downstream to the Bay.

4.0 Proposed Initial Stewardship Implementation Plan

4.1 General Project Description

4.1.1 Introduction and Summary

The purpose of this ISP is to circulate water through the South Bay salt ponds to minimize any effects on existing potential wildlife habitat, pond water quality and salinity levels during the planning and implementation of a long-term salt pond restoration program. The project includes installation of water control structures, operation of ponds including discharge of waters, and maintaining structures and levees. Following initial release of brines from salt-making operations, the ponds would be operated to generally limit salinity discharge levels to 40 ppt. The proposed discharge limit for long-term operations is 44 ppt to allow some flexibility in the operation of the individual pond systems during the initial stewardship period. The proposed pond operations are based on modeling data and may be modified by adaptive management based on results of wildlife and water quality monitoring data.

Following is a summary description of the model used to calculate predicted salinities and water depths under the ISP, predicted water depths in the ponds, proposed and modeled discharge salinities, and the structures to be installed to meet the project objectives. Detailed project descriptions for the Alviso, Baumberg, and West Bay complexes and their individual pond systems are included in Section 4.2. Section 4.2 also describes the modeled initial release conditions based on April 2002 pond conditions, which was used for design of the project structures and evaluate system constraints. Section 4.3 presents salinity model results for permit conditions under maximum initial release conditions and under phased initial release conditions for those same complexes. The preferred project for CEQA/NEPA evaluation includes the phased initial release scenario in Section 4.3.2.

4.1.2 Overall Hydraulic Design

The proposed hydraulic structures and circulation systems have been designed based on hydraulic modeling of the individual pond systems. The pond hydraulic model described in Section 3.4.1 was used to model initial and long-term conditions in each pond system for the ISP.

The pond model was used to simulate the pond systems for an 18-month period from April 1994 to October 1995. As described in Section 3.3.3, the time period was selected to include two summer evaporations seasons; one for a dry year with high bay salinities; and one for a wet year with low bay salinities.

4.1.3 Initial Salinity Releases

The initial release period is the startup period for the circulation of bay water through the pond systems. By the use of water management techniques developed during years of salt production, the targeted ponds' salinity will be reduced to levels similar to the salinity of the Bay. These water management techniques include the following:

- The use of tides to move water in and out of the various ponds and the Bay
- Careful monitoring of water movement and salinity
- Natural mixing of differential saline solutions
- Replacement of displaced high saline waters with Bay water

In a simplified example, Pond A's outflow structure will be opened to allow tides to discharge waters from the pond into the Bay. At the same time an adjacent pond, Pond B, will be partially drained into Pond A to take the place of the original discharged water. The intake structure to Pond B will also be opened to allow Bay water to enter Pond B. As the tides rise and the flows through the structures slow and cease, some natural mixing of the water will take place in the ponds reducing the salinity in the system slowly in a cost-effective manner.

For project design and to evaluate system constraints, the pond salinities during the initial release period were estimated based on salinity and water levels recorded in April 2002 as a representative time. April was considered a reasonable time for the initial release because bay salinities are generally low to maximize dilution of the higher initial release salinities within the ponds before discharge and in the receiving waters after discharge. Also, April is the beginning of the summer high evaporation season, before the salinity levels in the ponds start to increase.

The April 2002 initial release salinities were used in conjunction with recorded bay salinities, freshwater flows and evaporation rates for 1994 and 1995 to model a trial initial release scenario to begin the pond model for the long term conditions for each system. The actual pond salinities may vary as shown in the historic range of salinity in the individual ponds included in Table 4.1.5. Therefore, for permitting purposes, maximum initial salinity discharge levels were also modeled using two different release dates: April and July (see Section 4.1.5).

4.1.4 Pond Model Results

The pond model results for the April 2002 initial condition and long term model for each individual pond system are included in the system descriptions in Section 4.2. The model results are presented as graphs of significant hydraulic parameters over time for the model period of April 1994 to October 1995. In Section 4.3 the results of the two other release scenarios are displayed. These permit release scenarios include proposed maximum initial release salinity levels, as described in Section 4.1.

As an example illustrating the contents of the graphs, Figure 4-2 shows the model results for Alviso System A2W. The lower axis is the time within the model period. The left axis is the estimated discharge salinity from the outlet pond over time. For system A2W, using April 2002 pond salinity values, the initial salinity begins at approximately 31 parts per thousand (ppt). The discharge salinity decreases slightly during the first 2 months of the initial release then starts to increase as the summer evaporation increases. The pond salinity decreases in the fall and winter and increases the following summer.

The upper graph in Figure 4-2 also shows the gravity intake flow as a daily inflow volume in acre-feet, using the right axis of the graph. The daily inflow volume fluctuates with the tide cycle. The inflow is described as a gravity intake to distinguish the flow from a pump intake system. Other systems include pumped inflows. The gravity inflow is flow through a culvert with a flapgate (one way valve). The culvert would allow flow into the pond when the tide elevation outside the levee is above the water level in the pond. The flow graph also shows a discharge flow rate, also expressed as a daily volume in acre-feet. All of the discharge structures in the ISP systems would be gravity flow culverts that would discharge when the tide levels are lower than the water level in the discharge pond.

The lower graph in Figure 4-2 shows the same discharge salinity as the upper graph, with the calculated water levels in the intake pond and outlet pond. For system A2W, pond A1 is the intake pond and pond A2W is the outlet ponds. All of the systems are labeled based on the pond designation for the discharge pond. Therefore each discharge has a unique name and is associated with an individual system. For system A2W, the water levels in the intake pond A1 are always higher than the water level in the discharge pond A2W. Water flows from A1 to A2W by gravity.

4.1.5 Maximum Initial Release Salinities

Although the initial modeling utilized actual pond salinities from April 2002 for trial initial release conditions, those salinities are not static. Because of the variability of salinity conditions within the pond systems, an upper limit for the initial release salinity conditions is proposed. The upper limits for the initial salinities provide an upper bound for the initial release conditions for the discharge permit and CEQA/NEPA evaluation. These upper limits are presented in Table 4.1.5 and the simulation results of the pond systems are shown in Section 4.3.

Three pond groupings are proposed based on the maximum salinity that could be discharged. Note that not all ponds would directly discharge to the Bay or sloughs, but Table 4.1.5 lists the maximum salinity of each pond at the time discharge would occur. Ponds were designated for a particular salinity group based on the historic operation of the salt pond and system constraints on changes to the existing salinities. Salinity group 1 ponds would have a maximum initial discharge salinity of 65 ppt. These ponds are generally intake ponds or ponds near intakes with the lowest existing and historic salinities. Salinity group 2 ponds would have a maximum initial discharge salinity of 100 ppt except for Ponds A5, A7, and A8. Salinity Group 2 ponds are in the middle range of the ponds in the proposed initial stewardship project. Salinity group 3 ponds would have a maximum initial discharge salinity of 135 ppt. Additional model results of these maximum salinity release conditions are shown in Section 4.3.

The upper limit for the salinity group 3 ponds was established based on the ion balance in the salt water in the ponds. Sea water or bay water includes a variety of anions and cations, not just sodium and chloride ions. Above approximately 150 ppt, the first ions from the salt water begin to precipitate (calcium sulfate). Below that salinity the pond contents are concentrated bay water and could be diluted back to bay water concentrations without affecting the ratio of the ions in the water. Once some of the ions have precipitated out, the ion balance is affected and the relative concentration of sodium and calcium ions has been changed. This may affect species in the bay or sloughs if the brines were released. Unlike sodium chloride, the calcium sulfate (gypsum) cannot be readily dissolved by exposure to new freshwater. The proposed initial release from Alviso Ponds A19, A20, and A21 (Island Ponds) and West Bay Ponds 1-5 and SF2, which presently contain brines above 150 ppt, would occur after these 150 ppt brines were moved out of these ponds to the salt plant site and replaced with brines/waters that are less than 150 ppt.

Table 4.1.5
Salinity Groups

Salinity Group	Maximum Discharge Salinity	Alviso Complex Ponds	Baumberg Complex Ponds	West Bay Complex Ponds
Group 1	65 ppt	A1, A2W A2E, B1, B2, A3W, A3N	1,2,4,7 10,11	
Group 2	100 ppt	A5*, A7*, A8* A9, A10, A11, A14	5, 6, 1C, 2C, 3C, 4C, 5C, 6C	
Group 3	135 ppt	A12, A13, A15 A16, A17 A19, A20, A21	6A,6B 9,8A,8 12,13,14	1,2,3,4,5,5S SF2

* These ponds include an upper limit of 110 ppt

As noted previously, the model analyses for system design included trial initial release conditions and assumed that all of the continuous circulation ponds would have initial salinity and water surface elevations similar to the recorded conditions in April 2002. The Alviso Island ponds, Alviso ponds A22 and A23, and the West Bay complex ponds were not included in this initial release model analysis. Due to constraints associated with the existing salt operations and agreements between Cargill and DFG/FWS, circulation and discharge of waters from these ponds would be at a later time than the other ponds.

For CEQA/NEPA evaluation and discharge permitting, two permitting initial release scenarios were developed using the pond model described above and in Chapter 3. The results of the pond model for the permitting initial release scenarios are included in Section 4.3.

The modeled initial release scenarios are:

- **April 2002 Initial Salinity** - All systems except the island ponds (A19, A20, and A21), the A23 system, and the West Bay pond group to begin discharge in April. Initial pond salinities based on recorded values from April 2002.
- **Maximum Initial Salinity** - All systems except the island ponds (A19, A20, and A21), the A23 system, and the West Bay pond group to begin discharge in April. Initial pond salinities based on the maximum salinities from Table 4.1.5 above.
- **Phased Release, with Maximum Initial Salinity** - Selected ponds would begin initial release at the same time. These would include Alviso Systems A2W, A3W, A7 and Baumberg Systems 2, 8A and 11. The ponds were selected to represent a significant number of systems that could be included in a first phase of the project based on construction and operational constraints. The phased release was assumed to begin in July, to allow some construction in the spring after the winter rainy season. Most of the proposed system structures would not be accessible for construction during the winter. The initial pond salinities were based on the maximum salinities from Table 4.1.5 above. The remaining pond systems, Alviso Systems A14 and A16, and Baumberg System 2C, would start circulation in the subsequent year. The initial release for these later systems is proposed to occur the following April and the model results would be similar to the Maximum Initial Salinity scenario above.

The phased release scenario also included a modification of the operation for Baumberg System 11. Because the phased release would occur prior to completion of the Mount Eden Creek channel construction project, the proposed outlets to the new channel from ponds 10 and 11 would not be available for the phased release scenario. An alternative initial operation scheme was included which would use the existing pond 10 intake as an intake/outlet. The initial release would be from the intake and would release the volume of ponds 10 and 11. After the initial release, pond 11 would be operated as seasonal with no intake or discharge. Pond 11 would partially fill with rainwater during the winter and dry out during the summer.

The results of the simulation modeling for the April 2002 Initial Salinity scenario are presented in Section 4.2. The results for the Maximum Initial Salinity and the Phased Release scenarios are presented in Section 4.3. These proposed permitting initial release scenarios would not affect the modeled long-term operation results described in Section 4.2.

4.1.6 Long Term Discharge Salinities

The water control structures were designed to maintain discharge levels below 40 ppt year round. However, to anticipate potential operational issues that could occur during ISP operations, the possibility of salinity peaks up to 44 ppt were evaluated and will be included in the EIR/EIS for this project.

4.1.7 Summary of Water Surface Elevations

The existing average pond water surface elevations were based on recorded values for the past 6 years, January 1997 to December 2002. A summary of existing pond salinities, existing water surface elevations and predicted ISP conditions is shown on Table 4.1.7.

Table 4.1.7
Pond Elevations under Existing and ISP Conditions and Salinity under Existing Conditions

Pond	Pond Area (Acres)	Pond Bottom Elevation NGVD	Existing Average (Year Round) Depth (ft)	Salinity Range (ppt)	Summer					Winter				
					Existing			ISP	Change (ISP-Avg) (ft)	Existing			ISP	Change (ISP-Avg) (ft)
					6-year Average Depth (ft)	Depth Range		Avg Water Depth (ft)		6-year Average Depth (ft)	Depth Range		Avg Water Depth (ft)	
						Min (ft)	Max (ft)				Min (ft)	Max (ft)		
Alviso Ponds														
A1	277	-1.8	1.8	11-42	1.8	1.3	2.5	1.4	-0.4	1.8	1.4	2.8	1.7	-0.2
A2W	429	-2.4	1.8	15-43	1.8	1.1	2.6	1.9	0.2	1.8	1.3	2.8	2.2	0.4
B1	142	-0.8	1.5	13-41	1.4	0.7	2.2	1.2	-0.1	1.6	1.0	2.4	1.7	0.0
B2	170	-0.6	1.3	13-43	1.2	0.5	2.0	1.0	-0.1	1.4	0.8	2.2	1.5	0.0
A2E	310	-3.1	1.9	18-43	2.0	1.1	2.7	2.6	0.7	1.9	1.3	2.8	3.1	1.2
A3N	163	-1.4	0.6	16-41	0.8	0.0	1.2	**B/S**		0.6	-0.1	1.3	**B/S**	
A3W	560	-3.2	1.9	23-44	1.9	1.1	2.6	1.8	-0.1	2.0	1.3	2.9	2.1	0.2
A5	615	-0.6	0.7	28-60	0.7	0.2	1.1	1.0	0.3	0.8	0.1	1.2	1.2	0.4
A7	256	-0.5	0.6	28-75	0.5	0.0	0.9	0.9	0.4	0.7	-0.1	1.1	1.1	0.5
A8	406	-3.4	1.6	31-110	1.4	0.6	2.2	**B/S**		1.8	1.2	3.3	**B/S**	
A9	385	-0.2	4.1	11-38	4.1	3.5	4.7	2.2	-1.9	4.1	3.2	5.1	1.7	-2.3
A10	249	-0.8	3.3	17-45	3.3	2.8	4.0	2.6	-0.7	3.4	2.6	4.5	2.3	-1.1
A11	263	-1.8	3.5	28-69	3.3	2.5	4.3	3.1	-0.1	3.6	2.9	4.6	3.2	-0.4
A14	341	0.0	1.4	48-135	0.8	0.1	2.0	0.9	0.1	1.5	0.5	2.5	1.3	-0.3
A12	309	-2	3.4	35-66	3.1	2.3	4.2	**B**		3.7	2.5	4.6	**B**	
A13	269	-1.1	2.3	38-77	2.0	1.2	3.2	**B**		2.7	1.6	3.6	**B**	
A15	249	0.7	2.2	40-111	2.1	0.8	2.7	**B**		2.3	1.6	3.0	**B**	
A17	131	1.1	1.6	45-137	1.4	0.6	2.5	1.2	-0.3	1.8	1.3	2.7	1.1	-0.7
A16	243	0.6	2.1	43-122	1.9	1.0	2.8	1.7	-0.2	2.3	1.7	3.2	1.6	-0.7
A19	265	1.8	2.0	79-290	2.0	-0.2	2.9	**T**		2.1	1.1	3.0	**T**	
A20	63	1.8	1.9	87-289	1.7	0.4	2.6	**T**		2.0	1.2	3.1	**T**	
A21	147	2.31	1.2	87-304	1.0	-0.1	2.0	**T**		1.5	0.5	2.5	**T**	

Notes: S = Seasonal Pond
B = Batch Pond
T = Tidal Pond

Table 4.1.7
Pond Elevations under Existing and ISP Conditions and Salinity under Existing Conditions (Continued)

Pond	Pond Area (Acres)	Pond Bottom Elevation NGVD	Existing Average (Year Round) Depth (ft)	Existing Salinity Range (ppt)	Summer					Winter				
					Existing			ISP	Change (ISP-Avg) (ft)	Existing			ISP	Change (ISP-Avg) (ft)
					6-year Average Depth (ft)	Depth Range		Avg Water Depth (ft)		6-year Average Depth (ft)	Depth Range		Avg Water Depth (ft)	
						Min (ft)	Max (ft)				Min (ft)	Max (ft)		
Baumberg Ponds														
1	337	2.2	2.6	18-46	2.5	1.9	3.4	1.3	-1.2	2.8	2.3	3.8	2.3	-0.5
7	209	2.5	2.3	23-59	2.2	1.5	3.0	0.6	-1.6	2.5	2.0	3.5	1.9	-0.6
4	175	2.9	1.5	16-60	1.4	0.7	2.3	0.2	-1.2	1.6	0.9	2.7	1.5	-0.2
2	673	2.1	2.7	20-49	2.5	1.9	3.4	1.0	-1.6	2.9	2.3	3.9	2.3	-0.6
6	176	2.4	2.3	25-148	2.1	1.4	2.7	2.8	0.7	2.5	1.8	3.6	2.5	0.1
5	159	2.4	2.2	23-149	2.0	1.5	2.6	2.7	0.8	2.3	1.5	3.5	2.5	0.2
6C	78	2.8	1.7	23-132	1.5	1.0	2.1	2.2	0.7	1.8	1.1	2.9	2.1	0.3
4C	175	3.2	1.0	23-143	0.8	0.5	1.8	1.3	0.5	1.3	0.5	2.5	1.6	0.3
3C	153	2.9	1.3	23-145	1.1	0.7	2.1	1.1	0.0	1.6	0.7	2.8	1.7	0.1
1C	66	3.6	0.6	22-147	0.5	0.2	1.3	0.9	0.4	0.1	0.2	2.1	1.2	1.1
5C	111	3.4	0.8	20-136	0.6	0.3	1.5	1.1	0.5	1.1	0.3	2.3	1.4	0.3
2C	24	2.7	1.3	20-178	1.0	0.5	1.8	1.3	0.3	1.6	0.7	2.7	1.7	0.1
8	180	3.7	2.5	48-296	2.8	1.3	2.8	**S**		2.8	2.3	3.3	0.6	-2.2
6B	284	2.1	0.9	35-231	0.6	-0.6	2.0	**S**		1.2	0.6	2.7	0.9	-0.3
6A	340	0.9	2.2	32-184	1.9	1.1	3.2	**S**		2.4	1.8	4.0	2.1	-0.3
9	366	2.6	2.1	62-241	1.8	1.1	3.0	0.8	-1.0	2.4	1.8	3.3	2.0	-0.4
8A	256	4.0	0.7	69-265	0.4	-0.5	1.6	-2.0	-2.3	1.0	0.4	1.9	0.6	-0.4
12	99	2.9	1.7	27-328	1.4	0.1	2.7	**S**		1.9	1.5	2.9	1.1	-0.8
13	132	3.1	1.5	27-334	1.2	-0.1	2.5	**S**		1.7	1.2	2.6	0.9	-0.8
14	156	3.5	1.2	32-304	0.9	0.1	2.1	**S**		1.4	0.9	2.2	0.5	-0.9
10	214	2.4	1.3	16-74	1.3	0.3	1.6	1.2	-0.1	1.4	0.3	2.6	1.6	0.1
11	118	2.9	1.4	16-81	1.3	0.4	1.8	**S**		1.6	0.4	2.6	1.1	-0.5

Notes: S = Seasonal Pond
B = Batch Pond

Table 4.1.7
Pond Elevations under Existing and ISP Conditions and Salinity under Existing Conditions (Concluded)

Pond	**Pond Area (Acres)**	**Pond Bottom Elevation NGVD**	**Existing Average (Year Round) Depth (ft)**	**Existing Salinity Range (ppt)**	**Summer**					**Winter**				
					Existing			**ISP**	**Change (ISP-Avg) (ft)**	**Existing**			**ISP**	**Change (ISP-Avg) (ft)**
					6-year Average Depth (ft)	**Depth Range**		**Avg Water Depth (ft)**		**6-year Average Depth (ft)**	**Depth Range**		**Avg Water Depth (ft)**	
						Min (ft)	**Max (ft)**				**Min (ft)**	**Max (ft)**		
West Bay Ponds														
1	445	2.1	0.5	35-326	0.4	-2.0	2.9	0.9	0.5	0.8	-2.0	3.1	1.0	0.2
2	145	2.0	1.6	64-306	1.4	0.1	2.9	0.8	-0.6	1.7	0.2	3.4	0.9	-0.8
3	273	2.2	1.2	145-320	0.9	-0.4	2.4	0.8	-0.1	1.6	-0.4	2.7	0.9	-0.8
4	297	2.8	0.4	88-341	0.0	-1.8	1.5	0.7	0.6	0.7	-1.8	2.0	0.7	0.0
5	31	2.5	0.6	96-340	0.3	-1.6	1.7	1.0	0.7	1.0	-1.6	2.2	1.0	0.0
S5	29	2.5	-2.5					1.2					1.2	
SF2	242	2.6	1.0	76-316	1.0	0.3	2.1	0.7	-0.3	1.0	0.2	2.2	0.8	-0.2

Notes: S = Seasonal Pond
B = Batch Pond

4.1.8 Water Control Structures

The intake and outlet structures and internal connections were designed to provide adequate circulation and water quality control during the summer evaporation season. Tables 4.1.8 a, b, c, and d summarize existing and proposed water control structures for each pond system. Intake and outlet structures were sized to maintain discharge salinity levels below 40 ppt. for a summer after a low rainfall winter. Intake and outlet structures are designed with operable gates and flapgates to control water level.

Predicted flow rates for each system are described using average daily flow and peak flows for both the intake and outlet. During summer, the intake flows generally exceed the discharge flows due to the evaporation from the pond system. During winter, intake flows are less than discharge flows due to rainfall into the pond system.

Some control structures were designed to allow the ability to close off all flow, allow inflow only, or allow outflow only, offering the management ability to reverse direction of inflow and outflows when necessary to control salinity and/or water levels. In Alviso System A3W and Baumberg Systems B2 and 8A, under flood conditions, it may be necessary to use the intake as an outlet to drain excess volume from the system to prevent wave wash from excessive high water from damaging levees. In Alviso System A16, flows can be reversed to avoid inflows from San Jose Waste Water Treatment Facility. Intake flows in Alviso system A9 and A16 can be blocked or reversed during the winter to prevent entrainment of migrating salmonids. Because of the flapgates and the relative elevations of the tide and pond water levels, all intake flow would occur at high tide, and all outflows would occur at low tide.

Table 4.1.8a
Water Control Structures
Alviso

Structure Number	From	To	Type	Structure	new/existing
Alviso A2W System					
A2W-1-inlet	Charleston	A1	Gravity	60" gate	existing
A2W-2	A1	A2W	Gravity	72" siphon	existing
A2W-3	A2W	A2E	Gravity	siphon to A2E (A3W System)	existing
A2W-4-outlet	A2W	Bay	Gravity	48" gate	new
Alviso A3W System					
A3W-1-inlet	Bay	B1	Gravity	48" gate	new
A3W-2-inlet	Bay	B1	Gravity	36" gate	existing
A3W-3	B1	B2	Gravity	60' Gap	existing
A3W-4	B1	A2E	Gravity	48"gate	new
A3W-5	A2W	A2E	Gravity	siphon from A2W (A2W System)	
A3W-6	A2E	A3W	Gravity	2-36" pipes in series	existing
A3W-7	B2	A3W	Gravity	36" gate	replace A3w-7x
A3W-7x	B2	A3W	Gravity	24" gate	remove
A3W-8	B2	A3N	Batch	24" gate	existing
A3W-9	A3N	A3W	Batch	24" gate	existing
A3W-10-outlet	A3W	Guadalupe	Gravity	3x48" gates	new
Alviso A7 System					
A7-1-inlet	guadalupe	A5	Gravity	2 x 48" gates	new
A7-2	A5	A7	Gravity	12' cut	new
A7-3	A5	A7	Gravity	gap	fill existing gap
A7-4	A7	A8	Gravity	24" gate	existing
A7-5	A4	A5	Gravity	siphon from A4	existing
A7-6	A8	A11	Pump	4,000 gpm pump to A11/A7	new piping from existing pump
A7-7-outlet	A7	alviso	Gravity	2 x 48" gates	new
A7-8	guadalupe	A8	Gravity	overflow weir	new by others

Table 4.1.8a
Water Control Structures
Alviso
(Continued)

Structure Number	From	To	Type	Structure	new/existing
Alviso A14 System					
A14-1-inlet	alviso slough	A9	Gravity	2 x 48" gates	existing
A14-2	A9	A10	Gravity	48" gate	remove & replace
A14-3	A10	A11	Gravity	48" gate	existing
A14-4	A11	A12	Batch	48" gate	existing
A14-5	A12	A13	Batch	48" gate	remove & replace
A14-6	A15	A16	Batch	30" siphon to A16	existing
A14-7	A11	A14	Gravity	48" gate	new
A14-8	A14	A13	Batch	36" gate	existing
A14-9	A13	A15	Pump	22k gpm pump to A15	existing
A14-10-intake	coyote crk	A15	Alt Intake	48" gate	new
A14-11	A15	A14	Batch	36" gate	repair by others
A14-12	A9	A14	Gravity	36" gate	new by others
A14-outlet	A14	coyote ck	Gravity	2 x 48" gates	new
Alviso A16 System					
A16-1-inlet	coyote crk	A17	Gravity	48" gate	new
A16-2	A17	A18	Gravity	30" siphon w/gate to A18	existing
A16-3	A17	A16	Gravity	50' cut	existing
A16-4	A15	A16	Gravity	30" siphon w/gate from A15	existing
A16-5-outlet	A16	artesian slough	Gravity	48" gate	new
Alviso A23 System					
A23-1-intake	mud slough	A22	Gravity	48" gate	new
A23-2	A22	A23	Gravity	wood box	existing
A23-3-intake	mud slough	A23	Gravity	48" gate	new
A23-4	A22	A23	Gravity	24" gate at pump station	existing
A23-5	A23	A22	Gravity	24" gate at pump station	existing
A23-6	A23	Plant 2 CP4/CP5	Gravity	4000 gpm Crabby Joe Pump	existing

Table 4.1.8a
Water Control Structures
Alviso
(Concluded)

Structure Number	From	To	Type	Structure	new/existing
Island Ponds					
IP-1	A18	A19	Gravity	siphon from A18	existing
IP-2	A18	A19	Gravity	Coyote siphon pump	existing
IP-3	A19	A20	Gravity	siphon	existing
IP-4	A20	A21	Gravity	siphon	existing
IP-5	A21	mud slough pump	Gravity	24" gate	existing
IP-6	A21	plant 2	Pump	Mud Slough pump to Plant 2	existing

Table 4.1.8b
Water Control Structures
Baumberg

Structure Number	From	To	Type	Structure	new/existing
Baumberg 2 System					
B2-1-inlet	old alameda creek	1	Gravity	4 x 48" gates	new
B2-2	old alameda creek	1	Pump	30,000 gpm pump	existing
B2-3	1	2	Gravity	48" gate	replaces B2-3x
B2-3x	1	2	Gravity	8 x 42" wood gates	remove
B2-5	1	2	Gravity	fill existing gap	Fill
B2-6	1	7	Gravity	48" gate	new
B2-7	7	6	Gravity	48" gate to 6	remove
B2-8	7	4	Gravity	25' gap	existing
B2-9	4	5	Gravity	3 x 42" wood gates to 5	remove
B2-10	4	2	Gravity	40' gap	existing
B2-11-outlet	2	bay	Gravity	2 x 48" gates	new
B2-12	na	na	na	raise levee 4/5 & 7/6	raise existing

Table 4.1.8b
Water Control Structures
Baumberg
(Continued)

Structure Number	From	To	Type	Structure	new/existing
Baumberg 2c System					
B2c-1-inlet	continental	6	Gravity	36" siphon from continental (System 6A)	
B2c-2-inlet	old alameda creek	6	Pump	30,000 gpm pump	new
B2c-3	6	5	Gravity	15' gap	replace B2c-3x
B2c-3x	6	5	Gravity	4 x 45" wood gates	remove
B2c-4	5	6C	Gravity	48" gate	replace B2c-4x
B2c-4x	5	6C	Gravity	45" wood gate	remove
B2c-5	5	6C	Gravity	48" gate	replace B2c-5x
B2c-5x	5	6C	Gravity	36" gate	remove
B2c-6	7	6	Gravity	48" gate from 7	remove
B2c-7	4	5	Gravity	3X42" wood gates from 4	remove
B2c-8	6C	4C	Gravity	2 x 30" pipes	existing
B2c-9	1C	5C	Gravity	25' cut	existing
B2c-10	5C	4C	Gravity	25' gap	existing
B2c-11	4C	3C	Gravity	2 x 30" wood gates	existing
B2c-12	3C	2C	Gravity	25' cut w/bridge	existing
B2c-13	1C	5C	Gravity	24" pipe	existing
B2c-14	2C	alameda fcc	Gravity	2 x 48" gates	new
B2c-15	2C	1C	Gravity	30" Pipe	existing
B2c-16-inlet	alameda fcc	1C	Pump	7,660 gpm pump	existing
B2c-17-outlet	2C	Plant 1A	pump	Cal Hill transfer	existing

Table 4.1.1.3b
Water Control Structures
Baumberg
(Continued)

Structure Number	From	To	Type	Structure	new/existing
Baumberg 6a System					
B6a-1-inlet	North Ck	8	Gravity	48" gate	new by others
B6a-2	8	6b	Gravity	24" gate	remove & replace
B6a-3	6B	6A	Gravity	6" wood box	existing
B6a-4	Donut 2	6B	Gravity	36" gate	existing
B6a-5	Donut 2	8	Pump	continental pump	existing
B6a-6	Donut 1	8	Gravity	36" gate	existing
B6a-7	Donut 1	6	Gravity	36" siphon to 6	existing
B6a-8	Donut 1	6a	Gravity	36" gate	existing
B6a-9	Donut 1	Donut2	Gravity	36" gate	existing
B6a-10	6A	old alameda crk	Gravity	48" gate	new
Baumberg 8a System					
B8a-1-inlet	mt eden ck	9	Gravity	4 x 48" gates	new
B8a-2	14	9	Gravity	2 x 58" wood gates	existing
B8a-3	13	14	Gravity	2 x 42" wood gates	existing
B8a-4	Brine Ditch	12/13	Pump	10,000 gpm brine pump	existing
B8a-5	14	8x	Gravity	2 x 42" wood gates	existing
B8a-6	Brine Ditch	Brine Ditch	Gravity	2 x 42" wood gates	existing
B8a-7-inlet	north ck	8x	Gravity	48" pipe	existing
B8a-8	9	8A	Gravity	48" gate	existing w/ new weir
B8a-9	9	8A	Gravity	42" pipe	existing w/ new weir
B8a-10	north ck	8A	Gravity	48" gate	new by others
B8a-11	13	12	Gravity	cross levee abandoned	existing
B8a-12-outlet	8A	old alameda ck	Gravity	48" gate	new

Table 4.1.8b
Water Control Structures
Baumberg
(Concluded)

Structure Number	From	To	Type	Structure	new/existing
Baumberg 11 System					
B11-1-intake	new mt eden ck channel	10	Gravity	4 x 48" gates	new
B-11-2	10	11	Gravity	2 x 43" wood gates	existing
B-11-3	11	new mt eden ck channel	Gravity	48" gate	new by others
B-11-4	10	11	Gravity	48" gate	new by others
B-11-5	10	new mt eden ck channel	Gravity	48" gate	new by others
B11-6	bay	10	Gravity	4 x 48" gates	remove

Table 4.1.8c
Water Control Structures
West Bay

Structure Number	From	To	Type	Structure	new/existing
West Bay Ponds					
WB-1-inlet	ravenswood slough	1	Gravity	2 x 60" gates	existing
WB-1a-inlet/outlet	ravenswood slough	1	Gravity	48" gate	new
WB-2-inlet/outlet	ravenswood slough	3	Gravity	2 x 48" gates	new
WB-3	1	3 or 4	Pump	Ravenswood pump from 1	existing
WB-4-inlet/outlet	ravenswood slough	2	Gravity	2 x 48" gates	new
WB-5	2	1	Gravity	2 x 42" wood gates	existing
WB-6-inlet/outlet	bay	SF2	Gravity	3 x 48" gates	new
WB-7	2	SF2	Gravity	36" siphon	existing
WB-8	3	2	Gravity	30" siphon	existing
WB-9	3	S5	Gravity	36" wood gate	existing
WB-10	5	4	Gravity	existing gap	existing
WB-11-inlet	flood slough	S5	Gravity	48" gate	new
WB-12	S5	5	Gravity	2 x 36" wood gates	existing
WB-13-inlet/outlet	bay	4	Gravity	3 x 48" gates	new

4.1.9 Maintenance

Two types of maintenance would occur for all systems. The first would be normal inspection and maintenance of the gates, culverts, pumps and internal siphon structures throughout the year. The second would be long-term maintenance of the existing levees. Normal inspection and maintenance would occur monthly at the intake, outlet, and siphon to check that the gates and facilities are intact and operable. Gates, valve and siphon would require periodic operation and lubrication. Any damaged or inoperable equipment would be repaired as required.

Long-term maintenance of the levees would be required to compensate for subsidence and erosion. Because the existing levees were constructed from bay mud, the material shrinks and settles over time. It is anticipated that the on-going level of levee maintenance would continue in the future. There is an existing maintenance permit in place that is being transferred to the DFG/FWS.

More details of maintenance, including maintenance based upon monitoring, are included in Chapter 5.

4.2. Detailed Description Pond Complex Operations

4.2.1 Alviso System A2W

System A2W will consist of two ponds, A1 (intake) and A2W (outlet) as shown in Figure 4-1. The objectives for the system include:

- Establish tidal circulation through ponds A1 and A2W
- Maintain water surface elevations close to existing levels
- Maintain long term discharge salinity levels below 40 ppt
- Allow ability for one directional flow or close off all flow at intakes and outlet
- Locate outlet to minimize disturbance to tidal marsh and mudflat outboard of pond A2W.

The proposed system would include the following structures:

- Existing 60” gate intake at A1from lower Charleston Slough
- Existing 72” siphon under Mountain View Slough between A1 and A2W
- Existing staff gage at A1
- New 48” gate outlet structure at A2W to the Bay
- New staff gage at A2W

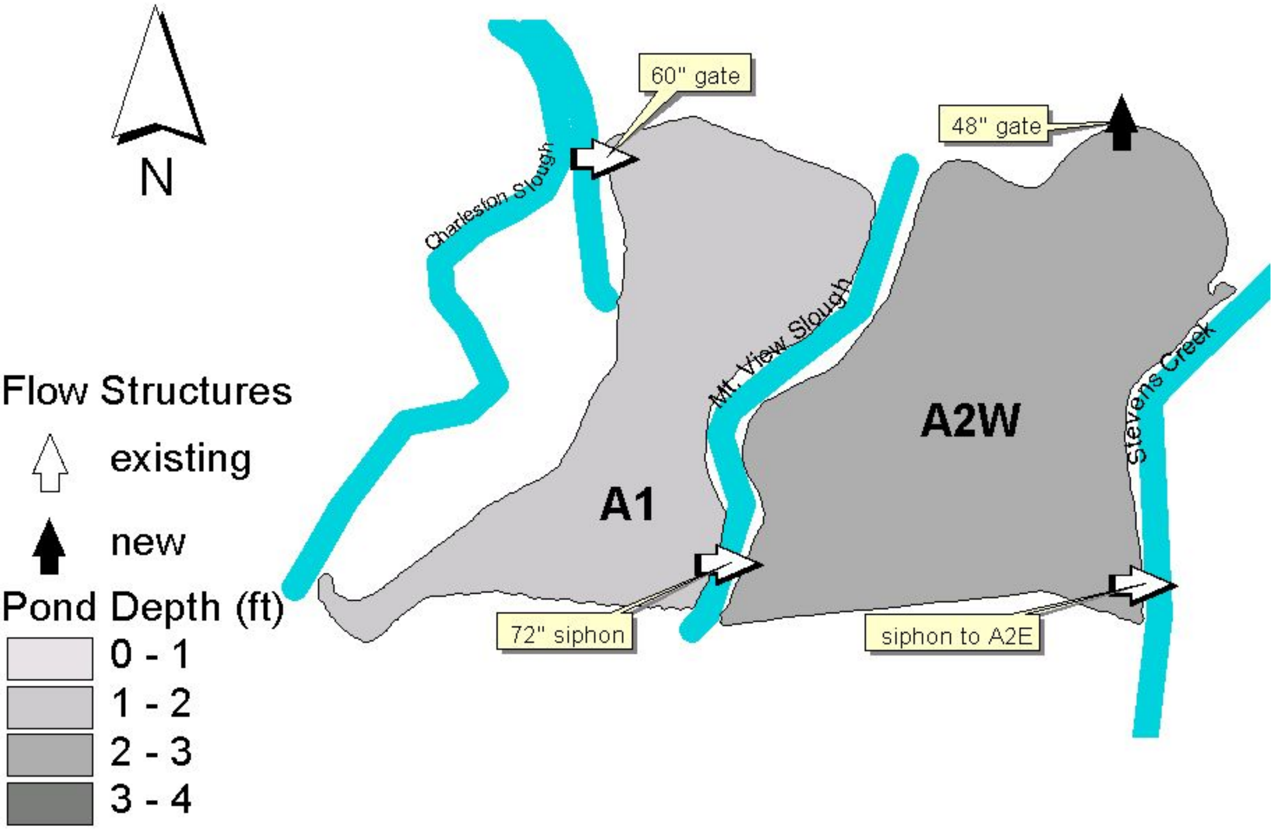


Figure 4-1
Map of Alviso A2W Inflow and Outflow Locations

4.2.1.1 Circulation Hydraulics

The intake location at the northwesterly end of A1 was selected to utilize the existing intake, as well as to allow inflow from lower Charleston Slough. The high tide salinities near the bay would be closer to normal bay salinity than farther upstream. The bay salinity would be closer to existing conditions in the ponds.

The outlet location at the northerly end of A2W was selected to allow outflow directly into the bay. The specific location of the outlet was selected because the mudflat and tidal marsh communities outside the levee are narrowest at the proposed location. However, the rate of discharge from A2W into the Bay may be limited by the elevations of mudflat/marsh area in the vicinity.

4.2.1.2 Interim Management Conditions

The system structure location map and graphs of pond operation flows, water levels and discharge salinities for the Alviso System A2W are shown in Figures 4-1 and 4-2.

The projected summer and winter daily flow and peak flow rates are shown in Table 4.2.1.2.1 below.

Table 4.2.1.2.1
Alviso System A2W Inflow and Outflow

Period	**Gravity Intake Flow**		**Outlet Flow**	
	Average	**Peak**	**Average**	**Peak**
Summer May - October	19 cfs 8,400 gpm	44 cfs 20,000 gpm	14 cfs 6,100 gpm	58 cfs 26,000 gpm
Winter November - April	18 cfs 8,200 gpm	44 cfs 20,000 gpm	19 cfs 8,700 gpm	100 cfs 45,000 gpm

The predicted water surface elevations during the initial stewardship period are shown in Table 4.2.1.2.2.

Table 4.2.1.2.2
Alviso System A2W Water Surface Elevations

Pond	**Area (acres)**	**Bottom Elevation (ft NGVD)**	**Water Elevation (ft NGVD)**		
			Existing	**Initial Stewardship**	
				Summer	**Winter**
A1	277	-1.8	0.0	-0.4	-0.1
A2W	429	-2.4	-0.6	-0.5	-0.2
Total/ Average	706	-2.2	-0.3	-0.4	-0.2

The control gate settings were not adjusted to actively manage the pond water levels. Active management of the control gate settings could maintain a more uniform water surface elevation in the ponds if necessary. For instance, the winter values shown are for a particularly wet (El Nino) winter and maximum pond elevations in A1 and A2W reached -0.2 ft NGVD, almost half a foot above the 5-year average for these ponds. However, the pond water levels normally vary due to operational considerations and climatic conditions. A1 and A2W have exceeded elevation 0.4 ft during 3 of the past 5 winters.

Although the ISP operation would allow tidal circulation through the pond system, the flow into and out of the ponds on a daily basis would be relatively small compared to the volume in the ponds. Typical daily water surface elevations would fluctuate by less than 0.1 ft.

4.2.1.3 Salinity

The estimated discharge salinity from pond A2W for long term operation conditions is shown in Figure 4-2. The model results are shown for the entire simulation period from April 1994 to October 1995. The model simulation period includes a dry year and a wet year to evaluate discharge salinities for a range of summer operation conditions.

The initial pond salinities and water surface elevations were based on measured conditions in early April 2002. The pond system transitions from the initial starting conditions in the first 4 to 6 weeks of operation.

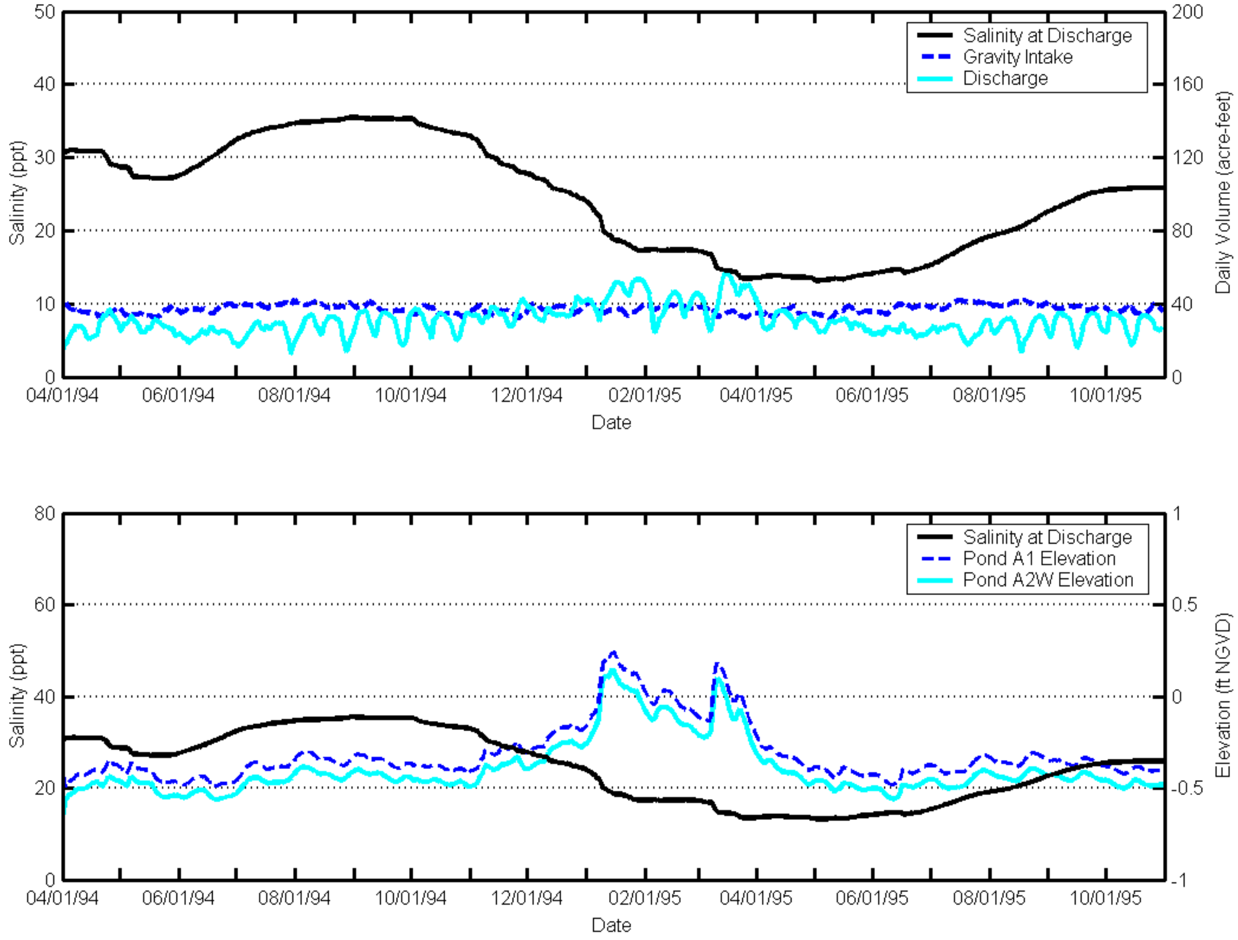
Table 4.2.1.3 shows the existing average summer and winter salinity levels based on recorded values for the past 6 years. The salinity in pond A2W has not been measured on a regular basis in the past. The salinity of pond A2W was estimated to be between the measured values for pond A1 and pond A2E, which are adjacent to pond A2W in the existing salt operation.

Table 4.2.1.3
System Alviso A2W Existing Pond Salinity

Pond	**Area (acres)**	**Average Pond Salinity (ppt)**		**Salinity Range (ppt)**
		Summer	**Winter**	
A1	277	26	22	11-42
A2W	429	28	25	15-43

The estimated pond salinities for the ISP operation would be within the range of the recorded pond salinities. Pond A1 is an existing intake pond and recorded salinities are close to bay salinity.

System A2W includes salinity group 1 ponds and could have a maximum initial discharge salinity of 65 ppt. If the salinity in the system were at the maximum at the start of bay water circulation, the discharge salinity would start at 65 ppt and decrease to be similar to the modeled conditions in Figure 4-2, Graph of Alviso A2W Operation Levels and Discharge Salinities, in a few months. Initial release scenarios, which include the maximum discharge salinity, have been modeled separately from the long-term salinity modeling for evaluation purposes.



Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-2
Graphs of Alviso A2W Operation Levels and Discharge Salinities

4.2.1.4 Management Operations

Ponds A1 and A2W will require limited active management. This would include on-going monitoring and inspections. The system may require adjustment of the control gates monthly or seasonally.

System A2W could be operated with reduced inflow and circulation during the winter season when evaporation is low. The proposed system includes an outlet weir to maintain minimum water levels with low flow rates. The system can be operated without an outlet weir, but may require more frequent adjustment of the control gates to control both water levels and salinities.

4.2.2 Alviso System A3W

Alviso System A3W consists of 5 ponds: B1 (intake), B2, A2E, A3W (outlet) and A3N, as shown in Figure 4-3. The objectives for the system include:

- Establish tidal circulation through ponds B1, B2, A2E and A3W
- Establish pond A3N as a seasonal or batch operation pond
- Maintain water surface elevations close to existing levels
- Maintain discharge salinity levels below 40 ppt.
- Locate new intake to prevent entrainment of salmonids should Stevens Creek support salmonids in the future
- Locate outfall to minimize disturbance to marsh along the A3W slough levee

The proposed plan would include the following structures:

- Existing 36” gate intake structure from the Bay at B1
- New 48” gate intake from the Bay at B1
- New 48” gate between B1 and A2E
- Existing 2x36” pipes in series between A2E and A3W.
- New 36” gate between B2 and A3W
- Existing gap between B1 and B2
- Existing 24” gate between B2 and A3N
- Existing 24” gate between A2N and A3W
- New 3x48” gate outlet at A3W to Guadalupe Slough. Two would be outlet only, and one would allow both inflow and outflow
- Existing staff gages at all ponds

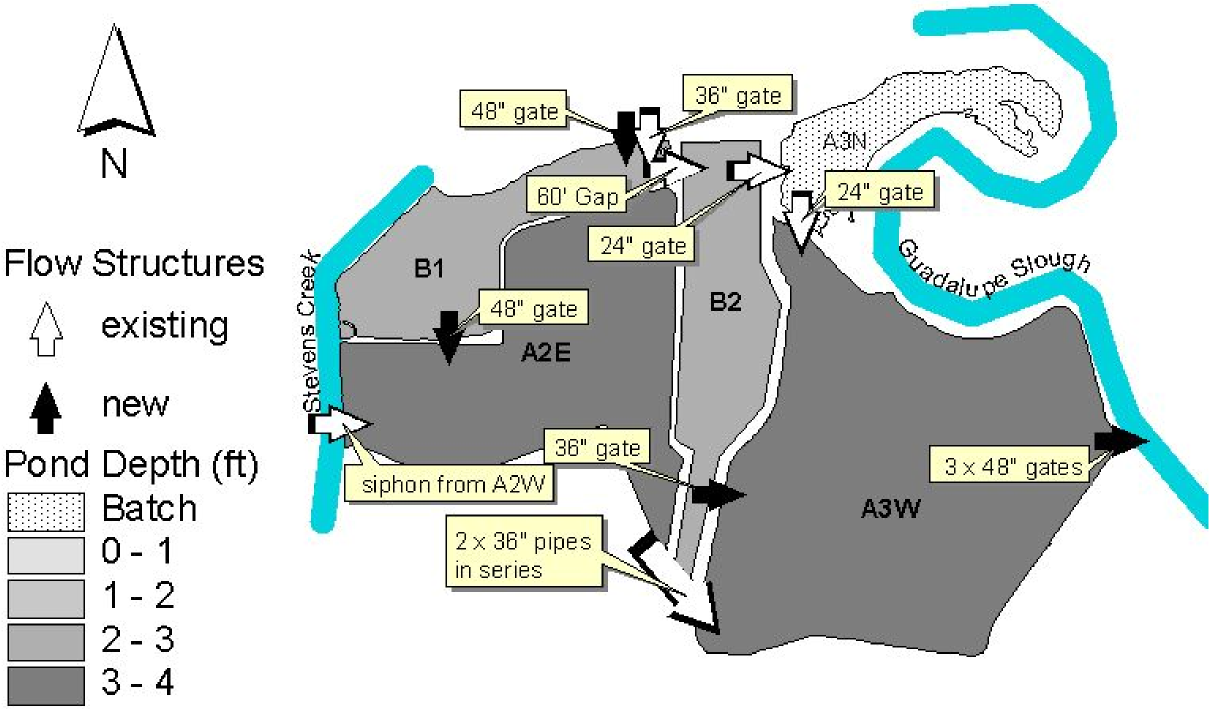


Figure 4-3
Map of Alviso A3W Inflow and Outflow Locations

4.2.2.1 Circulation Hydraulics

The intake location at the northeasterly end of B1 was selected to be near the existing intake and avoid inflow from the bay near the mouth of Stevens Creek. Stevens Creek has been identified as a potential salmonids fishery and migrating salmonids could be entrained in the intake flow if the intake were at Stevens Creek.

The outlet location at the easterly end of A3W was selected to allow outflow into Guadalupe Slough in close proximity to the existing dock structure near the Sunnyvale WWTP discharge. At that location, the new outfall would have the least impact on existing marsh along the slough levee.

The proposed control gates will allow intake at the outlet structure. It may be useful to intake at A3W to the dilute the pond volume if the pond salinity exceeds the discharge goals. Because of the flapgates and the relative elevations of the tide and pond water levels, all intake flow would occur at high tide, and all outflows would occur at low tide.

The long term discharge salinity levels at A3W would be at or above bay salinity, and would generally be higher than low tide salinity in Guadalupe Slough. Due to freshwater inflow from San Thomas Aquino Creek, Calabazas Creek, and the Sunnyvale WWTP, the salinity in Guadalupe Slough is typically lower than bay salinity, particularly at low tide water levels.

4.2.2.2 Interim Management Conditions

The system structure location map and graphs of pond operation flows, water levels and discharge salinities for the Alviso System A3W are shown in Figures 4-3 and 4-4.

Pond A3N was not included in the continuous operation model for the system. Pond A3N would operate as a seasonal or batch pond. As a seasonal pond, the pond would capture rainwater during the winter, and likely be dry during the summer. The pond salinity would not be controlled, but would fluctuate due to residual salt in the pond, rainwater inflows, and seasonal evaporation. As a batch pond, Pond A3N would not be subject to continuous flow. The volume and frequency of the intake and release would control the pond salinity in A3N similar to the existing operation levels. Water would be diverted from B2 to add volume to A3N, and discharged to A3W as needed to control water levels and salinity.

The predicted summer and winter daily average and peak flow rates for both the intake and outlet are shown in Table 4.2.2.2.1, below.

Table 4.2.2.2.1
Alviso System A3W Inflow and Outflow

Period	Gravity Intake Flow		Outlet Flow	
	Average	Peak	Average	Peak
Summer May - October	35 cfs 16,000 gpm	110 cfs 49,000 gpm	27 cfs 12,000 gpm	210 cfs 94,000 gpm
Winter November - April	32 cfs 14,000 gpm	110 cfs 50,000 gpm	34 cfs 15,000 gpm	250 cfs 110,000 gpm

The predicted water surface elevations during the initial stewardship period are shown in Table 4.2.2.2.2, below.

Table 4.2.2.2.2
Alviso System A3W Water Surface Elevations

Pond	Area (acres)	Bottom Elevation (ft NGVD)	Water Elevation (ft NGVD)		
			Existing	Initial Stewardship	
				Summer	Winter
B1	142	-0.8	0.7	0.4	0.9
A2E	310	-3.1	-1.2	-0.5	0.0
B2	170	-0.6	0.7	0.4	0.9
A3W	560	-3.2	-1.3	-1.4	-1.1
A3N	163	-1.4	-0.8	-	-
Total/ Average	1,345	-2.5	-0.4	-0.3	0.2

As modeled, the water level in the outlet Pond A3W will be within 0.1 ft of the existing average depth. The average water depth will be about 1.8 feet in summer and 2.1 feet in winter. The control gate settings were not adjusted to actively manage the pond water levels. Active management could maintain a more uniform water surface elevation in the ponds if necessary.

4.2.2.3 Salinity

The estimated discharge salinity from pond A3W into Guadalupe Slough is shown in Figure 4-4. The model results are shown for the entire simulation period from April 1994 to October 1995. The model simulation period includes a dry year and a wet year to evaluate discharge salinities for a range of summer operation conditions.

The initial pond salinities and water surface elevations were based on measured conditions in early April 2002. The pond system transitions from the initial starting conditions in the first 4 to 6 weeks of operation.

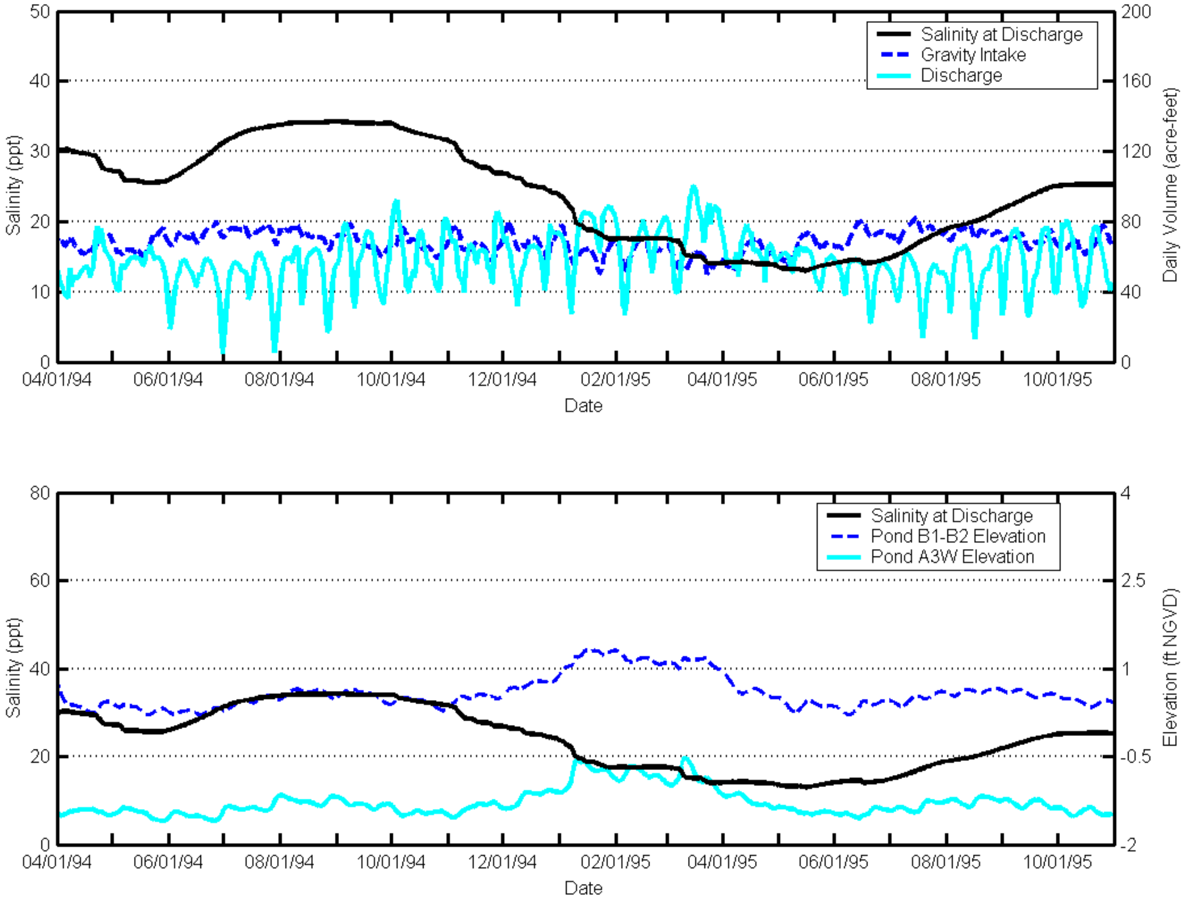
Pond A3N was not included in the pond hydraulic model and no initial stewardship condition salinity has been estimated for it. However, pond A3N may be operated as a batch or seasonal pond and therefore the salinity in it may be higher than in the other ponds in the A3W system.

Table 4.2.2.3 shows the existing average summer and winter salinity levels based on recorded values for the past 6 years.

Table 4.2.2.3
Alviso A3W System Existing Pond Salinity

Pond	Area (acres)	Average Pond Salinity (ppt)		Salinity Range (ppt)
		Summer	Winter	
B1	142	24	21	13-41
A2E	310	30	28	18-43
B2	170	26	22	13-43
A3W	560	34	30	23-44
A3N	163	27	25	16-41

System A3W includes salinity group 1 ponds and could have a maximum initial discharge salinity of 65 ppt. If the salinity in the system were at the maximum at the start of bay water circulation, the discharge salinity would start at 65 ppt and decrease to be similar to the modeled conditions in Figure 4-4 in a few months. Initial release scenarios which include the maximum discharge salinity have been modeled separately from the long term salinity modeling for evaluation purposes.



Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-4
Graphs of Alviso A3W Operation Levels and Discharge Salinities

4.2.2.4 Management Operations

Ponds B1, B2, and A3W will require limited active management. The intake, internal connections, and outlet structures generally have sufficient capacity and gravitational for salinity control in winter and spring.

Pond A3N would be operated as a seasonal or batch pond. For seasonal operations, the pond would be drained initially and no further operation would be required. The pond would fill with 1 to 2 feet of rainwater during the winter, which would evaporate during the summer. Because the bottom of pond A3N is 1½ feet below sea level, some groundwater seepage may occur to keep portions of the pond bottom wet during the summer.

Pond A3N has existing gates to operate as a batch pond. Water would be released from B2 to A3N to manage the volume in the pond and thus manage the amount of salt in the pond. This may affect the circulation in B1, B2, and A3W and may require additional analysis of flow rates and mixing in A3W. If the salinities in A3N become significantly higher than the salinity in A3W, there may be constraints on the discharge flow to A3W and the Guadalupe Slough. The flows through B1 and B2 to A3W would need to dilute the higher salinity inflow from A3N to a level that could be discharged from A3W. This may be limited during the summer high evaporation season due to the hydraulics of the system.

The discharge flow from gravity outlet from pond A3W to Guadalupe Slough may be affected by high flood tides during periods of high rainfall. There is a low levee on the south side of the pond which can be eroded by wave action if the water levels are high. It may be preferable to limit or stop inflow to the system during the winter to control the maximum water level. This is similar to the existing commercial salt operation. The outlet gates would need to be adjusted after large storms to drain excess volume from the system. Based on system model estimates, the outlet culverts would have capacity to allow circulation during the winter.

4.2.3 Alviso System A7

System A7 consists of 3 ponds: A5 (intake) and A7 (outlet) and seasonal pond A8 as shown in Figure 4-5. The objectives for the system include:

- Establish tidal circulation through the pond system through A5 and A7
- Establish pond A8 as a seasonal or batch operation pond
- Consider operating pond A8 at high salinity (120-150 ppt) during summer to favor brine shrimp. This would require additional analysis of flows and salinities in the System A14 or System A7
- Maintain project water elevations similar to existing elevations
- Maintain discharge salinities at levels below 40 ppt
- Locate intake to minimize entrainment of migrating steelhead using Alviso Slough
- Allow reversal of intake and outlet flow to better manage salinity and to drain ponds after storm events

The proposed system would include the following structures:

- New 2x48” gate intake at A5 from Guadalupe Slough
- New cut at the internal levee between A5 and A7
- Fill existing cut at the north end of the internal levee between A5 and A7
- Existing 24” control gate from A7 to A8
- Existing 4,000 gpm pump from A8 to A11. Modify outlet piping to allow discharge to A7
- New 2x48” gate outlet at A7 into Alviso Slough
- Existing staff gage in both ponds.

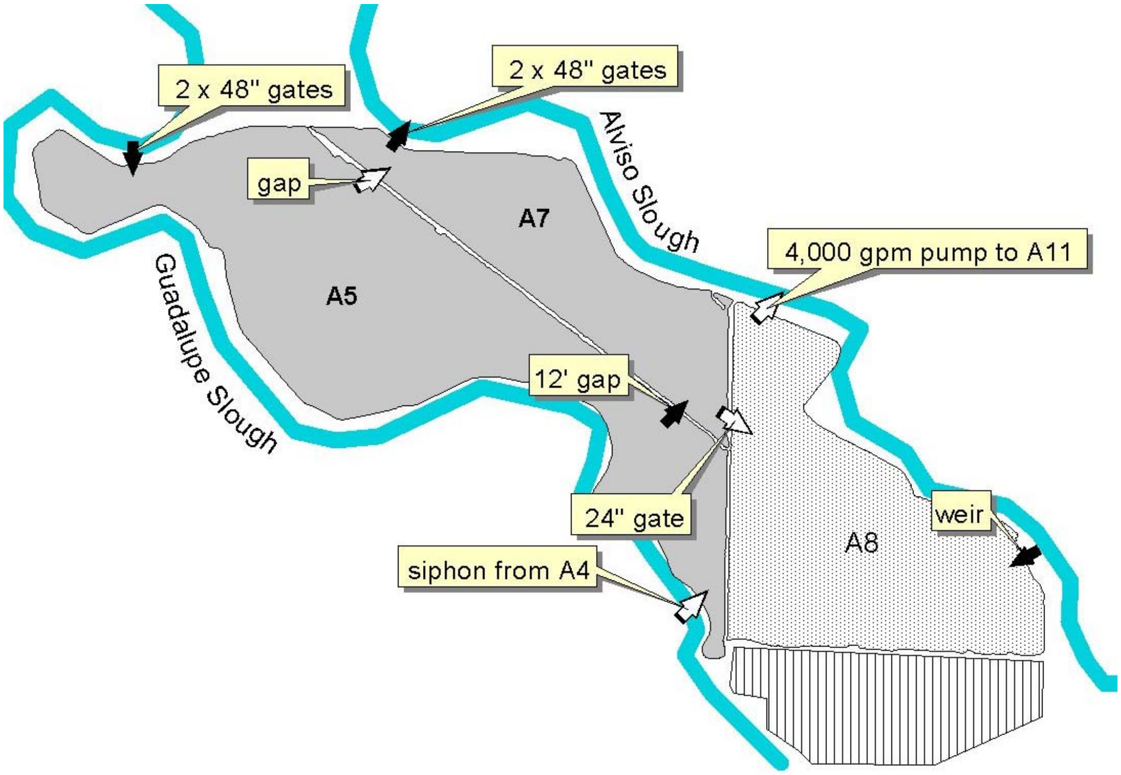


Figure 4-5
Map of Alviso A7 Inflow and Outflow Locations

4.2.3.1 Circulation Hydraulics

The intake location at the northwesterly end of A5 was selected to allow inflow from Guadalupe Slough as close to the bay as possible. The high tide salinities near the bay would be closer to normal bay salinity than farther upstream. Due to freshwater inflows from Calabazas and San Tomas Aquino Creeks, other drainage channels, and the Sunnyvale WWTP, the salinity upstream in Guadalupe Slough generally is lower than bay salinity. The bay salinity would be closer to existing conditions in the ponds.

The outlet location at the northerly end of A7 was selected to allow outflow into Alviso Slough as close to the bay as possible. The outlet salinity levels would be at or above bay salinity, but would generally be higher than low tide salinity in Alviso Slough. Due to freshwater inflow form Guadalupe River the salinity in Alviso Slough generally is lower than bay salinity, particularly at low tide levels.

The A7 intake location was avoided because of the presence of steelhead in the Guadalupe River which use Alviso Slough as a migration route. Intake of water from Alviso Slough during the migration seasons could entrain migrating fish.

4.2.3.2 Interim Management Conditions

The system structure location map and graphs of pond operation flows, water levels and discharge salinities for the Alviso System A7 are shown in Figures 4-5 and 4-6.

Pond A8 was not included in the continuous circulation operation model for the system. Pond A8 would operate as either a seasonal or batch pond. As a seasonal pond, the pond would contain rainwater during the winter, and generally be dry during the summer. The pond salinity would not be controlled, but would fluctuate due to residual salt in the pond, rainwater inflows, and seasonal evaporation. As a batch pond, Pond A8 would operate at a lower elevation than A5 or A7, similar to the existing operation levels. Water would be diverted from A7 to add volume to A8, and pumped to A11 or A7 as needed to control water levels and salinity. A8 would not require a continuous flow.

Additionally, the Santa Clara Valley Water District will use ponds A8, A5, and A7 to capture flood flows to minimize the extent and duration of flooding in Alviso resulting from the Lower Guadalupe River flood control project. An overflow weir will be constructed at A8 by the flood control project sponsor. Overflows would occur in major flood events greater than a 10-year flood in the lower Guadalupe River. When the ponds fill with floodwaters, the Water District will pump the ponds to drain floodwaters back to Alviso Slough or Guadalupe Slough. For more information see the Draft Lower Guadalupe River Flood Protection Project Mitigation and Monitoring Plan (Santa Clara Valley Water District, August 7, 2002). The proposed intake and outlet gates in ponds A5 and A7 would be available to supplement the discharge for flood overflows from System A7.

The estimated system flow rates for the long term ISP operation are shown in Table 4.2.3.2.1, below. The table includes average daily flow and peak flows for both the intake and outlet.

Table 4.2.3.2.1
Alviso System A7 Inflow and Outflow

Period	**Gravity Intake Flow**		**Outlet Flow**	
	Average	**Peak**	**Average**	**Peak**
Summer May - October	22 cfs 10,000 gpm	69 cfs 31,000 gpm	16 cfs 7,300 gpm	68 cfs 31,000 gpm
Winter November - April.	22 cfs 10,000 gpm	69 cfs 31,000 gpm	23 cfs 10,000 gpm	100 cfs 45,000 gpm

The predicted water surface elevations during the initial stewardship period are shown in Table 4.2.3.2.2, below. Note that Ponds A5 and A7 would operate at the same water elevations.

Table 4.2.3.2.2
Alviso System A7 Water Surface Elevations

Pond	**Area (acres)**	**Bottom Elevation (ft NGVD)**	**Water Elevation (ft NGVD)**		
			Existing	**Initial Stewardship**	
				Summer	**Winter**
A5	615	-0.6	0.1	0.4	0.6
A7	256	-0.5	0.1	0.4	0.6
A8	406	-3.4	-1.8	-	-
Total/ Average	1,277	-1.4	0.1	0.4	0.7

The control gate settings were not adjusted to actively manage the pond water levels in the pond model. Active management could maintain a more uniform water surface elevation in the ponds if necessary. For instance, the winter values shown are for a particularly wet (El Nino) winter and maximum pond elevations in A5 and A7 reached 1.0 ft NGVD, almost a foot above the 6-year average for these ponds. However, the pond water levels normally vary due to operational considerations and climatic conditions. A5 and A7 have exceeded elevation 0.6 ft during 2 of the past 6 winters.

4.2.3.3 Salinity

The estimated discharge salinity from pond A7 into Alviso Slough is shown in Figure 4-6. The model results are shown for the entire simulation period from April 1994 to October 1995. The model simulation period includes a dry year and a wet year to evaluate discharge salinities for a range of summer operation conditions.

The initial pond salinities and water surface elevations were based on measured conditions in early April 2002. The pond system transitions from the initial starting conditions in the first 4 to 6 weeks of operation.

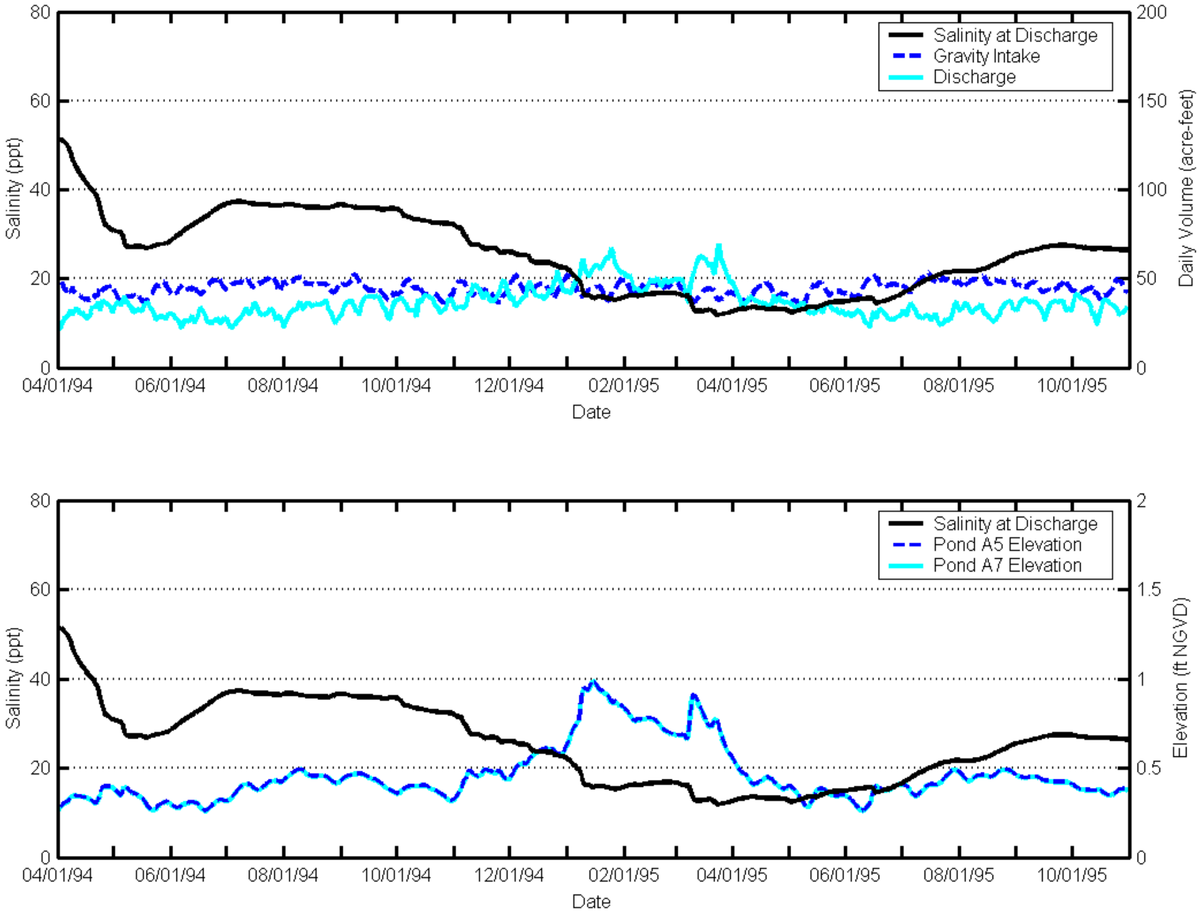
As noted previously, pond A8 was not included in the pond hydraulic model and no initial stewardship condition salinity has been estimated for A8. Since pond A8 is a batch or seasonal pond, the salinity can be adjusted using management alternatives. The salinity in A8 may be higher than in the other ponds in the system.

Table 4.2.3.3 shows the existing average summer and winter salinity levels based on recorded values for the past 6 years.

Table 4.2.3.3
Alviso System A7 Existing Pond Salinity

Pond	**Area (acres)**	**Average Pond Salinity (ppt)**		**Salinity Range (ppt)**
		Summer	**Winter**	
A5	615	45	41	28-60
A7	256	58	45	28-75
A8	406	74	60	31-110

System A7 includes salinity group 2 ponds and could have a maximum initial discharge salinity of 100 ppt. Ponds A5 and A7 may be as high as 110 ppt. If the salinity in the system were at the maximum at the start of bay water circulation, the discharge salinity would start at 110 ppt and decrease to be similar to the modeled conditions in a few months. Initial release scenarios that include the maximum discharge salinity have been modeled separately from the long-term salinity modeling for evaluation purposes.



Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-6
Graphs of Alviso A7 Operation Levels and Discharge Salinities

4.2.3.4 Management Operations

Ponds A5 and A7 will require limited active management. Pond A8 would be operated as a seasonal or batch pond. For seasonal operations, the pond would be drained initially and no further operation would be required. The pond would fill with 10 to 20 inches of rainwater during the winter, which would evaporate during the summer. Because the bottom of pond A8 is over 3 feet below sea level, some groundwater seepage may occur to keep portions of the pond bottom wet during the summer.

As a batch pond, A8 would not have continuous flow operation similar to A5 or A7. All outflows from A8 must be pumped to A11 or A7. The batch pond operation would minimize the amount of pumping required. Water would be diverted from A7 to maintain the volume in the pond. Water would be pumped from A8 to A11 or A7 to decrease the volume in the pond and reduce the amount of salt in A8. If the salinity in A8 is maintained at a level similar to the A11 or A7 levels, there would be no constraint on the timing and flow from A8 to A11 or A7.

If the salinity in A8 is significantly higher than the salinity in A11 or A7, there may be constraints on the flow to A11 or A7. The flow through the A14 system, which includes A11, or the A7 system, would need to dilute the higher salinity inflow from A8 to a level that could be discharged from A14 or A7. This may be limited during the summer high evaporation season due to the hydraulics of the system. The flow to A11 would also be limited during the winter when the flow through the A14 system would be reduced or closed to limit potential entrainment of salmonids.

Pond A5 includes an existing siphon under Guadalupe Slough from pond A4. Pond A4 has been acquired by the Santa Clara Valley Water District (SCVWD) for a proposed restoration project. Based on the proposed schedule for the long-term restoration of pond A4 there may be a requirement for interim management of the pond during the initial stewardship period for the DFG and FWS ponds. One or more alternatives being considered by the SCVWD for interim management may include operation of pond A4 as a batch pond with periodic outflows through the siphon to pond A5. If SCVWD and FWS agree that flows from A4 are appropriate the flows would be restricted to time periods and salinity levels which would not have a significant effect on flow rates or discharge salinities from pond A7. SCVWD would be responsible for preparation of a suitable operation plan for interim management of pond A4 in coordination with the operation of System A7.

4.2.4 Alviso System A14

System A14 consists of 7 ponds: A9 (intake), A10, A11 and A14 (outlet) and batch ponds A12, A13, and A15 as shown in Figure 4-7. The objectives for the system include:

- Establish tidal circulation through A9, A10, A11 and A14
- Establish a batch pond operation for ponds A12, A13, and A15
- Establish multiple intakes to batch ponds
- Operate batch ponds at high salinity (120-150 ppt) during summer to favor brine shrimp
- Maintain project condition water levels close to existing levels
- Maintain discharge salinity below 40 ppt

- Minimize entrainment of salmonids by limiting inflows during winter.

The proposed system includes:

- Existing 2x48” intake at A9 from Alviso Slough (intake flow only)
- Existing 48” control gates from:
  - A9 to A10
  - A10 to A11
- New control gate from A11 to A14.
- New 2x48” gate outlet at A14 into Coyote Creek
- Existing control gates for batch pond operations:
  - 48” gate from A11 to A12
  - 48” gate from A12 to A13
  - 36” gate from A14 to A1
  - .
- Existing 22,000 gpm pump from A13 to A15.
- Existing siphon from A15 to A16
- New 48” gate intake at A15 from Coyote Creek
- Existing 36” control gate from A15 to A14
- Existing staff gages in all ponds

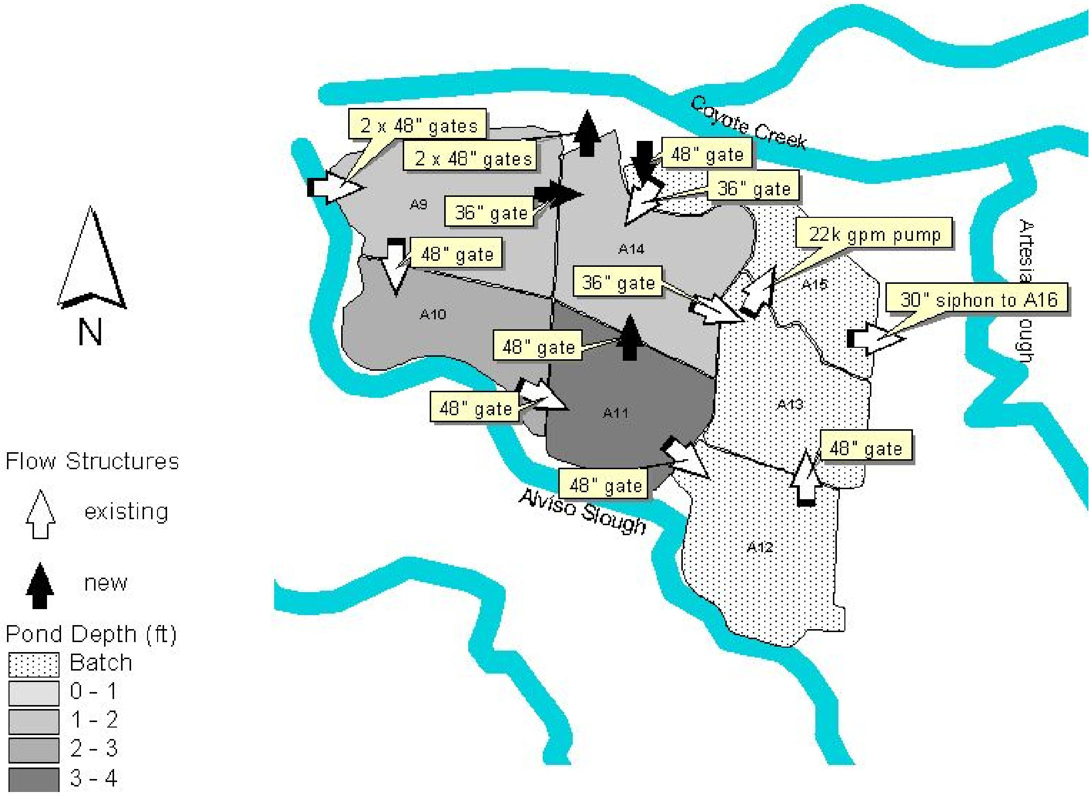


Figure 4-7
Map of Alviso 14 Inflow and Outflow Locations

4.2.4.1 Circulation Hydraulics

The existing intake at A9 allows intake only, and would not be modified. The new outlet structures would include operable gates and flapgates, to allow inflow at the outlet when necessary. For instance, it may be necessary to use A14 as a mixing chamber for higher salinity flows from A15, which may require inflows from Coyote Creek to A14. In addition, the control gates would allow partial culvert openings to control water levels. Because of the flapgates and the relative elevation of the tides and pond water levels, all intake flow would occur at high tide, and all outflows would occur at low tide.

The outlet location at the northerly end of A14 was selected to allow outflow into Coyote Creek at a location near an existing channel within the marsh area along the levee. The existing channel drains part of the marsh area to the existing dredge lock cut at the north end of A15. This would minimize the potential disturbance in the marsh.

Ponds A12, A13, and A15 are proposed for batch operations that will allow higher salinities in those ponds. The goal for these higher salinity ponds would be to reach summer salinity levels between 120 and 150 ppt to provide habitat for brine shrimp and wildlife which feeds on the brine shrimp. Lower salinity water would be diverted from ponds A11 and A14 in A12 and A13 and evaporation would increase the salinity over time. Higher salinity water would be pumped up to A15 as needed to maintain the pond volume. Additional low salinity water would be added to make up lost volume and lower salinity if needed. Excess volume in the batch system would be released to the A16 system for dilution and discharge to Artesian Slough and Coyote Creek.

Ponds A12, A13, and A15 are called a batch system because it is anticipated that the ponds will be operated in a series of batch operations to control the individual pond volumes and salinities. For example, a typical operation may be to add 3 inches of low salinity water from A11 to A12 to make up lost volume and reduce the pond salinity, or release 6 inches of water from A15 to A16 to lower the pond volume to make room for inflows from A12 and A13. Using individual transfers of volume from one pond to another simplifies the planning necessary for control of the pond salinities.

4.2.4.2 Interim Management Conditions

The system structure location map and graphs of pond operation flows, water levels and discharge salinities for the Alviso System A14 are shown in Figures 4-7 and 4-8.

Ponds A12, A13, and A15 were not included in the continuous operation model for the system because they would operate as batch ponds.

The estimated system flow rates using average daily flow and peak flows for both the inlet and outlet are shown in Table 4.2.4.2.1, below. The pond circulation model did not include adjustments in the flows for diversions to the batch ponds. No values are estimated for intake flows during the winter assuming the intake will be closed to avoid potential entrainment of migrating salmonids.

Table 4.2.4.2.1
Alviso System A14 Inflow and Outflow

Period	Gravity Intake Flow		Discharge Flow	
	Average	Peak	Average	Peak
Summer May - October	38 cfs 17,000 gpm	230 cfs 100,000 gpm	26 cfs 12,000 gpm	89 cfs 40,000 gpm
Winter November - April	-	-	9 cfs 3,900 gpm	44 cfs 20,000 gpm

The predicted water surface elevations during the initial stewardship period are shown in Table 4.2.4.2.2, below.

Table 4.2.4.2.2
Alviso System A14 Water Surface Elevations

Pond	Area (acres)	Bottom Elevation (ft NGVD)	Water Elevation (ft NGVD)		
			Existing	Initial Stewardship	
				Summer	Winter
A9	385	-0.2	3.9	2.0	1.5
A10	249	-0.8	2.5	1.8	1.5
A11	263	-1.8	1.7	1.3	1.4
A14	341	-0.0	1.4	0.9	1.3
A12	309	-2.0	1.4	-	-
A13	269	-1.1	1.2	-	-
A15	249	0.7	2.8	-	-
Total/ Average	2,440	-0.5	2.1	1.6	1.4

4.2.4.3 Salinity

The estimated discharge salinity from pond A14 into coyote Creek is shown in Figure 4-8. The model results are shown for the entire simulation period from April 1994 to October 1995. The model simulation period includes a dry year and a wet year to evaluate discharge salinities for a range of summer operation conditions.

The initial pond salinities and water surface elevations were based on measured conditions in early April 2002. The pond system transitions from the initial starting conditions in the first 4 to 6 weeks of operation.

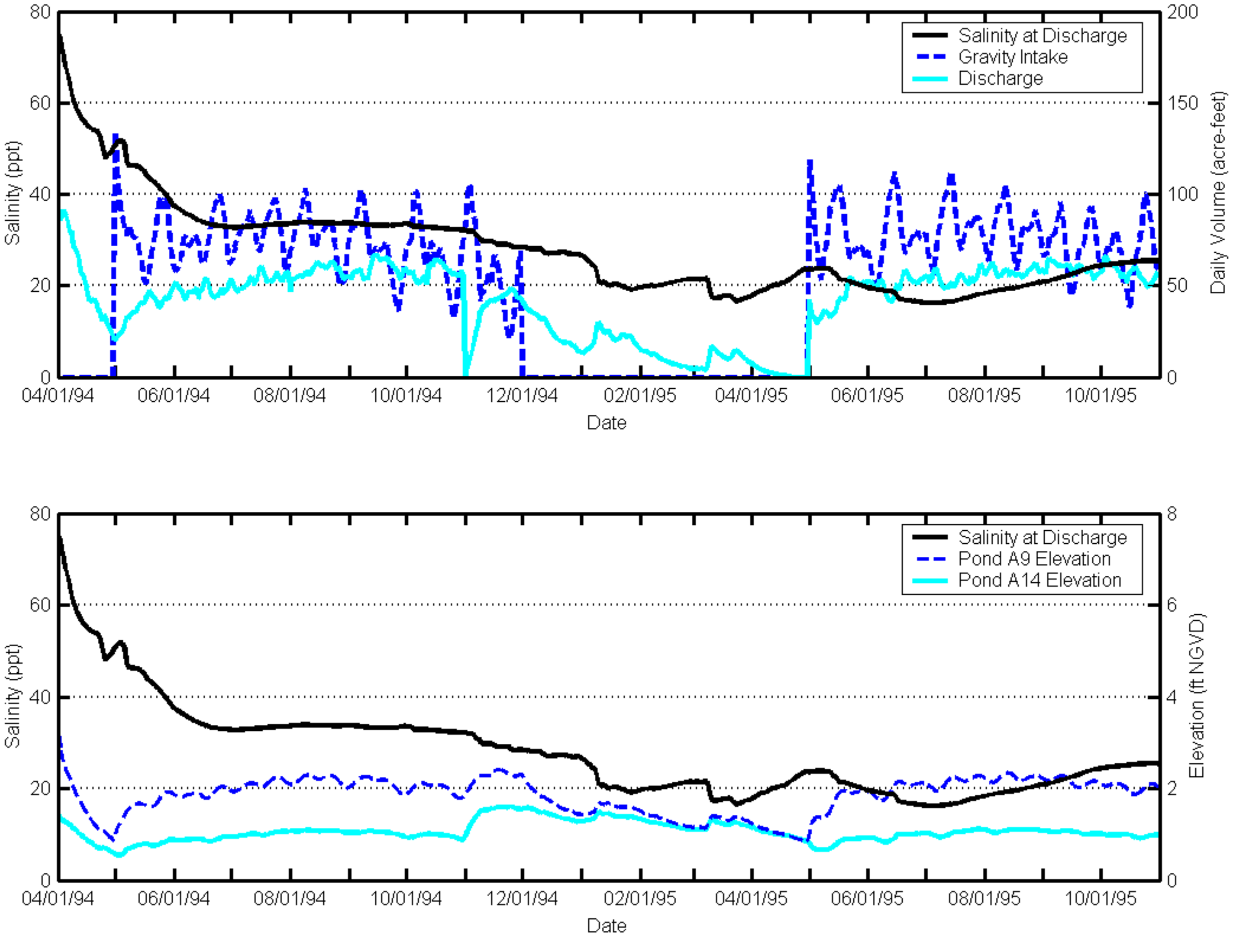
Table 4.2.4.3 shows the existing average summer and winter salinity levels in the ponds based on recorded values for the past 6 years.

Table 4.2.4.3
Alviso System A14 Existing Pond Salinity

Pond	Area (acres)	Average Pond Salinity (ppt)		Salinity Range (ppt)
		Summer	Winter	
A9	385	25	24	11-38
A10	249	28	26	17-45
A11	263	44	49	28-69
A14	341	85	75	48-135
A12	309	49	47	35-66
A13	269	58	52	38-77
A15	249	66	59	40-111

As noted previously, ponds A12, A13, and A15 were not included in the pond hydraulic model and no initial stewardship condition salinity has been estimated for the batch ponds. As batch ponds, the salinity can be adjusted using management alternatives. The proposed salinity in the batch ponds would be in the range of 120 to 150 ppt during the summer, but may be lower during the winter during wet years.

System A14 includes salinity group 2 and 3 ponds. The circulation ponds A9, A10, A11 and A14 are salinity group 2 ponds with a maximum initial salinity of 100 ppt. The batch ponds A12, A13, and A15 are salinity group 3 ponds with a maximum initial salinity of 135 ppt. A15 will be released through A16. Because the batch ponds would not be part of the circulation pond system and would not be included in the initial release, the initial release would have a maximum initial discharge salinity of 100 ppt if the salinity in the system is at the maximum. If the salinity in the system were at the maximum at the start of bay water circulation, the discharge salinity could start at 100 ppt and decrease to be similar to the modeled conditions in Figure 4-8 in a few months. Initial release scenarios which include the maximum discharge salinity have been modeled separately from the long term salinity modeling for evaluation purposes.



Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-8
Graphs of Alviso 14 Operation Levels and Discharge Salinities

4.2.4.4 Management Operations

Ponds A9, A10, A11, and A14 will require limited active management. During the winter season, the A9 intake would be closed to prevent entrainment of migrating salmonids. For planning purposes, this was assumed to extend from December through April. During the winter, rainfall would tend to increase the water levels in the ponds. The water levels in the ponds would be set by a weir at the outfall or adjustment of the control gates to avoid flooding of the existing internal levees or wave damage to the levees.

Ponds A12, A13 and A15 would be operated as batch ponds to maintain summer salinity levels in the range of 120 to 150 ppt for brine shrimp habitat. Water would be diverted from A11 or A14 into ponds A12 and A13 for makeup water as necessary to control salinity. Water would be pumped from A13 to A15 for makeup water in A15. Excess volume in A12 and A13 would be pumped up to A15. Excess water in A15 would be discharged to A16.

Because the proposed salinity in A15 would be significantly higher than the salinity in A16, there may be constraints on the flow to A16. The flow through the A16 system would need to dilute the higher salinity inflow from A15 to a level that could be discharged from A16. This may be limited during the summer high evaporation season due to the hydraulics of the system. It would also be limited during the winter when the flow through the A16 system would be reduced or closed to limit potential entrainment of salmonids from Coyote Creek at A17. If these constraints prevent intake from Coyote Creek, the flows will be reversed in the A16 system during the winter and intake from Artesian Slough instead of Coyote Creek.

The proposed intake to A15 from Coyote Creek would also allow flow from the creek into A15 during the summer. Inflows from the creek would have lower salinity than makeup water from A13. This would lower the salinity in A15, if necessary. In addition, control gates would be available from A9 to A14 and from A15 to A14. These gates could be used to increase the flow through A14 from A9 and allow A14 to be used as a mixing pond for releases from A15. Flow could also be released from A13 to A14 by adjusting the water level in A13.

For winter operation, the gates from A9, A10, and A11 were assumed to be open to allow rainfall to drain to A14. This would minimize the need for water level management during the winter. However, the water levels in A9 and A10 would be lower than existing conditions. The winter water level in A9 would be approximately 2.3 feet below the average winter water levels for the existing commercial salt operations. The winter water levels in each individual pond could be maintained at different water levels by closing the internal pond connection gates at the start of the winter season. Excess water from rainfall would need to be drained from the system after larger storms and would require additional active management to adjust the interior control gates.

The summer water level for pond A9 for the ISP condition is approximately 1.9 feet below the existing condition average summer water level. The lower water level was required to increase the intake flow through the existing intake gates and provide sufficient circulation flows to maintain salinities within the system. The gravity intake flows are dependent on the size of the intake structure and the pond water level in comparison to the slough water levels. More active management of water levels in the system may allow summer operation of ponds A9 and A10 at higher levels depending on the discharge salinities, flows to the batch ponds, and the intake salinities. The modeled discharge salinities at pond A14 were near 35 ppt during the summer with higher than normal intake salinities.

4.2.5 Alviso A16 System

System A16 consists of 2 ponds: A17 (intake) and A16 (outlet) as shown in Figure 4-9. The objectives for the system include:

- Establish tidal circulation through A17 and A16
- Maintain water surface levels close to existing levels
- Maintain discharge salinity levels below 40 ppt
- Minimize entrainment of salmonids by:
  Close A17 intake during winter, or
  Reversal of intake and outlet flow during winter
- Minimize potential for avian botulism by controlling salinity levels.

The proposed system would include:

- New 48” gate intake at A17 from Coyote Creek
- New 48” gate outlet structure at A16 into Artesian Slough
- Existing siphon between A15 (from System A14) to A16
- Existing gap between A17 and A16
- Existing staff gage in both ponds.

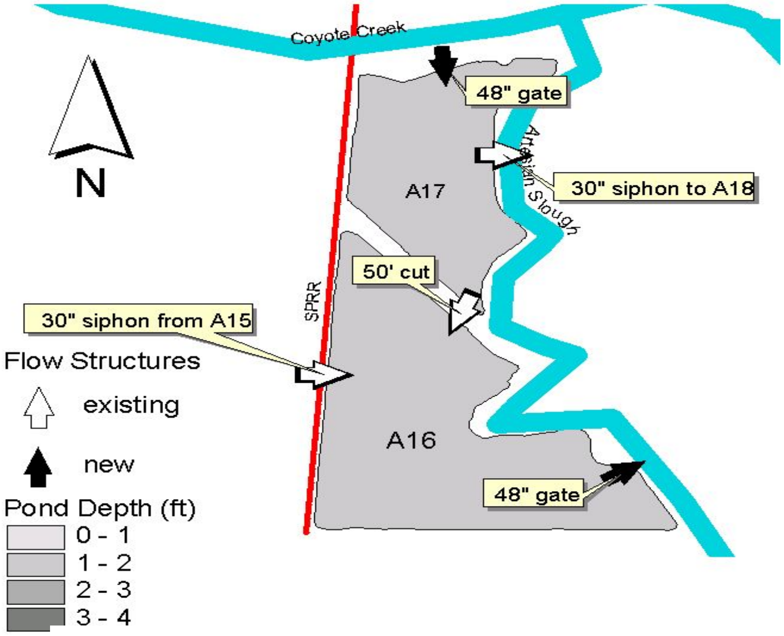


Figure 4-9
Map of Alviso 16 Inflow and Outflow Locations

4.2.5.1 Circulation Hydraulics

The inlet and outlet structures would include operable gates and flapgates to close off all flow, allow inflow only, or allow outflow only. Therefore, the inflow and outflow direction for the system could be reversed if necessary. For instance, a summer operation with an intake from Coyote Creek was preferred to avoid inflows from Artesian Slough at the City of San Jose wastewater treatment plant outfall. However, it may be necessary to intake at A16 from Artesian Slough during the winter to minimize potential entrainment of migrating salmonids in Coyote Creek. The control gates would allow partial culvert openings to control water levels. Because of the flapgates and the relative elevations of the tides and pond levels, all intake flow would occur at high tide, and all outflows would occur at low tide.

4.2.5.2 Interim Management Conditions

The system structure location map and graphs of pond operation flows, water levels and discharge salinities for the Alviso System A16 are shown in Figures 4-9 and 4-10.

The estimated system flow rates using average daily flow and peak flows for both the intake and outlet are shown in Table 4.2.5.2.1, below. No values are estimated for intake flows during the winter assuming the intake will be closed to avoid entrainment of migrating salmonids. For planning purposes, summer was considered May to October, and winter was November to April.

Table 4.2.5.2.1
Alviso System A16Inflow and Outflow

Period	**Gravity Intake Flow**		**Discharge Flow**	
	Average	**Peak**	**Average**	**Peak**
Summer May - October	15 cfs 6,800 gpm	106 cfs 48,000 gpm	12 cfs 5,400 cfs	32 cfs 14,000 gpm
Winter November - April	-	-	3 cfs 1,300 gpm	24 cfs 11,000 gpm

The predicted water surface elevations during the initial stewardship period are shown in Table 4.2.5.2.2, below. Note that Ponds A16 and A17 operate at the same water elevation.

Table 4.2.5.2.2
Alviso System A16 Water Surface Elevations

Pond	**Area (acres)**	**Bottom Elevation (ft NGVD)**	**Water Elevation (ft NGVD)**		
			Existing	**Initial Stewardship**	
				Summer	**Winter**
A17	131	1.1	2.7	2.3	2.2
A16	243	0.6	2.7	2.3	2.2
Total/ Average	374	0.8	2.7	2.3	2.2

Much of the variation in operating water levels in the ponds is due to the initial starting conditions and the transitions between winter and summer conditions. In particular, the ponds started at elevation 2.5 ft in April 1994 and the water level decreased over the first few weeks to below elevation 2.0 ft with no inflows in April. The water level then increased back to 2.5 ft. in May when the intake was opened to allow inflow from Coyote Creek and fluctuated between 1.7 and 2.6 ft for the rest of the simulation period.

4.2.5.3 Salinity

The estimated discharge salinity from pond A16 into Artesian Slough is shown in Figure 4-10. The model results are shown for the entire simulation period from April 1994 to October 1995. The model simulation period includes a dry year and a wet year to evaluate discharge salinities for a range of summer operation conditions.

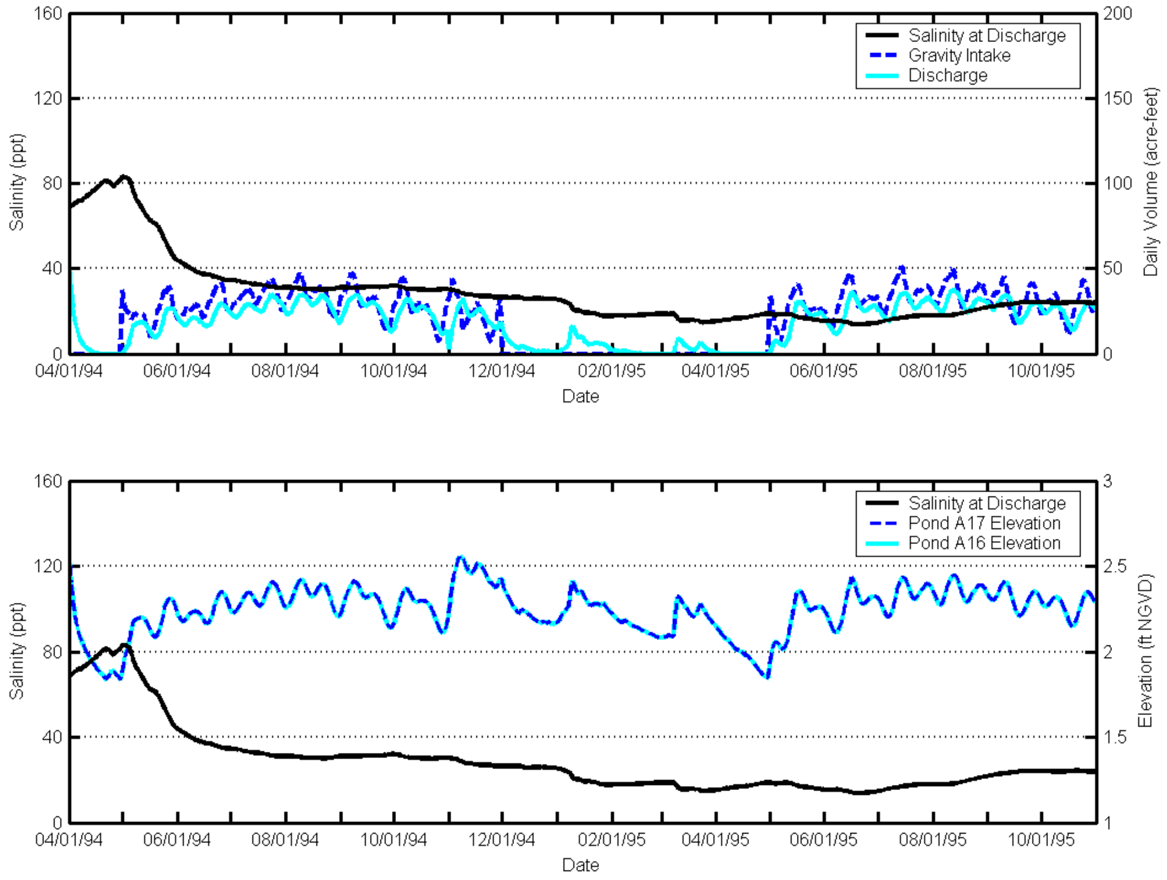
The initial pond salinities and water surface elevations were based on measured conditions in early April 2002. The pond system transitions from the initial starting conditions in the first 4 to 6 weeks of operation.

Table 4.2.5.3 shows the existing average summer and winter salinity levels based on recorded values for the past 6 years.

Table 4.2.5.3
Alviso System A16 Existing Pond Salinity

Pond	**Area (acres)**	**Average Pond Salinity (ppt)**		**Salinity Range (ppt)**
		Summer	**Winter**	
A17	131	77	67	45-137
A16	243	74	67	43-122

System A16 includes salinity group 3 ponds and could have a maximum initial discharge salinity of 135 ppt. If the salinity in the system were at the maximum at the start of bay water circulation, the discharge salinity would start at 135 ppt and decrease to be similar to the modeled conditions in Figure 4-10 in a few months. Initial release scenarios that include the maximum discharge salinity have been modeled separately from the long term salinity modeling for evaluation purposes.



Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-10
Graphs of Alviso 16 Operation Levels and Discharge Salinities

4.2.5.4 Management Operations

Ponds A16 and A17 will require limited active management. During the winter season, December through April, the A17 intake would be closed to prevent entrainment of migrating salmonids. The control gates would need to be adjusted weekly or monthly during the summer circulation period.

Pond A16 includes a siphon from pond A15 in the A14 system. As discussed in the previous section 4.2.1.6, A15 would contain higher salinity water between 120 and 150 ppt to provide brine shrimp habitat. Excess water from ponds A12, A13, and A15 would be released to A16 on a batch basis. Because the proposed salinity in A15 would be significantly higher than the salinity in A16, there may be constraints on the flow to A16. The flow through the A16 system would need to dilute the higher salinity inflow from A15 to a level that could be discharged from A16. This may be limited during the summer high evaporation season due to the hydraulics of the system. It would also be limited during the winter when the flow through the A16 system would be reduced or closed to limit potential entrainment of salmonids from Coyote Creek at A17. An operational alternative would be to reverse the flow in the A16 system during the winter and intake from Artesian Slough instead of Coyote Creek. Salinities in Artesian Slough are lower than in Coyote Creek due to the San Jose WWTP discharge, and may be more effective to dilute higher salinity inflows from A15. In addition, Artesian Slough does not have a salmonid fishery.

Based on the average salinity of the inflows from Coyote Creek and the average summer inflows to the A16 system, in an average year the release from the batch ponds through A15 to A16 would need to extend for approximately 4 months to prevent the salinity in A16 from exceeding 40 ppt.

4.2.6 Alviso Complex Island Ponds

The Alviso complex island ponds consist of ponds A19, A20, and A21 as shown in Figure 4-11. The proposed management for this system is a full tidal water regime. The objectives for the system include:

- Establish full circulation into ponds A19, A20, and A21
- Locate levee breaches to minimize disturbance to tidal marsh habitat

The system includes:

- New levee breaches:
    - 2 breaches, pond A19 to Coyote Creek
    - 1 breach, pond A20 to Coyote Creek
    - 2 breaches, pond A21 to Coyote Creek
- Seal and abandon existing siphons:
    - Siphon from pond A19 to A20
    - Siphon from pond A20 to A21
    - Siphon from pond A18 to A19
    - Siphon from pond A21 to plant 2
- Remove Coyote siphon pump
- Remove Mud Slough pump after transfer of brine to plant
- Remove existing control gate from pond A21 to Mud Slough pump

- Existing staff gages at all ponds.

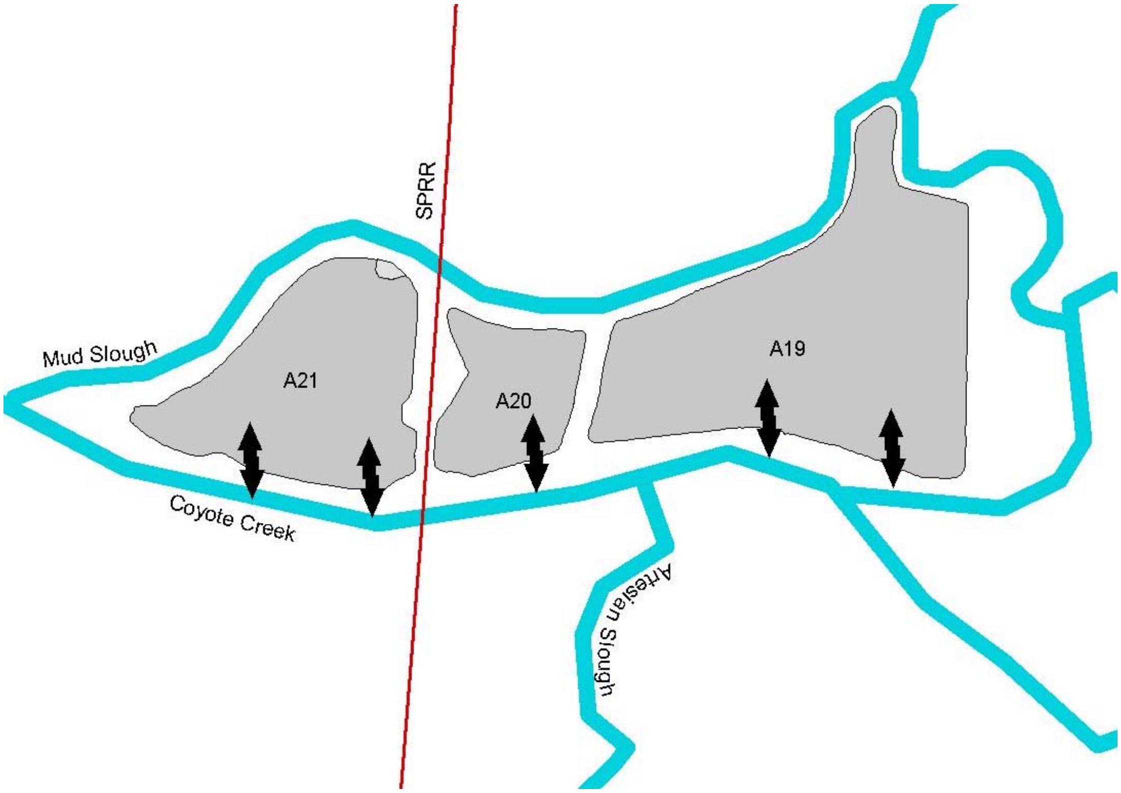


Figure 4-11
Map of Alviso Complex Island Breach Locations

4.2.6.1 Circulation Hydraulics

The island pond group contains three separate ponds. Each include one or more levee breaches to Coyote Creek to allow full tidal circulation within the pond. The ponds would each operate independently. The proposed breach locations were selected to avoid locations near the existing railroad bridge at Coyote Creek, and to minimize construction within the existing marsh areas along Coyote Creek.

The existing pond connection siphons would be sealed and abandoned. The existing Coyote siphon pump and Mud Slough pump would be removed.

4.2.6.2 Interim Management Conditions

The island pond breach locations are shown in Figure 4-11. The estimated water surface elevation for Coyote Creek and the island ponds for a typical two-day period are shown in Figure 4-12. The estimated tidal inflow conditions were based on hydrodynamic modeling of the Coyote Creek area including the proposed levee breaches.

For long term conditions, the individual breaches were assumed to be near the existing pond bottom elevations. The actual size would vary by location, but the largest breach was approximately 600 square feet below mean higher high water. The breach size was estimated to be consistent with existing studies which show that tidal breaches are generally stable with maximum velocities in the range of 2.8 to 3.8 fps (Goodwin, 1996). Due to limitations of the hydrodynamic model, the breaches were assumed to be one grid cell (25 meters) wide with depths approximately 5 ft below the pond bottom elevations.

The existing pond bottom elevations in the island ponds range from elevation 1.7 ft to 2.2 ft NGVD. The borrow ditches around the edges of the ponds are estimated to be 4 to 8 feet below the typical pond bottom elevations. Based on the estimated water levels shown in Figure 4-12, the pond bottoms would only be inundated at higher high tide levels. Only limited portions of the pond bottoms may be inundated at lower high water. Therefore, the pond bottoms would be inundated for 6 to 10 hours per day. The borrow ditch areas may be inundated for most of the day with some deeper areas inundated at all times.

The estimated mean tidal prism and mean higher high tide prism are shown in Table 4.2.6.2, below.

Table 4.2.6.2.1
Alviso Island Pond System Tidal Prism Volume

Pond	**Mean Tidal Prism**	
	All High Tides	**Higher High Tides**
A19	470 af	640 af
A20	150 af	190 af
A21	290 af	390 af

The predicted water surface elevations during the initial stewardship priod are shown in Table 4.2.6.2.2, below.

Table 4.2.6.2.2
Alviso Island Pond System Water Surface Elevations

Pond	Area (acres)	Bottom Elevation (ft NGVD)	Water Elevation (ft NGVD)		
			Existing	Initial Stewardship	
				Summer	Winter
A19	265	1.8	3.8	2.9	2.5
A20	63	1.8	3.7	2.8	2.5
A21	147	2.3	3.5	3.3	3.1
Total/ Average	475	2.0	3.7	3.0	2.7

4.2.6.3 Salinity

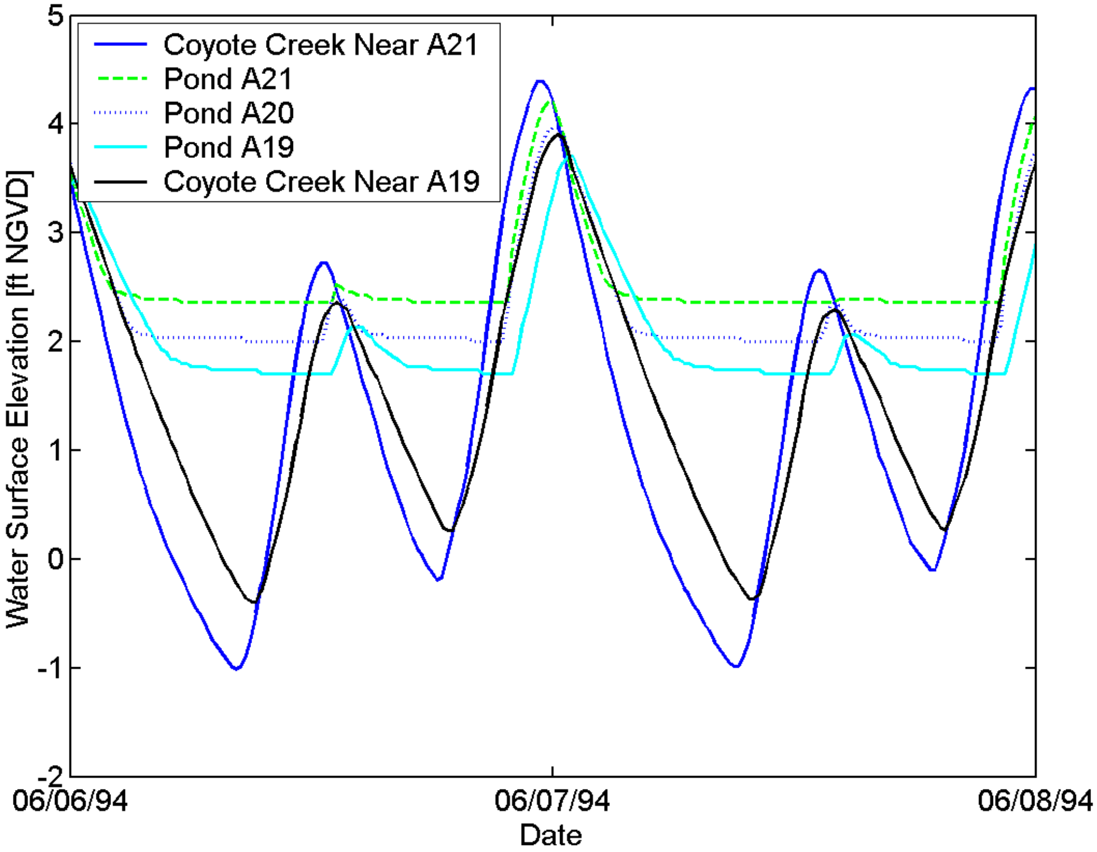
Table 4.2.6.3 shows the existing average summer and winter salinity levels in the island ponds based on values recorded for the past 6 years.

Table 4.2.6.3
Alviso Island Pond System Existing Pond Salinity

Pond	Area (acres)	Average Pond Salinity (ppt)		Salinity Range (ppt)
		Summer	Winter	
A19	265	152	132	79-290
A20	63	158	139	87-289
A21	147	173	151	87-304

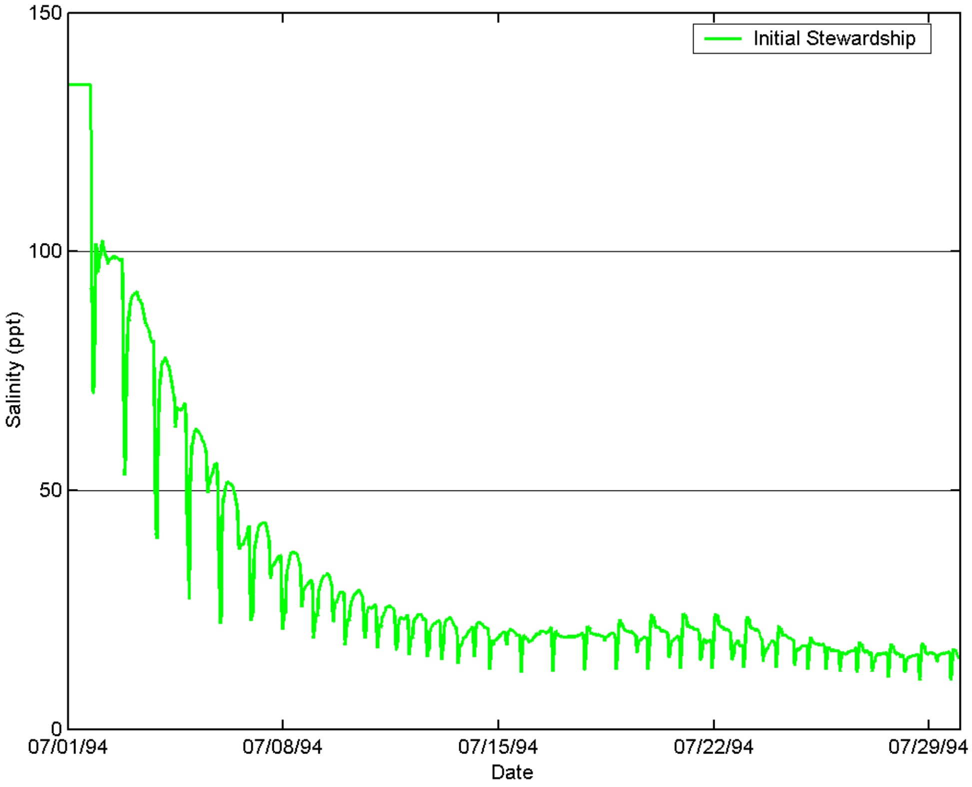
The initial breach conditions for the island ponds were modeled using the hydrodynamic model for two initial breach scenarios. The initial breach scenarios were based on an initial pond salinity at the maximum value of 135 ppt, with the starting water levels at 2.2 ft NGVD, the bottom elevation of pond A21. The pond volume above that elevation would be transferred to Cargill Plant 2 using the Mud Slough pump before the pump is removed. The initial breaches were modeled to be approximately 25 meters wide at the average pond bottom elevation. The constructed initial breaches may be narrower, which would reduce the initial flows to and from the ponds. The proposed scenario would phase the initial breach openings for the three ponds beginning with pond A19, followed 2 days later by pond A20 and 2 additional days later by pond A21. An alternative breach scenario included initial breach elevations at 1 ft NGVD.

The estimated pond salinities at the breach locations are shown in Figures 4-13 to 4-15. As shown in the salinity graphs, the initial salinities begin at approximately 135 ppt and rapidly decrease to near Coyote Creek values within one to two weeks. The pond salinities at the breach locations show daily fluctuations due to the inflows of lower salinity water from Coyote Creek on incoming tides and subsequent mixing with higher salinity water within the pond and borrow ditches.



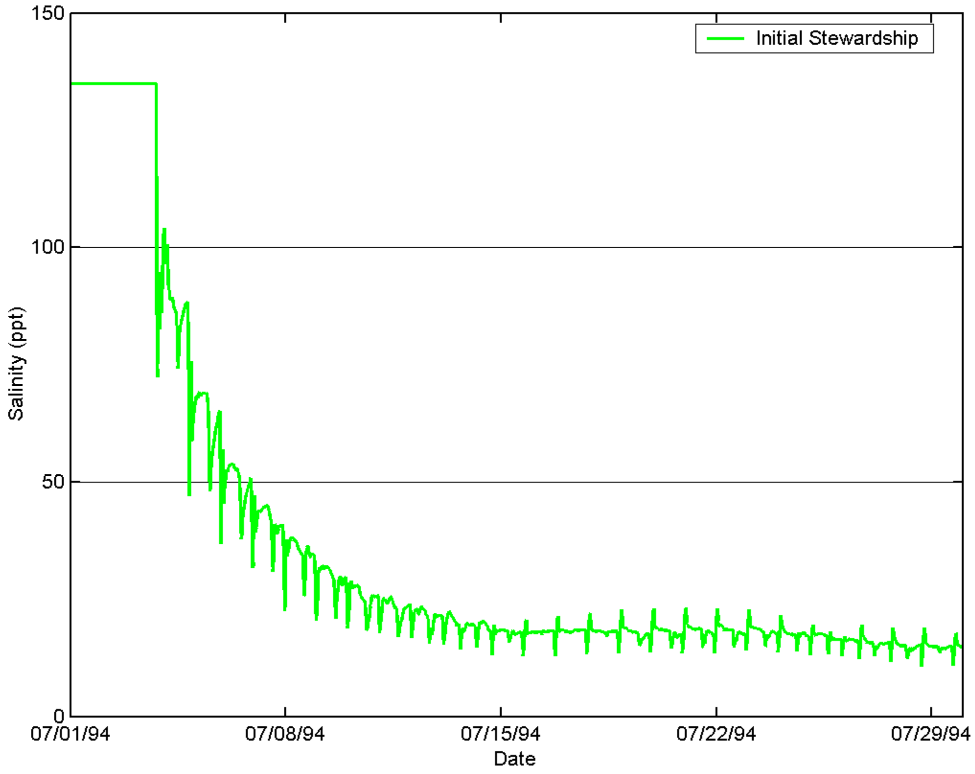
Note: Pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-12
Graphs of Coyote Creek, Alviso Ponds A19, A20 & A21 Operation Levels



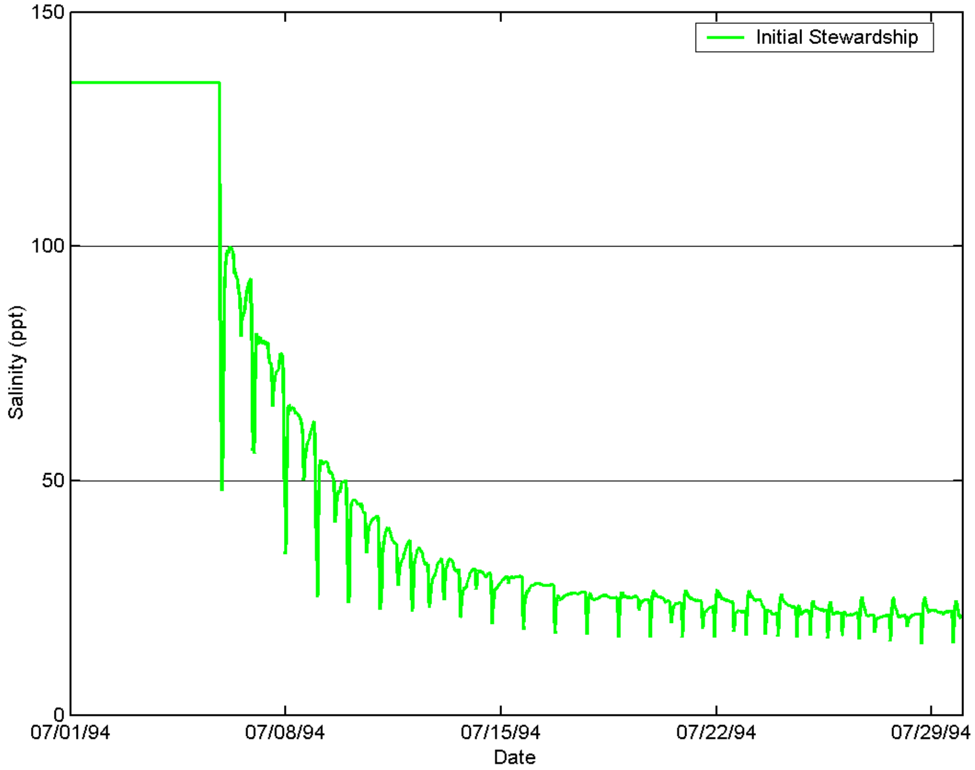
Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-13
Modeled Salinity at Alviso A19 Breach for Initial Release



Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-14
Modeled Salinity at Alviso A20 Breach for Initial Release



Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-15
Modeled Salinity at Alviso A21 Breach for Initial Release

4.2.6.4 Management Operations

The island ponds with the proposed breaches will require no active management or maintenance. It is anticipated that the existing levees will degrade over time due to erosion from rainfall, tidal flows, and flood flows. The pond bottom areas would become middle level salt marsh areas.

As noted previously, the proposed initial breach sizes may not be stable. The estimated maximum breach velocities for certain breach locations may be higher than 4 fps. The initial breach size and configuration would be expected to erode over time to a more stable configuration. The size and shape of the stable breaches would depend on the long-term circulation through the individual breach, the elevation of the Coyote Creek marsh at the location, and the durability of the soils within the levee. Depending on the site conditions, the individual breaches may become both deeper and wider.

An alternative management plan for the island pond group, which may be considered, would include operating the island ponds as seasonal ponds for the Initial Stewardship period. The existing brines in the ponds would be transferred to the Cargill Plant 2 to the maximum extent possible. The residual brines in the borrow ditches and low areas would evaporate in place. As seasonal ponds, the island ponds would partially fill with winter rainfall. The rainwater would evaporate during the spring and summer, and the ponds would be dry until the following winter. The seasonal pond alternative would not require construction of any intake or outlet structures. There would be no discharges to the bay or sloughs.

4.2.7 Alviso System A23

The Alviso system A23 consists of ponds A22 and A23 as shown in Figure 4-16. The objectives for the system include:

- Establish intakes for tidal inflows to ponds A22 and A23
- Establish potential outlets for future outflows from ponds A22 and A23
- Locate intake/outlet structures to minimize disturbance to tidal marsh habitat

The system includes:

- New 48” gravity intake/outlet structures:
    Pond A22 to Mud Slough
    Pond A23 to Mud Slough
- Existing pond connections:
    Wood box from A22 to A23
    24” gate from A22 to Crabby Joe pump vault
    24” gate from A23 to Crabby Joe pump vault
- Existing Crabby Joe pump to Cargill plant 2
- Existing staff gages at both ponds

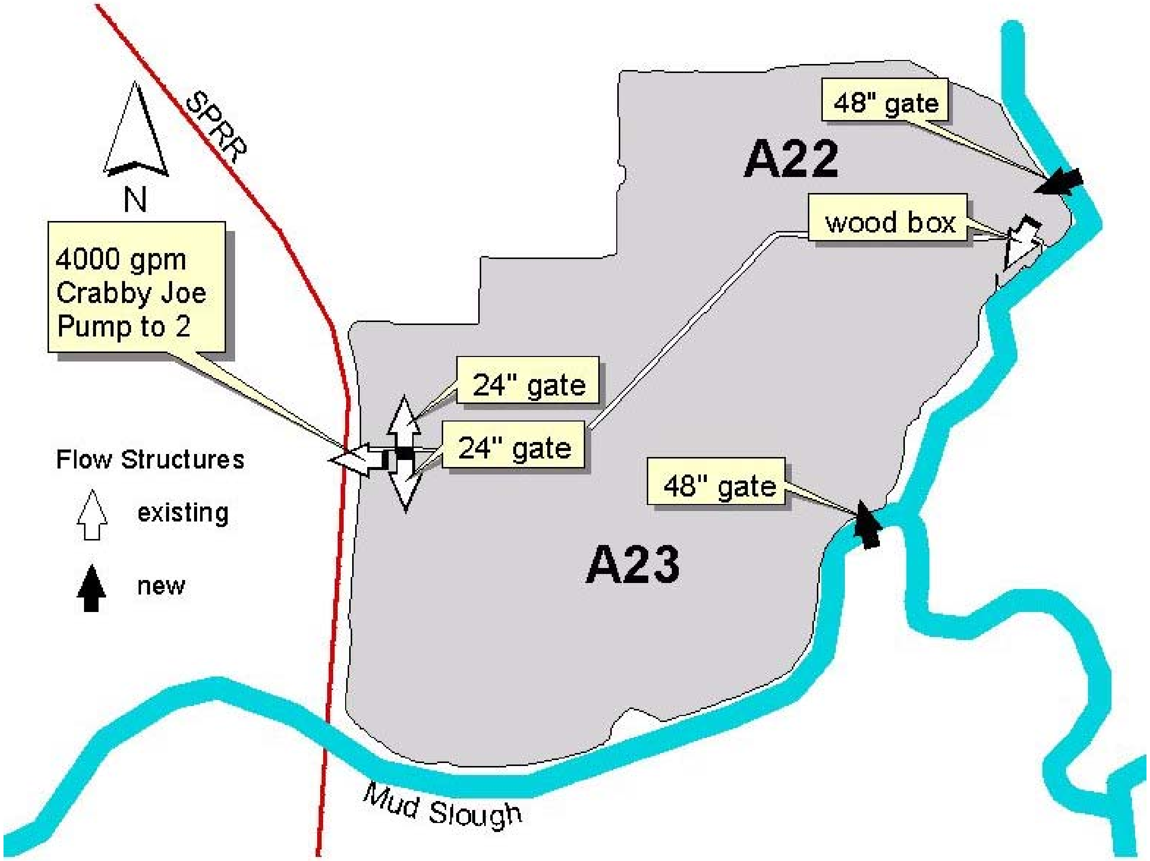


Figure 4-16
Map of Alviso A23 Inflow and Outflow Locations

4.2.7.1 Circulation Hydraulics

The A23 pond group would contain ponds A22 and A23. Based on current plans, there would be no discharge to Mud Slough.

During the initial stewardship period, the ponds may intake bay water from Mud Slough to dilute the pond contents, dissolve crystallized salt within the ponds, and move water to plant 2. The intakes from Mud Slough would only operate as a batch operation. All discharges from the pond group would be pumped to plant 2 using the Crabby Joe pump.

The intake/outlet structures would include the control gates necessary to allow discharge to Mud Slough only to provide flexibility for future restoration operations. Any future discharges from this system would be requested in a future discharge permit application.

4.2.7.2 Interim Management Conditions

The proposed inflow operations for ponds A22 and A23 have not been planned in detail. Inflows could occur to dissolve salt deposits in these ponds. The resulting brines would be brought into the existing Cargill salt operation. No discharge to Mud Slough would be included. No estimates for pond operation levels or salinities have been established. However, the proposed operation for A22 and A23 may be similar to existing water levels. Water levels have ranged from dry to 3 feet deep in A23 and from dry to 1.5 feet deep in A22. Summer operations would accommodate nesting by snowy plovers.

Table 4.2.7.2 shows the existing average summer and winter salinity levels based on values recorded for the past 6 years.

Table 4.2.7.2
Alviso System A23 Existing Pond Salinity

Pond	**Area (acres)**	**Average Pond Salinity (ppt)**		**Salinity Range (ppt)**
		Summer	**Winter**	
A22	270	236	185	66-296
A23	445	275	240	178-302

4.2.7.3 Management Operations

During the next 8 years, the A23 system will require minimal active management to open and close intake structure(s) as needed.

4.2.8 Baumberg System 2

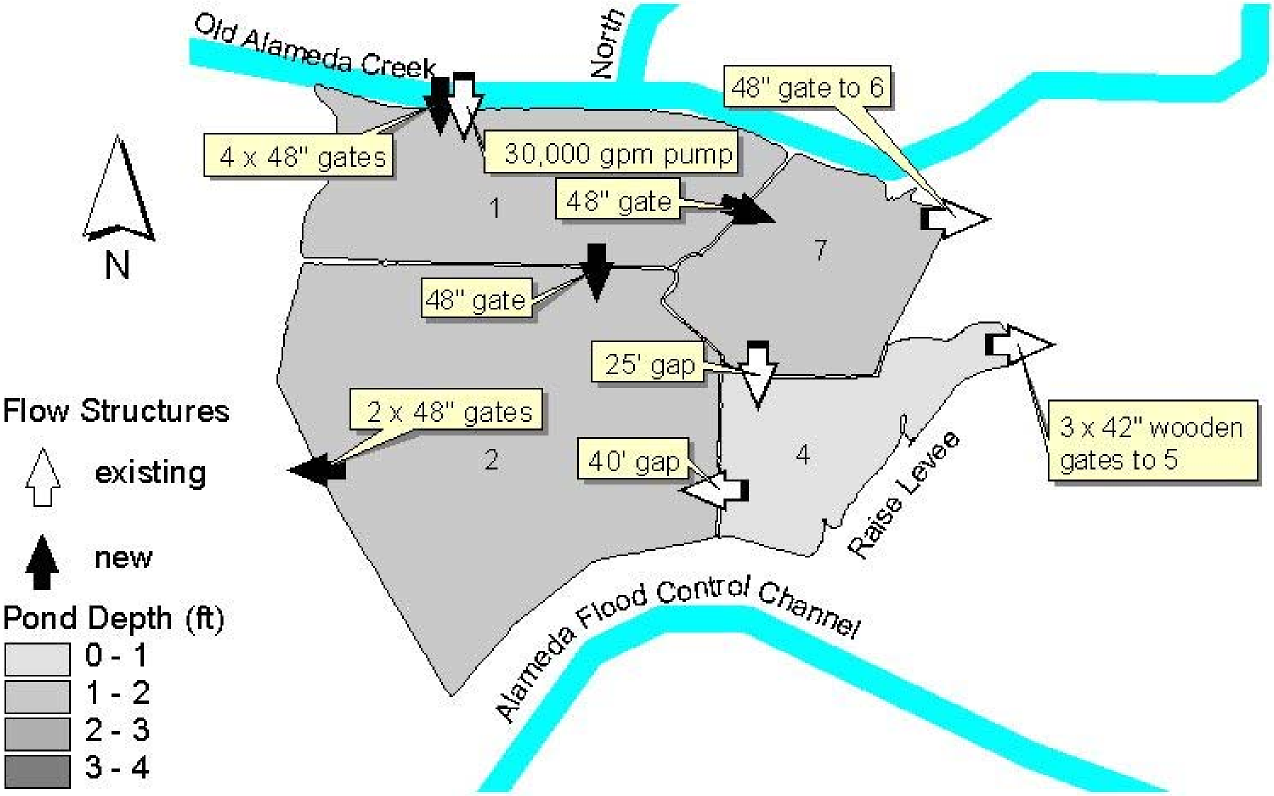
The Baumberg System 2 consists of 4 ponds: ponds 1 (intake), 2 (outlet), 4 and 7 as shown in Figure 4-17. The objectives for the system include:

- Establish tidal circulation through the pond system through Baumberg 1, 4, 7 and 2
- Operate water surface levels lower than existing conditions
- Maintain discharge salinity levels below 40 ppt
- Manage for different water surface elevations summer vs. winter
    Summer water elevations lower than winter elevations to increase gravity inflow
- Summer average depth of at least 1-ft. ponds 1 and 2
- Summer partial dry-down in ponds 7 and 4
- Winter average depth of 1 ft. in all ponds
- Supplement inflow using the intake pump at pond 1 to control the summer salinity
- Allow reversal of flow at intake and outlet to drain ponds after storm events or serve as a contingency should gates fail

The proposed system includes:

- New 4x48” gate intake at pond 1 from Old Alameda Creek
- Existing 30,000 gpm intake pump station at pond 1 from Old Alameda Creek.

- New connection gates
    - 48” gate from pond 1 to 7.
    - 48” gate from pond 1 to 2.
    - New 2x48” gate outlet structure with control weir at pond 2 into the Bay
- Existing levee gaps between
    - Ponds 7 and 4
    - Ponds 4 and 2
- Removal of existing gate(s) between
    - Ponds 7 and 6
    - Ponds 4 and 5
    - Ponds 1 and 2
- Raise existing levees on east side of ponds 7 and 4
- Existing staff gages at all ponds.



Note: Pond depths based on winter conditions.

Figure 4-17
Map of Baumberg 2 Inflow and Outflow Locations

4.2.8.1 Circulation Hydraulics

The circulation pattern for the system would be to intake at pond 1, then flow through ponds 7 and 4 to the outlet at pond 2. All four intake culverts would include operable gates and flapgates to allow inflow. Two culverts would include gates to allow outflow, if necessary. Controls to allow outflow at the intake structure are included to maintain management flexibility and allow discharge from pond 1 in the event of flooding or a gate failure within the system. Because of the flapgates and the relative elevation of the tides and pond levels, all gravity intake flow would occur at high tide, and all outflows would occur at low tide.

The existing intake pump station at pond 1 will remain to supplement gravity inflows into the system during the summer high evaporation period. Because the pond bottom elevations and water elevations are relatively high, the gravity flow intakes are effective only during short periods at high tides. During periods of weak tides, little gravity inflow would occur and the pump would be needed to supplement the inflow. The intake pump station also operates only at high tide.

The outlet structure at pond 2 to the Bay would include operable gates and flapgates to close off all flow or allow outflow only. The control gates at the intake and outlet culverts would allow partial culvert openings to control water levels.

The initial stewardship conditions would include different operation plans for the winter and summer. The operating water levels in the ponds would be lower during the summer to increase the gravity inflow into the system during the higher evaporation season. The water level in pond 2 would be approximately 3.1 ft NGVD during the summer, and 3.4 ft NGVD during the winter. Because of the high bottom elevations in ponds 7 and 4, they would be only partially wet during the summer.

4.2.8.2 Interim Management Conditions

The system structure location map and graphs of pond operation flows, water levels and discharge salinities for the Baumberg System 2 are shown in Figures 4-17 and 4-18.

The estimated system flow rates using average daily flow and peak flows for both the intake and outlet are shown in Table 4.2.8.2.1, below.

Table 4.2.8.2.1
Baumberg System 2 Inflow and Outflow

Period	**Gravity Intake Flow**		**Pumped Intake Flow**	**Discharge Flow**	
	Average	**Peak**		**Average**	**Peak**
Summer May – October	25 cfs 11,000 gpm	467 cfs 210,000 gpm	15 cfs 7,000 gpm	36 cfs 16,000 gpm	57 cfs 26,000 gpm
Winter November – April	4 cfs 1,900 gpm	363 cfs 160,000 gpm	4 cfs 2,000 gpm	10 cfs 4,400 gpm	14 cfs 6,100 gpm

The predicted water surface elevations during the initial stewardship period are shown in Table 4.2.8.2.2, below.

Table 4.2.8.2.2
Baumberg System 2 Water Surface Elevations

Pond	**Area (acres)**	**Bottom Elevation (ft NGVD)**	**Water Elevation (ft NGVD)**		
			Existing	**Initial Stewardship**	
				Summer	**Winter**
1	337	2.2	4.8	3.4	4.5
7	209	2.5	4.8	3.1	4.4
4	175	2.9	4.4	3.1	4.4
2	673	2.1	4.8	3.1	4.4
Total/ Average	1,394	2.3	4.7	3.2	4.4

4.8.2.3 Salinity

The estimated discharge salinity from pond 2 to San Francisco Bay is shown in Figure 4-15. The model results are shown for the entire simulation period from April 1994 to October 1995. The model simulation period includes a dry year and a wet year to evaluate discharge salinities for a range of summer operation conditions.

The initial pond salinities and water surface elevations were based on measured conditions in early April 2002. The pond system transitions from the initial starting conditions in the first 4 to 6 weeks of operation.

The pond hydraulic model assumes that pumping would start if the discharge salinity exceeds 37 ppt, and stop if the discharge salinity is below 36 ppt. Because the discharge salinity responds slowly to the increased inflow, the pumps generally would operate for several day or weeks at a time. The pumping criteria were developed to limit the maximum initial discharge salinity to less than 40 ppt. The pumping criteria could be modified to conform to other discharge goals. A higher allowable discharge goal would reduce the need for pumping.

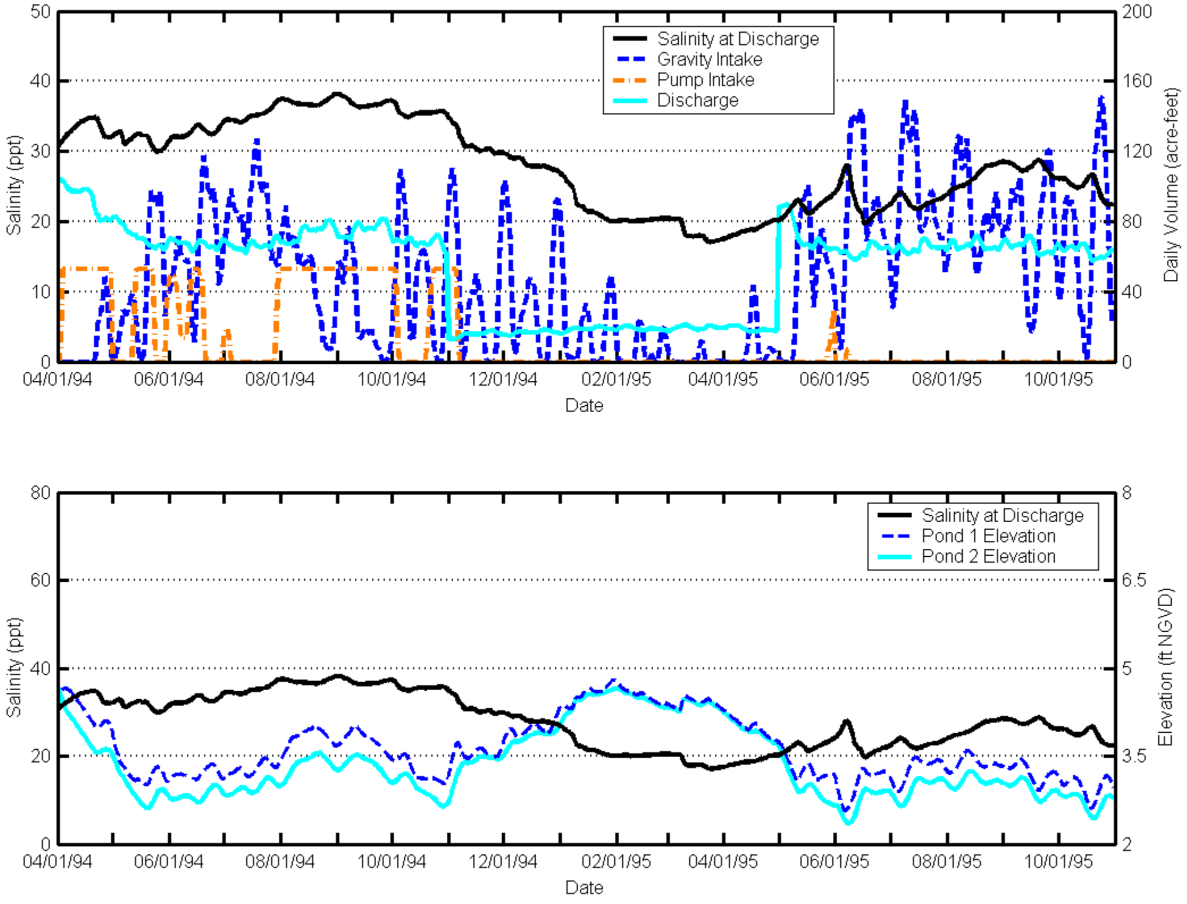
As shown in Figure 4-15, the system required significant pumping during the summer of 1994, which was a relatively dry year with relatively high salinity in the South San Francisco Bay. The following year, 1995 was much wetter. Therefore, the ponds started the summer with relatively low salinity and the intake water from the bay has a lower salinity. The model results show that only limited pumping would be required for the summer 1995 conditions.

The initial stewardship plan would generally maintain the existing salinity levels in the ponds compared to the existing salt making operations. Table 4.2.8.3 shows the existing average summer and winter salinity levels in the ponds for the past 6 years.

Table 4.2.8.3
Baumberg System 2 Existing Pond Salinity

Pond	**Area (acres)**	**Average Pond Salinity (ppt)**		**Salinity Range (ppt)**
		Summer	**Winter**	
1	337	31	27	18-46
7	209	42	33	23-59
4	175	41	30	16-60
2	673	35	29	20-49

System 2 includes salinity group 1 ponds and could have a maximum initial discharge salinity of 65 ppt. If the salinity in the system were at the maximum at the start of bay water circulation, the discharge salinity would start at 65 ppt and decrease to be similar to the modeled conditions in Figure 4-15 in a few months. Initial release scenarios which include the maximum discharge salinity have been modeled separately from the long term salinity modeling for evaluation purposes.



Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-18
Graphs of Baumberg 2 Operation Levels and Discharge Salinities

4.2.8.4 Management Operations

Baumberg System 2 will require active management during the summer, as well as during the transitions to and from the summer operation. The intake culverts do not have sufficient capacity to allow adequate flow for salinity control during the summer. The inflow may need to be supplemented using the intake pump to control the summer salinity. It is anticipated that the supplemental pump would be controlled manually based on the measured salinity in pond 2 on approximately a weekly basis. The intake pump includes an automatic level switch to turn the pump on at high tide and off at low tide.

For the winter operation, the gate from pond 1 to pond 7 would be open and the gate from pond 1 to pond 2 would be closed. Water from the bay would circulate from pond 1 to 7, to 4, and to pond 2. Because of rainfall and low evaporation during the winter, no supplemental pumping would be required in normal years. The water level in the system would be controlled by the outlet gate settings.

In the spring the system would be changed to the summer operation condition. This was assumed to occur in early May, but could vary depending on habitat conditions in the ponds. For example, the transition could be delayed or advanced based on use of the pond by migratory birds, or salinity levels in the ponds.

For the summer operation, the planned water levels would be lower by approximately 1 foot. The water levels in the system would be controlled by the outlet gate settings. The lower operating levels throughout the system would provide a significant increase in the gravity inflow from the intake culverts in pond 1. In addition, the gate from pond 1 to pond 2 would be at least partially opened to reduce the headloss for flow from pond 1 to pond 2. The gate from pond 1 to pond 7 would be partially open to provide limited circulation through ponds 7 and 4.

Based on modeling of the system for historic tide and evaporation conditions in 1994, the gravity intake system would not be sufficient to maintain the maximum salinity goals during periods of weak tides. Gravity inflows would only occur at high tide levels in the bay. During periods of weak tides, with lower high tides, the inflow would be reduced. Weak tide periods may extend for a week to 10 days. With low inflows from the bay and high evaporation, the salinity levels in the ponds would increase, and may exceed the design goal of 40 ppt. Therefore, supplemental pumping would be provided from the existing intake pump from Old Alameda Creek to pond 1. A proposed operation scheme was developed in which pumping would start if the discharge salinity exceeds 37 ppt, and stop if the discharge salinity is below 36 ppt. Because the discharge salinity responds slowly to the increased inflow, the pumps generally would operate for several days or weeks at a time. The pumping criteria could be modified to conform to other discharge goals. A higher allowable discharge goal would reduce the need for pumping. Based on the pond modeling for 1994 and 1995, the supplemental pumping would be necessary during summer periods with higher Bay intake salinity, but may not be required during wet years with lower ambient salinity in the Bay.

4.2.9 Baumberg System 2C

The Baumberg System 2C consists of eight ponds: ponds 6 (intake), 5, 6C, 4C, 3C, 2C (outlet), 1C (intake) and 5C as shown in Figure 4-19. The objectives for the system include:

- Establish two tidally-initiated pumped circulation systems
    - A main system through Baumberg ponds 6, 5, 6C, 4C, 3C, and 2C
    - A smaller system through ponds 1C and 5C
- Operate water levels similar to existing levels
- Maintain discharge salinity levels below 40 ppt. System will require active management

- Manage for different water surface elevations summer vs. winter

- Inflows using the intake pumps to control the summer salinity

The proposed system includes:

- New 30,000 gpm intake pump station at pond 6 from Old Alameda Creek

- Existing connection gates and/or pipes
    - Remove 4x45" gate from pond 6 to 5
    - Remove 36" pipe from pond 5 to 6C
    - Remove 45" gate from pond 5 to 6C
    - 2x30" pipes from pond 6C to 4C
    - Remove 2x30" gate from pond 4C to 3C
    - 25' gap from pond 3C to 2C
    - 25' gap from pond 5C to 4C
    - 25' gap from pond 1C to 5C
    - Remove 24" pipe from pond 1C to 5C
    - Remove 30" pipe from 2C to Cal Hill transfer pump

- Remove Cal Hill transfer pump

- Seal and abandon siphon from Cal Hill transfer pump to plant 1

- Seal and abandon siphon from Continental pump to pond 6

- New connections
    - 15' gap from 6 to 5
    - 2x48" gates from 5 to 6C

- Existing 7,660 gpm intake pump station at pond 1C from Alameda FCC

- New 2x48" gate outlet at pond 2C into the Alameda Flood Control Channel (FCC)

- Existing staff gages in all ponds

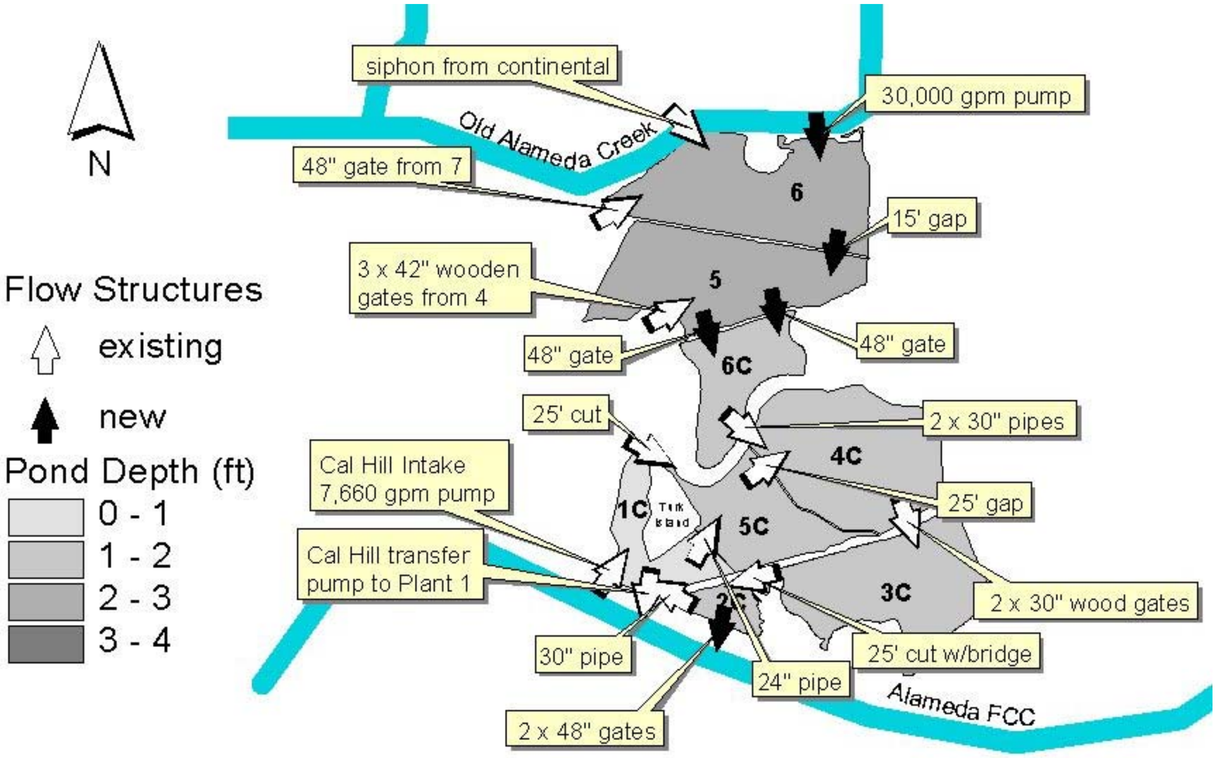


Figure 4-19
Map of Baumberg 2C Inflow and Outflow Locations

4.2.9.1 Circulation Hydraulics

The proposed intake pump would provide continuous circulation through ponds 6, 5, 6C, 4C, 3C, and 2C during the summer months. Water would be pumped primarily during high tide into pond 6 and then be conveyed by gravity into ponds 5, 6C, 4C, 3C and 2C. A new gravity outlet at pond 2C consisting of two 48” gates would discharge flows into the Alameda FCC.

The existing intake pump at pond 1C would operate to provide inflows to a smaller sub-system consisting of pond 1C and 5C. This pond sub-system would operate on a continuous basis or could be operated seasonally as a batch system to allow higher salinity in ponds 1C and 5C. Pond 5C would discharge to pond 4C.

Flows through both these two sub-systems would be primarily unidirectional to pond 2C. The outlet structure from pond 2C would discharge to Alameda FCC through two 48” flapgates at low tide. The new outlet in pond 2C would be constructed as close to San Francisco Bay as possible. The outlet structure would also include a weir to control the minimum water level in pond 2C. The weir would include weir boards to adjust the weir elevation.

The control gates at the intake and outlet culverts would allow partial culvert openings to control water levels. Because of the flapgates, all gravity outflows would occur during low tide in the channel. Because of the shallow depths in Old Alameda Creek, all pumped inflows would occur at high tide.

The initial stewardship conditions would include different operation plans for the winter and summer. The operating water levels in the lower ponds (4C, 3C, and 2C) would be slightly lower during the summer to increase the gravity flow through the system from the upper ponds (6, 5, and 6C) during the higher evaporation season. The water level would vary approximately 1 foot in elevation NGVD during the summer between the upper and lower ponds.

4.2.9.2 Interim Management Conditions

The system structure location map and graphs of pond operation flows, water levels and discharge salinities for the Baumberg System 2C are shown in Figures 4-19 and 4-20.

The estimated system flow rates are shown in Table 4.2.9.2.1, below. The table includes average and peak discharge flows for both summer and winter. The pumped intake flows are limited to the summer season in order to balance evaporation from the pond system. The summer intake flows are just under the average discharge flows, accounting for summer evaporation rates. However, peak summer discharges may nearly triple the average discharge flows when the weir elevation is lowered. Average and peak winter discharge flows are much lower, approximately 70-80 percent less than summer flows. Although significant rainfall enters the pond system during winter, no pumped intake flows occur in winter and the weir elevation is raised almost a foot.

Table 4.2.9.2.1
Baumberg System 2C Inflow and Outflow

Period	**Gravity Intake Flow**		**Pumped Intake Flow**	**Discharge Flow**	
	Average	**Peak**		**Average**	**Peak**
Summer May – October	-	-	27 cfs 12,000 gpm	22 cfs 10,000 gpm	70 cfs 31,000 gpm
Winter November – April	-	-	3 cfs 1,500 gpm	6 cfs 2,600 gpm	21 cfs 9,400

The predicted water surface elevations during the initial stewardship period are shown in Table 4.2.9.2.2.

Table 4.2.9.2.2
Baumberg System 2C Water Surface Elevations

Pond	**Area (acres)**	**Bottom Elev (ft NGVD)**	**Water Elev (ft NGVD)**		
			Existing	**Initial Stewardship**	
				Summer	**Winter**
6	176	2.4	4.6	5.1	4.9
5	159	2.4	4.5	4.1	4.9
6C	78	2.8	4.4	5.0	4.9
4C	175	3.2	4.2	4.5	4.8
3C	153	2.9	4.3	4.1	4.7
5C	111	3.4	3.4	4.5	4.8
1C	66	3.6	3.5	4.5	4.8
2C	24	2.7	4.0	4.0	4.4
Total/Average	942	2.9	4.1	4.6	4.6

4.2.9.3 Salinity

The estimated discharge salinity from pond 2C to Alameda Flood Control Channel is shown in Figure 4-20. The model results are shown for the entire simulation period from April 1994 to October 1995. The model simulation period includes a dry year and a wet year to evaluate discharge salinities for a range of summer operation conditions.

The initial pond salinities and water surface elevations were based on measured conditions in early April 2002. The pond system transitions from the initial starting conditions in the first 4 to 6 weeks of operation.

The pond hydraulic model assumes that pumping would start if the discharge salinity exceeds 37 ppt, and stop if the discharge salinity is below 36 ppt. Because the discharge salinity responds slowly to the increased inflow, the pumps generally would operate for several days or weeks at a time. The pumping criteria were developed to limit the maximum initial discharge salinity to less than 40 ppt. The pumping criteria could be modified to conform to other discharge goals. A higher allowable discharge goal would reduce the need for pumping.

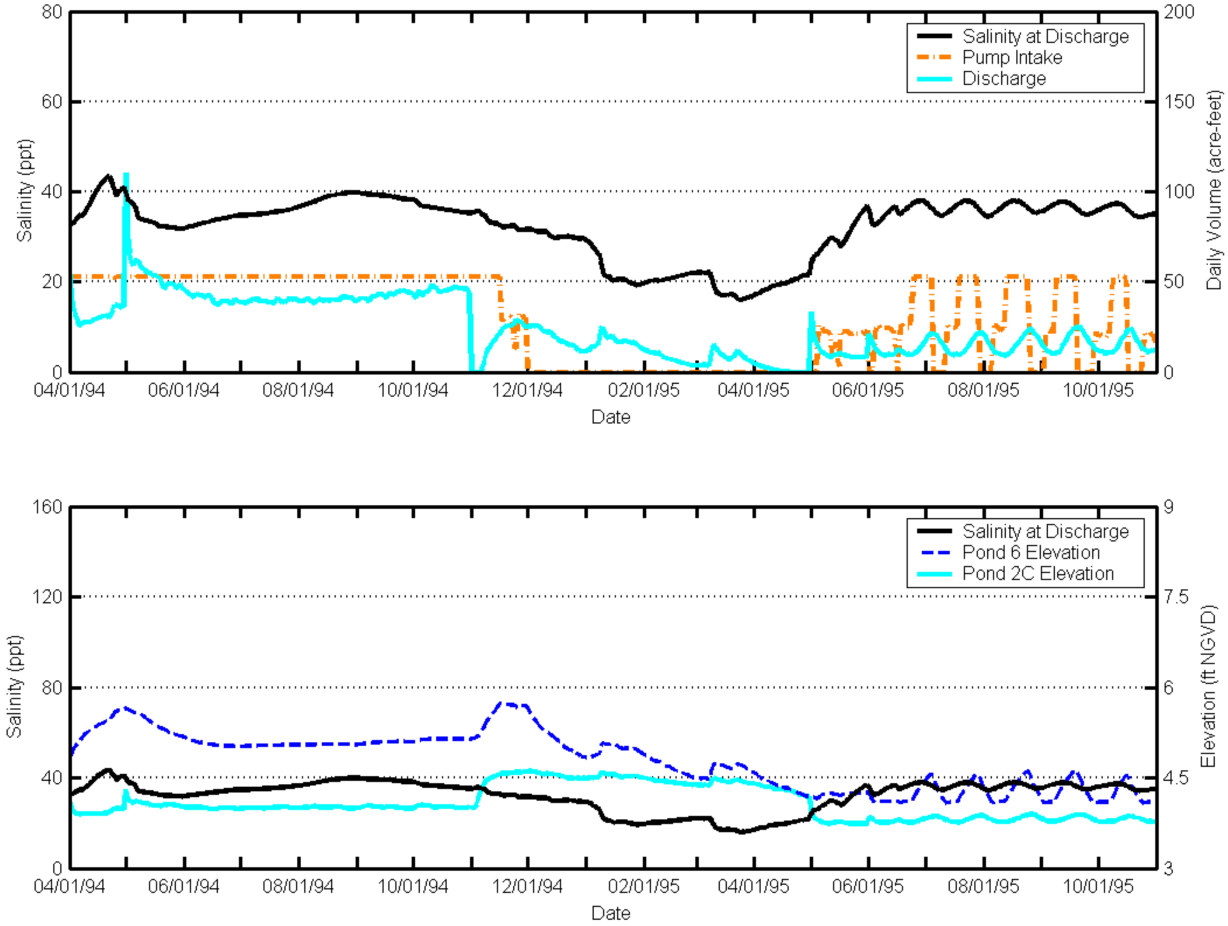
As shown in Figure 4-17, the system required significant continuous pumping during the summer of 1994, which was a relatively dry year with relatively high salinity in the South San Francisco Bay. 1995 was a much wetter year. Therefore, the ponds start the summer with somewhat lower salinity and the intake water from the bay has a lower salinity. Figure 4-18 shows that intermittent pumping was required for the summer 1995 conditions.

Table 4.2.9.3 shows the existing average summer and winter salinity levels based on recorded values for the past 6 years.

Table 4.2.9.3
Baumberg System 2C Existing Pond Salinity

Pond	Area (acres)	Average Pond Salinity (ppt)		Salinity Range (ppt)
		Summer	**Winter**	
6	176	67	64	25-148
5	159	64	62	23-149
6C	78	67	56	23-132
4C	175	72	49	23-143
3C	153	76	48	23-145
5C	111	61	49	20-136
1C	66	46	46	21-147
2C	24	77	48	20-178

System 2C includes salinity group 2 ponds and could have a maximum initial discharge salinity of 100 ppt. If the salinity in the system were at the maximum at the start of bay water circulation, the discharge salinity would start at 100 ppt and decrease to be similar to the modeled conditions in Figure 4-17 in a few months. Initial release scenarios which include the maximum discharge salinity have been modeled separately from the long term salinity modeling for evaluation purposes.



Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-20
Graphs of Baumberg 2C Operation Levels and Discharge Salinities

4.2.9.4 Management Operations

Baumberg System 2C will require active year round management because the intake pumping would be controlled by the discharge salinities at pond 2C. Active management will also be important in the transition period entering and exiting the summer management regime. The water surface elevations would be controlled primarily by the intake pump operations at ponds 6 and 1C and the discharge weir elevation at pond 2C.

Because of rainfall and low evaporation during the winter, winter pumping would typically not be required. However, limited pumping may be required during extreme drought winters with low rainfall. For winter operation, the discharge weir elevation at the 2C outlet structure would be set high enough (4.3 NGVD) to provide open water throughout the system. Winter operation pumping may be required to maintain water levels.

In the spring the system would be changed to the summer operation condition. The outlet weir would be lowered by approximately 1 foot (3.6 NGVD). This was assumed to occur in early May, but could vary depending on habitat conditions in the ponds. For example, the transition could be delayed or advanced based on use of the pond by migratory birds, or salinity levels in the ponds.

Lowering the discharge weir would lower the operating levels throughout the system and provide a significant increase in the gravity flow between ponds. The summer operation elevations would be similar to the existing operating elevations for downstream ponds. The new intake pump at pond 6 and the existing pump at pond 1C should have sufficient capacity to provide flow for salinity control during the spring, summer, and fall as needed. A proposed operation scheme was developed in which pumping would start if the discharge salinity exceeds 37 ppt, and stop if the discharge salinity is below 36 ppt. Because the discharge salinity responds slowly to the increased inflow, the pumps generally would operate for several days or weeks at a time. The pumping criteria could be modified to conform to other discharge goals such as a reduction in odors associated with pond drying.

A higher allowable salinity discharge goal would reduce the need for pumping. Based on the pond modeling for 1994 and 1995, the supplemental pumping would be necessary during summer periods with higher bay intake salinity, but may be significantly reduced during wet years with lower ambient salinity in the bay.

Ponds 1C and 5C would be a separate sub system within the overall system. Inflows from Alameda Flood Control Channel would be pumped as necessary to control salinity in the sub system. The sub system would discharge to pond 4C. This sub system may also be operated as a batch system with higher salinity to provide habitat for brine shrimp and related species. This may require additional analysis of pond salinities in pond 2C.

There are no salmonid migration concerns in Old Alameda Creek to limit pumped intake at pond 6, however there is the potential for future regulation of anadromous fish in Alameda Flood Control Channel.

4.2.10 Baumberg System 6A

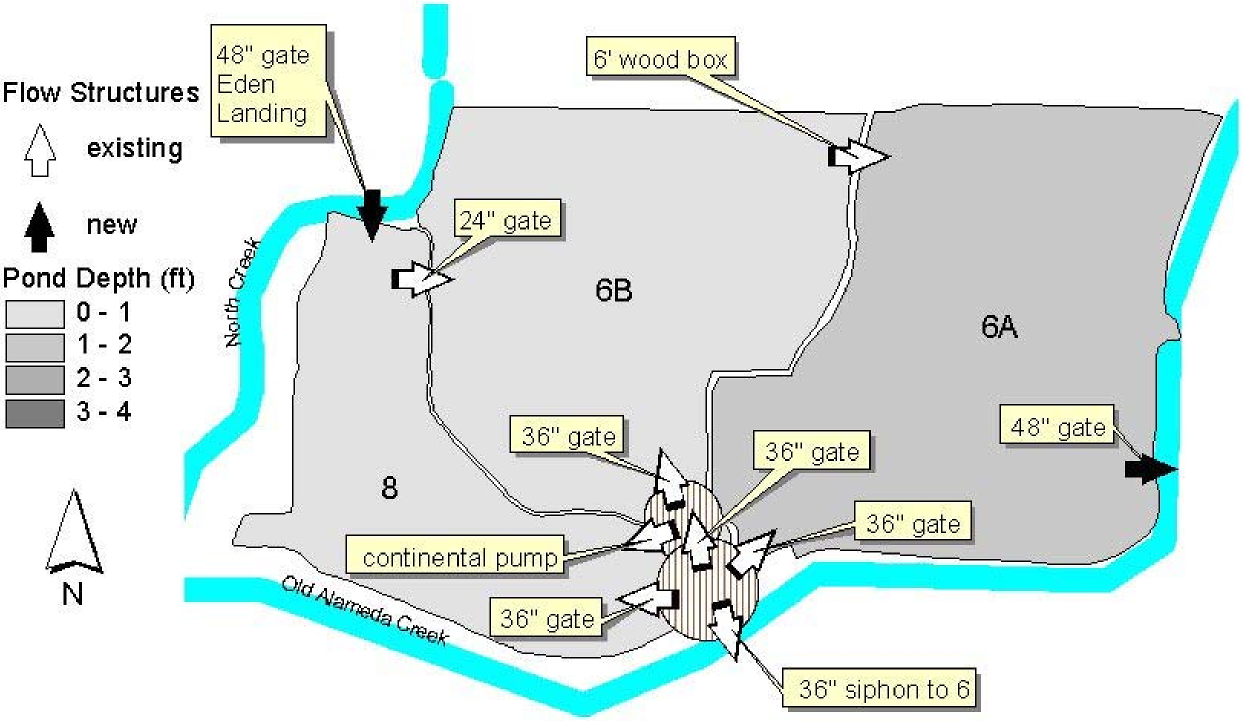
The Baumberg System 6A consists of 3 ponds: ponds 8 (intake), 6B and 6A (outlet) as shown in Figure 4-19. The objectives for the system include:

- Establish ponds 8, 6B and 6A as seasonal or seasonally muted tidal pond (6A only)

- Manage for different water surface elevations summer vs. winter
    - Drain ponds in late spring for seasonal operation, or
    - Lower the water levels in late spring and allow muted tidal flow into pond 6A
    - Maintain open water during the winter
- Operate water levels lower than existing levels
- Maintain discharge salinity at levels below 40 ppt.

The proposed system includes:

- New 48” gravity intake at pond 8 from North Creek
- Existing internal connection between
    - Pond 8 to 6B, two 36” gates
    - Ponds 6B and 6A, 6” box
    - Ponds 8 and 6A, 36” gate
- New 48” outlet with control weir at pond 6A into Old Alameda Creek
- Removal of existing continental pump
- Seal and abandon the siphon under Old Alameda Creek from pond 6A to 6
- Existing staff gage at all ponds



Note: Pond depths based on winter conditions.

Figure 4-21
Map of Baumberg 6A Inflow and Outflow Locations

4.2.10.1 Circulation Hydraulics

As a seasonal or muted tidal pond system, the system would not be subject to continuous circulation through ponds during the summer high evaporation season. The seasonal ponds would be filled during the fall to provide open water during the winter and early spring. The seasonal ponds would be drained in the spring. Due to the hydraulic limitations of the intake to pond 8 and the limited capacity of Old Alameda Creek, it was not considered practical to maintain continuous circulation in the 6A system during the summer.

Pond 6A may be operated as a muted tidal pond during the summer. With muted tidal operation, the outlet culvert would be opened to allow both inflow and outflow on each tidal cycle. The pond would then have a daily cycle of wetting and drying for part of the pond. Because of the limitation of the culvert and the creek channel, the daily tidal cycle within the pond would be relatively small, generally less than one foot. The tidal cycle in the bay is generally over six feet.

The intake and outlet structures and internal connections were designed to provide circulation for filling the pond system in the fall and to empty the ponds in the spring. The proposed intake structure into pond 8 at North Creek would include one 48” gravity culvert. All gravity intake flows would occur at high tide. The proposed intake structure would be constructed as part of the North Creek levee improvements to be completed as part of the Eden Landing restoration project.

In addition, the existing control structures include two control ponds located between the three ponds near Old Alameda Creek. The control ponds are shown in Figure 4-19, but not to scale. The actual ponds are each less than 1 acre. As shown in the plan, the south control pond (also called a donut) is connected by gated culverts to ponds 8 and 6A, to the north control pond and the siphon to pond 6 across Old Alameda Creek. The north control pond is connected to pond 6B. The north control pond was the source for water for the Continental pump, which pumped up into pond 8. For the salt making operations, the control ponds and pump were used to transfer water to and from pond 6. For the initial stewardship conditions, the pump and siphon would not be required. The system would be separate from the pond system south of Old Alameda Creek.

The system outlet structure would be located on the eastern end of pond 6A, and would discharge to Old Alameda Creek. All outflows would occur at low tide.

The initial stewardship conditions would include different operation plans for the ponds during the winter and summer seasons. The ponds would be seasonal and would have open water through the system during the winter. During the summer, the ponds would be dry or include a limited area of muted tidal area in pond 6A.

4.2.10.2 Interim Management Conditions

The inflow and outflow locations and graphs of pond operation levels and discharge salinities for the system are shown in Figures 4-19 and 4-20. Because the 6A system has been proposed for seasonal operation, only winter operation conditions are shown. The time scale shown is from November through June. Other systems which include summer operation show time scales from April 1994 through November 1995.

The estimated system flow rates using average daily flow and peak flows for both the intake and outlet are shown in Table 4.2.10.1, below. The summer conditions assume that all three ponds would be seasonal and dry during the summer. The winter conditions assume that there would be circulation through the system during the winter. The winter flows are controlled by the maximum tidal elevations in North Creek and the water surface elevation in pond 8.

Table 4.2.10.1
Baumberg System 6A Inflow and Outflow

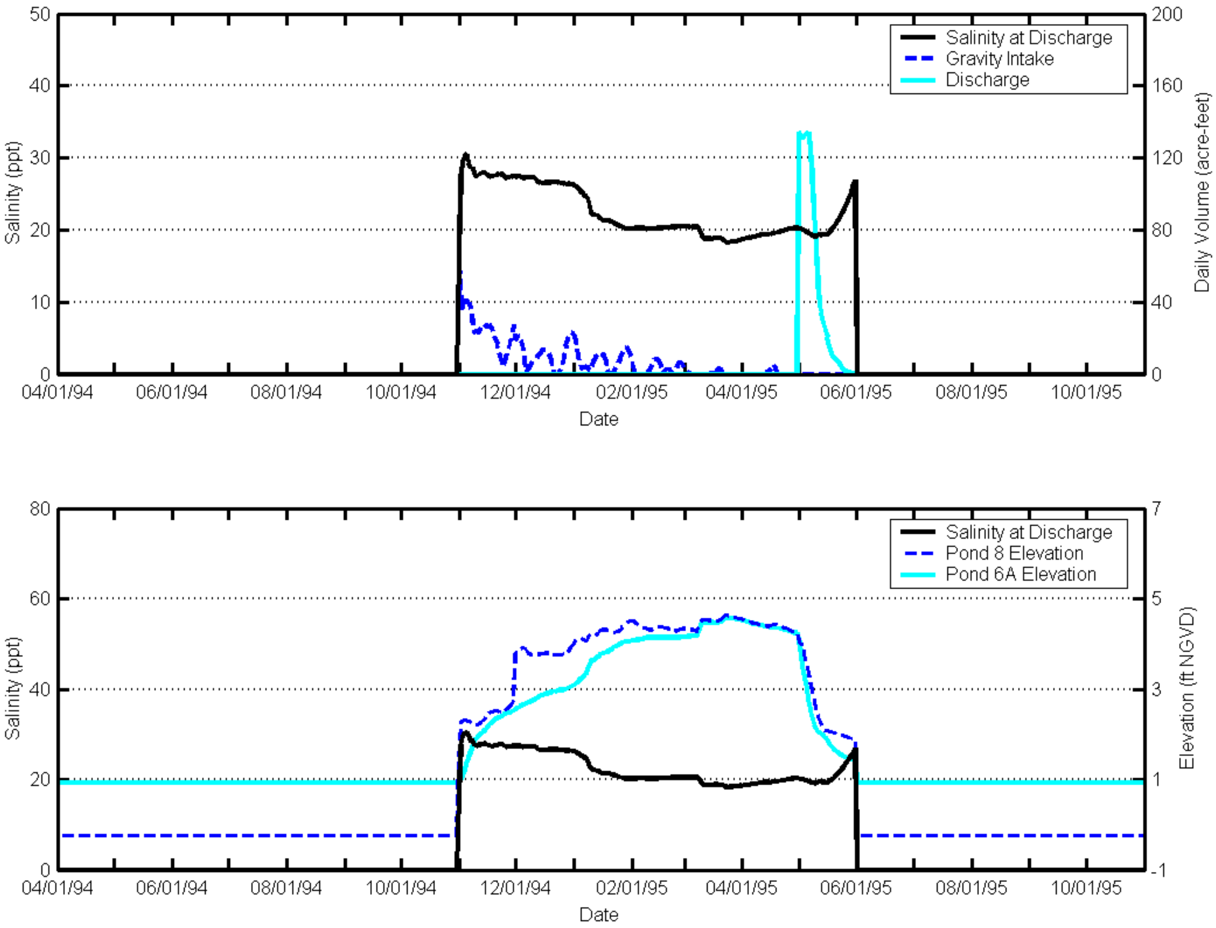
Period	**Gravity Intake Flow**		**Discharge Flow**	
	Average	**Peak**	**Average**	**Peak**
Summer	-	-	-	-
Winter November - May	2 cfs 700 gpm	82 cfs 37,000 gpm	2 cfs 1,000 gpm	13 cfs 5,900 gpm

The predicted water surface elevations during the initial stewardship period are shown in Table 4.2.10.2.2, below.

Table 4.2.10.3
Baumberg System 6A Existing Pond Salinity

Pond	**Area (acres)**	**Average Pond Salinity (ppt)**		**Salinity Range (ppt)**
		Summer	**Winter**	
8	180	138	110	48-299
6B	284	108	71	35-231
6A	340	94	63	32-184

System 6A includes salinity group 3 ponds and could have a maximum initial discharge salinity of 135 ppt. If the salinity in the system were at the maximum at the start of bay water circulation, the discharge salinity would start at 135 ppt and the discharge would decrease in a few months as the ponds drain. Additional modeling analysis may be required to evaluate alternative initial release discharges to Old Alameda Creek.



Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-22
Graphs of Baumberg 6A Operation Levels and Discharge Salinities

4.2.10.4 Management Operations

Baumberg System 6A will require limited active management, primarily during the transitions to and from the winter operation conditions. Pond water surface elevations would be controlled primarily by adjusting the control gates at the intake and outlet, between ponds. Intake salinities would be the similar to the bay salinity and pond salinities would be similar to existing bay salinities.

For the winter operation, the gates from pond 6B to pond 6A would be open to equalize the water surface elevations within the ponds. Water from the bay would circulate from pond 8 to 6B and 6A. Pond 8 would operate at a higher elevation because the pond bottom is higher. The water level in pond 8 may be controlled by a weir at the discharge, or by adjustment of the pond 8 control gates.

In the spring the system would be drained for the summer condition. This was assumed to occur in early May, but could vary depending on habitat conditions in the ponds. For example, the transition could be delayed or advanced based on use of the pond by migratory birds, or salinity levels in the ponds.

Because ponds would be operated as seasonal ponds, the ponds would slowly drain and dry during the late spring, and no further management would be required until winter. The ponds would then become part of the continuous flow operation in winter.

If pond 6A is to be operated as a muted tidal pond during the summer, the outlet culvert would be opened to allow inflow and outflow and the water level would be controlled by the outlet weir. Without the outlet weir the pond would only contain minimal water at extreme high tides.

4.2.11 Baumberg System 8A

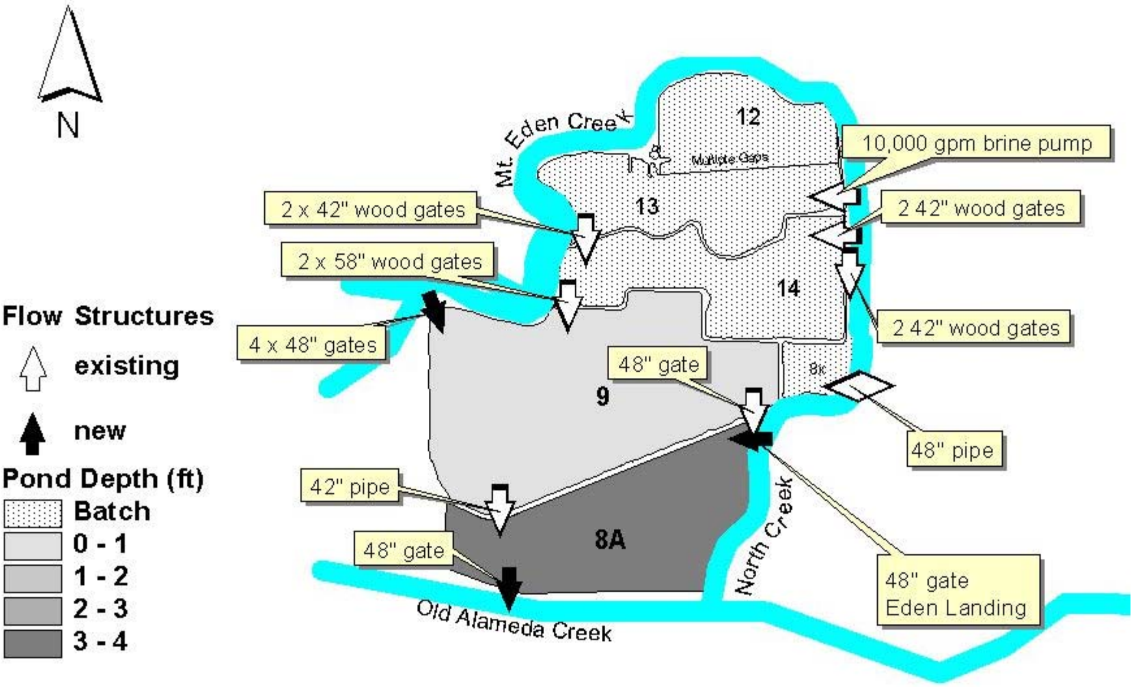
The Baumberg System 8A consists of 6 ponds: ponds 9 (intake), 8x and 8A (outlet) and seasonal ponds 12, 13 and 14, as shown in Figure 4-21. The objectives for the system include:

- Establish tidal circulation through ponds 9 and 8A
- Allow portions of 8A to dry-down in summer
- Establish ponds 12, 13, and 14 as seasonal ponds or winter batch ponds
- Manage for different water surface elevations summer vs. winter
    - Summer water elevations lower than winter elevations to increase gravity inflow
- Operate water levels lower than exiting levels
- Maintain discharge salinity at levels below 40 ppt
- Allow reversal of intake and outlet flow to better maintain constant water levels, drain ponds after storm events, or serve as a contingency should gates fail.

The proposed system would include:

- New 4x48” gated intake at pond 9 from Mount Eden Creek

- Existing internal connections from
  - Pond 13 to 14, 2x42” wood gates
  - Pond 14 to 9, 2x58” wood gates
  - Pond 9 to 8A, 42” pipe and 48” gate
- Existing multiple levee gaps between pond 12 and 13 (abandoned levee)
- Existing 10,000 gpm brine pump at pond 13 would be used as an intake pump from pond 8x or from Mount Eden Creek extension to pond 13
- Modify connections from pond 9 to 8A to include fixed weirs
- New 48” outlet at pond 8A into Old Alameda Creek
- New 48” intake gate at 8A from North Creek (part of Eden Landing Ecological Reserve Restoration project)
- Existing staff gages in all ponds



Note: Pond depths based on winter conditions.

Figure 4-23
Map of Baumberg 8A Inflow and Outflow Locations

4.2.11.1 Circulation Hydraulics

All four culverts of the pond 9 intake structure at Mount Eden Creek would include operable gates and flapgates to allow inflow. However two culverts would include gates to allow outflow, if necessary. Controls to allow outflow at the intake structure are included to maintain management flexibility and allow discharge from pond 9 in the event of flooding or a gate failure within the system. A 48" intake gate has been constructed at the northeasterly end of pond 8A as part of the Eden Landing restoration project. The pond 8A intake would increase circulation within pond 8A.

The outlet structure from pond 8A would include operable gates and flapgates to close off all flow or allow outflow only or allow inflow and outflow. The control gates at the intake and outlet culverts would allow partial culvert openings to control water levels. All gravity intake flow would occur at high tide, and all outflows would occur at low tide.

The operating water levels in the ponds would be lower during the summer to increase the gravity inflow into the system during the higher evaporation season. The water level in pond 9 would be approximately 3.4 ft NGVD during the summer, and 4.6 ft NGVD during the winter. The minimum water level in pond 9 would be controlled by fixed weirs at the connections to pond 8A. The fixed weirs would not be adjustable using weir boards. Because of the high bottom elevations in pond 8A, it would be only partially wet during the summer.

The existing brine pump at pond 13 will remain to provide inflows to the seasonal ponds 12, 13, and 14. The pump will intake from pond 8x or from the extension of Mount Eden Creek. The Mount Eden Creek extension will be constructed as part of the Eden Landing restoration project. Inflows to pond 8x will use the existing intake from North Creek. Because of the high bottom elevation in pond 8x, only the borrow ditches will be wet for normal tidal conditions. The ditches will be used to transport inflow from North Creek to the pump at pond 13.

4.2.11.2 Interim Management Conditions

The system structure location map and graphs of pond operation flows, water levels and discharge salinities for the Baumberg System 8A are shown in Figures 4-21 and 4-22.

The estimated system flow rates using average daily flow and peak flows for both the intake and outlet are shown in Table 4.2.11.2.1, below.

Table 4.2.11.2.1
Baumberg System 8A Inflow and Outflow

Period	**Gravity Intake Flow**		**Discharge Flow**	
	Average	**Peak**	**Average**	**Peak**
Summer May - October	38 cfs 17,000 gpm	420 cfs 190,000 gpm	35 cfs 7,400 gpm	88 cfs 40,000 gpm
Winter November - April	4 cfs 1,600 gpm	306 cfs 140,000 gpm	4 cfs 1,800 gpm	7 cfs 2,900 gpm

The predicted water surface elevations during the initial stewardship period are shown in Table 4.2.11.2.2, below.

Table 4.2.11.2.2
Baumberg System 8AWater Surface Elevations

Pond	**Area (acres)**	**Bottom Elevation (ft NGVD)**	**Water Elevation (ft NGVD)**		
			Existing	**Initial Stewardship**	
				Summer	**Winter**
9	356	2.6	4.7	3.4	4.6
8A	256	4.0	4.6	2.0	4.5
12	99	2.9	4.8	-	4.0
13	132	3.1	4.6	-	4.0
14	156	3.5	4.7	-	4.0
Total/ Average	1,008	3.0	4.7	3.4	4.2

The starting conditions for the model were based on water surface elevations and salinity levels in April 2002 to include the potential initial release conditions at the start of the circulation operations in ponds 9 and 8A. Therefore, the starting water surface elevations are similar to winter operation levels and are reduced during May to the summer operation levels.

The water levels in pond 8 show more daily fluctuation than other ponds including other outlet ponds. To increase circulation in pond 8A, the outlet was assumed to be fully open during the summer to increase circulation. The daily fluctuation in pond 8A with tidal inflow from both Old Alameda Creek and North Creek was estimated to be approximately 0.60 ft or less. However, during the summer only the borrow ditch areas would be affected. This represents approximately 10 percent of the entire pond area. There may also be some additional low areas from historic sloughs within the pond bottom, which may also be affected.

The water levels in ponds 9 and 8A would be lower during the summer for the initial stewardship conditions than for existing conditions. The initial stewardship conditions were designed to maintain a minimum average depth of 1.0 ft in pond 9 during the summer and 1.0 ft in pond 8A during the winter. Pond 8A would generally be dry during the summer operation, with circulation flows in the borrow ditches.

4.2.11.3 Salinity

The estimated discharge salinity from pond 8A to Old Alameda Creek is shown in Figure 4-22. The model results are shown for the entire simulation period from April 1994 to October 1995. The model simulation period includes a dry year and a wet year to evaluate discharge salinities for a range of summer operation conditions.

The initial pond salinities and water surface elevations were based on measured conditions in early April 2002. The pond system transitions from the initial starting conditions in the first 4 to 6 weeks of operation.

Table 4.2.11.3
Baumberg System 8A Existing Pond Salinity

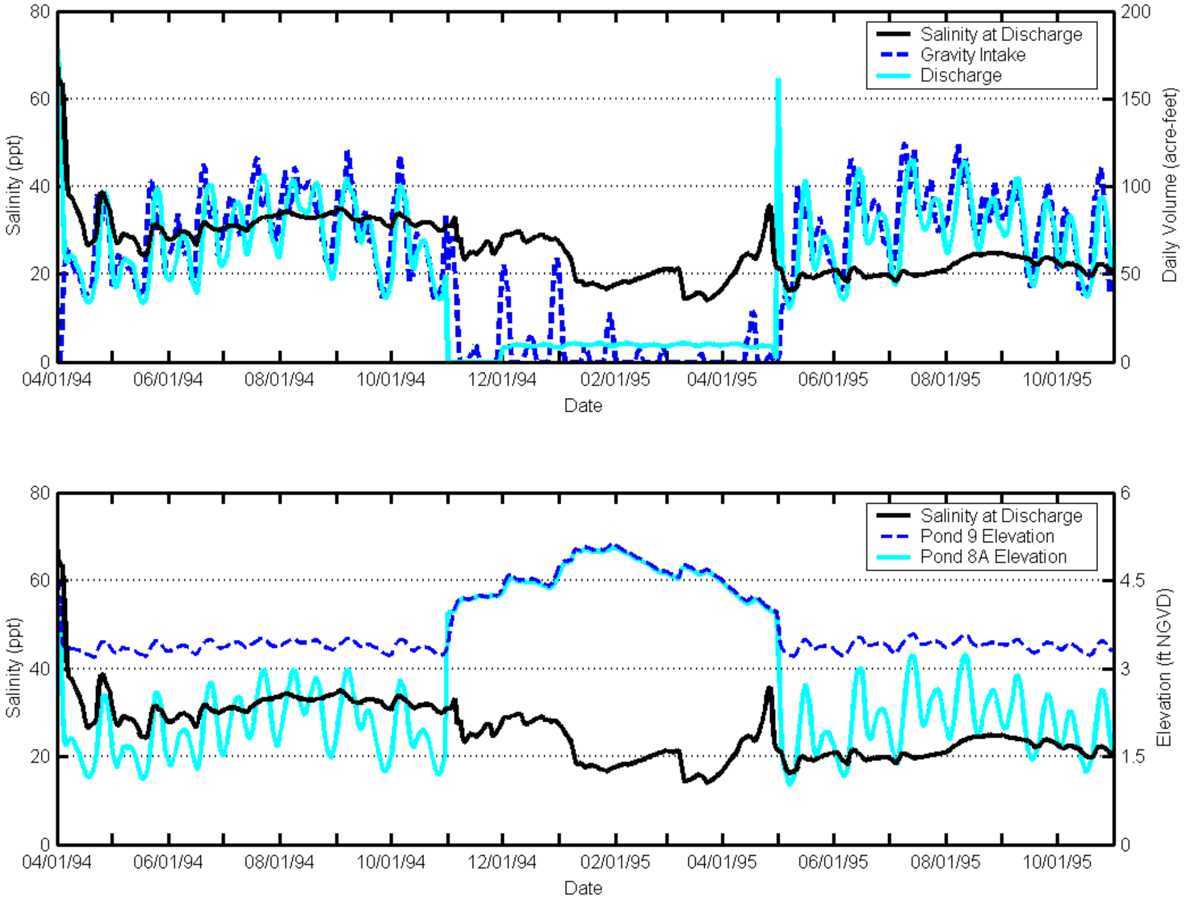
Pond	**Area (acres)**	**Average Pond Salinity (ppt)**		**Salinity Range (ppt)**
		Summer	**Winter**	
9	356	149	111	62-279
8A	256	159	118	69-285
12	99	107	81	27-328
13	132	99	81	27-334
14	156	124	91	32-304

It should be noted that all of the ponds in the system are operated as batch ponds for the existing salt making operations. This means that large volumes of water are transferred from pond to pond during relatively short periods of time rather than continuous flow during the evaporation season. Therefore, the salinity in each pond can change significantly from month to month and year to year. In addition, during 2001 and 2002 the operations were affected by construction for North Creek and the Eden Landing restoration. Salinity levels in the system were higher than in previous years.

Ponds 12, 13, and 14 were not included in the continuous operation model for the system. These ponds would operate as seasonal or batch ponds. As seasonal ponds, the ponds would contain rainwater during the winter, and generally be dry during the summer. The pond salinity would not be controlled, but would fluctuate due to residual salt in the pond, rainwater inflows, and seasonal evaporation.

As batch ponds, the ponds may be filled with bay water from North Creek during the fall using the pump from pond 8x. The salt water would remain in the ponds during the winter and discharged to pond 9 in the spring. Additional inflows could be added during the winter to control the salinity in the batch ponds. This type of batch operation would allow different winter habitat conditions in ponds 12, 13, and 14 than the seasonal operation, with higher salinity and more consistent water levels.

System 8A includes salinity group 3 ponds and would have a maximum initial discharge salinity of 135 ppt. If the salinity in the system were at the maximum at the start of bay water circulation, the discharge salinity would start at 135 ppt and decrease to be similar to the modeled conditions in Figure 4-22 in a few months. Initial release scenarios which include the maximum discharge salinity have been modeled separately from the long term salinity modeling for evaluation purposes.



Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-24
Graphs of Baumberg 8A Operation Levels and Discharge Salinities

4.2.11.4 Management Operations

Baumberg System 8A will require limited active management, primarily during the transitions to and from the summer operation conditions, as well as winter management of ponds 12, 13, and 14 if they are operated as batch ponds.

For the winter operation, the gates from pond 9 to pond 8A would be open. Water from the bay would circulate from pond 9 to 8A. The outlet control gates from pond 8A would be set to control the water levels in ponds 8A and 9.

In the spring the system would be changed to the summer operation condition. This was assumed to occur in early May, but could vary depending on habitat conditions in the ponds. For example, the transition could be delayed or advanced based on use of the pond by migratory birds, or salinity levels in the ponds.

For the summer operation, the inlet and outlet structures at pond 8A should be open for muted tidal inflow and outflow. The water level in pond 9 would be controlled by the fixed weirs between pond 9 and pond 8A.

Based on modeling of the system for historic tide and evaporation conditions in 1994, the gravity intake system would be sufficient to maintain the maximum salinity goals during periods of weak tides. Weak tide periods are the portion of the lunar cycle with higher low tides and lower high tides. Gravity inflows would only occur at high tide levels in the bay. During periods of weak tides, with lower high tides, the inflow may be reduced. Weak tide periods may extend for a week to 10 days. A sensitivity analysis was prepared to evaluate the potential effects of extreme high evaporation combined with weak tides. The 1994 weak tide summer period was rerun using evaporation values 20 percent higher than normal. This corresponds to an evaporation condition with approximately a 25-year recurrence interval. This means that on average, it would be exceeded once in a 25-year period.

Ponds 12, 13, and 14 would be operated as seasonal or winter batch ponds. For seasonal pond operations, the pond would be drained initially and no further operation would be required. The pond would fill with 10 to 20 inches of rainwater during the winter that would evaporate during the summer.

As batch ponds, ponds 12, 13, and 14 would not have continuous flow operation similar to 9 and 8A. All inflows to 12, 13, and 14 must be pumped from pond 8x and North Creek. Water would be pumped from 8x in the fall to establish an operational water level in the ponds. Supplemental water may be added during the winter to maintain water levels in dry years. In wet years, surplus water may be released from pond 14 to pond 9 to limit the maximum water level in the ponds. Depending on weather conditions, the batch operation may require gate adjustment weekly or more frequently. If the salinity in ponds 12, 13 and 14 begins to increase in the spring the ponds may require additional inflows to control the salinity. In general, the batch ponds would be drained to pond 9 in the spring to minimize the pumping required for salinity control in the seasonal ponds during the summer high evaporation season.

4.2.12 Baumberg System 11

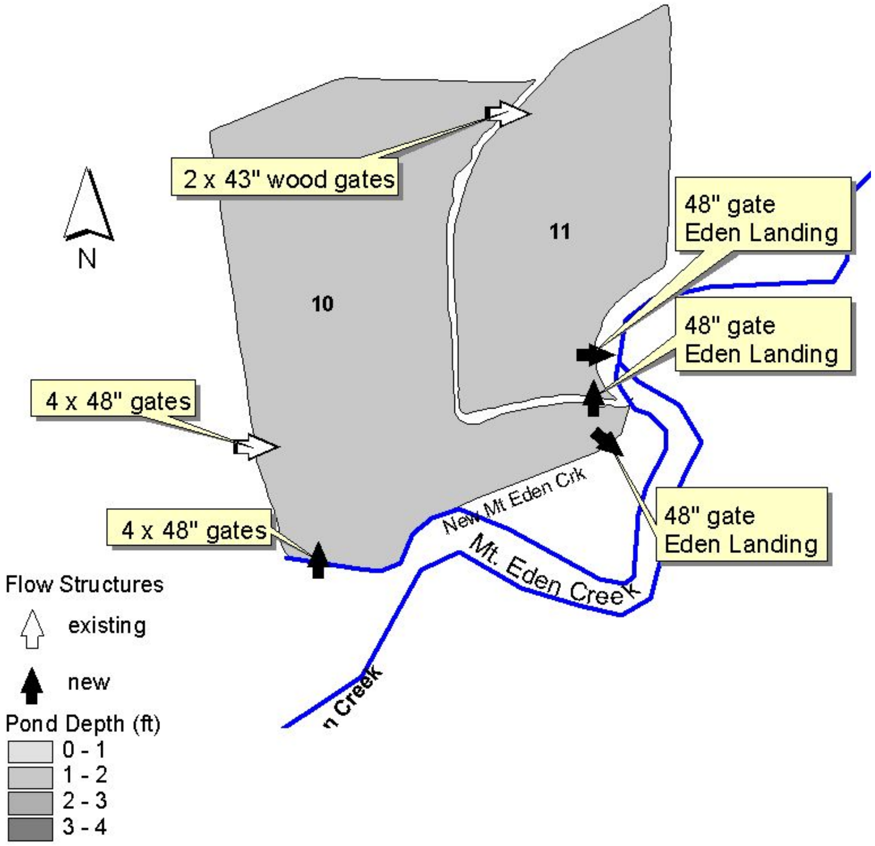
The Baumberg System 11 consists of ponds 10 (intake and outlet) and pond 11 (outlet) as shown in Figure 4-23. The objectives for the system include:

- Establish tidal circulation through ponds 10 and 11
- Establish pond 11 as a seasonal or muted tidal pond

- Manage for different water surface elevation levels summer vs. winter
    - Summer water elevations lower than winter elevations to increase gravity inflow
- Operate water surface levels lower than existing levels
- Maintain discharge salinity at levels below 40 ppt
- Locate intake to minimize disturbance to tidal marsh habitat
- Allow reversible flow at new intake and outlet structures.

The system includes:

- New 4x48" gravity intake structure at pond 10 from lower Mount Eden Creek (to replace the existing intake structure from the San Francisco Bay)
- Existing 2x43" wood gates between ponds 10 and 11
- New 48" gate between ponds 10 and 11
- New 48" gravity outlet structures with control weir Mt. Eden Creek at
    - Pond 10
    - Pond 11 (both are part of Eden Landing restoration project)
- Remove existing gates from ponds 10 and 11 to the brine ditch at Mount Eden Creek (part of the Eden Landing restoration project)
- Existing staff gages at both ponds



Note: Pond depths based on winter conditions.

Figure 4-25
Map of Baumberg 11 Inflow and Outflow Locations

4.2.12.1 Circulation Hydraulics

This pond group would contain two continuous circulation ponds: 10 & 11. The system has different operation plans for winter and summer seasons to meet summer evaporation conditions. The intake and outlet structures and internal connections were designed to provide circulation for water quality control during the summer evaporation season and allow seasonal flow through pond 11. All four intake gates would allow tidal inflow to pond 10. Two of the culverts would include control gates to allow outflow at the intake structure. All gravity intake flows would occur at high tide. The proposed intake structure would replace an existing intake structure from San Francisco Bay into pond 10. The replacement has been proposed due to the age and condition of the existing intake. The new location has been proposed to improve flow conditions at the intake. The existing intake is located in a large marsh area with tidal action only at high tide. The proposed location would be in an area of lower Mount Eden Creek with less marsh area.

Table 4.2.10.2.2
Baumberg System 6A Water Surface Elevations

Pond	Area (acres)	Bottom Elevation (ft NGVD)	Water Elevation (ft NGVD)		
			Existing	Interim Management	
				Summer	Winter
8	180	3.7	6.5	-	4.3
6B	284	2.1	3.0	-	3.0
6A	340	0.9	3.1	-	3.0
Total/ Average	804	2.	4.2	-	3.3

The starting conditions for the model were based on the ponds being empty at the beginning of the winter period. Therefore, the starting water surface elevations are at the bottom of the ponds and increase during the first months of the model. The water levels remain relatively constant during the winter, and then decrease during May when the ponds would be drained for the summer.

The water levels in pond 8 show some daily fluctuation, generally in the range of 0.3 to 0.5 ft. This is due to the relatively short intake period at high tide in comparison to the longer outlet period during the day when water would drain to ponds 6B and 6A. During this period, the water levels in pond 8 would be within the borrow ditch areas until 6A and 6B had been filled. The outlet flows would be controlled by the outlet weir at pond 6A.

4.2.10.3 Salinity

The estimated discharge salinity from pond 6A is shown in Figure 4-20. The salinity was estimated using the hydraulic model for the pond system. The initial pond salinity of 0 ppt assumed that there was no water in the ponds. This was based on the assumption that the ponds would be transferred dry and that there would be no initial release in April to drain the existing water in the ponds. If the ponds are transferred wet, additional analysis may be required to evaluate initial release discharges to Old Alameda Creek.

For the winter operation shown in Figure 4-20, the pond salinity would rapidly increase to match the intake salinity of approximately 25 ppt during the fall as the ponds fill. No actual discharge would occur during this period. In February when the ponds are full and begin to discharge, the salinity would begin to decrease due to rainfall within the system, and lower intake salinity from North Creek. The salinity for North Creek was assumed to be the same as the measured salinity in the bay at the Cargill Baumberg intake.

Pond 6A may be partially wet during the summer operation. The outlet structure at pond 6A could be opened to allow both inflow and outflow. The water level would be adjusted using the outlet weir to control the salinity in the pond. For lower water levels in the pond, the net daily inflow and outflow would increase to reduce the effect of evaporation within the pond. The lower pond elevation also reduces the wet area in the pond and therefore reduces the evaporation.

Table 4.2.10.3 shows the existing average summer and winter salinity levels based on recorded values for the past 5 years.

A new 48" gate would be installed between ponds 10 & 11 at the southern end of pond 11. This additional internal connection would supplement existing inflows to pond 11 from pond 10 via two 43" wood gates located in the northern half of the ponds.

There are existing wooden gates from ponds 10 and 11 to a brine ditch on the west side of Mount Eden Creek that would be removed. The brine ditch has been used to transfer water for the commercial salt operation. The ditch connected ponds 10 and 11 with the existing brine pump at pond 13. The brine ditch and the existing gates to the brine ditch will be removed as part of Mount Eden Creek improvements for the Eden Landing Salt Pond Restoration project.

Two outlet structures, one on the eastern end of pond 10 and the other on the southeastern end of pond 11, would discharge to Mount Eden Creek. The outlet structures would both consist of a single 48" culvert. All outflows would occur at low tide. The outlet culverts would be constructed as part of the Mount Eden Creek improvements for the Eden Landing restoration project to replace the existing wooden gates and the existing brine ditch.

The initial stewardship conditions would include different operation plans for each pond during the winter and summer seasons. The operating water levels in the ponds would be lower during the summer to increase the gravity inflow into the system during the higher evaporation season. The water level would be approximately 3.1 ft NGVD during the summer, and 4.0 ft NGVD during the winter. Because of the high bottom elevations in pond 11, it would be only partially wet during the summer. Therefore, pond 11 would be closed off from pond 10 and pond 11 would be operated as a muted tidal or seasonal pond during the summer. Pond 10 would discharge directly to Mt. Eden Creek during the summer.

During the winter, the circulation pattern would be from pond 10 to pond 11, then to Mount Eden Creek. The control gates would be adjusted to maintain higher water levels and create open water habitat in both ponds. Pond 11 would discharge into Mt. Eden Creek during the winter.

4.2.12.2 Interim Management Conditions

The system structure location map and graphs of pond operation flows, water levels and discharge salinities for the Baumberg System 11 are shown in Figures 4-23 and 4-24.

The estimated system flow rates using average daily flow and peak flows for both the intake and outlet are shown in Table 4.2.12.2.1, below.

Table 4.2.12.2.1
Baumberg System 11 Inflow and Outflow

Period	**Gravity Intake Flow**		**Discharge Flow**	
	Average	**Peak**	**Average**	**Peak**
Summer	28 cfs 13,000 gpm	348 cfs 156,000 gpm	26 cfs 12,000 gpm	70 cfs 31,000 gpm
Winter	11 cfs 4,900 gpm	318 cfs 144,000 gpm	12 cfs 5,200 gpm	65 cfs 29,000 gpm

The predicted water surface elevations during the initial stewardship period are shown in Table 4.2.12.2.2, below. Note that Ponds 11 becomes seasonal after one month.

Table 4.2.12.2.2
Baumberg System 11 Water Surface Elevations

Pond	Area (acres)	Bottom Elevation (ft NGVD)	Water Elevation (ft NGVD)		
			Existing	Interim Management	
				Summer	Winter
10	214	2.4	3.8	3.1	4.0
11	118	2.9	4.3	-	4.0
Total/ Average	332	2.6	4.0	3.1	4.0

The starting conditions for the model were based on water surface elevations and salinity levels in April 2002 to include the potential initial release conditions at the start of the circulation operations in ponds 10 and 11. Therefore, the starting water surface elevations are similar to winter operation levels and are reduced during May to the summer operation levels.

The water levels in pond 10 some daily fluctuation, generally in the range of 0.2 to 0.3 ft. This is due to the relatively short intake period at high tide in comparison to the longer outlet period at low tide. The outlet flows would be controlled by the outlet control gate at pond 10.

The water levels in ponds 10 and 11 would be lower during the summer for the initial stewardship conditions than for existing conditions. The initial stewardship conditions were designed to maintain a minimum average depth of 0.70 ft in pond 10 during the summer, and 1.60 ft in pond 10 during the winter. Pond 11 would generally be dry during the summer operation, and would contain approximately 1.0 ft of water during the winter.

4.2.12.3 Salinity

The estimated discharge salinity from pond 10 or 11 to Mount Eden Creek is shown in Figure 4-24. The model results are shown for the entire simulation period from April 1994 to October 1995. The model simulation period includes a dry year and a wet year to evaluate discharge salinities for a range of summer operation conditions.

The initial pond salinities and water surface elevations were based on measured conditions in early April 2002. The pond system transitions from the initial starting conditions in the first 4 to 6 weeks of operation.

Pond 11 would be drained in the late spring and remain dry during the summer high evaporation season. The model analysis assumed that pond 11 would be drained in May and filled in November.

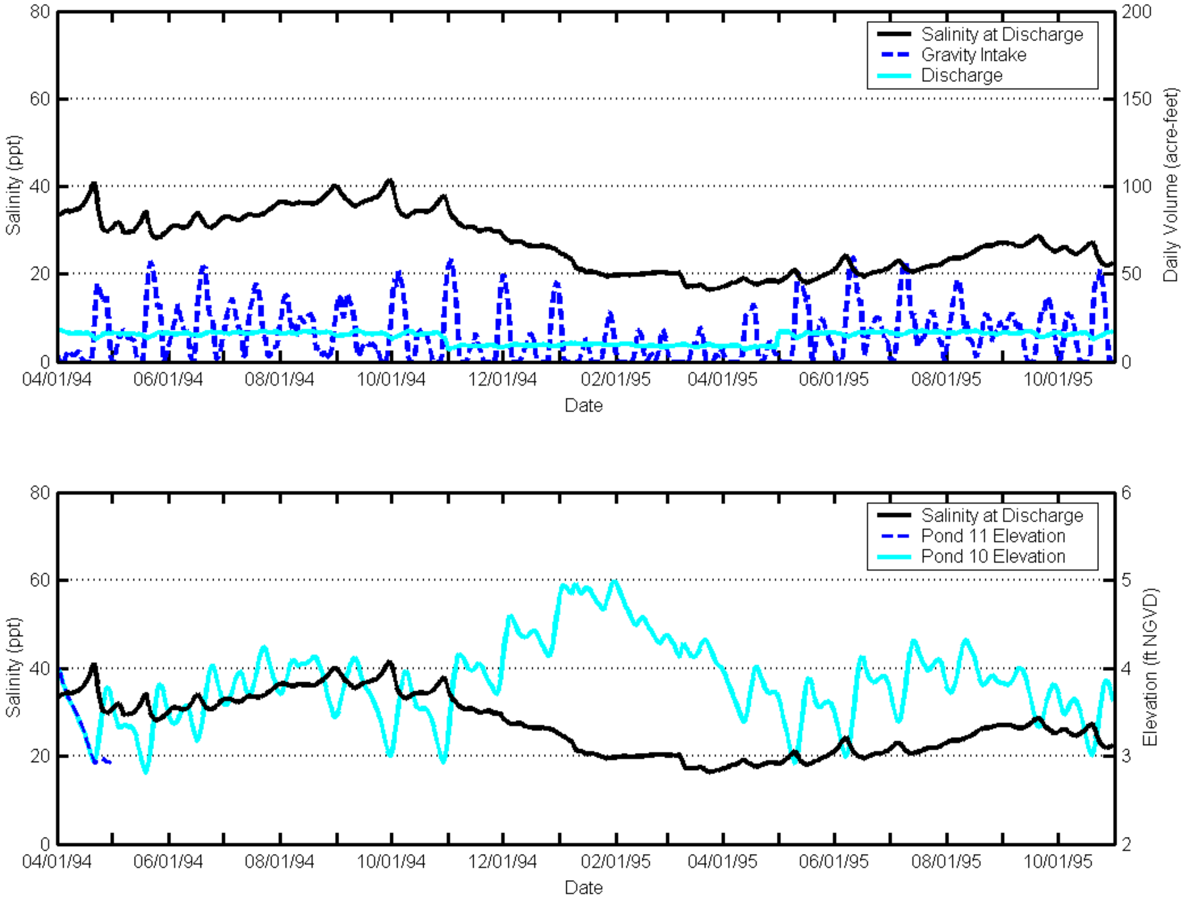
Pond 11 was not included in the continuous operation model for the system during the summer. The pond would operate as a muted tidal or seasonal pond in summer. As a seasonal pond, it would generally be dry during the summer. The pond salinity would be controlled by the control gate opening and the balance between evaporation and the daily inflow and outflow.

Table 4.2.12.3 shows the existing average summer and winter salinity levels based on values recorded for the past 5 years.

Table 4.2.12.3
Baumberg 11System Existing Pond Salinity

Pond	Area (acres)	Average Pond Salinity (ppt)		Salinity Range (ppt)
		Summer	**Winter**	
10	214	37	27	16-74
11	118	47	32	16-81

System 11 includes salinity group 1 ponds and could have a maximum initial discharge salinity of 65 ppt. If the salinity in the system were at the maximum at the start of bay water circulation, the discharge salinity would start at 65 ppt and decrease to be similar to the modeled conditions in Figure 4-24 in a few months. Initial release scenarios which include the maximum discharge salinity have been modeled separately from the long term salinity modeling for evaluation purposes.



Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-26
Graphs of Baumberg 11 Operation Levels and Discharge Salinities

4.2.12.4 Management Operations

Baumberg System 11 will require active management, primarily during the transitions to and from the summer operation conditions. Water surface elevations would be primarily controlled by adjusting the outlet control gates. Intake salinities would be the same as bay salinities and pond salinities would be similar to existing bay salinities.

For the winter operation, the gates from pond 10 to pond 11 would be open. Water from the bay would circulate from pond 10 to 11. The control gates at the outlet structures from ponds 10 and 11 would be set to provide open water throughout the system.

In the spring the system would be changed to the summer operation condition. This was assumed to occur in early May, but could vary depending on habitat conditions in the ponds. For example, the transition could be delayed or advanced based on use of the pond by migratory birds, or salinity levels in the ponds.

For the summer operation, the pond 10 outlet gate would be adjusted to lower the pond water level by approximately 1.0 feet. This would provide a significant increase in the gravity inflow from the intake culverts in pond 10. The internal connections between ponds 10 and 11 would be closed so that pond 11 would be operated as a seasonal pond or muted tidal pond.

Based on modeling of the system for historic tide and evaporation conditions in 1994, the gravity intake system would be sufficient to maintain the maximum salinity goals during periods of weak tides. Gravity inflows would only occur at high tide levels in the bay. During periods of weak tides, with lower high tides, the inflow may be reduced. Weak tide periods may extend for a week to 10 days. A sensitivity analysis was prepared to evaluate the potential effects of extreme high evaporation combined with weak tides. The 1994 weak tide summer period was rerun using evaporation values 20 percent higher than normal. This corresponds to an evaporation condition with approximately a 25-year recurrence interval. This means that on average, it would be exceeded once in a 25-year period. The estimated inflow from the gravity intake culverts would maintain the discharge salinity below approximately 40 ppt.

Because pond 11 would be operated as muted tidal or seasonal pond, the pond would slowly drain and dry up over summer and no further management would be required until winter. The pond would then become part of the continuous flow operation in winter. If pond 11 is to be operated as a muted tidal pond during the summer, the outlet culvert would be opened to allow inflow and outflow and the water level would be controlled by the outlet weir. Without the outlet weir the pond would only contain minimal water at extreme high tides.

4.2.13 West Bay Complex Ponds

The West Bay pond group consists of five pond systems. The complex includes seven ponds: 1, 2, 3, 4, 5, S5 and SF2. The West Bay pond group is shown in Figure 4-25. The objectives for the system include:

- Establish tidal circulation through ponds 1, 2, 3, 4, 5 and S5
- Maintain discharge salinity at levels below 40 ppt
- Locate intakes to minimize disturbance to tidal marsh habitat
- Allow reversible flow at new intake/outlet structures

The system includes:

- New gravity intake/outlet structures:

  48” culvert, pond 1 to Ravenswood Slough
  2x48” culverts, pond 2 to Ravenswood Slough
  2x48” culverts, pond 3 to Ravenswood Slough
  3x48” culverts, pond 4 to Westpoint Slough
  48” culvert, pond S5 to Flood Slough Restoration Area
  3x48” culverts, pond SF2 to San Francisco Bay

- Existing 2x60” intake at pond 1

- Seal and abandon existing 36” siphon from pond 2 to SF2

- Existing pond connections:

  2x42” wood gates from pond 2 to 1
  30” siphon from pond 3 to 2
  36” wood gate from pond 3 to S5
  2x36” wood gates from pond S5 to 5
  Gap between pond 5 and 4
  Ravenswood pump and siphon from pond 1

- Existing staff gages at all ponds.

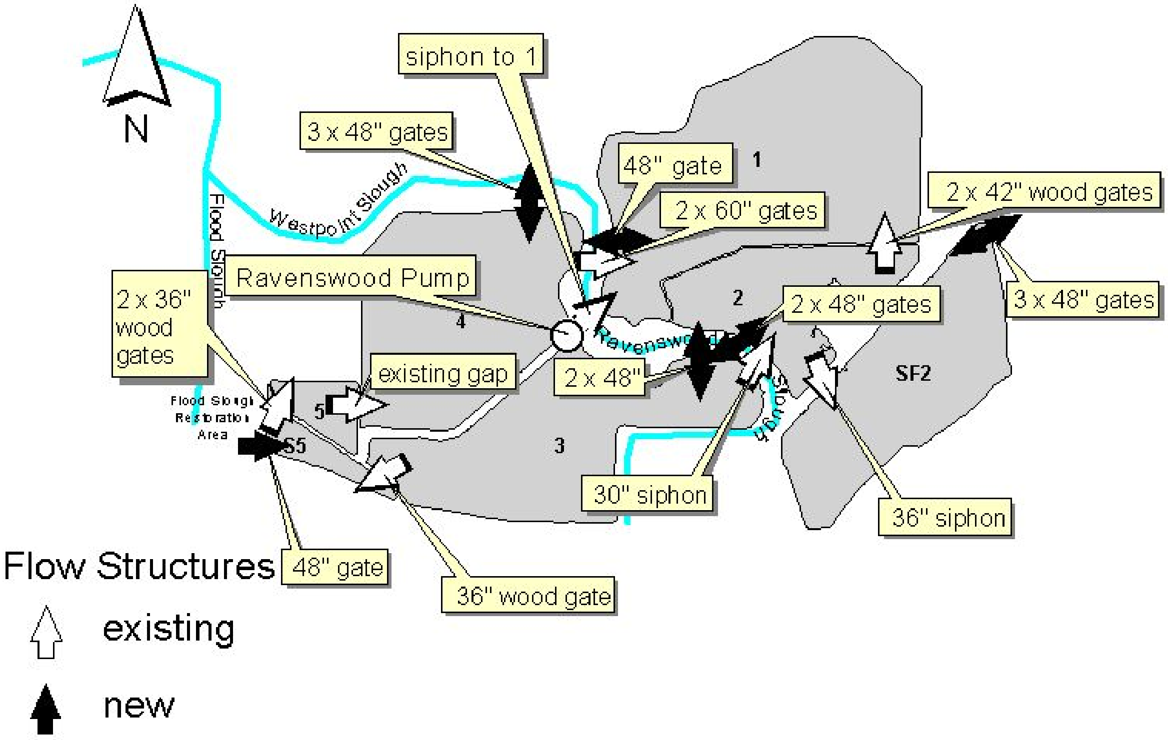


Figure 4-27
Map of West Bay Complex Inflow and Outflow Locations

4.2.13.1 Circulation Hydraulics

The West Bay pond group would contain five separate sub systems. Ponds 1, 2, 3, and SF2 would each be an independent single pond system with inlet/outlet structures. The inlet/outlet structures would allow tidal inflow at high tide and outflow at low tide. The intake/outlet structures were designed to provide circulation for water quality control during the summer evaporation. All gravity intake flows would occur at high tide, and all outflows would occur at low tide. The proposed intake/outlet structures were located minimize construction within the existing marsh areas along the bay and slough levees.

The other west bay pond group would include S5 (inlet), 5, and 4 (inlet/outlet). The major flow to the system would be from the pond 4 intake. There would be a supplemental intake structure to provide circulation from the Flood Slough Restoration Area west of pond S5. The supplemental intake would provide circulation through both ponds S5 and 5.

4.2.13.2 Interim Management Conditions

The system structure location map and graphs of pond operation flows, water levels and discharge salinities for the West Bay pond group are shown in Figures 4-25 and 4-26.

The estimated system flow rates using average daily flow and peak flows for both the intake and outlet are shown in Table 4.2.13.2.1, below.

Table 4.2.13.2.1
West Bay Pond Systems Inflow and Outflow

Pond System	**Gravity Intake Flow**		**Discharge Flow**	
	Average	**Peak**	**Average**	**Peak**
1	34 cfs 15200 gpm	318 cfs 142600 gpm	33 cfs 14800 gpm	100 cfs 44700 gpm
2	25 cfs 9600 gpm	201 cfs 90100 gpm	24 cfs 9000 gpm	74 cfs 31800 gpm
3	21 cfs 1100 gpm	196 cfs 88200gpm	21 cfs 1100 gpm	71 cfs 46500 gpm
Pond 4	18cfs 8200 gpm	204 cfs 118500 gpm	18 cfs 8200 gpm	75 cfs 33600gpm
SF2	22cfs 9900 gpm	274 cfs 122800 gpm	22 cfs 9900 gpm	97 cfs 43700 gpm

The predicted water surface elevations during the initial stewardship period are shown in Table 4.2.13.2.2, below.

Table 4.2.13.2.2
West Bay Pond Systems Water Surface Elevations

Pond	**Area (acres)**	**Bottom Elevation (ft NGVD)**	**Water Elevation (ft NGVD)**		
			Existing	**Interim Management**	
				Summer	**Winter**
1	445	2.1	2.6	3.0	3.1
2	145	2.0	3.5	2.8	2.8
3	273	2.2	3.4	2.9	3.0
4	297	2.8	3.2	3.5	3.5
5	31	2.5	3.1	3.5	3.5
S5	29	2.5		3.7	3.7
SF2	242	2.6	3.6	3.3	3.4
Total/ Average	1462	2.4	3.2	3.3	3.3

The starting conditions for the model were based on water surface elevation levels in April 2002 to include the potential initial release conditions at the start of the circulation operations in the West Bay ponds. The starting water surface elevations are higher than the proposed operation levels and therefore water levels would decrease during the first month of operation. On average, the initial stewardship conditions in the West Bay ponds would be approximately 0.1 ft higher than the than the historic conditions in the ponds. For ponds 1, 4 and 5 the ISP conditions would be higher. For ponds 2, 3, and SF2 the ISP conditions would be lower. There are no existing water level records for pond S5.

The outlet flows would be controlled by an outlet weir at each pond outlet or using the culvert control gates. The weir may be necessary to maintain minimum water levels during low tides. The average bottom elevation in the west bay ponds is approximately 2.4 feet above mean tide elevation.

4.2.13.3 Salinity

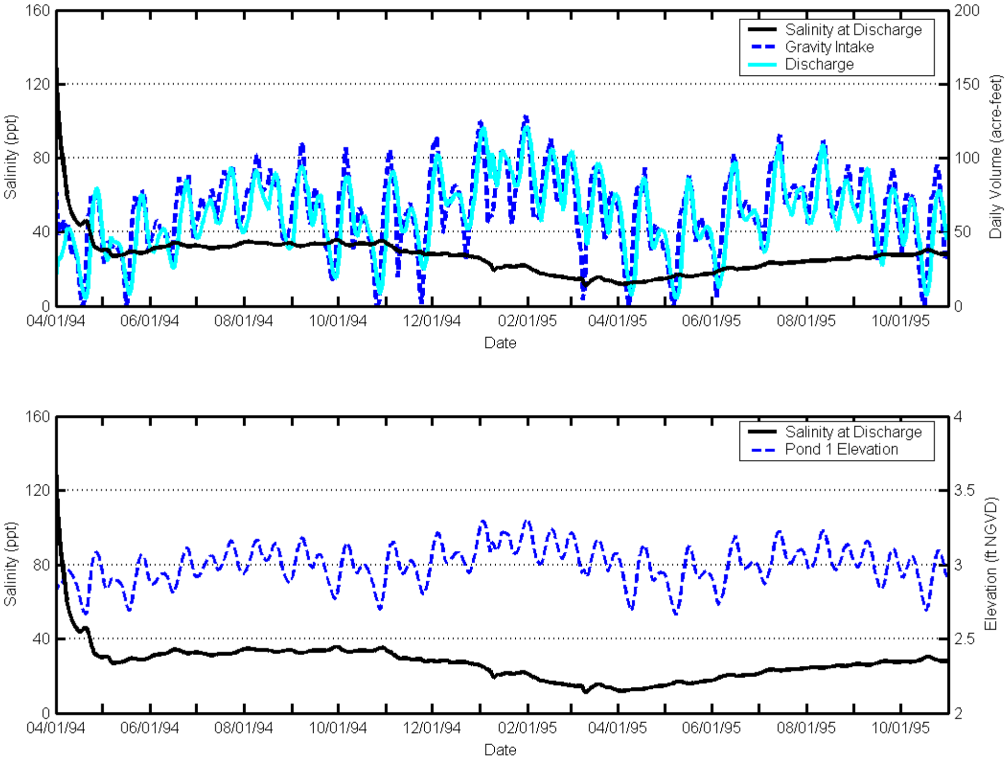
The estimated discharge salinity from the West Bay ponds system is shown in Figures 4-27, 4-28, and 4-29. The model results are shown for the entire simulation period from April 1994 to October 1995. The model simulation period includes a dry year and a wet year to evaluate discharge salinities for a range of summer operation conditions.

The initial pond salinities and water surface elevations were based on measured conditions in early April 2002. The pond system transitions from the initial starting conditions in the first 4 to 6 weeks of operation.

Table 4.2.13.3 shows the existing average summer and winter salinity levels based on values recorded for the past 6 years. There are no recorded salinities for pond S5.

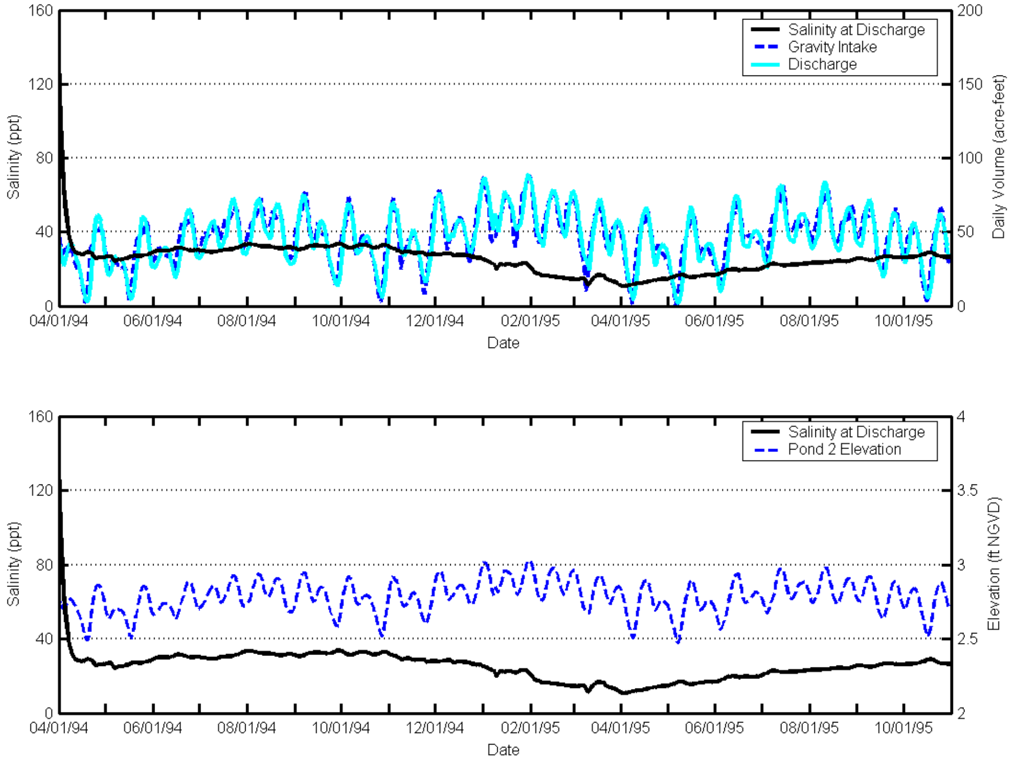
Table 4.2.13.3
West Bay Pond Systems Existing Pond Salinity

Pond	Area (acres)	Average Pond Salinity (ppt)		Salinity Range (ppt)
		Summer	Winter	
1	445	150	130	35-326
2	145	211	176	64-306
3	273	244	191	145-320
4	297	276	198	88-341
5	31	274	200	96-340
S5	29			
SF2	242	202	157	76-316



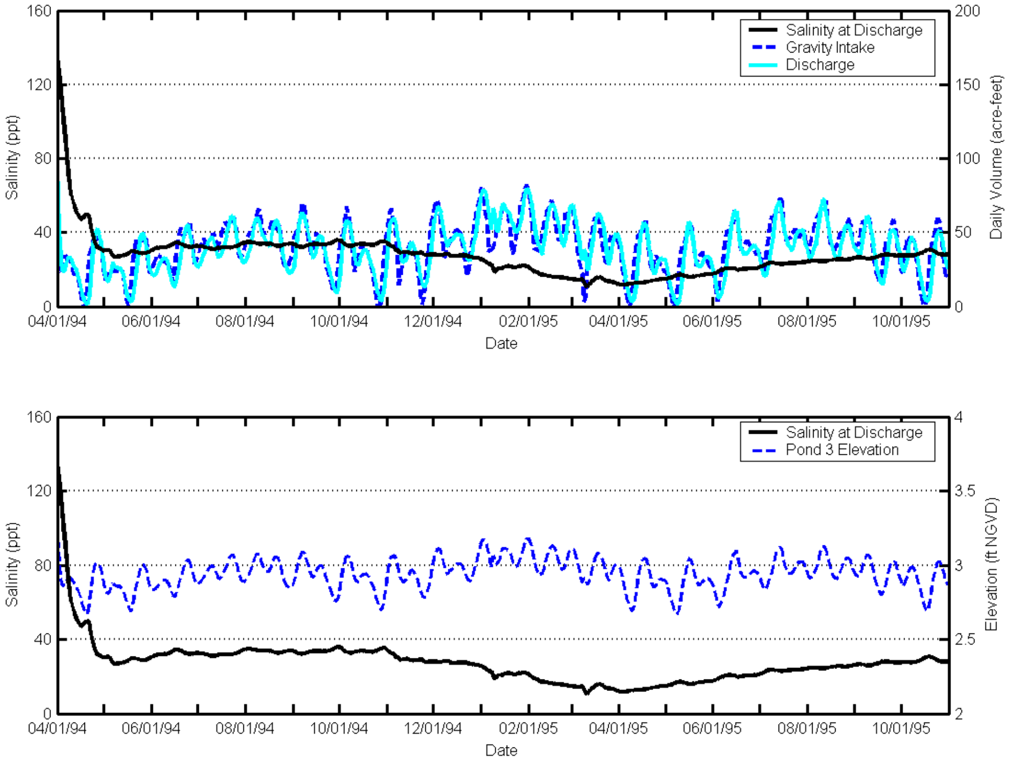
Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-28
Graph of West Bay 1 Discharge Salinities



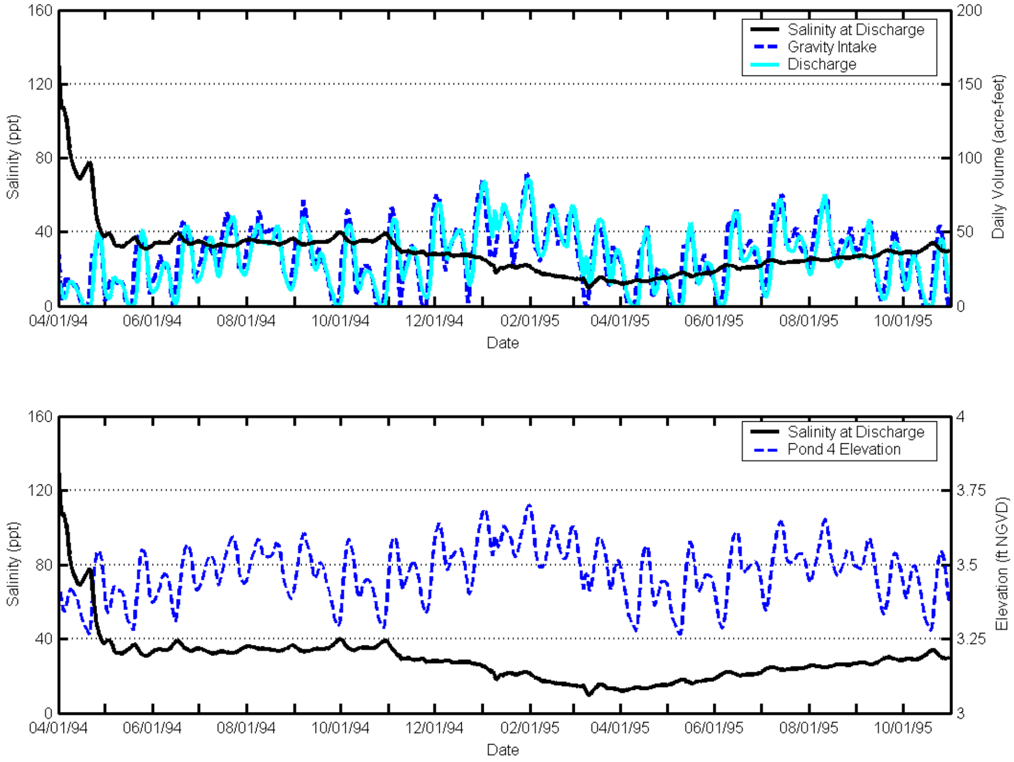
Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-29
Graph of West Bay 2 Discharge Salinities



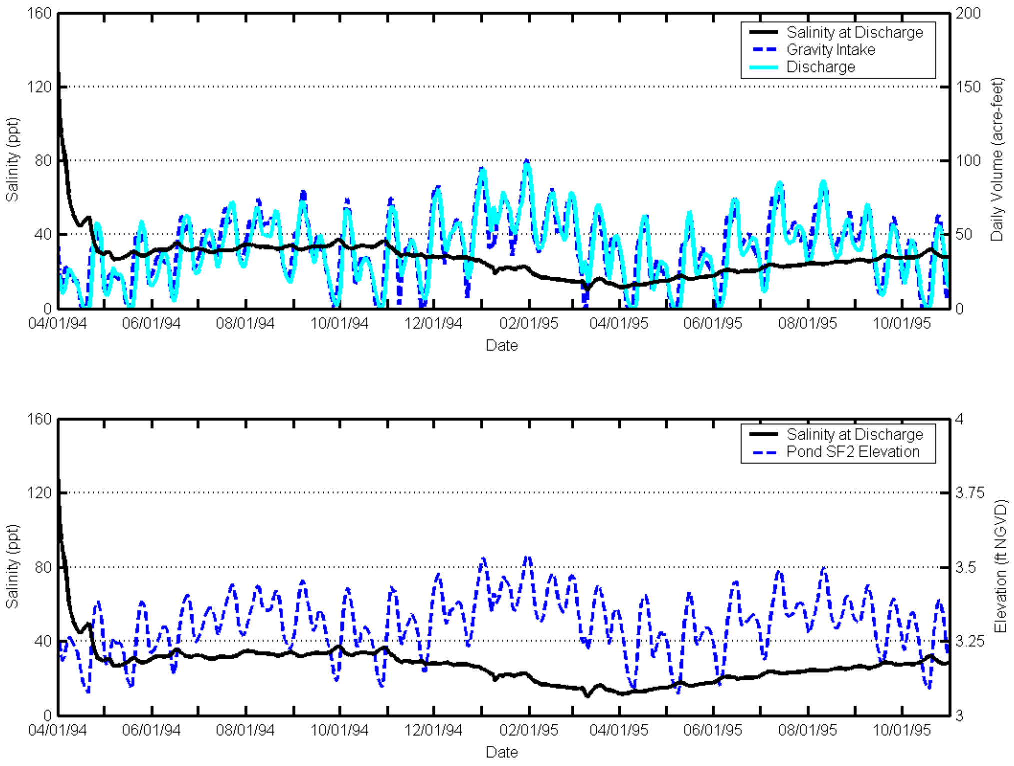
Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-30
Graph of West Bay 3 Operational Levels and Discharge Salinities



Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-31
Graph of West Bay 4 Operational Levels and Discharge Salinities



Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-32

Graph of West Bay SF2 Operational Levels and Discharge Salinities

4.2.13.4 Management Operations

The West Bay ponds will require limited active management. Once the muted tidal and tidal circulation operation has been established the operation would only require active management to adjust the operating water surface elevations. With outlet weirs, this may be necessary for an unusual event or maintenance, or to improve the habitat conditions within the ponds. Without the outlet weirs, the water levels would be controlled by the outlet control gate settings. The gate settings may require adjustment on weekly or monthly periods.

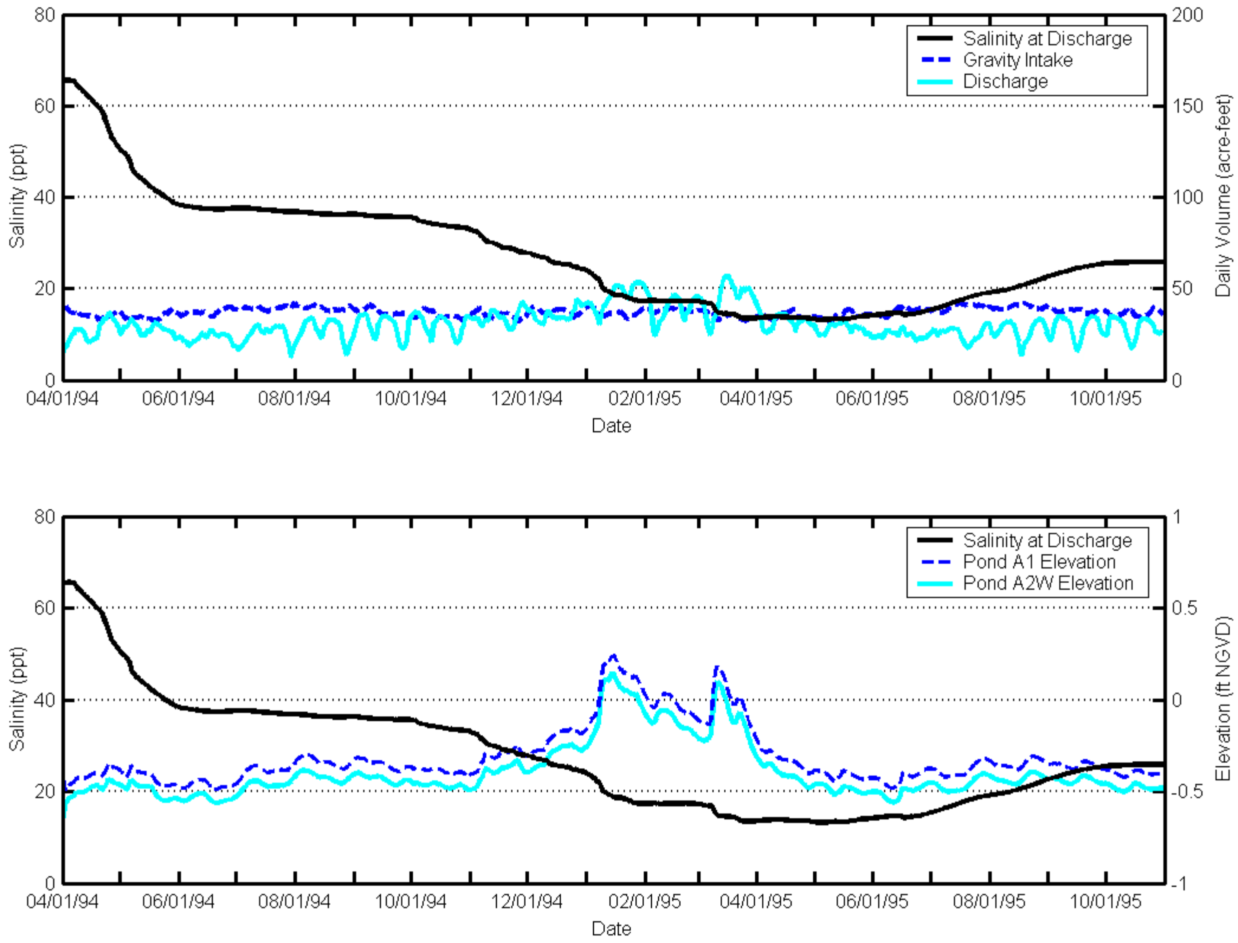
The five separate sub systems in the West Bay complex include intake/outlet structures. Since the inflows and outflows would occur at the same location, there may be limited mixing within the individual ponds. Shallow areas within the ponds may not be well mixed by wind and wave action. For ponds 1, 2, 3, and 4, the Ravenswood pump station and existing connection structures between the ponds may be used to increase mixing by providing circulation to other locations within the individual ponds.

4.3 Proposed Permit Initial Release Scenarios

This section presents the salinity curves for two proposed permit initial release scenarios: Maximum Initial Salinity and Phased Release. The structures of the complexes will remain as presented in Section 4.2.

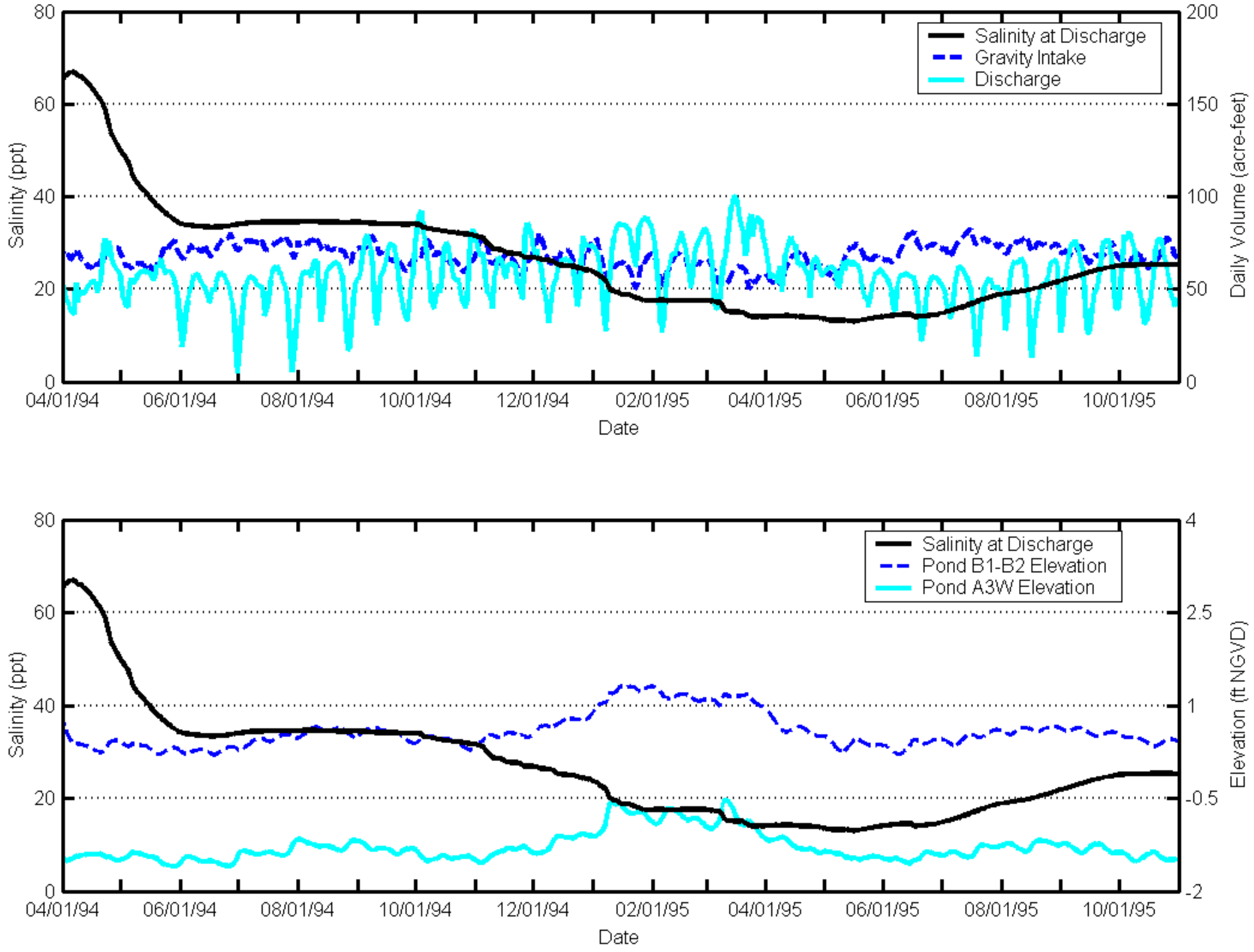
4.3.1 Maximum Initial Salinity

All systems except the island ponds (A19, A20, and A21), the A23 system, and the West Bay pond group to begin discharge in April. Initial pond salinities based on the maximum salinities from Table 4.1.5. The initial release scenario was modeled for 18 months from April through the following October. The initial release level salinity results from the maximum scenario simulations follow.



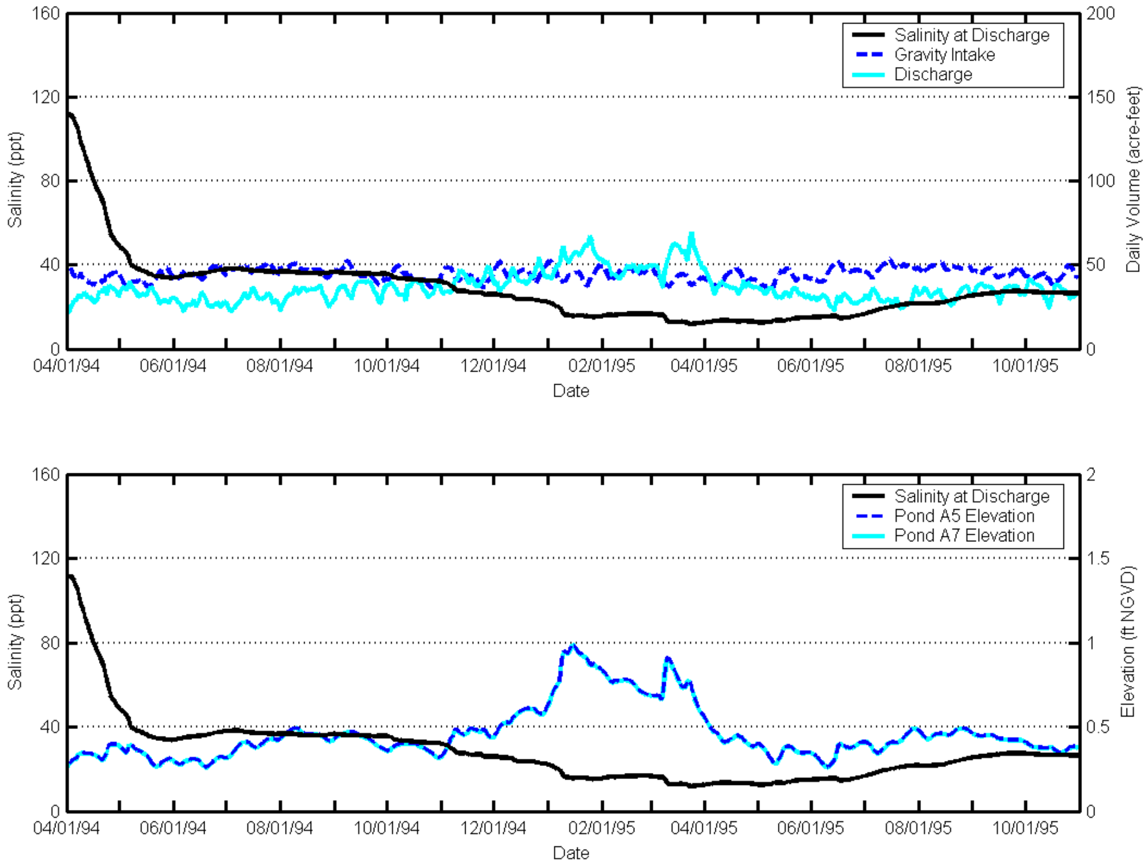
Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-33
Graphs of Alviso A2W Maximum Levels and Discharge Salinities



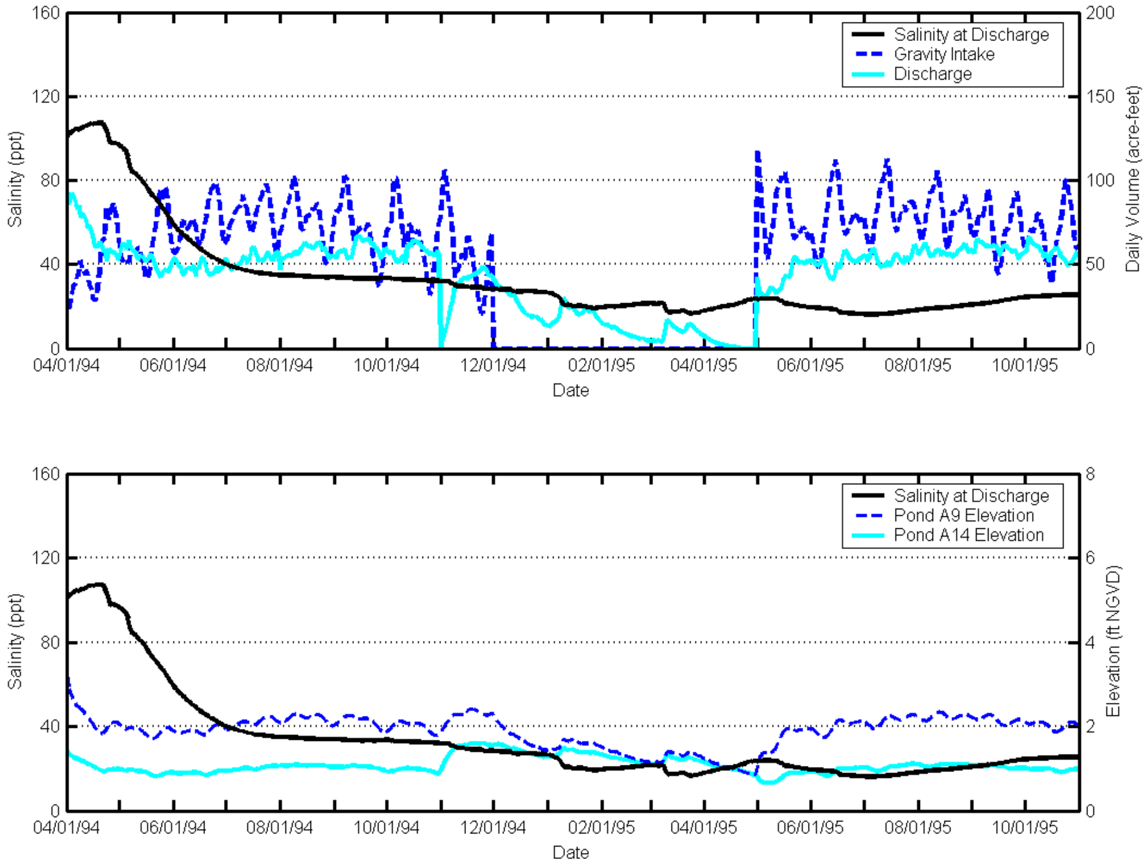
Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-34
Graphs of Alviso A3W Maximum Levels and Discharge Salinities



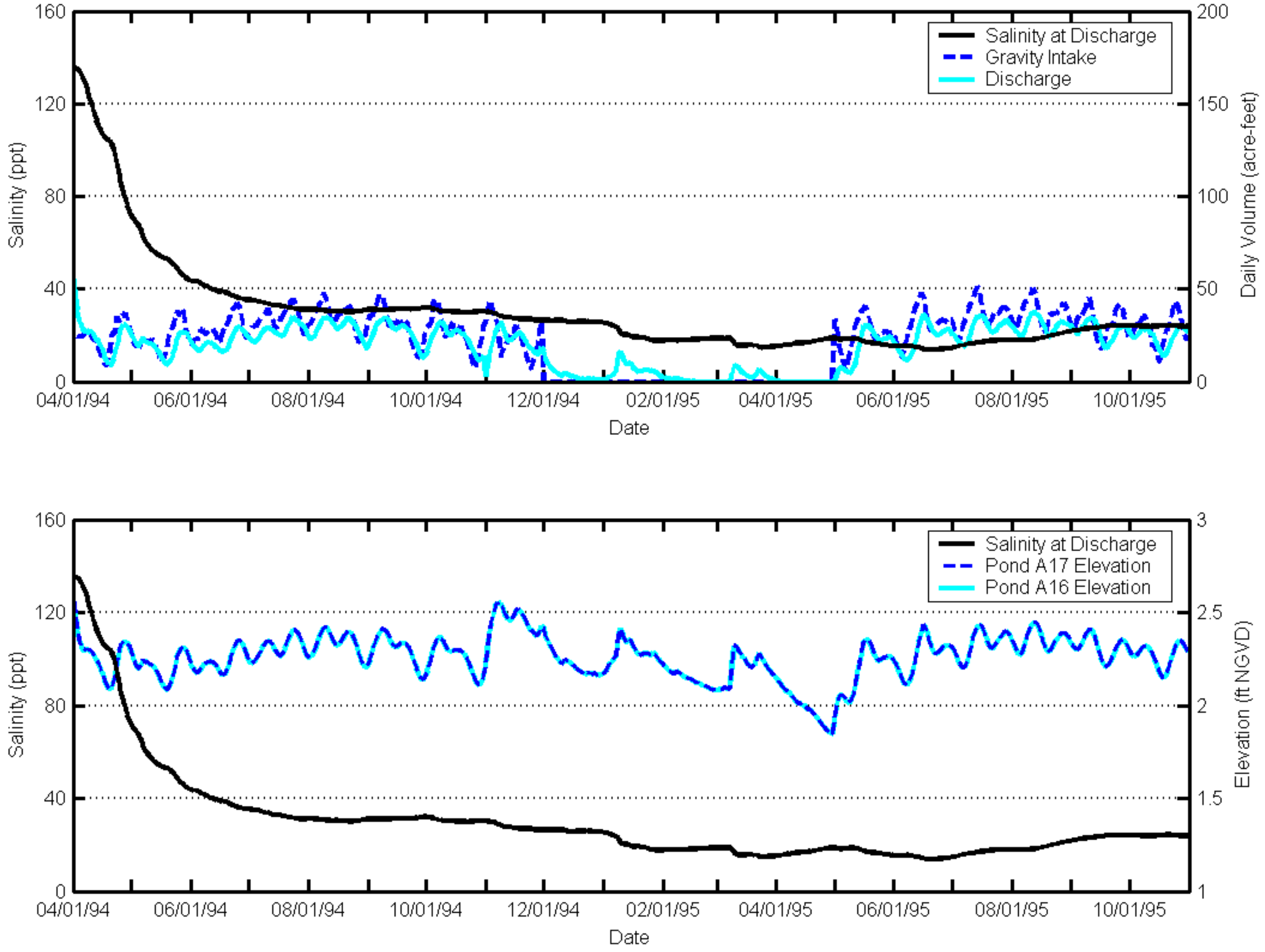
Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-35
Graphs of Alviso A7 Maximum Levels and Discharge Salinities



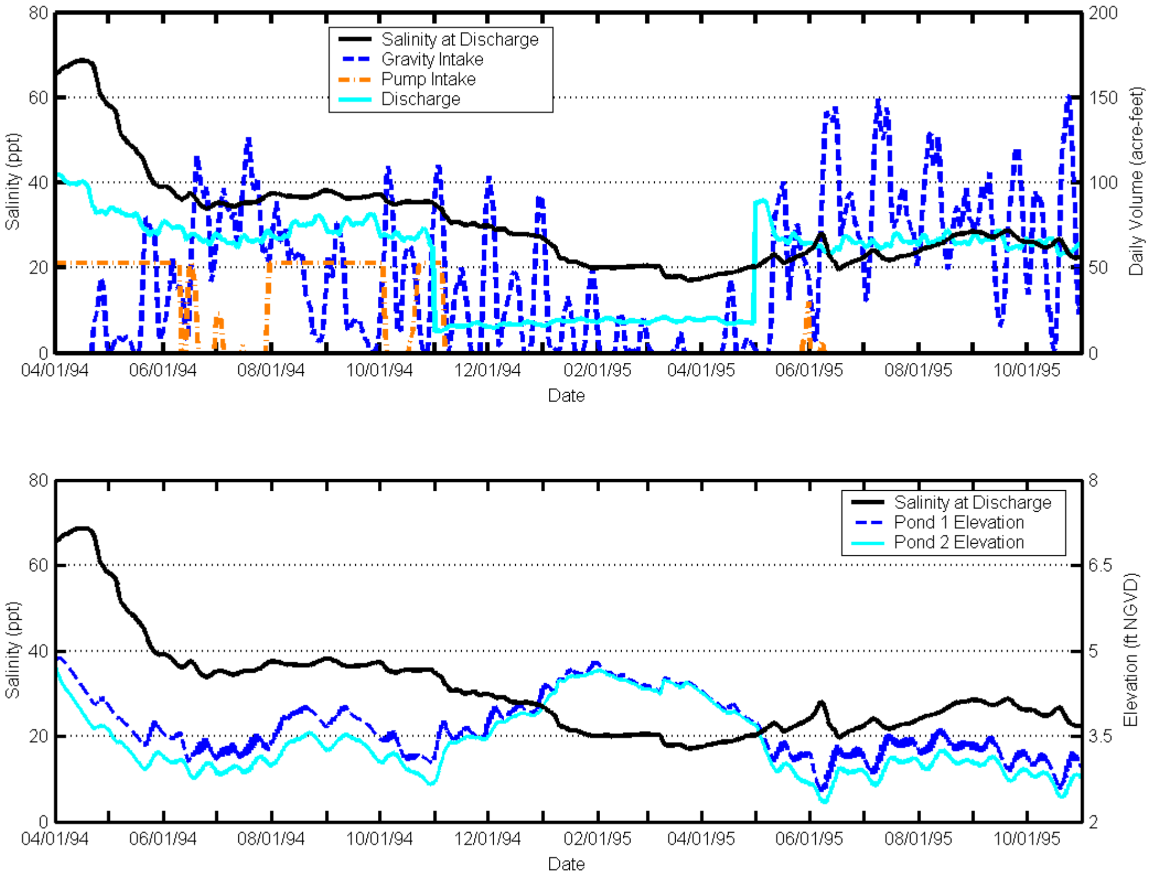
Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-36
Graphs of Alviso A14 Maximum Levels and Discharge Salinities



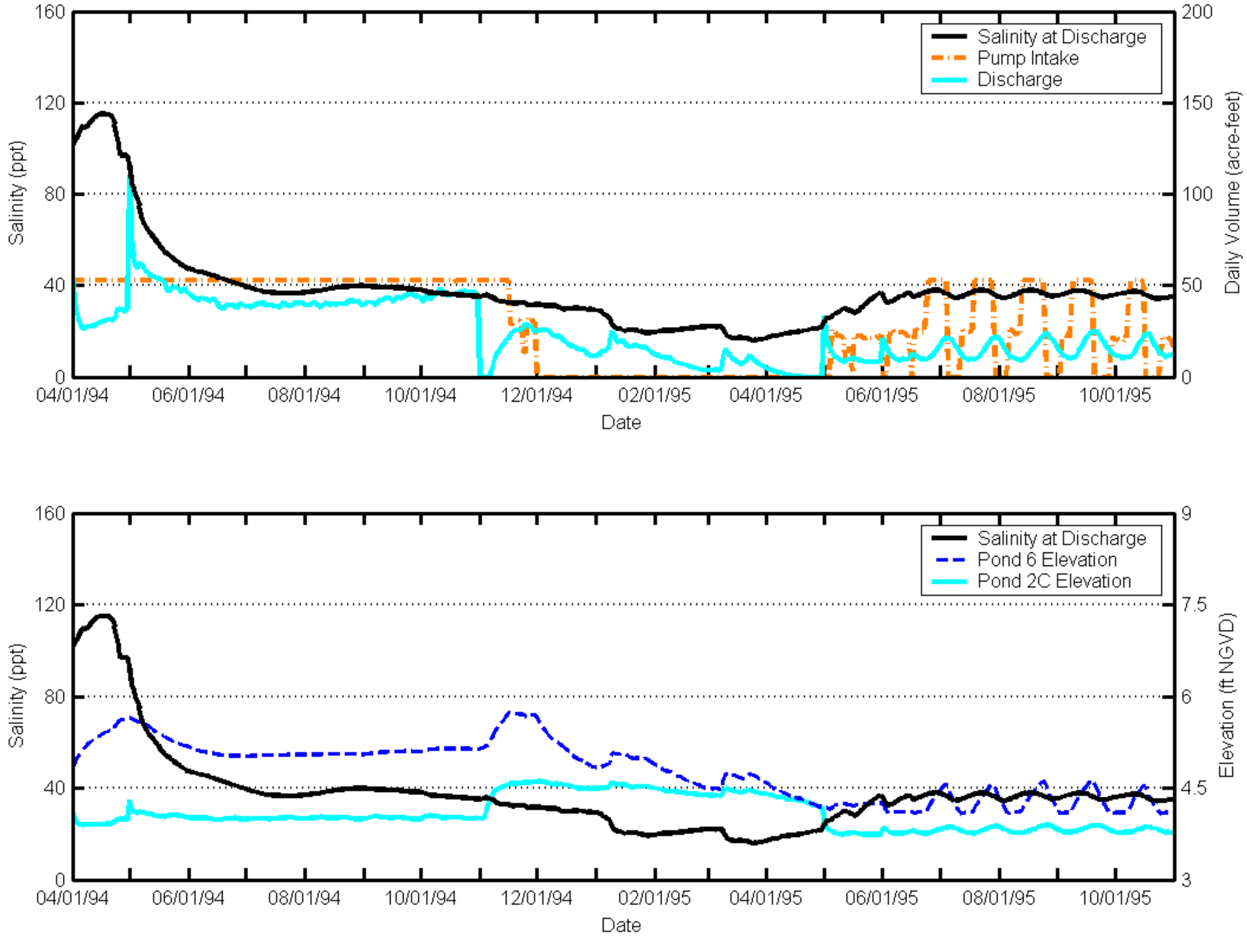
Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-37
Graphs of Alviso A16 Maximum Levels and Discharge Salinities



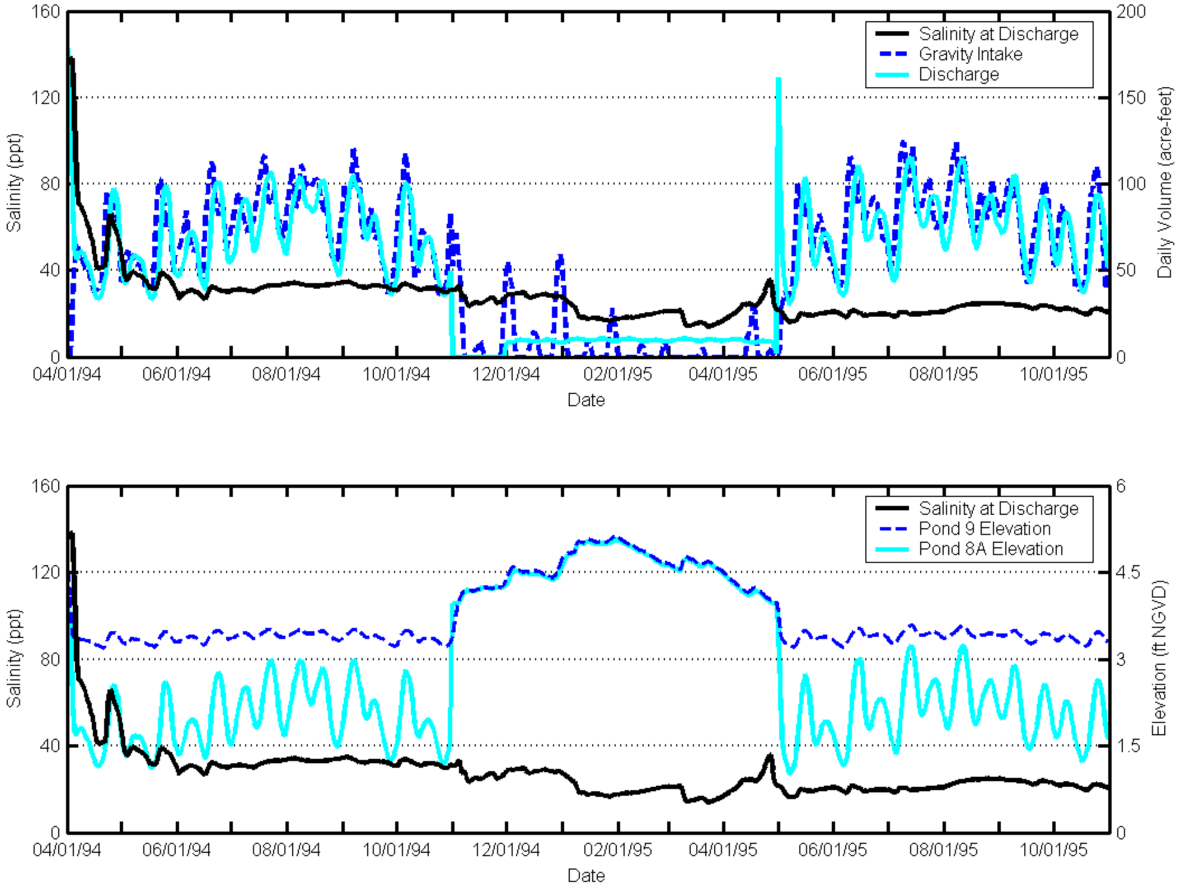
Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-38
Graphs of Baumberg 2 Maximum Levels and Discharge Salinities



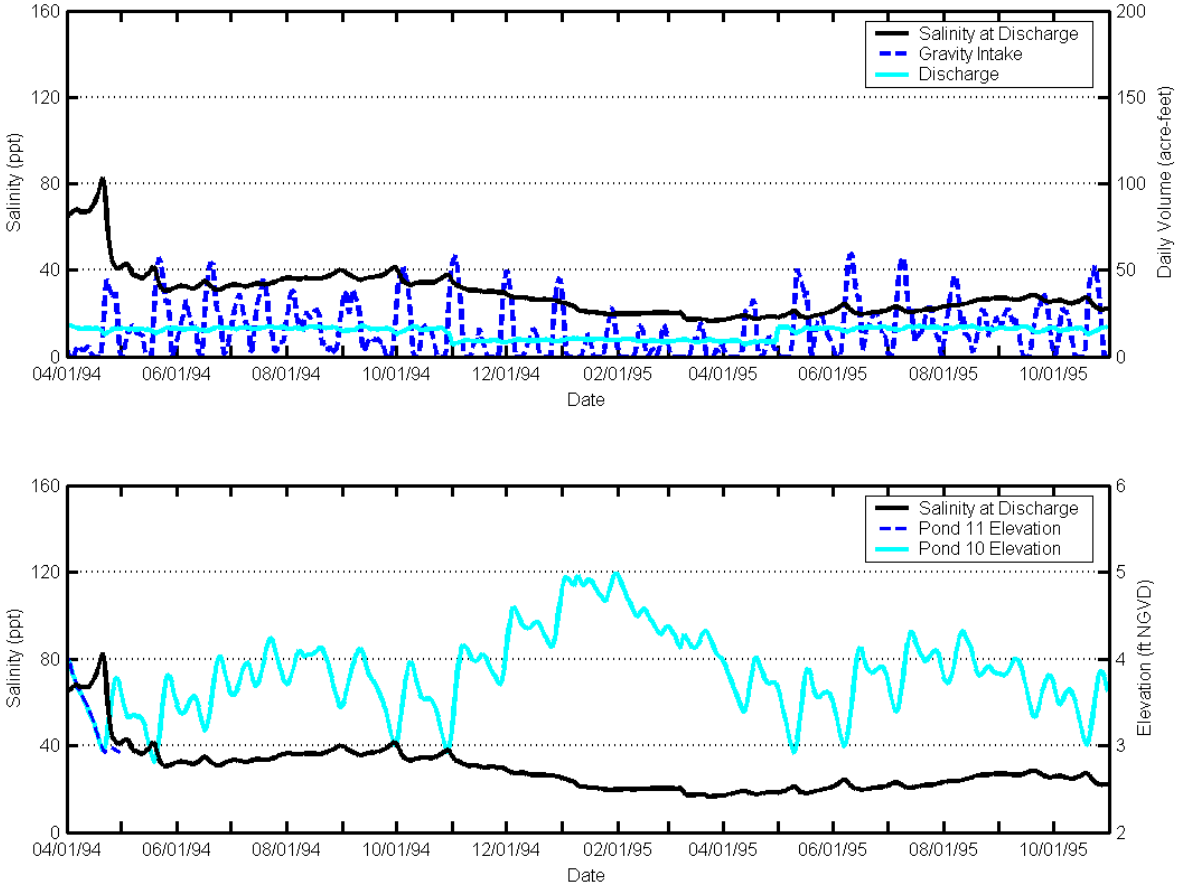
Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-39
Graphs of Baumberg 2C Maximum Levels and Discharge Salinities



Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-40
Graphs of Baumberg 8A Maximum Levels and Discharge Salinities

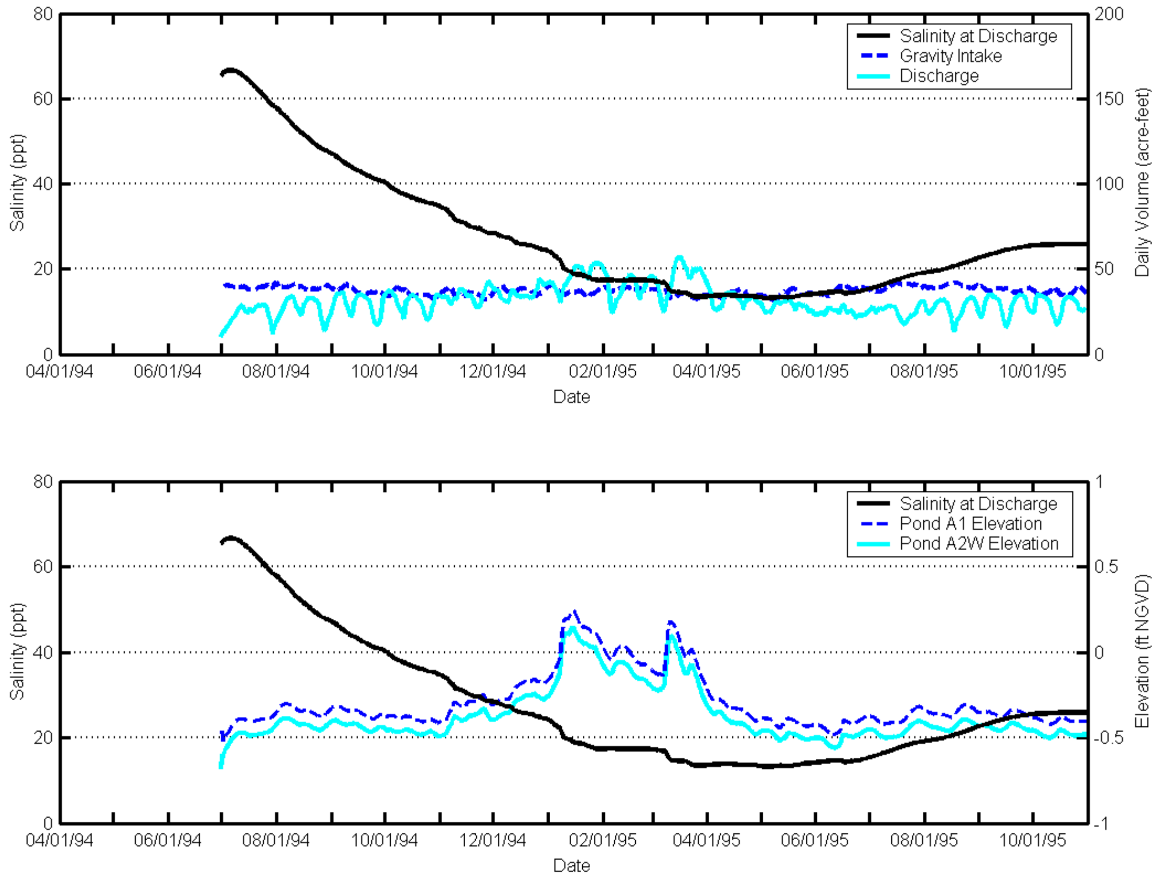


Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-41
Graphs of Baumberg 11 Maximum Levels and Discharge Salinities

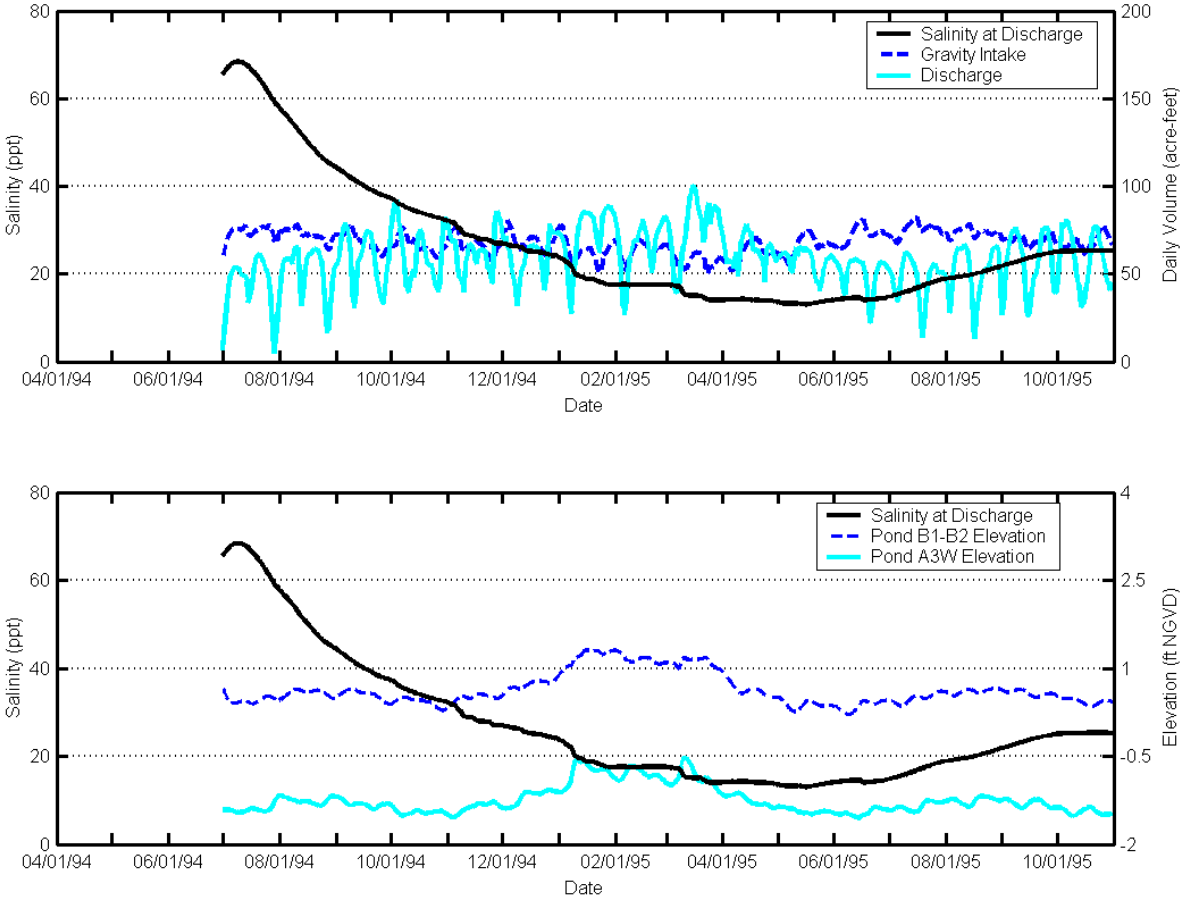
4.3.2 Phased Release

The Phased release scenario is to release selected groups of ponds or individual ponds over time. This approach was chosen to adapt management strategies in subsequent releases. The initial phase will include Alviso Systems A2W, A3W, A7 and Baumberg Systems 2, 8A and 11. The ponds were selected to represent a significant number of systems that could be included in a first phase of the project based on construction and operational constraints. The remainder of the ponds would be released the following year. The phased release was assumed to begin in July, to allow for some construction in the spring after the winter rainy season. Most of the proposed system structures would not be accessible for construction during the winter. The initial pond salinities for this modeling effort were based on the worst case conditions of the maximum salinities from Table 4.1.5. The initial release scenario was modeled for 16 months from July through the following October. After the modeled initial release period, the long term operation conditions would be the same as the operation results shown in Section 4.2. The initial salinity and pond release level results from the simulations follow.



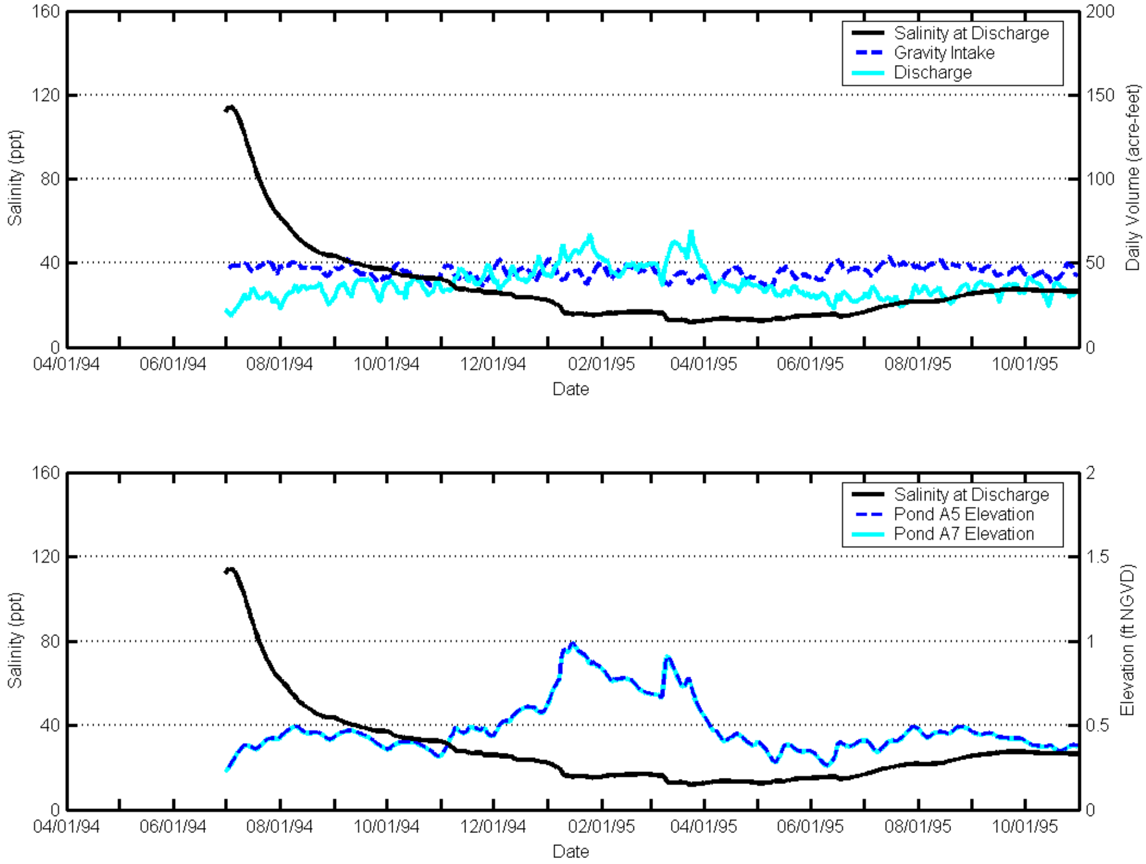
Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-42
Graphs of Alviso A2W Phased Release Levels and Discharge Salinities



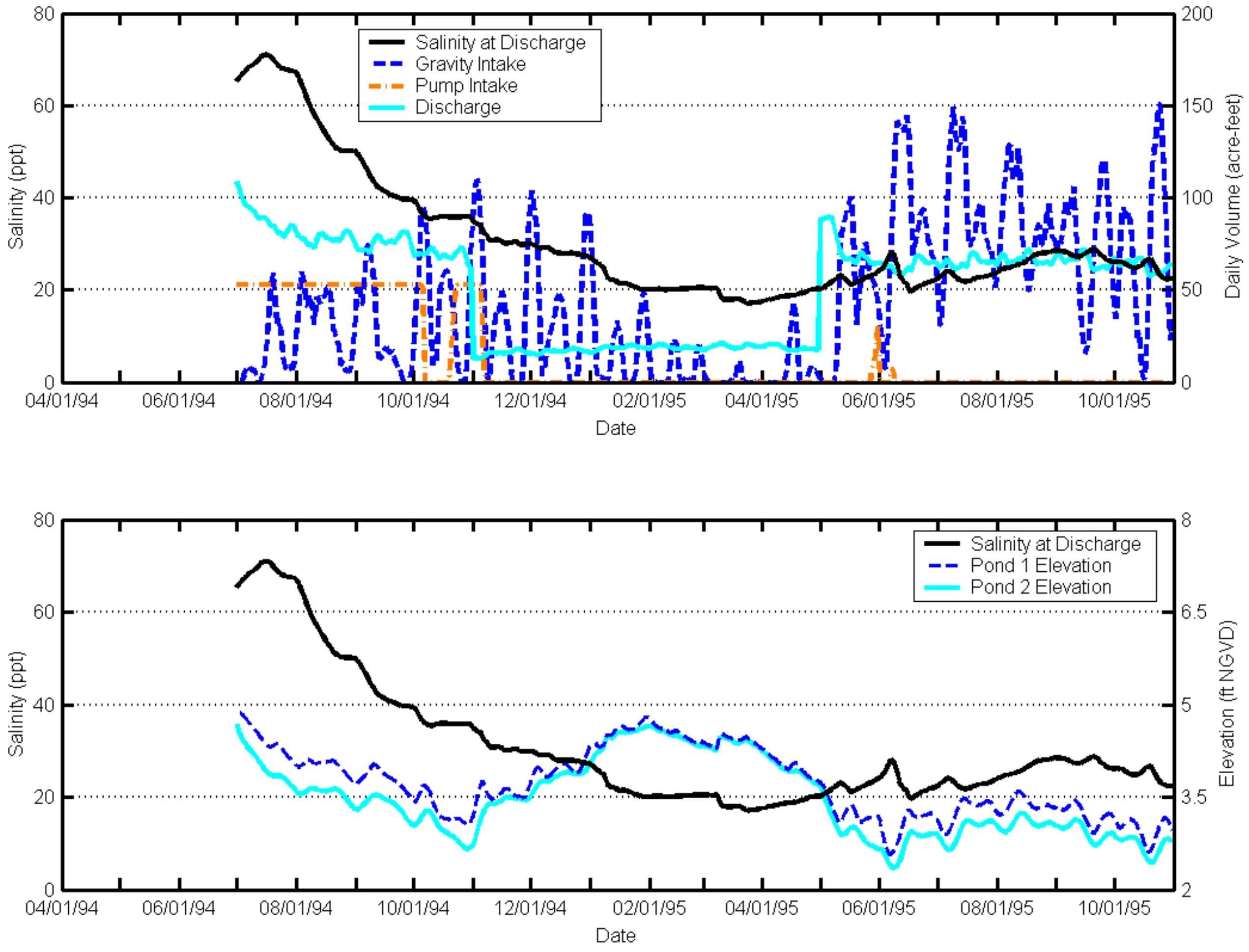
Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-43
Graphs of Alviso A3W Phased Release Levels and Discharge Salinities



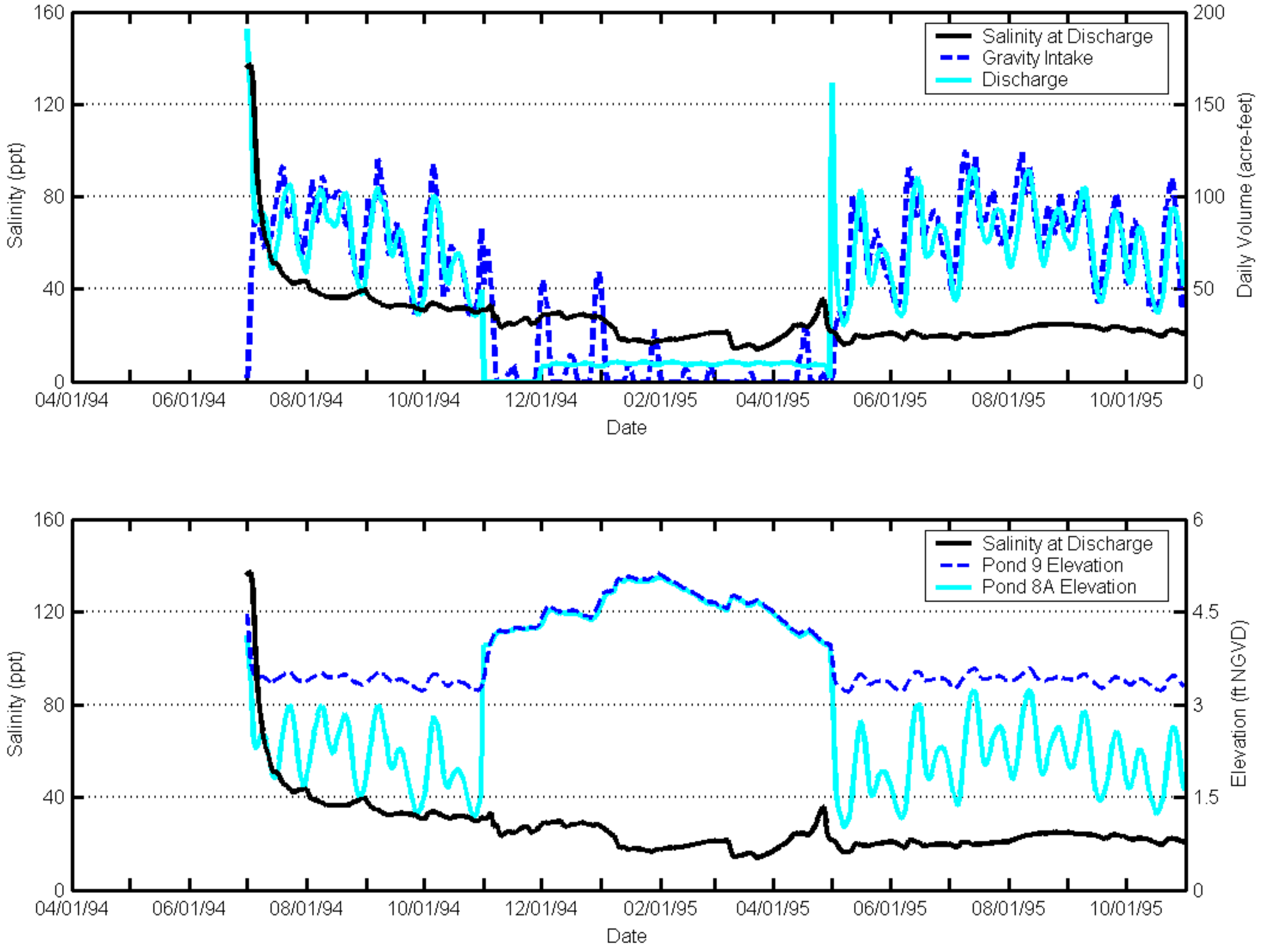
Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-44
Graphs of Alviso A7 Phased Release Levels and Discharge Salinities



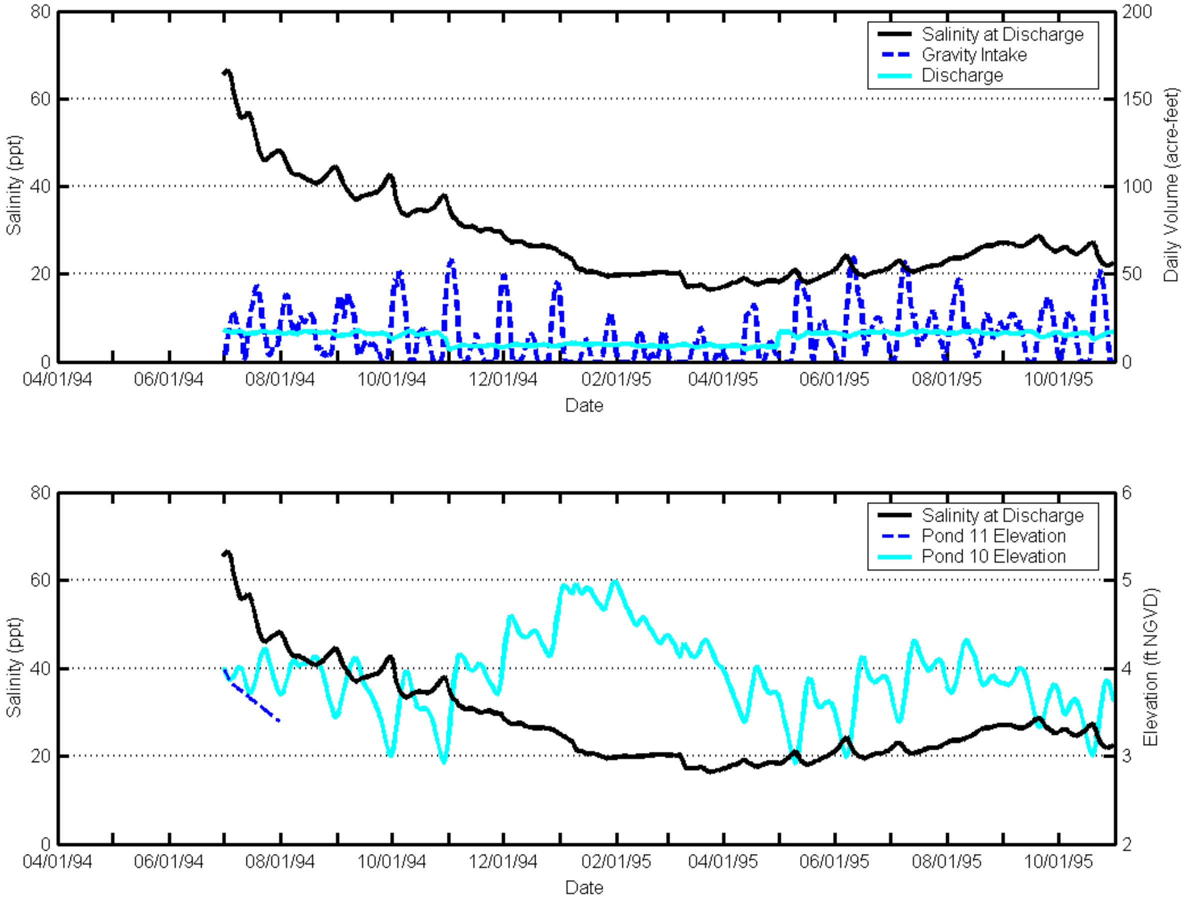
Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-45
Graphs of Baumberg 2 Phased Release Levels and Discharge Salinities



Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-46
Graphs of Baumberg 8A Phased Release Levels and Discharge Salinities



Note: Salinity and pond operation predicted based on 1994-1995 weather and tidal conditions

Figure 4-47
Graphs of Baumberg 11 Phased Release Levels and Discharge Salinities

4.4 Public Access

Under prior management for commercial salt operations, most of the ponds included in the ISP were closed to public access. However, Alviso Ponds A-9 through A-17 and the West Bay Ponds 1 and 2 were previously owned by the U.S. Fish and Wildlife Service as part of the Don Edwards San Francisco Bay National Wildlife Refuge (Refuge) and were open to the public for pedestrian and bicycle access to promote wildlife observation, wildlife photography, interpretation, and environmental education opportunities. These ponds will continue to be open for similar public access activities during the Initial Stewardship period. General public access to other ponds in the Alviso, Baumberg and West Bay complexes will be limited to regularly scheduled docent-led tours during Initial Stewardship. More extensive public access opportunities in these areas will be developed during the long-term South Bay Salt Pond restoration planning process.

For many years prior to the recent acquisition of the ponds by State and Federal agencies, Cargill had provided waterfowl hunting opportunities on many of its Baumberg and Alviso salt ponds through leases to private individuals. In addition, the Refuge's West Bay Ponds 1 and 2 have been open to public waterfowl hunting for many years during the State designated season (generally October through January). During the Initial Stewardship period, the Refuge intends to continue to allow public waterfowl hunting via foot access on West Bay Ponds 1; to open Alviso Ponds A-2E, A-3W, B-1, and B-2 for waterfowl hunting via access by boat, and to open Alvixo Ponds A-5, A-7, and A-8W for waterfowl hunting via access by foot or boat during State-designated seasons. Cargill has previously issued private waterfowl hunting leases on all the aforementioned Alviso Ponds. These opportunities will now be available to the public. More detailed information on the hunting plan for the Refuge ponds, such as access and timing restrictions, will be included as an Appendix to the EIR/EIS.

4.5 Construction Period Resource Protection Measures

The following Best Management Practices will be employed to protect wetland and biological resources:

Construction for implementation of the ISP will be timed to avoid impact to critical resources. Construction activities in snowy plover nesting areas will occur between September 1 and February 1 after and prior to the snowy plover nesting season. Earlier start dates may be allowed if monitoring demonstrates that snowy plover nesting is completed and the young are capable of flight.

For any channel excavation, fabric (silt fence) or heavy gage plastic fences will be erected along the edges of the excavation areas. The exclusion fences will be maintained in working condition through completion of the work. Additionally, no construction work will occur within 700 feet of clapper rail nesting habitat during the nesting season between February 1 and August 31, unless prior monitoring studies indicate no clapper rail nesting activity.

Qualified biological monitors knowledgeable of the restoration and management plan goals and objectives and familiar with salt marsh harvest mouse, clapper rail, and snowy plover biology and habitat requirements will be utilized to oversee construction activities. The monitors' responsibilities will include:

- Remain present on the site during all excavation and other construction work in or adjacent to occupied habitats for the listed species.
- Stake or fence areas to be avoided by construction equipment.
- Retain authority to control or halt construction activity that is not consistent with the approved construction plans and any amendments.

- Notify the Department of Fish and Game, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, and Regional Water Quality Control Board of any unanticipated damage to protected habitat areas, erosion or water quality problems in excess of permit requirements, or dead or injured listed species.

The following specific measures shall be implemented to the maximum extent practicable in order to minimize project impacts. Section 4.5.1 describes measures needed to prevent pollution during construction. Section 4.5.2 describes measures needed to protect wildlife during construction and subsequent operation and maintenance periods.

4.5.1 Pollution Prevention

4.5.1.1 Siltation Controls

Install silt fences, localized silt barriers or other erosion control measures during construction in wetland and aquatic habitats located in creeks and sloughs. No sediment controls will be applied when runoff is directed toward pond interiors unless sensitive wildlife resources are identified.

Maintain siltation controls in properly functioning condition in accordance with the manufacturer's specifications and good engineering practices. Controls will be removed after construction. Should sediment escape the construction site, off-site accumulations of sediment will be removed and placed in a location directed toward pond interiors.

4.5.1.2 Hazardous Materials

All wastes created during construction (e.g. trash, excess construction material, etc.) would be removed from the construction area and disposed of in an approved disposal site. No trash or other solid waste pollutants will be buried within the construction area or discharged into waters of the United States. All applicable State and or local waste disposal regulations will be complied with.

Generation of fugitive dust would be minimized by accepted practices. If precipitation occurs during construction, vehicular traffic along the construction corridor will be minimized to reduce the potential for erosion.

Gasoline, diesel fuels, lubricants and other potential pollutants would be stored in containers that would prevent their accidental release. Any unused lubricants or used engine oil will be removed from the site and disposed of at an approved facility. Additional steps to prevent the accidental discharge of potential pollutants are described in a project-specific spill prevention plan.

Overnight or out-of-use equipment will be parked on impervious mats/tarps to capture leaking oil and lubricants.

Routine maintenance of equipment will be limited to fueling and lubricating equipment. No major cleaning or major equipment repairs would be conducted at the construction site.

Prior to construction an environmental inspector who will verify the limits of authorized construction work areas and identify any additional stabilization needed or special construction management needed to protect sensitive wildlife. During construction if deposition or disturbance impairing water quality or harming wildlife occurs, the construction activity will be ceased and rescheduled or the design of the discharge will be changed to prevent reoccurrence.

4.5.2 Wildlife Protection Measures

4.5.2.1 During Installation of Water Control Structures

Use only those locations which were identified in the plan, since they have minimum coverage of pickleweed or other marsh vegetation outboard of the levee and are generally located away from major salmonid migration routes. Any adjustments at the site during installation should be concurred upon by a qualified biologist.

Identify, maintain and protect existing vegetated aquatic habitats by marking limits of construction for all equipment. Silt fencing will be used to delineate construction area boundary. Construction access, staging and temporary soil stockpile areas will be contained within the identified construction area.

Minimize construction activities near colonial nesting bird colonies during breeding seasons.

Either conduct construction activities between September 1 and February 1 to avoid the California clapper rail breeding season; or, conduct call counts using standardized protocols prior to construction.

4.5.2.2 During Breaching of Levees

Activities may be conducted by dredge or land-based equipment.

For external levees, if pond holds water:

- Remove final segment of levee materials at high tide to allow some internal mixing before waters are discharged to the bay.
- If pond is dry, remove final segment of levee materials at either low or high tide.
- Avoid breaching activities near nesting bird colonies during breeding season.

For external levee breaches near vegetated wetland habitats:

- Either remove levee materials between September 1 and February 1 to avoid the California clapper rail breeding season; or, conduct call counts using standardized protocols prior to construction. Construct breaches during the breeding season only if no rails are found within 700 feet of the structure site.
- Avoid breaching dry ponds during the snowy plover breeding season, breaching will occur only after September 1, or if surveys show no nesting snowy plovers in the ponds.

4.5.2.3 Operation of Water Control Structures

Manage pond levels to allow a two-foot freeboard to prevent over-topping of the levees during storm conditions.

To the extent practicable, manage intake and outflows to achieve an adequate turnover of pond waters throughout the year to reduce excessive buildup of algae and other odor- producing materials. It is recognized that all ponds surrounding the Bay will produce algae.

Provide regular maintenance of trash racks and intake and outflow structures to assure that they are operating properly.

To reduce impacts to juvenile salmonids during migration, seasonally close intake structures at Pond A-9 and A17 (December through April)

Operate flow-through ponds, seasonal ponds and batch ponds, to maintain and enhance waterbird habitats. Monitor waterbird use of the ponds and adapt water management activities to meet their needs, while maintaining discharge limits identified in this ISP.

5.0 South Bay Salt Pond Restoration Monitoring

Monitoring will be conducted to document compliance with the California Regional Water Quality Control Board discharge requirements, wildlife use, and to determine management requirements. Specific monitoring studies will be conducted to assess:

- Water quality and sediment data
- Salinity and water depths in the ponds for management
- Presence of avian botulism
- Water bird distribution, composition, and abundance;

Additional surveys and studies conducted through university research or by private individuals are encouraged. All study protocols, however, will require approval from the Department of Fish and Game and the U.S. Fish and Wildlife Service.

5.1 Water Quality and Sediment Monitoring

Objectives: The objectives of this monitoring program are to:

- Demonstrate compliance with California Regional Water Quality Control Board, San Francisco Bay Region's discharge requirements
- Document the areal and temporal extent of water quality excursions from ambient
- Document the responses of the biota (fish and invertebrates) to releases of brine into the South Bay and tributaries
- Provide in-pond water quality, and sediment data upon which to manage the pond systems to best meet discharge criteria, and prevent conditions that may exacerbate wildlife exposure to contaminants, or increase the spread of avian botulism.

Salinity and water levels currently are recorded on a weekly basis in the ponds. In addition to other water quality monitoring, the initial stewardship plan would include similar weekly monitoring. There are existing staff gages in most ponds. A new gage will be placed in any pond that currently does not have an existing gage.

5.1.1 Sample Functions and Locations

The functions and locations of the water quality and sediment monitoring will be established in the EIR/EIS.

5.2 Salinity and Water Depth for Pond Management

To assure proper salinity and desired water depths, pond depths within the ponds for habitat management and for managing discharges, and salinities will be monitored weekly as access conditions permit. Water levels in ponds with nesting islands will be assessed for either flooding or land bridging of the islands. The condition of levees, pumps, and other infrastructure will be tracked as well.

At the Baumberg Complex, the transition from summer to winter operation will occur in November with summer operations beginning in April. These dates were determined by historic weather patterns. This is typically when the ratio of evaporation to precipitation shifts. These dates will be altered in years where there is a substantial change from normal evaporation and precipitation.

5.3 Wildlife

5.3.1 Waterbird Distribution, Composition, and Abundance

Since waterbirds have come to rely on the existing salt pond system, and since water levels and salinities in the system will be modified by the ISP, waterbirds will be monitored to determine changes in their distribution, composition, and abundance. The U.S. Geological Survey has monitored Alviso Ponds 9 through 16 for several years and is conducting baseline research monitoring for all ponds included in the ISP from April 2003 to April 2004. The surveys are being conducted once monthly at high tides. The data being collected includes species, numbers, type of use (feeding/roosting), and grid location within the pond. The area covered includes the crown of the levee to the center of the pond.

Following implementation of the ISP, monthly surveys would be conducted in each pond system at high tides. Species and number data will be collected by pond and compared to the baseline information. Additionally, each spring, at least one "window" survey will be conducted in all DFG and FWS ponds (including those not part of the ISP). During a "window" survey all ponds are counted at a high tide at essentially the same time to determine the distribution of shorebirds in the South Bay. Data on species, numbers, and locations will be collected.

5.3.1.1 Breeding Surveys

Nesting waterbirds can be impacted by changing water levels near the nest sites on levess and islands, as well as changes on food availability. A number of colonial breeding bird surveys are presently conducted in the South Bay Salt Ponds, mainly by the San Francisco Bay Bird Observatory (SFBBO). Rather than duplicate those efforts, the ISP would use those survey results to identify nest sites in need of protection from water level fluctuation. In addition to the islands within the ponds, interior levees will be checked monthly from March to July for nesting shorebirds (e.g., stilts and avocets) which could be affected by water levels.

5.3.1.2 Avian Botulism

Outbreaks of avian botulism generally occur in fresh to brackish waters in late summer and fall when air and water temperatures are high. In the South Bay, this has occurred in areas near existing South Bay water treatment facilities. The salt ponds in the ISP most likely to be affected are the ponds closest to these existing water treatment facilities. The effluent channels are presently surveyed by SFBBO. The following actions will be taken to reduce the spread of avian botulism.

- If there is evidence of avian botulism in areas surveyed by SFBBO, Refuge Staff will survey the adjacent ponds using shallow draft boats.
- All personnel conducting operational activities on the ponds will be trained to recognize symptoms of avian botulism and would make special observation efforts during late August, September, and October when outbreaks generally occur.
- If dead birds are found, they will be retrieved and incinerated in an approved facility. Sick birds will be brought to an approved avian restoration facility.

Appendix A: Organic Data

This appendix presents the organic data collected in the sediment analysis discussed in Chapter 2, Section 2.3, Sediment Quality and the additional water quality data discussed in Chapter 2, Section 2.4, Hydrology and Water Quality.

Table A-1

Dioxins and Furans in ISP Pond Surface Water
Data Source: Hydroscience

Complex	Pond No.	Total Dioxins/ Furans
		Total TEC (pg/L)
Alviso	A9	0.023
	Bay	0.063
Baumberg	10	1.34
West Bay	1	1.20

pg/L = Picograms per Liter

Table A-2

Organics in Groundwater
Data Source: Santa Clara Valley Water District

Pond No.	Sample ID	TPH diesel	TPH oil	TPH gasoline	SVOCs	VOCs	BTEX	Benzene	Ethylbenzene	Toluene	Total Xylenes
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
A4	MW-1	<59	<290	<50	<10-<50	<5-<100	<0.5				
A4	MW-1	<50	<250	<50							
A4	MW-1	<59	<290								
A4	MW-2	61	<250	<50	<10-<50	<5-<100	<0.5				
A4	MW-2	<50	<250	<50							
A4	MW-2	<50	<250								
A4	MW-3	<50	<250	<50	<10-<50	<5-<100	<0.5				
A4	MW-3	<50	<250	<50							
A4	MW-3	<50	<250								
A18	NGW 1-14	<50		<50				<0.5-2.5	<0.5-2.5	<0.5-2.6	<0.5-2.7
A18	ZGW 2-6	140		<50				<0.5-2.5	<0.5-2.5	<0.5-2.6	<0.5-2.7

Table A-2

Organics in Groundwater

(Concluded)

Pond No.	Sample ID	Bromodichloro-methane	Bromomethane	Chloroform	Dibromochloro-methane	1,4-dichlorobenzene	Other VOCs	Total PAHs	PAHs (as Benzo[a]pyrene)
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
A4	MW-1	░	░	░	░	░	░	░	░
A4	MW-1	░	░	░	░	░	░	░	░
A4	MW-1	░	░	░	░	░	░	░	░
A4	MW-2	░	░	░	░	░	░	░	░
A4	MW-2	░	░	░	░	░	░	░	░
A4	MW-2	░	░	░	░	░	░	░	░
A4	MW-3	░	░	░	░	░	░	░	░
A4	MW-3	░	░	░	░	░	░	░	░
A4	MW-3	░	░	░	░	░	░	░	░
A18	NGW 1-14	<0.5-2.7	<0.5-2.7	<0.5-2.7	<0.5-2.7	<0.5-2.7	<0.5-10	<0.5-10	<0.5-0.95
A18	ZGW 2-6	<0.5-2.7	<0.5-2.7	<0.5-2.7	<0.5-2.7	<0.5-2.7	<0.5-10	<0.5-10	<0.5-0.95

Notes:	BTEX	Benzene, toluene, ethylbenzene, xylene
	mg/L	Milligrams per liter
	PAHs	Polynuclear aromatic hydrocarbons
	TPH	Total petroleum hydrocarbons
	SVOCs	Semi-volatile organic componds
	VOCs	Volatile organic compounds
	µg/L	Micrograms per liter
	░	= Not Analyzed

Table A-3

SVOC Sediment Sample Results

Data Source: Hydroscience

		Alviso Ponds						**Baumberg Ponds**								**West Bay Ponds**	
Parameter	**SampleID** **Date**	**A2W-A-S** 8/27/02		**A9-A-S** 8/27/02		**Bay-A-S** 8/27/02		**10-B-S** 8/26/02		**2C-B-S** 8/26/02		**2C DUP** 8/26/02		**Bay-B-S** 8/26/02		**1-RC-S** 8/26/02	
Semi-Volatile Organics (ug/kg)	*Method*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*
Acenaphthene	**8270C**	**35.1**	**ND**	**25.3**	**ND**	**21.5**	**ND**	**16.2**	**ND**	**20.7**	**ND**	**19.8**	**ND**	**18.2**	**ND**	**18.4**	**ND**
Acenaphthylene	**8270C**	**36.9**	**ND**	**26.5**	**ND**	**22.8**	**ND**	**17.0**	**ND**	**21.7**	**28.9J**	**20.8**	**ND**	**19.1**	**ND**	**19.3**	**ND**
Anthracene	**8270C**	**19.4**	**ND**	**13.9**	**ND**	**11.8**	**ND**	**8.93**	**ND**	**11.4**	**89.7**	**10.9**	**ND**	**10.0**	**ND**	**10.1**	**ND**
Benzidine	**8270C**	**572**	**ND**	**412**	**ND**	**350**	**ND**	**254**	**ND**	**336**	**ND**	**323**	**ND**	**297**	**ND**	**300**	**ND**
Benzo (a) anthracene	**8270C**	**21.2**	**ND**	**15.3**	**ND**	**13.0**	**ND**	**9.78**	**ND**	**12.5**	**305**	**12.0**	**ND**	**11.0**	**ND**	**11.1**	**ND**
Benzo (a) pyrene	**8270C**	**21.1**	**ND**	**15.2**	**ND**	**12.9**	**ND**	**9.72**	**ND**	**12.4**	**280**	**11.9**	**ND**	**10.9**	**ND**	**11.0**	**ND**
Benzo (b) fluoranthene	**8270C**	**21.2**	**ND**	**15.3**	**ND**	**13.0**	**ND**	**9.78**	**ND**	**12.5**	**315**	**12.0**	**ND**	**11.0**	**ND**	**11.1**	**ND**
Benzo (g,h,i) perylene	**8270C**	**31.8**	**ND**	**22.9**	**ND**	**19.4**	**ND**	**14.7**	**ND**	**18.7**	**143**	**17.9**	**ND**	**16.5**	**ND**	**16.6**	**ND**
Benzo (k) fluoranthene	**8270C**	**25.3**	**ND**	**18.2**	**ND**	**15.5**	**ND**	**11.8**	**ND**	**14.9**	**98.7**	**14.3**	**ND**	**13.1**	**ND**	**13.2**	**ND**

Table A-3

SVOC Sediment Sample Results
(Continued)

		Alviso Ponds						Baumberg Ponds								West Bay Ponds	
Parameter	**SampleID**	**A2W-A-S**		**A9-A-S**		**Bay-A-S**		**10-B-S**		**2C-B-S**		**2C DUP**		**Bay-B-S**		**1-RC-S**	
	Date	8/27/02		8/27/02		8/27/02		8/26/02		8/26/02		8/26/02		8/26/02		8/26/02	
Semi-Volatile Organics (ug/kg)	*Method*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*
Benzyl alcohol	8270C	9.89	ND	7.11	ND	6.05	ND	4.58	ND	5.81	ND	5.58	ND	5.13	ND	5.18	ND
Bis(2-chloroethoxy) methane	8270C	49.8	ND	35.9	ND	30.5	ND	23.0	ND	23.0	ND	28.1	ND	25.9	ND	26.1	ND
Bis(2-chloroethyl) ether	8270C	54.6	ND	39.3	ND	33.4	ND	25.2	ND	32.1	ND	30.9	ND	28.4	ND	28.6	ND
Bis (2- chlaroisopropyl) ether	8270C	60.5	ND	43.5	ND	37.0	ND	27.9	ND	35.8	ND	34.2	ND	31.4	ND	31.7	ND
Bis(2-ethylhexyl) phthalate	8270C	39.3	ND	28.3	121J	24.0	ND	18.1	97.9	23.1	92.7J	22.2	43.8J	20.4	59.4J	20.6	ND
4-Bromophenyl phenyl ether	8270C	25.5	ND	18.3	ND	15.8	ND	11.7	ND	15.0	ND	14.4	ND	13.2	ND	13.5	ND
Butyl benzyl phthalate	8270C	28.2	ND	20.3	ND	17.3	ND	13.0	ND	16.5	ND	15.8	ND	14.8	ND	14.8	ND
Carbazole	8270C	33.9	ND	24.4	ND	20.7	ND	15.6	ND	19.9	ND	19.2	ND	17.6	ND	17.8	ND
4-Chlaroaniline	8270C	30.3	ND	21.8	ND	18.8	ND	14.0	ND	17.9	ND	17.1	ND	15.7	ND	15.9	ND
4-Chlaro-3-methyiphenol	8270C	57.3	ND	41.2	ND	35.0	ND	28.4	ND	33.7	ND	32.3	ND	29.7	ND	30.0	ND

Table A-3

SVOC Sediment Sample Results
(Continued)

		Alviso Ponds						**Baumberg Ponds**								**West Bay Ponds**	
Parameter	**SampleID** **Date**	**A2W-A-S** 8/27/02		**A9-A-S** 8/27/02		**Bay-A-S** 8/27/02		**10-B-S** 8/26/02		**2C-B-S** 8/26/02		**2C DUP** 8/26/02		**Bay-B-S** 8/26/02		**1-RC-S** 8/26/02	
Semi-Volatile Organics (ug/kg)	*Method*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*
2-Chioronaphthalene	**8270C**	**41.9**	**ND**	**30.2**	**ND**	**25.7**	**ND**	**19.3**	**ND**	**24.7**	**ND**	**23.7**	**ND**	**21.8**	**ND**	**22.0**	**ND**
2-Chlarophenol	**8270C**	**44.5**	ND	**32.0**	ND	**27.2**	ND	**20.5**	ND	**26.2**	ND	**25.1**	ND	**23.1**	ND	**23.3**	ND
4-Chlorophenyl phenyl ether	**8270C**	**33.5**	**ND**	**24.2**	**ND**	**20.8**	**ND**	**15.5**	**ND**	**19.8**	**ND**	**19.0**	**ND**	**17.5**	**ND**	**17.8**	**ND**
Chrysene	**8270C**	**19.7**	**ND**	**14.2**	**ND**	**12.1**	**ND**	**9.08**	**ND**	**11.9**	**ND**	**11.1**	**ND**	**10.2**	**ND**	**10.3**	**ND**
Dibenz (a,h) anthracene	**8270C**	**34.3**	**ND**	**24.7**	**ND**	**21.0**	**ND**	**15.8**	**ND**	**20.2**	**ND**	**19.4**	**ND**	**17.8**	**ND**	**18.0**	**ND**
Dibenzofuran	**8270C**	**37.2**	**ND**	**25.8**	**ND**	**22.8**	**ND**	**17.2**	**ND**	**21.9**	**ND**	**21.0**	**ND**	**19.3**	**ND**	**19.5**	**ND**
Di-n-butyl phthalate	**8270C**	**26.6**	**31.8J**	**19.1**	**21.0J**	**16.3**	**ND**	**12.2**	**ND**	**15.8**	**26.6J**	**16.0**	**26.6J**	**13.8**	**18.5J**	**13.9**	**ND**
1,2-Dichlarobenzene	**8270C**	**62.3**	**ND**	**44.8**	**ND**	**38.1**	**ND**	**28.7**	**ND**	**36.8**	**ND**	**35.2**	**ND**	**32.3**	**ND**	**32.8**	**ND**
1,3-Dichlarobenzene	**8270C**	**58.4**	**ND**	**42.0**	**ND**	**35.7**	**ND**	**6.9**	**ND**	**34.4**	**ND**	**33.0**	**ND**	**30.3**	**ND**	**30.8**	**ND**

Table A-3

SVOC Sediment Sample Results
(Continued)

		Alviso Ponds						**Baumberg Ponds**								**West Bay Ponds**	
Parameter	**SampleID**	**A2W-A-S**		**A9-A-S**		**Bay-A-S**		**10-B-S**		**2C-B-S**		**2C DUP**		**Bay-B-S**		**1-RC-S**	
	Date	8/27/02		8/27/02		8/27/02		8/26/02		8/26/02		8/26/02		8/26/02		8/26/02	
Semi-Volatile Organics (ug/kg)	*Method*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*
2-Chioronaphthalene	8270C	41.9	ND	30.2	ND	25.7	ND	19.3	ND	24.7	ND	23.7	ND	21.8	ND	22.0	ND
2-Chlarophenol	8270C	44.5	ND	32.0	ND	27.2	ND	20.5	ND	26.2	ND	25.1	ND	23.1	ND	23.3	ND
4-Chlorophenyl phenyl ether	8270C	33.5	ND	24.2	ND	20.8	ND	15.5	ND	19.8	ND	19.0	ND	17.5	ND	17.8	ND
Chrysene	8270C	19.7	ND	14.2	ND	12.1	ND	9.08	ND	11.9	ND	11.1	ND	10.2	ND	10.3	ND
Dibenz (a,h) anthracene	8270C	34.3	ND	24.7	ND	21.0	ND	15.8	ND	20.2	ND	19.4	ND	17.8	ND	18.0	ND
Dibenzofuran	8270C	37.2	ND	25.8	ND	22.8	ND	17.2	ND	21.9	ND	21.0	ND	19.3	ND	19.5	ND
3,3.-Dichlorobenzidine	8270C	38.1	ND	26.0	ND	22.1	ND	18.8	ND	21.2	ND	20.4	ND	18.7	ND	18.9	ND
2,4-Dichlorophenol	8270C	36.5	ND	26.3	ND	22.3	ND	16.8	ND	21.5	ND	20.6	ND	19.0	ND	19.1	ND
Diethyl phthalate	8270C	11.1	ND	7.95	ND	6.76	ND	5.10	ND	6.50	6.73J	6.24	13.6J	5.74	ND	5.79	ND

Table A-3

SVOC Sediment Sample Results
(Continued)

		Alviso Ponds						**Baumberg Ponds**								**West Bay Ponds**	
Parameter	**SampleID**	**A2W-A-S**		**A9-A-S**		**Bay-A-S**		**10-B-S**		**2C-B-S**		**2C DUP**		**Bay-B-S**		**1-RC-S**	
	Date	8/27/02		8/27/02		8/27/02		8/26/02		8/26/02		8/26/02		8/26/02		8/26/02	
Semi-Volatile Organics (ug/kg)	*Method*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*
2,4-Dimethylphenol	**8270C**	**16.5**	**ND**	**1.9**	**ND**	**10.1**	**ND**	**7.60**	**ND**	**9.69**	**ND**	**9.30**	**ND**	**8.55**	**ND**	**8.63**	**ND**
Dimethyl phthalate	**8270C**	**23.1**	**ND**	**16.6**	**ND**	**14.1**	**ND**	**10.6**	**ND**	**13.6**	**ND**	**13.0**	**ND**	**12.0**	**ND**	**12.1**	**ND**
4,6-Dinitro-2-methylphenol	**8270C**	**37.8**	**ND**	**27.2**	**ND**	**23.1**	**ND**	**17.4**	**ND**	**22.2**	**ND**	**21.3**	**ND**	**19.8**	**ND**	**19.8**	**ND**
2,4-Dinitrophenol	**8270C**	**75.1**	ND	**54.0**	ND	**45.9**	ND	**34.8**	ND	**44.2**	ND	**42.4**	ND	**39.0**	ND	**38.3**	ND
2,4-Dinitrotoiuene	**8270C**	**28.0**	**ND**	**20.2**	**ND**	**17.1**	**ND**	**12.8**	**ND**	**16.5**	**ND**	**15.8**	**ND**	**14.5**	**ND**	**14.7**	**ND**
2,6-Dinitrotoluene	**8270C**	**41.3**	**ND**	**29.7**	**ND**	**25.3**	**ND**	**19.1**	**ND**	**24.3**	**ND**	**23.3**	**ND**	**21.4**	**ND**	**21.8**	**ND**
Di-n-octyl phthalate	**8270C**	**31.8**	**ND**	**22.8**	**ND**	**19.4**	**ND**	**14.6**	**ND**	**18.6**	**ND**	**17.9**	**ND**	**16.4**	**ND**	**16.8**	**ND**
Fluoranthene	**8270C**	**23.5**	**ND**	**16.9**	**ND**	**14.4**	**ND**	**10.9**	**ND**	**13.8**	**547**	**13.3**	**ND**	**12.2**	**ND**	**12.3**	**ND**
Fluorene	**8270C**	**30.9**	**ND**	**22.2**	**ND**	**18.9**	**ND**	**14.2**	**ND**	**18.2**	**35.1J**	**17.4**	**ND**	**18.0**	**ND**	**16.2**	**ND**

Table A-3

SVOC Sediment Sample Results
(Continued)

		Alviso Ponds						Baumberg Ponds								West Bay Ponds	
Parameter	**SampleID**	**A2W-A-S**		**A9-A-S**		**Bay-A-S**		**10-B-S**		**2C-B-S**		**2C DUP**		**Bay-B-S**		**1-RC-S**	
	Date	8/27/02		8/27/02		8/27/02		8/26/02		8/26/02		8/26/02		8/26/02		8/26/02	
Semi-Volatile Organics (ug/kg)	*Method*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*
Hexachlorobenzene	**8270C**	**21.3**	ND	**15.3**	ND	**13.0**	ND	**9.81**	ND	**12.5**	ND	**12.0**	ND	**11.0**	ND	**11.1**	ND
Hexachlorobutadiene	**8270C**	**48.7**	**ND**	**35.0**	**ND**	**29.8**	**ND**	**22.4**	**ND**	**28.6**	**ND**	**27.5**	**ND**	**25.3**	**ND**	**25.5**	**ND**
Hexacholarocyclopenladiene	**8270C**	**47.9**	**ND**	**34.5**	**ND**	**29.3**	**ND**	**22.1**	**ND**	**28.2**	**ND**	**27.1**	**ND**	**24.9**	**ND**	**25.1**	**ND**
Hexachloroethane	**8270C**	**61.0**	**ND**	**43.9**	**ND**	**37.3**	**ND**	**28.1**	**ND**	**35.9**	**ND**	**34.4**	**ND**	**31.6**	**ND**	**31.9**	**ND**
Indeno (1,2,3-00) pyrene	**8270C**	**29.7**	**ND**	**21.4**	**ND**	**18.3**	**ND**	**13.7**	**ND**	**17.5**	**129**	**16.8**	**ND**	**15.4**	**ND**	**15.6**	**ND**
lsophorone	**8270C**	**51.9**	ND	**37.3**	ND	**31.7**	ND	**23.9**	ND	**30.5**	ND	**29.3**	ND	**26.9**	ND	**27.2**	ND
2-Methylnaphthalene	**8270C**	**52.3**	**ND**	**37.8**	**ND**	**32.0**	**ND**	**24.1**	**ND**	**30.8**	**ND**	**29.5**	**ND**	**27.1**	**ND**	**27.4**	**ND**
2-Methylphenol	**8270C**	**45.0**	**ND**	**32.4**	**ND**	**27.8**	**ND**	**20.8**	**ND**	**26.5**	**ND**	**25.4**	**ND**	**23.4**	**ND**	**23.8**	**ND**
4-Methylphenoi	**8270C**	**42.8**	**ND**	**30.8**	**ND**	**26.2**	**ND**	**19.8**	**ND**	**25.2**	**ND**	**24.2**	**ND**	**22.2**	**ND**	**22.4**	**ND**

Table A-3

SVOC Sediment Sample Results

(Continued)

		Alviso Ponds						**Baumberg Ponds**								**West Bay Ponds**	
Parameter	**SampleID**	**A2W-A-S**		**A9-A-S**		**Bay-A-S**		**10-B-S**		**2C-B-S**		**2C DUP**		**Bay-B-S**		**1-RC-S**	
	Date	8/27/02		8/27/02		8/27/02		8/26/02		8/26/02		8/26/02		8/26/02		8/26/02	
Semi-Volatile Organics (ug/kg)	*Method*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*
Naphthaiene	8270C	49.8	ND	35.9	ND	30.4	ND	22.9	ND	29.3	ND	28.1	ND	25.8	ND	26.1	ND
2-Nitroaniline	8270C	26.8	ND	19.3	ND	16.4	ND	12.4	ND	15.8	ND	15.2	ND	13.9	ND	14.1	ND
3-Nitroaniline	8270C	44.9	ND	32.3	ND	27.5	ND	20.7	ND	26.4	ND	25.4	ND	23.3	ND	23.5	ND
4-Nitroaniline	8270C	37.7	ND	27.1	ND	23.1	ND	17.4	ND	22.2	ND	21.3	ND	19.6	ND	19.7	ND
Nitrobenzene	8270C	55.2	ND	39.7	ND	33.8	ND	25.4	ND	32.5	ND	31.2	ND	28.6	ND	28.9	ND
2-Nitrophenol	8270C	51.9	ND	37.3	ND	31.7	ND	23.9	ND	30.5	ND	29.3	ND	26.9	ND	27.2	ND
4-Nitrophenol	8270C	19.6	ND	14.1	ND	12.0	ND	9.02	ND	11.5	ND	11.0	ND	10.2	ND	10.2	ND
N-Nitrosodiphenylamine	8270C	55.1	ND	39.6	ND	99.7	ND	25.4	ND	32.4	ND	31.1	ND	28.6	ND	28.8	ND
N-Nitrosodi-n-propylamlne	8270C	54.2	ND	39.0	ND	33.2	ND	25.0	ND	31.9	ND	30.8	ND	28.1	ND	28.4	ND
Pentachlorophenol	8270C	41.3	ND	29.7	ND	25.3	ND	19.1	ND	24.3	ND	23.3	ND	21.4	ND	21.8	ND

Table A-3
SVOC Sediment Sample Results
(Concluded)

		Alviso Ponds						**Baumberg Ponds**								**West Bay Ponds**	
Parameter	**SampleID**	**A2W-A-S**		**A9-A-S**		**Bay-A-S**		**10-B-S**		**2C-B-S**		**2C DUP**		**Bay-B-S**		**1-RC-S**	
	Date	8/27/02		8/27/02		8/27/02		8/26/02		8/26/02		8/26/02		8/26/02		8/26/02	
Semi-Volatile Organics (ug/kg)	*Method*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*
Phenanthrene	**8270C**	**13.4**	**ND**	**9.53**	**ND**	**8.19**	**8.55J**	**6.17**	**ND**	**7.87**	**388**	**7.56**	**ND**	**6.95**	**ND**	**7.01**	**ND**
Phenol	**8270C**	**60.5**	ND	**43.5**	ND	**37.0**	ND	**27.9**	ND	**35.8**	ND	**34.2**	ND	**31.4**	ND	**31.7**	ND
Pyrene	**8270C**	**19.8**	**ND**	**14.2**	**14.6J**	**12.1**	**19.4J**	**8.12**	**ND**	**11.8**	**588**	**11.2**	**ND**	**10.3**	**ND**	**10.4**	**ND**
Pyridine	**8270C**	**60.8**	**ND**	**43.7**	**ND**	**37.2**	**ND**	**28.0**	**ND**	**35.7**	**ND**	**34.3**	**ND**	**31.5**	**ND**	**31.8**	**ND**
1,2,4- Trichlorobenzene	**8270C**	**48.8**	**ND**	**35.0**	**ND**	**29.7**	**ND**	**22.4**	**ND**	**28.8**	**ND**	**27.4**	**ND**	**25.2**	**ND**	**25.5**	**ND**
2,4,5- Trichlarophenol	**8270C**	**52.6**	**ND**	**37.8**	**ND**	**32.2**	**ND**	**24.2**	**ND**	**30.9**	**ND**	**28.7**	**ND**	**27.3**	**ND**	**27.5**	**ND**
2,4,6- Trichlorophenol	**8270C**	**38.1**	**ND**	**27.4**	**ND**	**23.3**	**ND**	**17.6**	**ND**	**22.4**	**ND**	**21.5**	**ND**	**19.8**	**ND**	**20.0**	**ND**

Notes:
DL = Detection Limit
ND = Non Detect
J = Detected, but below the reporting limit, therefore, result is an estimated concentration MDL (method detection limit)

Table A-4
SVOC Composite Sediment Sample Results
Alviso Island Ponds
Source: Hydroscience

Parameters													
	Sample ID	A20-A-S-SCOMP		A20-A-S-DCOMP		A21-A-S-SCOMP		A21-A-S-DCOMP		A19-A-S-DCOMP		A19-A-S-SCOMP	
	Date	12/18/02		12/18/02		12/18/02		12/18/02		12/18/02		12/18/02	
Semi-Volatile Organics (ug/L)	*METHOD*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*
Acenaphthene	8270C	15.2	ND	23.2	ND	19.2	ND	17.0	ND	15.6	ND	15.2	ND
Acenaphthylene	8270C	15.9	ND	24.3	ND	20.2	ND	17.9	ND	16.3	ND	15.9	ND
Anthracene	8270C	8.36	ND	12.8	ND	10.6	ND	9.38	ND	8.58	ND	8.37	ND
Benzidine	8270C	247	ND	377	ND	313	ND	277	ND	254	ND	247	ND
Benzo (a) anthracene	8270C	9.16	9.33J	14.0	18.4J	11.6	19.5J	10.3	17.9 J	9.40	13.0 J	9.17	9.90 J
Benzo (b) fluoranthene	8270C	9.16	ND	14.0	22.6J	11.6	21.6J	10.3	20.3J	9.40	12.4 J	9.17	ND
Benzo (k) fluoranthene	8270C	10.9	ND	16.7	ND	13.8	ND	12.2	ND	11.2	ND	10.9	ND
Benzo (g,h,i) perylene	8270C	13.7	ND	21.0	ND	17.4	18.8J	15.4	16.0J	14.1	ND	13.7	ND
Benzo (a) pyrene	8270C	9.10	ND	13.9	21.8J	11.5	20.2J	10.2	20.3J	9.34	10.1 J	9.11	ND
Benzyl alcohol	8270C	4.27	ND	6.52	ND	5.41	ND	4.79	ND	4.38	ND	4.28	ND
Bis(2-chloroethoxy)methane	8270C	21.5	ND	32.9	ND	27.3	ND	24.1	ND	22.1	ND	21.6	ND
Bis(2-chloroethyl)ether	8270C	23.6	ND	36.0	ND	29.9	ND	26.5	ND	24.2	ND	23.6	ND
Bis(2-chloroisopropyl)ether	8270C	26.1	ND	39.9	ND	33.1	ND	29.3	ND	26.8	ND	26.2	ND
Bis(2-ethylhexyl)phthalate	8270C	17.0	54.4J	25.9	79.6J	21.5	21.6J	19.0	190	17.4	25.4 J	17.0	ND
4-Bromophenyl phenyl ether	8270C	11.0	ND	16.8	ND	13.9	ND	12.3	ND	11.3	ND	11.0	ND
Butyl benzyl phthalate	8270C	12.2	ND	18.6	ND	15.4	ND	13.7	ND	12.5	ND	12.2	ND
Carbazole	8270C	14.6	ND	22.4	ND	18.6	ND	16.4	ND	15.0	ND	14.7	ND
4-Chloroaniline	8270C	13.1	ND	20.0	ND	16.6	ND	14.7	ND	13.5	ND	13.1	ND
4-Chloro-3-methylphenol	8270C	24.7	ND	37.8	ND	31.3	ND	27.7	ND	25.4	ND	24.8	ND
2-Chloronaphthalene	8270C	18.1	ND	27.7	ND	23.0	ND	20.3	ND	18.6	ND	18.1	ND
2-Chlorophenol	8270C	19.2	ND	29.3	ND	24.3	ND	21.5	ND	19.7	ND	19.2	ND
4-Chlorophenyl phenyl ether	8270C	14.5	ND	22.2	ND	18.4	ND	16.3	ND	14.9	ND	14.5	ND

Table A-4
SVOC Composite Sediment Sample Results
Alviso Island Ponds
(Continued)

Parameters													
	Sample ID	A20-A-S-SCOMP		A20-A-S-DCOMP		A21-A-S-SCOMP		A21-A-S-DCOMP		A19-A-S-DCOMP		A19-A-S-SCOMP	
	Date	12/18/02		12/18/02		12/18/02		12/18/02		12/18/02		12/18/02	
Semi-Volatile Organics (ug/L)	*METHOD*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*
Chrysene	8270C	8.51	ND	13.0	ND	10.8	11.1J	9.54	13.5J	8.73	ND	8.52	ND
Dibenz (a,h) anthracene	8270C	14.8	ND	22.6	ND	18.8	ND	16.6	ND	15.2	ND	14.8	ND
Dibenzofuran	8270C	16.1	ND	24.5	ND	20.4	ND	18.0	ND	16.5	ND	16.1	ND
Di-n-butyl phthalate	8270C	11.5	29.1J	17.5	39.4J	14.5	32.7J	12.9	30.2J	11.8	23.7 J	11.5	26.9 J
1,2-Dichlorobenzene	8270C	26.9	ND	41.1	ND	34.1	ND	30.2	ND	27.6	ND	26.9	ND
1,3-Dichlorobenzene	8270C	25.2	ND	38.5	ND	32.0	ND	28.3	ND	25.9	ND	25.3	ND
1,4-Dichlorobenzene	8270C	25.4	ND	38.7	ND	32.1	ND	28.4	ND	26.0	ND	25.4	ND
3,3´-Dichlorobenzidine	8270C	15.6	ND	23.8	ND	19.8	ND	17.5	ND	16.0	ND	15.6	ND
2,4-Dichlorophenol	8270C	15.8	ND	24.1	ND	20.0	ND	17.7	ND	16.2	ND	15.8	ND
Diethyl phthalate	8270C	4.77	18.1J	7.29	23.5J	6.05	20.2J	5.35	22.8J	4.90	9.02 J	4.78	21.4 J
2,4-Dimethylphenol	8270C	7.12	ND	10.9	ND	9.02	ND	7.98	ND	7.30	ND	7.13	ND
Dimethyl phthalate	8270C	9.96	ND	15.2	ND	12.6	ND	11.2	ND	10.2	ND	9.98	ND
4,6-Dinitro-2-methylphenol	8270C	16.3	ND	24.9	ND	20.7	ND	18.3	ND	16.7	ND	16.3	ND
2,4-Dinitrophenol	8270C	32.4	ND	49.5	ND	41.1	ND	36.4	ND	33.3	ND	32.5	ND
2,4-Dinitrotoluene	8270C	12.1	ND	18.5	ND	15.3	ND	13.6	ND	12.4	ND	12.1	ND
2,6-Dinitrotoluene	8270C	17.8	ND	27.3	ND	22.6	ND	20.0	ND	18.3	ND	17.9	ND
Di-n-octyl phthalate	8270C	13.7	ND	20.9	ND	17.3	ND	15.3	ND	14.0	ND	13.7	ND
Fluoranthene	8270C	10.2	11.5J	15.5	34.4J	12.9	34.1J	11.4	39.4	10.4	18.6 J	10.2	14.3 J
Fluorene	8270C	13.3	ND	20.4	ND	16.9	ND	15.0	ND	13.7	ND	13.4	ND
Hexachlorobenzene	8270C	9.19	ND	14.0	ND	11.6	ND	10.3	ND	9.43	ND	9.20	ND
Hexachlorobutadiene	8270C	21.0	ND	32.1	ND	26.6	ND	23.6	ND	21.6	ND	21.0	ND
Hexachlorocyclopentadiene	8270C	20.7	ND	31.6	ND	26.2	ND	23.2	ND	21.2	ND	20.7	ND
Hexachloroethane	8270C	26.3	ND	40.2	ND	33.4	ND	29.5	ND	27.0	ND	26.4	ND

Table A-4
SVOC Composite Sediment Sample Results
Alviso Island Ponds
(Continued)

Parameters													
	Sample ID	A20-A-S-SCOMP		A20-A-S-DCOMP		A21-A-S-SCOMP		A21-A-S-DCOMP		A19-A-S-DCOMP		A19-A-S-SCOMP	
	Date	12/18/02		12/18/02		12/18/02		12/18/02		12/18/02		12/18/02	
Semi-Volatile Organics (ug/L)	*METHOD*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*	*MDL*	*Results*
Indeno (1,2,3-cd) pyrene	8270C	12.8	ND	19.6	ND	16.3	ND	14.4	ND	13.2	ND	12.9	ND
Isophorone	8270C	22.4	ND	34.2	ND	28.4	ND	25.1	ND	23.0	ND	22.4	ND
2-Methylnaphthalene	8270C	22.6	ND	34.5	ND	28.6	ND	25.3	ND	23.2	ND	22.6	ND
2-Methylphenol	8270C	19.4	ND	29.7	ND	24.6	ND	21.8	ND	20.0	ND	19.5	ND
4-Methylphenol	8270C	18.5	ND	28.2	ND	23.4	ND	20.7	ND	19.0	ND	18.5	ND
Naphthalene	8270C	21.5	ND	32.8	ND	27.2	ND	24.1	ND	22.1	ND	21.5	ND
2-Nitroaniline	8270C	11.6	ND	17.7	ND	14.7	ND	13.0	ND	11.9	ND	11.6	ND
3-Nitroaniline	8270C	19.4	ND	29.6	ND	24.6	ND	21.7	ND	19.9	ND	19.4	ND
4-Nitroaniline	8270C	16.3	ND	24.9	ND	20.6	ND	18.3	ND	19.9	ND	16.3	ND
Nitrobenzene	8270C	23.8	ND	36.4	ND	30.2	ND	26.7	ND	24.5	ND	23.9	ND
2-Nitrophenol	8270C	22.4	ND	34.2	ND	28.4	ND	25.1	ND	23.0	ND	22.4	ND
4-Nitrophenol	8270C	8.45	ND	12.9	ND	10.7	ND	9.48	ND	8.67	ND	8.46	ND
N-Nitrosodiphenylamine	8270C	23.8	ND	36.3	ND	30.1	ND	26.7	ND	24.4	ND	23.8	ND
N-Nitrosodi-n-propylamine	8270C	23.4	ND	35.8	ND	29.7	ND	26.3	ND	24.0	ND	23.5	ND
Pentachlorophenol	8270C	17.8	ND	27.3	ND	22.6	ND	20.0	ND	18.3	ND	17.9	ND
Phenanthrene	8270C	5.78	9.33J	8.83	22.6J	7.2	25.0J	6.48	25.2J	5.9	14.7 J	5.79	14.8 J
Phenol	8270C	26.1	ND	39.9	ND	33.1	ND	29.3	ND	26.8	ND	26.2	ND
Pyrene	8270C	8.54	13.2J	13.0	50.3	10.8	44.5	9.58	48.6	8.76	23.7 J	8.55	22.0 J
Pyridine	8270C	26.2	ND	40.1	ND	33.2	ND	29.4	ND	26.9	ND	26.3	ND
1,2,4-Trichlorobenzene	8270C	21.0	ND	32.1	ND	26.6	ND	23.5	ND	21.5	ND	21.0	ND
2,4,5-Trichlorophenol	8270C	22.7	ND	34.7	ND	28.8	ND	25.5	ND	23.3	ND	22.7	ND
2,4,6-Trichlorophenol	8270C	16.5	ND	25.1	ND	20.8	ND	18.5	ND	16.9	ND	16.5	ND

Table A-4

SVOC Composite Sediment Sample Results

Alviso Island Ponds

(Concluded)

Notes:
MDL = Method Detection Limit
ND = Not Detected
J = Detected, but below the reporting limit; therefore, result is an estimated concentration MDL method detection limit.

Table A-5
Dioxin and Furan Sediment Sample Results
Data Source: Hydroscience

		A9-A-S			Bay-A-S			10-B-S			1-RC-S		
Congener	TEF[a]	Result	Code	TEC	Result	Code	TEC	Result	Code	TEC	Result	Code	TEC
2,3,7,8-TCDD	1	<0.174	U		<0.218	U		<0.127	U		<0.266	U	
1,2,3,7,8-PeCDD	1.0	<0.265	U		<0.293	U		<0.216	U		<0.331	U	
1,2,3,4,7,8-HxCDD	0.1	<0.227	U		<0.3	U		<0.155	U		<0.355	U	
1,2,3,6,7,8-HxCDD	0.1	<0.272	U		<0.329	U		1.459	J	0.146	<0.406	U	
1,2,3,7,8,9-HxCDD	0.1	<0.244	U		<0.308	U		1.303	J	0.130	<0.372	U	
1,2,3,4,6,7,8-HpCDD	0.01	20.856		0.209	15.982		0.160	56.230		0.562	<0.588	U	
OCDD	0.0001	401.670		0.040	172.535		0.017	896.873		0.090	3.948	J	0.000
2,3,7,8-TCDF	0.1	1.685		0.169	1.137		0.114	0.814		0.081	<0.408	U	
1,2,3,7,8-PeCDF	0.05	<0.161	U		<0.194	U		<0.149	U		<0.266	U	
2,3,4, 7 ,8-PeCDF	0.5	<0.164	U		<0.196	U		<0.146	U		<0.263	U	
1,2,3,4,7,8-HxCDF	0.1	<0.205	U		0.464	J	0.046	0.456	J	0.046	<0.271	U	
1,2,3,6,7,8-HxCDF	0.1	<0.202	U		<0.244	U		<0.242	U		<0.238	U	
1,2,3,7,8,9-HxCDF	0.1	<0.298	U		<0.425	U		<0.327	U		<0.412	U	
2,3,4,6,7,8-HxCDF	0.1	<0.231	U		<0.287	U		0.870	J	0.087	<0.255	U	
1,2,3'4'6' 7 ,8-HpCDF	0.01	3.827	J	0.038	4.696	J	0.047	5.696		0.057	<0.464	U	
1,2,3,4,7,8,9-HpCDF	0.01	<0.732	U		<0.606	U		<0.505	U		<0.873	U	
OCDF	0.0001	13.811		0.001	11.716		0.001	16.049		0.002	<1.675	U	
Total TEqC				**0.457**			**0.385**						**0.000**

U = Undetected. Actual concentration is at or below the given concentration.
J = Estimated Value. Concentration is below the Method Calibration Limit (MCL), but above non-detect.

[a] TEF values obtained from the *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California* - State Implementation Policy (SIP) [September 10, 2001]

Appendix B: Additional Data for Surrounding Area

This appendix presents the data collected in the surrounding water bodies and discussed Chapter 2, Section 2.3, Sediment Quality and Chapter 2, Section 2.4, Hydrology and Water Quality.

Table B-1

Guadalupe River Sediment Data

Units = mg/kg dry weight

Sample ID	Depth	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
SS-22-1	0.5-1	NA	NA	NA	19	49	1.4	66	NA		
SS-22-1A	1-1.5	ND	ND	ND	55	48	ND	93	ND	ND	46
	4-4.5	5.2	ND	ND	81	13	4.8	230	24	ND	87
	7.5-8	15	ND	ND	62	67	4	370	ND	ND	70
SS-01	0.5-1	4.6	ND	49	29	52	NA	77	ND	ND	71
TP-H-6	3.5-4.5	19	3	68	160	750	0.2	63	ND	ND	4200
	C&T	6	NA	NA	NA	NA	NA	NA	NA	NA	NA
TP-H-7	2-3	6.9	ND	91	32	13	2.6	120	ND	ND	85
TP-H-3b	5-6	NA	NA	NA	19	8	NA	41	NA	NA	NA
TP-H-5	2.5-4	14	ND	18	170	1900	1.1	26	ND	ND	590
	5-6	7.6	ND	85	24	7	3.6	110	ND	ND	61
TP-H-1	9.5-11	4	NA	NA	52	1700	NA	78	ND	NA	NA
	A		ND	65.6	63.5	944	6	125	NA	ND	435
SS-02	2-2.4	4.9	ND	67	45	19	NA	89	ND	ND	77
TP-H-4ab	5.5-6.5	NA	NA	NA	39	100	NA	63	NA	NA	NA
	9.5-10	NA	NA	NA	81	220	NA	57	NA	NA	NA
TP-H-2	1.5-2	NA	NA	NA	32	92	NA	47	NA	NA	NA
TP-H-3a	3.5-4.5	NA	NA	NA	19	8	NA	49	NA	NA	NA
SS-22-2	0.5-1	NA	NA	NA	30	60	NA	96	NA	NA	NA
SS-22-3	0.5-1	NA	NA	NA	29	61	4.3	95	NA	NA	NA
SB-11	8-10	1.22	0.5	49.1	29.6	19	0.1	61.5	0.19	0.3	62.1
	10-12	0.3	0.7	41.6	25	11	ND	77.5	0.37	0.4	54.3
SS-18	0.2-0.5	2.6	0.8	75	43	89	0.66	110	ND	ND	160
TP-3-1	1-2	NA	NA	NA	23	52	NA	84	NA	NA	NA
TP-3-2	1.5-2.5	NA	NA	NA	23	14		62	NA	NA	NA
SS-22-4	0.5-1	NA	NA	NA	16	15	9.2	120	NA	NA	NA
TP-3-3A	0.2-0.6	NA	NA	NA	28	110	NA	59	NA	NA	NA

Table B-1

Guadalupe River Sediment Data
(Continued)

Units = mg/kg dry weight

Sample ID	Depth	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
SS-22-4A	0.5-1	ND	ND	39	22	7	1	44	ND	ND	49
TP-3-3	0.5-1	NA	NA	NA	29	310	NA	50	NA	NA	NA
SS-22-5	0.5-1	NA	NA	NA	35	230	4.6	78	NA	NA	NA
TP-3-4A	0.2-0.6	NA	NA	NA	33	86	NA	120	NA	NA	NA
MW-9	12-14	1.86	0.6	37.6	27	ND	ND	94.9	0.98	ND	63.3
	28-29	0.2	1.2	57	53.2	11	0.08	85.1	7.92	ND	169
SS-22-5A	0.5-1	5.3	ND	40	16	12	3.3	71	ND	ND	51
TP-3-4	1.5-2	NA	NA	NA	49	130	NA	260	NA	NA	NA
SB-12	0-9	9.1	3.6	45	235	1390	2.52	456	0.29	0.9	840
	15-18	2.38	0.9	65.5	33.6	14	0.08	102	0.39	0.4	76.1
SS-22-6	0.5-1	NA	NA	NA	20	20	2	45	NA	NA	NA
SS-03	3-4.5	15	8.9	170	2800	5500	NA	1400	ND	ND	3200
TP-3-5	1.5-2.5	NA	NA	NA	38	710	NA	62	NA	NA	NA
SS-04	2-3	8.6	91	88	1200	3400	NA	4600	ND	ND	4800
MW-3-2	5.5-7	NA	NA	NA	21	11	NA	67	NA	NA	NA
	10-12	NA	NA	NA	16	9	NA	37	NA	NA	NA
	15-17	NA	NA	NA	17	6	NA	23	NA	NA	NA
TP-3-6b	7-7.5	NA	NA	NA	24	16	NA	920	NA	NA	NA
TP-3-8	1-1.5	NA	NA	NA	46	99	NA	210	NA	NA	NA
TP-3-6a	3-3.5	2.3	NA	NA	390	1100	NA	1100	ND	NA	NA
	A	NA	ND	34.3	221	1590	1.4	884	NA	ND	579
MW-3-1	5-6.5	NA	NA	NA	29	13	NA	110	NA	NA	NA
	10-12	NA	NA	NA	41	12	NA	57	NA	NA	NA
SS-22-7	0.5-1	NA	NA	NA	20	25	1.5	48	NA	NA	NA
TP-3-10b	8-8.5	NA	NA	NA	31	15	NA	110	NA	NA	NA
TP-3-10a	3-3.5	1.6	NA	NA	200	400	NA	400	ND	NA	NA
	A	NA	ND	61.2	294	666	1	339	NA	ND	272

Table B-1

Guadalupe River Sediment Data
(Continued)

Units = mg/kg dry weight

Sample ID	Depth	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
TP-3-7	2.5-3	NA	NA	NA	16	63	NA	42	NA	NA	NA
TP-3-9	1.5-2.5	NA	NA	NA	130	240	NA	120	NA	NA	NA
SS-22-8	0.5-1	NA	NA	NA	17	37	6.4	57	NA	NA	NA
TP-3-11B	3.5-4	NA	NA	NA	30	410	NA	310	NA	NA	NA
TP-3-11C	6-6.5	NA	NA	NA	32	77	NA	140	NA	NA	NA
TP-3-11b	6.5-7	NA	NA	NA	190	370	NA	60	NA	NA	NA
TP-3-11D	6-6.5	NA	NA	NA	360	180	NA	340	NA	NA	NA
TP-3-9A	1-1.5	NA	NA	NA	33	150	NA	67	NA	NA	NA
TP-3-11a	2-2.5	NA	NA	NA	600000	150	NA	400	NA	NA	NA
SS-22-9	0.5-1	NA	NA	NA	59	63	5.6	120	NA	NA	NA
SB-10	16-17	3.56	1.1	51.4	37.4	12.9	ND	78.5	0.67	0.4	74.9
	23-24	0.52	0.7	45.3	25.9	5.5	ND	62.2	0.66	0.6	59.6
SS-22-10	0.5-1	NA	NA	NA	27	23	0.6	59	NA	NA	NA
SS-22-11	0.5-1	NA	NA	NA	25	30	4.6	79	NA	NA	NA
SS-22-12	0.5-1	NA	NA	NA	23	25	3	67	NA	NA	NA
SS-05	1.5-2	5.4	0.4	83	36	14	NA	130	ND	ND	74
SS-22-13	0.5-1	NA	NA	NA	29	46	2.6	78	NA	NA	NA
	C&T	3	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW-7	3-5	4.82	0.7	47.6	28.9	11	1.89	77.2	0.74	ND	71.8
	12-13	3.52	1	135	40.3	8.6	0.24	215	1.87	0.3	102
SS-22-13A	0.5-1	5.9	ND	68	32	48	3.3	87	ND	ND	80
SS-22-14	0.5-1	NA	NA	NA	34	120	2.8	84	NA	NA	NA
	4-4.5	5.3	ND	25	94	120	3.2	180	ND	ND	120
	7.5-8	7.5	ND	ND	88	40	ND	120	ND	ND	67
SS-17	0.2-0.5	2.8	0.5	78	28	60	0.58	110	ND	ND	98
WP-5-1	2-3.5	NA	NA	NA	30	12	NA	100	NA	NA	NA

Table B-1

Guadalupe River Sediment Data

(Continued)

Units = mg/kg dry weight

Sample ID	Depth	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
SB-8	15-16	3.6	0.7	41.1	26.3	6.3	ND	65.3	ND	0.4	60.2
	24-25	0.6	1.4	46.8	30.9	10.3	0.07	67	0.51	0.6	95.8
SS-22-15	0.5-1	NA	NA	NA	53	180	1.8	81	NA	NA	NA
SS-22-15A	0.5-1	6.4	ND	51	27	34	3.3	68	ND	ND	86
	2.5-3	ND	ND	64	29	63	1.1	73	ND	ND	80
	C&T	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA
	C&T	3	NA	NA	NA	NA	NA	NA	NA	NA	NA
TP-5-1	0.5-1	NA	NA	NA	27	14	NA	95	NA	NA	NA
WP-5-2	2-3.5	NA	NA	NA	30	15	NA	88	NA	NA	NA
SS-22-16	0.5-1	NA	NA	NA	29	35	1.2	73	NA	NA	NA
SS-22-17	0.5-1	NA	NA	NA	22	24	ND	47	NA	NA	NA
SS-22-17A	0.5-1	5.9	ND	60	38	37	1.2	82	ND	ND	100
	C&T	4	NA	NA	NA	NA	NA	NA	NA	NA	NA
SS-22-17B	0.5-1	ND	ND	64	34	41	1.7	100	ND	ND	110
	C&T	3	NA	NA	NA	NA	NA	NA	NA	NA	NA
SS-06	1-1.5	3.6	0.6	72	140	59	NA	79	ND	ND	110
SS-22-18B	0.5-1	NA	NA	NA	35	54	3.4	85	NA	NA	NA
SS-7-1	0.5-1	6.4	ND	66	24	17	2.7	87	ND	ND	100
SS-22-18C	4-4.5	14	ND	130	38	27	4.5	180	ND	ND	120
	C&T	6							NA	NA	NA
	7.5-8	16	ND	160	26	10	0.36	270	ND	ND	60
SS-22-18CR	0.5-1	NA	NA	NA	NA	NA	NA	68	NA	NA	NA
	4-4.5	NA	NA	NA	NA	NA	4.1	NA	NA	NA	NA
SS-22-18A	0.5-1	NA	NA	NA	31	56	5.9	100	NA	NA	NA
SS-7-2	0.5-1	ND	ND	91	40	54	2.6	100	ND	ND	190
	C&T	4	NA	NA	NA	NA	NA	NA	NA	NA	NA
SS-22-19	0.5-1	NA	NA	NA	35	60	4	92	NA	NA	NA

Table B-1

Guadalupe River Sediment Data

(Continued)

Units = mg/kg dry weight

Sample ID	Depth	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
SS-7-3	0.5-1	19	ND	46	42	86	1.1	64	ND	ND	460
SS-7-3R	0.5-1	NA	NA	NA	NA	78	NA	NA	NA	NA	NA
SS-07	3-3.5	5.4	ND	59	49	61		66	ND	ND	80
SS-22-21	0.5-1	NA	NA	NA	35	100	3.2	96	NA	NA	NA
SS-22-21R	0.5-1	NA	NA	NA	NA	76	NA	NA	NA	NA	NA
SS-09	1.5-2	7.4	0.6	73	170	100	NA	110	ND	ND	140
MW-8	12-14	3.52	0.4	29.7	27.2	6.7	ND	55.2	0.18	ND	43.1
	18-20	1.7	0.8	48.2	36.9	13	ND	68	0.96	ND	74
MW-6-1	5-6.5	NA	NA	NA	25	10	NA	84	ND	NA	NA
	10-12	NA	NA	NA	30	17	NA	160	ND	NA	NA
	13-15	NA	NA	NA	20	6	NA	44	ND	NA	NA
	21-22	NA	NA	NA	24	7	NA	41	NA	NA	NA
SB-7	12-14	1.98	0.6	48.3	25.9	9.8	ND	63.7	0.27	ND	51.5
	24-25	1.06	0.6	35.4	27.5	8.1	ND	69	0.21	ND	56.8
SS-6-1	3-4.5	NA	NA	NA	34	130	NA	84	ND	NA	NA
SS-22-22	0.5-1	NA	NA	NA	17	9	ND	39	NA	NA	NA
SB-6-1	10-12	NA	NA	NA	30	11	NA	86	ND	NA	NA
	18-19	NA	NA	NA	29	12	NA	44	ND	NA	NA
	25-27	NA	NA	NA	27	13	NA	51	ND	NA	NA
SB-6	24-26	2.14	0.6	34.6	21.6	7	ND	57.6	0.21	ND	52.7
	33-38	1.54	0.6	49.4	34.5	14	0.07	80.2	8.39	ND	73.6
MW-6-2	5-6.5	NA	NA	NA	24	11	NA	85	ND	NA	NA
	10-12	NA	NA	NA	27	10	NA	110	ND	NA	NA
	17-18	NA	NA	NA	16	5	NA	37	ND	NA	NA
SS-10	1.5-2	6	0.5	140	33	27	NA	230	ND	ND	78
SS-7-4	0.5-1	ND	ND	53	23	6	1.7	67	ND	ND	61
SS-22-20	0.5-1	NA	NA	NA	69	64	1.5	52	NA	NA	NA

Table B-1

Guadalupe River Sediment Data
(Continued)

Units = mg/kg dry weight

Sample ID	Depth	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
SS-22-22A	0.5-1	ND	ND	49	22	34	3.5	62	ND	ND	65
SS-25	0.5-1	5.8	1.2	95.4	36.2	37.2	0.23	203	0.24	0.6	105
SS-7-5	0.5-1	ND	ND	49	22	3	0.7	55	ND	ND	58
SS-08	2.7-3.2	3.8	0.6	60	38	64	NA	82	ND	ND	120
SS-26	0.5-1	4.46	1.4	226	32.2	36.5	0.76	588	0.17	0.4	106
SS-11	2-2.5	16	1.8	84	68	180	NA	120	ND	ND	230
SS-22-22B	0.5-1	6.5	ND	68	28	20	1.6	97	ND	ND	62
SS-22-23	0.5-1	NA	NA	NA	35	71	6.5	76	NA	NA	NA
	4-4.5	ND	ND	ND	65	21	0.41	120	ND	ND	65
	7.5-8	ND	1	17	71	38	1.2	100	ND	ND	75
SS-22-23R	0.5-1	NA	NA	NA	NA	89	2.6	NA	NA	NA	NA
SS-22-23A	0.5-1	ND	ND	1.1	30	59	1.8	79	ND	ND	91
SB-9-1	3-4.5	NA	NA	NA	6	3	NA	2	NA	NA	NA
	8-9.5	NA	NA	NA	30	3	NA	47	NA	NA	NA
	13-15	NA	NA	NA	51	6	NA	190	NA	NA	NA
	18-20	NA	NA	NA	30	8	NA	63	NA	NA	NA
SS-22-24	0.5-1	NA	NA	NA	23	46	3.2	51	NA	NA	NA
MW-9-1	3-4.5	NA	NA	NA	37	100	NA	43	NA	NA	NA
	8-9.5	NA	NA	NA	22	11	NA	92	NA	NA	NA
	13-15	NA	NA	NA	28	16	NA	110	NA	NA	NA
	18-20	NA	NA	NA	32	9	NA	83	NA	NA	NA
SS-22-24A	0.5-1	5.2	ND	56	100	55	1.2	74	ND	ND	100
MW-9-2	3.5-5	NA	NA	NA	56	7	NA	130	NA	NA	NA
	8-9.5	NA	NA	NA	25	6	NA	40	NA	NA	NA
	13-15	NA	NA	NA	32	4	NA	41	NA	NA	NA
SS-22-25	0.5-1	NA	NA	NA	16	7	0.05	79	NA	NA	NA
SS-22-26	0.5-1	NA	NA	NA	47	67	3.4	68	NA	NA	NA
SS-11-1	0.5-1	NA	NA	NA	16	7	NA	37	NA	NA	NA

Table B-1

Guadalupe River Sediment Data

(Continued)

Units = mg/kg dry weight

Sample ID	Depth	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
SS-22-27	0.5-1	NA	NA	NA	58	82	0.8	31	NA	NA	NA
	4-4.5	7	ND	33	55	21	1.7	130	ND	ND	67
	7.5-8	6.4	3	ND	65	10	0.46	95	ND	ND	53
SS-21	1.5-1.8	6	0.7	69	34	100	NA	66	ND	ND	190
SS-11-2	0.5-1	NA	NA	NA	26	120	NA	64	NA	NA	NA
SS-11-2R	0.5-1	NA	NA	NA	NA	160	NA	NA	NA	NA	NA
SS-22	1.3-1.8	3.3	7.6	78	37	96	NA	50	ND	ND	160
MW-5	2.5-4.5	5	ND	71	28	7.2	0.25	110	ND	ND	54
	10-12	1.3	4.5	27	11	ND	ND	40	ND	ND	29
	16-18	0.8	ND	36	16	ND	0.08	52	0.4	ND	39
SS-11-3	0.5-1	NA	NA	NA	41	77	3.4	81	NA	NA	NA
SS-22-28	0.5-1	NA	NA	NA	61	68	14.6	90	NA	NA	NA
SS-22-28R	0.5-1	NA	NA	NA	NA	NA	49	NA	NA	NA	NA
SS-12	1.2-1.5	3.7	0.4	54	27	51	NA	110	ND	ND	94
SS-22-29	0.5-1				56	64	4.7	59	NA	NA	NA
SS-13	1.5-1.7	4.4	0.4	50	57	68	NA	67	ND	ND	110
SS-22-30	0.5-1				40	54	8.3	46	NA	NA	NA
	4-4.5	11	ND	42	850	140	4.2	310	ND	1	390
SS-22-30R	0.5-1	NA	NA	NA	NA	NA	0.75	NA	NA	NA	NA
	4-4.5	NA	NA	NA	170	130	NA	98	NA	NA	NA
SS-14	2.2-2.6	3.2	0.4	56	32	78	NA	80	ND	ND	88
SS-22-31	0.5-1	NA	NA	NA	12	11	10.9	45	NA	NA	NA
SS-22-31R	0.5-1	NA	NA	NA	NA	NA	1.6	NA	NA	NA	NA
SS-22-31A	0.5-1	ND	ND	36	27	28	0.42	47	ND	ND	80
SS-16	0.2-0.5	2.1	0.4	74	24	40	0.9	96	ND	ND	86
SS-22-31B	0.5-1	ND	ND	76	70	53	1.9	120	ND	ND	92
SS-22-32	0.5-1	NA	NA	NA	140	73	4.6	91	NA	NA	NA

Table B-1

Guadalupe River Sediment Data

(Continued)

Units = mg/kg dry weight

Sample ID	Depth	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
SS-22-33	0.5-1	2	NA	NA	280	150	2.1	70	ND	NA	NA
	A	NA	ND	88.6	124	330	1.3	124	NA	ND	204
	3-4	8.1	ND	91	650	170	1.1	130	ND	ND	200
SS-22-33R	3-4	NA	NA	NA	700	370	NA	NA	NA	NA	NA
SS-22-34	0.5-1	NA	NA	NA	800	55	0.5	52	NA	NA	NA
	2.5-3.5	ND	ND	85	7.1	140	1.7	90	ND	ND	160
SS-22-35	0.5-1	NA	NA	NA	250	120	0.7	73	NA	NA	NA
	2.5-3	14	ND	68	100	78	1.4	75	ND	ND	100
	6.5-7	6.4	ND	90	38	10	0.39	120	ND	ND	76
	C&T	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA
SS-14-1	0.5-1	NA	NA	NA	280	94	NA	110	NA	NA	NA
SS-14-1R	0.5-1	NA	NA	NA	640	NA	NA	NA	NA	NA	NA
SS-14-2	0.5-1	NA	NA	NA	54	89	NA	140	NA	NA	NA
SS-22-36	0.5-1	NA	NA	NA	31	70	NA	110	NA	NA	NA
MW-4	8-11	NA	NA	NA	NA	7.56	NA	NA	NA	NA	NA
	13-14	NA	NA	NA	NA	4.54	NA	NA	NA	NA	NA
	14-15	NA	NA	NA	NA	5.16	NA	NA	NA	NA	NA
SS-18-1	0.5-1	1.1	NA	NA	49	540	NA	48	ND	NA	NA
	A	NA	ND	55.6	53.3	453	1.2	94	NA	ND	430
SS-18-1R	0.5-1	NA	NA	NA	NA	95	NA	NA	NA	NA	NA
SS-22-37	0.5-1	NA	NA	NA	32	51	NA	58	NA	NA	NA
SB-16-7	1-2	ND	0.44	96	44	91	0.42	160	ND	ND	96
	4-5	ND	ND	58	22	ND	1.6	64	ND	ND	43
	9-10	ND	ND	48	33	ND	ND	88	ND	ND	54
SB-16-8	1-2	ND	ND	88	40	11	0.43	140	ND	ND	72
	4-5	ND	ND	54	29	ND	0.2	74	ND	ND	49
	9-9.5	3.1	ND	48	35	ND	ND	80	ND	ND	55
SS-18-2	0.5-1	NA	NA	NA	23	56	NA	55	NA	NA	NA

Table B-1

Guadalupe River Sediment Data
(Continued)

Units = mg/kg dry weight

Sample ID	Depth	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
SB-16-9	1-2	ND	0.25	68	48	65	3.7	110	ND	ND	100
	4-5	ND	0.29	44	21	ND	1.2	66	ND	ND	45
	9-10	ND	ND	46	27	ND	0.14	80	ND	ND	51
SS-18-3	0.5-1	NA	NA	NA	19	330	NA	45	NA	NA	NA
SS-18-3R	0.5-1	NA	NA	NA	NA	110	NA	NA	NA	NA	NA
SS-22-38	0.5-1	NA	NA	NA	41	52	NA	160	NA	NA	NA
SS-16-3	-	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SS-22-38A	4-4.5	6.4	ND	ND	140	160	1.1	110	ND	ND	140
	7.5-8	7.3	ND	ND	79	130	2.8	150	ND	ND	140
SB-16-6	0.5-1.5	27	ND	51	41	100	0.49	82	ND	ND	92
	3.5-4.5	ND	ND	44	29	110	3.1	60	ND	ND	65
	8.5-9.5	ND	ND	44	26	ND	ND	76	ND	ND	49
SS-27	1-2	4.28	0.9	39.8	24.7	23.9	0.33	56.6	0.31	0.3	66.2
SS-15	0.2-0.5	3.3	0.5	70	28	65	1.1	110	ND	ND	86
SB-16-5	0.5-1.5	ND	ND	39	49	14	2.5	58	ND	ND	190
	3.5-4.5	ND	0.78	50	70	170	1.7	69	ND	ND	200
	8.5-9.5	ND	ND	44	31	ND	ND	85	ND	ND	51
SS-16-2	-	ND	ND	87	45	20	1.8	140	ND	ND	80
	-	ND	ND	110	50	ND	0.23	190	ND	ND	78
SB-16-4	1.5-2	ND	ND	33	27	150	3.2	50	ND	ND	75
	4-5	ND	ND	100	49	ND	0.34	160	ND	ND	80
	8.5-9.5	3.3	ND	32	26	ND	ND	58	ND	ND	39
SB-16-3	1-2	ND	ND	79	36	64	0.93	140	ND	ND	74
	3.5-4.5	4.3	ND	37	81	290	3.3	58	ND	0.51	160
	8.5-9.5	ND	ND	23	34	ND	ND	37	3	ND	36
MW-6	0-3	3.72	1	114	44.5	11	0.46	194	ND	0.7	75.7
	3-6	9.08	0.6	41.6	25.2	7.2	0.26	62.8	ND	ND	47.1
	11-13	8.94	0.5	30.5	20	8.4	ND	50.7	ND	0.3	50.1

Table B-1

Guadalupe River Sediment Data
(Continued)

Units = mg/kg dry weight

Sample ID	Depth	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
MW-6A	0-2.5	NA	0.8	67.2	30.5	13	NA	113	0.25	0.4	65.4
	11-13	NA	0.5	33.3	18	8.5	NA	48.4	ND	ND	45.3
SS-22-39	0.5-1	NA	NA	NA	97	120	NA	140	NA	NA	NA
SS-22-39R	0.5-1	NA	NA	NA	NA	100	NA	NA	NA	NA	NA
SS-29	1-2	4.36	1.2	102	40.4	7.1	1.24	161	0.2	0.4	75.3
SS-16-1	2-3	ND	ND	71	33	10	2.3	110	ND	ND	64
	1-1.5	ND	0.75	30	67	68	0.5	69	ND	ND	120
	6-6.5	ND	0.52	77	47	32	0.96	120	ND	ND	150
	11-12	ND	0.28	66	41	14	0.74	100	ND	0.52	70
	11-12	ND	0.43	46	27	6	ND	58	ND	0.88	49
SB-16-2	1.5-2.5	ND	0.38	54	28	7	5.2	89	ND	ND	50
	4.5-6.5	ND	ND	130	52	27	0.58	180	ND	ND	87
SS-30	0.5-1	9.96	3.3	62.8	7110	751	2.88	86.7	ND	0.6	3200
SS-22-40	0.5-1	NA	NA	NA	40	120	NA	140	NA	NA	NA
SS-28	1-2	12.9	1	46.2	34.2	73.8	3.97	75.6	0.27	0.3	114
SS-22-41	0.5-1	NA	NA	NA	50	190	NA	160	NA	NA	NA
	3-4	7.8	ND	160	32	41	2	180	ND	ND	300
	5-5.5	ND	ND	55	29	ND	0.28	64	ND	ND	69
SS-22-41R	0.5-1	NA	NA	NA	NA	100	NA	NA	NA	NA	NA
MW-3	13-18	3.06	0.3	31.5	14	5	ND	34.5	ND	ND	35.9
MW-3	18-20	5.36	0.4	34.3	16	7.4	ND	53.8	ND	ND	37.5
MW-3	20-23	3.74	0.7	44.3	30.4	7.7	ND	59	ND	ND	56.7
SS-22-42	0.5-1	NA	NA	NA	30	50	NA	96	NA	NA	NA
SS-22-43	0.5-1	NA	NA	NA	32	82	NA	150	NA	NA	NA
SS-22-43	4-4.5	22	ND	50	82	13	6.5	330	ND	ND	74
SS-22-43	7.5-8	ND	ND	ND	74	52	0.23	99	15	ND	59
SS-22-43R	0.5-1	NA	NA	NA	NA	67	NA	NA	NA	NA	NA
SS-22-43R	4-4.5	NA	NA	NA	NA	NA	0.62	47	NA	NA	NA

Table B-1

Guadalupe River Sediment Data
(Continued)

Units = mg/kg dry weight

Sample ID	Depth	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
SB-3	18-23	4.44	0.6	38.4	19	17	ND	56	ND	0.3	55.4
SB-3	28-30	0.82	0.6	41.1	29.4	11	ND	61.9	0.29	ND	65.3
SB-3	30-33	0.68	0.6	39.6	21.8	6.9	ND	54.7	0.18	0.2	49.7
SB-19-1	2-3	NA	NA	NA	91	25	NA	12	NA	NA	NA
SB-19-1	6-7.5	NA	NA	NA	50	20	NA	9	NA	NA	NA
SB-19-1	10-12	NA	NA	NA	33	19	NA	6	NA	NA	NA
SB-19-2	1.5-2.5	NA	NA	NA	46	15	NA	9	NA	NA	NA
SB-19-2	9-11	NA	NA	NA	40	33	NA	7	NA	NA	NA
SB-19-2	14-16	NA	NA	NA	43	20	NA	9	NA	NA	NA
SS-19-1	0.5-1	NA	NA	NA	65	36	NA	150	NA	NA	NA
SS-19-3	0.5-1	NA	NA	NA	71	21	NA	26	NA	NA	NA
SS-19-2	0.5-1	NA	NA	NA	71	21	NA	28	NA	NA	NA
SS-22-44	0.5-1	NA	NA	NA	38	66	NA	190	NA	NA	NA
SS-17-1	0.5-1	NA	NA	NA	37	110	NA	95	NA	NA	NA
SS-17-2	0.5-1	NA	NA	NA	29	270	NA	70	NA	NA	NA
SS-17-2R	0.5-1	NA	NA	NA	NA	390	NA	NA	NA	NA	NA
SS-17-3	0.5-1	ND	ND	67	9	42	0.25	43	15	ND	13
SS-17-4	0.5-1	ND	ND	ND	12	23	0.17	37	28	ND	23
MW-2	8-9	3.7	ND	33	25	7.1	ND	43	ND	ND	47
MW-2	13-15	3.8	ND	45	26	8.9	ND	63	ND	ND	62
MW-2	16-18	2.7	ND	38	23	7.3	ND	58	ND	ND	51
SS-22-45	0.5-1	NA	NA	NA	35	43	NA	170	NA	NA	NA
SS-22-46	0.5-1	NA	NA	NA	33	50	NA	170	NA	NA	NA
SS-22-47	0.5-1	NA	NA	NA	35	66	NA	160	NA	NA	NA
SS-15-1	0.5-1	NA	NA	NA	58	390	NA	130	NA	NA	NA
SS-15-1R	0.5-1	NA	NA	NA	NA	210	NA	NA	NA	NA	NA
SB-15-1	5-6.5	NA	NA	NA	33	11	NA	120	NA	NA	NA
SB-15-1	8-9	NA	NA	NA	14	5	NA	37	NA	NA	NA

Table B-1

Guadalupe River Sediment Data

(Continued)

Units = mg/kg dry weight

Sample ID	Depth	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
SB-15-1	15-17	NA	NA	NA	20	11	NA	46	NA	NA	NA
SS-22-48	0.5-1	NA	NA	NA	37	86	NA	170	NA	NA	NA
SS-22-48	4-4.5	13	ND	25	110	29	8	430	ND	ND	84
SS-22-48	7.5-8	11	ND	ND	63	25	12	380	ND	ND	84
SS-22-48	C&T	7	NA	NA	NA	NA	NA	NA	NA	NA	NA
SS-22-48R	0.5-1	NA	NA	NA	NA	86	NA	NA	NA	NA	NA
SS-22-48R	4-4.5	NA	NA	NA	NA	NA	NA	270	NA	NA	NA
SS-22-48R	7.5-8	NA	NA	NA	NA	NA	22	NA	NA	NA	NA
SB-15-2	8-9	NA	NA	NA	14	5	NA	45	NA	NA	NA
SB-15-2	15-17	NA	NA	NA	28	6	NA	39	NA	NA	NA
SS-15-2	0.5-1	NA	NA	NA	36	36	NA	190	NA	NA	NA
SS-22-49	0.5-1	NA	NA	NA	34	69	NA	150	NA	NA	NA
SS-22-50	0.5-1	NA	NA	NA	36	120	NA	150	NA	NA	NA
SS-22-50	3-4	6.1	ND	61	23	9	0.3	79	ND	ND	54
SS-22-50	C&T	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA
SS-22-50	7-8	ND	ND	60	14	4	0.11	51	ND	ND	35
SS-22-50	C&T	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA
SS-22-50R	1-1.5	NA	NA	NA	NA	64	NA	NA	NA	NA	NA
SB-2	7-10	5.92	0.6	34.8	16	6.7	ND	56.5	ND	ND	42.1
SB-2	13-18	7.22	0.3	37.9	20.8	6	ND	61.3	0.16	ND	38.5
SS-22-51	0.5-1	NA	NA	NA	43	200	NA	120	NA	NA	NA
SS-22-52	0.5-1	NA	NA	NA	160	85	NA	330	NA	NA	NA
SS-22-52	4-4.5	ND	ND	58	83	65	1.1	200	ND	ND	87
SS-22-52R	0.5-1	NA	NA	NA		48	NA	140	NA	NA	NA
SS-22-53	0.5-1	NA	NA	NA	37	21	NA	140	NA	NA	NA
SB-1	14-18	3.1	0.4	42.4	22	11	0.13	56.2	ND	ND	47.7
SB-1	28-30	1.34	0.7	35.3	29	8.3	0.08	62.2	0.28	ND	66.2
SB-1	30-33	2.12	0.5	38.8	25.4	9.8	0.07	53.7	0.22	ND	62.6

Table B-1

Guadalupe River Sediment Data
(Concluded)

Units = mg/kg dry weight

Sample ID	Depth	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
SS-22-54	0.5-1	NA	NA	NA	36	54	NA	170	NA	NA	NA
SS-22-54A	4-4.5	21	ND	ND	89	29	5	720	ND	ND	80
SS-22-54A	7.5-8	11	ND	ND	72	56	6	460	ND	ND	60
SS-22-54AR	4-4.5	NA	NA	NA	NA	NA	NA	560	NA	NA	NA
SS-22-54AR	7.5-8	NA	NA	NA	NA	NA	6.1	NA	NA	NA	NA
SS-22-55	0.5-1	NA	NA	NA	34	44	NA	120	NA	NA	NA
MW-1	5-8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW-1	12-14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
SS-22-56	0.5-1	NA	NA	NA	24	22	NA	98	NA	NA	NA
SS-22-57	0.5-1	NA	NA	NA	30	27	NA	91	NA	NA	NA
SS-22-58	0.5-1	NA	NA	NA	32	10	NA	68	NA	NA	NA
SS-22-59	0.5-1	NA	NA	NA	36	58	NA	170	NA	NA	NA
SS-22-60	0.5-1	NA	NA	NA	41	16	NA	150	NA	NA	NA
SS-22-61	0.5-1	NA	NA	NA	50	35	NA	110	NA	NA	NA
SS-22-62	0.5-1	NA	NA	NA	31	59	NA	150	NA	NA	NA

Maximum[a]	27	4.5	226	850	944	9.2	920	3	1	840
Minimum[a]	0.2	0.25	1.1	6	3	0.05	2	0.16	0.2	13
Arithmetic Mean[a]	6.04	0.88	61.02	59.89	75.87	2.09	112.44	0.52	0.49	105.17
n[b]	341	341	341	342	343	341	343	344	343	343

Notes: [a] Does not include outliers

[b] Includes outliers and non-detects

ND	Not detected
NA	Not analyzed
▨	Outlier

Table B-2

Pond A-4 Perimeter (Alviso Complex)
Data Source: Santa Clara Valley Water District

Units = mg/kg (wet or dry weight not specified)

Sample No.	Depth	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
Method No.		EPA 6010B	EPA 6010B	EPA 6010B	EPA 6010B	EPA 6010B	EPA 7471	EPA 6010B	EPA 6010B	EPA 6010B	EPA 6010B
SED-1-0.5	0.5	47	<5	55	40	9.7	<0.05	70	<25	<5	67
SED-1-2.5	2.5	36	<5	46	23	8.2	<0.05	60	<25	<5	56
SED-2-0.5	0.5	32	<5	48	43	9.8	<0.05	75	<25	<5	80
SED-2-2.5	2.5	31	<5	36	94	31	<0.05	32	<25	<5	72
SED-3-0.5	0.5	30	<5	33	62	9.6	0.0560	50	<25	<5	62
SED-3-2.5	2.5	41	<5	48	42	10.0	<0.05	58	<25	<5	61
SED-4-0.5	0.5	33	<5	38	20	<5	0.0630	46	<25	<5	41
SED-4-2.5	2.5	24	<5	28	16	<5	0.0640	40	<25	<5	33
SED-5-0.5	0.5	44	<5	49	24	10	<0.05	59	<25	<5	50
SED-5-2.5	2.5	30	<5	30	12	7.9	0.1090	43	<25	<5	38
SED-6-0.5	0.5	39	<5	46	37	10	<0.05	50	<25	<5	55
SED-6-2.5	2.5	35	<5	42	23	8.6	<0.05	45	<25	<5	42
SED-7-0.5	0.5	42	<5	44	22	13	0.0570	52	<25	<5	47
SED-7-2.5	2.5	42	<5	48	28	11	<0.05	56	<25	<5	55
SED-8-0.5	0.5	37	<5	47	21	8.7	<0.05	56	<25	<5	51
SED-8-2.5	2.5	44	<5	46	20	5.6	0.0790	53	<25	<5	46

Maximum	2.50	47.00	<5	55.00	94.00	31.00	0.1090	75.00	<25	<5	80.00
Minimum	0.50	24.00	<5	28.00	12.00	<5	0.0560	32.00	<25	<5	33.00
Arithmetic Mean	1.50	36.69	<5	42.75	32.94	10.94	0.0713	52.81	<25	<5	53.50
Median	1.50	36.50	<5	46.00	23.50	9.75	0.0635	52.50	<25	<5	53.00
n	16	16	16	16	16	16	16	16	16	16	16

Table B-3

Pond A-8 Perimeter (Alviso Complex)
Data Source: Santa Clara Valley Water District

Units = mg/kg (wet or dry weight not specified)

Sample No.	Depth	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
Method No.		EPA 6010	EPA 6010	EPA 6010	EPA 6010	EPA 6010	EPA 7471	EPA 6010	EPA 6010	EPA 6010	EPA 6010
KSS-1	0-0.5	7.1	<0.50	40	58	20	0.21	48	<5.0	<0.50	63
KSS-2	0-0.5	8.9	<0.50	44	26	9.9	0.29	52	<5.0	<0.50	46
KSS-3	0-0.5	7	<0.50	49	17	6.3	0.7	49	<5.0	<0.50	40
KSS-4	0-0.5	<5.0	<0.50	46	15	<5.0	0.027	38	<5.0	<0.50	48

Maximum	0.50	8.90	<0.50	49.00	58.00	20.00	0.7000	52.00	<5.0	<0.50	63.00
Minimum	0.00	<5.0	<0.50	40.00	15.00	<5.0	0.0270	38.00	<5.0	<0.50	40.00
Arithmetic Mean	0.00	7.67	<0.50	44.75	29.00	12.07	0.3068	46.75	<5.0	<0.50	49.25
Median	0.00	7.10	<0.50	45.00	21.50	9.90	0.2500	48.50	<5.0	<0.50	47.00
n	4	4	4	4	4	4	4	4	4	4	4

Table B-4

Pond A-18 Perimeter Near Shore Sediment (Alviso Complex)
Data Source: City of San Jose

Units = mg/kg wet weight
ND = Non detect

Method No.	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series
Sample No.	**Arsenic**	**Cadmium**	**Chromium**	**Copper**	**Lead**	**Mercury**	**Nickel**	**Selenium**	**Silver**	**Zinc**
NNS 1-0.5	ND	ND	51	27	ND	0.024	63	ND	0.18	61
NNS 1-2.5	ND	ND	38	27	ND	0.023	42	ND	ND	55
NNS 2-0.5	ND	ND	34	20	ND	0.047	36	ND	0.12	45
NNS 2-2.5	ND	0.28	39	24	ND	0.053	40	ND	ND	55
NNS 3- 0.5	3.6	ND	19	10	7.3	0.052	30	ND	ND	20
NNS 3- 1.0	9.1	0.3	32	18	9.5	0.064	51	ND	0.11	47
NNS 3- 2	8.1	ND	37	18	8.5	0.14	55	ND	ND	39
NNS 3- 5	3.8	ND	13	6.8	ND	0.054	16	ND	ND	12
NNS 4-0.5	ND	ND	14	9.2	ND	0.033	21	0.1	ND	14
NNS 4-2.5	ND	ND	14	7.9	ND	0.0096	22	ND	ND	15
NNS 5-0.5	ND	ND	41	26	ND	0.049	49	ND	0.1	56
NNS 5-2.5	ND	0.42	53	28	ND	0.013	69	ND	0.28	60
SNS 6-0.5	ND	0.21	52	37	ND	0.063	67	ND	0.2	58
SNS 6-2.5	ND	ND	51	25	ND	0.045	63	6.2	0.22	54
SNS 7-0.5	ND	0.28	49	49	ND	0.073	70	ND	0.16	79
SNS 7-2.5	ND	ND	49	25	ND	0.048	63	ND	0.1	53
SNS 8-0.5	ND	1.2	37	42	ND	0.24	79	ND	0.72	76
SNS 8-1	ND	ND	76	35	ND	0.071	140	ND	0.24	70
SNS 8-2	ND	ND	50	30	ND	0.03	78	ND	ND	65
SNS 8-5	ND	ND	69	35	ND	0.04	93	ND	ND	86
SNS 9-0.5	ND	ND	49	20	ND	0.16	55	ND	ND	47
SNS 9-2.5	ND	ND	64	39	ND	0.021	82	ND	ND	65

Table B-4

Pond A-18 Perimeter Near Shore Sediment (Alviso Complex)
(Continued)

Units = mg/kg wet weight
ND = Non detect

Method No.	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series
Sample No.	**Arsenic**	**Cadmium**	**Chromium**	**Copper**	**Lead**	**Mercury**	**Nickel**	**Selenium**	**Silver**	**Zinc**
SNS 10-0.5	ND	ND	41	19	6	0.023	68	ND	ND	46
SNS 10-2.5	5	0.21	33	19	9.8	0.071	69	ND	ND	41
ZNS 11-0.5	ND	ND	56	43	ND	0.056	90	ND	0.16	67
ZNS 11-2.5	ND	ND	44	23	ND	0.061	62	ND	0.28	57
ZNS 12-0.5	10	0.91	33	29	13	0.1	70	ND	0.24	58
ZNS 12-2.5	7.8	0.22	43	25	10	0.09	73	ND	0.15	52
ZNS 13-0.5	ND	ND	52	36	ND	0.046	76	ND	0.23	63
ZNS 13-1.0	ND	0.23	49	32	ND	0.033	77	ND	0.12	67
ZNS 14-0.5	5.2	ND	23	12	11	0.12	40	ND	0.1	22
ZND 14-2.5	ND	ND	45	18	ND	0.07	53	ND	0.16	47
ZNS 15-0.5	6.2	0.3	29	19	16	0.1	50	ND	0.12	47
ZNS 15-2.5	3.5	ND	15	12	5.2	0.057	23	ND	ND	17
ENS 16-0.5	22	0.24	45	28	17	0.25	81	ND	0.36	54
ENS 16-3.0	9.9	ND	49	26	ND	0.22	68	ND	0.31	62
ENS 17-0.5	7.6	ND	49	26	ND	0.058	72	ND	0.14	57
ENS 17 3.0	8.9	ND	51	24	ND	0.42	69	ND	ND	57
ENS 18-1.0	5.1	ND	38	21	10	0.083	49	ND	ND	49
ENS 18-3.0	8.6	ND	36	19	8.6	0.05	49	ND	ND	41
ENS 18-5.0	15	ND	48	24	ND	0.056	65	ND	ND	50
ENS 19-0.5	7.7	ND	48	24	8.4	0.068	66	ND	ND	51
ENS 19-2.5	ND	ND	48	26	ND	0.045	71	ND	ND	53
ENS 20-0.5	20	ND	60	27	ND	0.078	76	ND	0.14	64

Table B-4

Pond A-18 Perimeter Near Shore Sediment (Alviso Complex)

(Concluded)

Units = mg/kg wet weight
ND = Non detect

Method No.	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series
Sample No.	**Arsenic**	**Cadmium**	**Chromium**	**Copper**	**Lead**	**Mercury**	**Nickel**	**Selenium**	**Silver**	**Zinc**
ENS 20-2.5	23	ND	44	26	10	0.032	60	ND	0.24	59

Maximum	23.00	1.20	76.00	49.00	17.00	0.42	140.00	6.20	0.72	86.0
Minimum	3.50	0.21	13.00	6.80	5.20	0.01	16.00	0.10	0.10	12.0
Arithmetic Mean	9.51	0.40	42.44	24.82	10.02	0.08	61.36	3.15	0.21	51.4
Median	7.95	0.28	45.00	25.00	9.80	0.06	65.00	3.15	0.16	54.0
n	20	12	45	45	15	45	45	2	25	45

Table B-5

Pond A-18 Interior Pond Sediment (Alviso Complex)
Data Source: City of San Jose

Units = mg/kg wet weight
ND = Non detect

Method No.	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series	EPA 6000/7000 series
Sample No.	**Arsenic**	**Cadmium**	**Chromium**	**Copper**	**Lead**	**Mercury**	**Nickel**	**Selenium**	**Silver**	**Zinc**
WPS-2 0-0.5	5.6	ND	39	16	5.5	0.046	34	ND	ND	33
WPS-2 0.5-1	ND	0.2	46	24	ND	0.083	46	ND	ND	58
WPS-4 0.5-1.5	ND	ND	52	24	ND	0.31	89	ND	ND	60
WPS-4 4-5	32	ND	58	33	ND	0.02	78	ND	ND	69
WPS-7 0.5-1.5	8.5	0.2	ND	4.7	7.9	0.035	11	ND	0.34	18
WPS-7 4-5	5.8	0.22	34	14	6.6	0.021	46	ND	ND	31
WPS -11 0.5-1.5	ND	0.2	46	24	ND	0.083	46	ND	ND	58
WPS 11 4-5	ND	ND	55	22	ND	0.2	64	ND	ND	50
EPS-3 0.5-1	ND	ND	55	20	ND	0.27	62	ND	ND	58
EPS-9 1.5-2.5	ND	ND	51	22	ND	0.32	51	ND	ND	53
EPS-9 3-5	11	0.64	46	26	14	0.042	88	ND	ND	68
EPS-10 4-5	ND	0.32	31	16	24	0.055	43	ND	ND	49
EPS-12 0.5-1.5	ND	ND	51	26	ND	0.054	51	ND	ND	48
EPS-12 4-5	ND	ND	55	20	ND	0.04	57	ND	ND	50

Maximum	32.00	0.64	58.00	33.00	24.00	0.3200	89.00		0.34	69.00
Minimum	5.60	0.20	31.00	4.70	5.50	0.0200	11.00		0.34	18.00
Arithmetic Mean	12.58	0.30	47.62	20.84	11.60	0.1128	54.71		0.34	50.21
Median	8.50	0.21	51.00	22.00	7.90	0.0545	51.00		0.34	51.50
n	5	6	13	14	5	14	14		1	14

Table B-6

Petroleum Hydrocarbons in Pond A18 Surface Water
Data Source: City of San Jose

Pond No.	**Sample ID**	**TPH-gasoline mg/L**	**TPH diesel (C10-C28) mg/L**
A18	WP1W	<0.05	0.17
A18	WP2W	<0.05	0.11
A18	WP4W	<0.05	0.15
A18	WP5W	<0.05	0.15
A18	WP6W	<0.05	0.15
A18	WP7W	<0.05	0.19
A18	WP8W	<0.05	0.12
A18	EP3W	<0.05	0.19
A18	EP9W	<0.05	0.17
A18	EP9DW (rep)	<0.05	0.18
A18	EP10W	<0.05	0.14
A18	EP11W	<0.05	0.24
A18	EP12W	<0.05	0.17

Notes: mg/L = Milligrams per Liter

List of Acronyms

ABAG	Association of Bay Area Governments
af	acre-feet
AFCC	Alameda Flood Control Channel
BCDC	San Francisco Bay Conservation and Development Commission
bgs	Below ground surface
BMP	Best management practices
BOD	Biological Oxygen Demand
Caltrans	California Department of Transportation
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeter
cms	cubic meters per second
CNPS	California Native Plant Society
Corps	US Army Corps of Engineers
DEM	Digital Elevation Model
DFG	California Department of Fish and Game
EA	Environment Assessment
EAP	Emergency Action Plan
EIR	environmental impact report
EIS	environmental impact statement
EOP	Emergency Operations Plan
EPA	US Environmental Protection Agency
ER-L	Effects Range - Low
ER-M	Effects Range - Median
FEMA	Federal Emergency Management Agency
FR	Federal Register
gpm	Gallons per Minute
GPS	Global Positioning System
GRR	General Re-Evaluation and Environmental Report
HEC-RAS	Hydrologic Engineering Center-River Analysis System
HRT	Hydraulic Residence Time
ISP	Initial Stewardship Plan
km	kilometer
LCA	Local Cooperative Agreement
LS!	Life Science! Inc.
MDL	Mean Detection Limit
mgd	Megagallons per day
MHHW	mean higher high water
MHW	mean high water
MLLW	mean lower low water
MMP	migration and monitoring plan
NEPA	National Environmental Policy Act
NGVD	National Geodetic Vertical Datum
NHC	Northwest Hydraulic Consultants
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Agency
NOP	Notice of Preparation
PG&E	Pacific Gas and Electric Company
ppm	Parts per million
ppt	Parts per thousand
RMS	Root mean squared (average dynamic)
ROW	right-of-way
RWQCB	San Francisco Bay Regional Water Quality Control Board

SCVWD	Santa Clara Valley Water District
SEMS	Standardized Emergency Management System
SFBBO	San Francisco Bay Bird Observatory
SMP	Stream Maintenance Program
SR	State Route
SSFB	South San Francisco Bay
SWPPP	stormwater pollution prevention plan
TBD	To be Determined
TBS	To be Supplied
TRIM	Tide, Residual, Intertidal, and Mudflat
UPRR	Union Pacific Railroad
US 101	US Highway 101
USDA	US Department of Agriculture
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
WQO	Water Quality Objection

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