APPENDIX E: Identification and Evaluation of the South San Francisco Bay Solar Salt Industry Landscape

(Alameda, Santa Clara, and San Mateo Counties, California)

For the

Don Edwards San Francisco Bay National Wildlife Refuge and
California Department of Fish and Game

Archimedes Screw pumps, Oliver Salt Works, Eden Landing, view to S (2007-12-01:57).

By

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Introduction

The South Bay Salt Pond Restoration Project's (SBSPRP) goal is to convert the heavily modified environment of the solar salt industry back to native salt marsh. The restoration is focused on portions of San Mateo, Santa Clara, and Alameda Counties, and comprises approximately 15,100 acres of former salt ponds located around the edge of South San Francisco Bay. The SBSPRP encompasses property managed by the U.S. Fish and Wildlife Service (USFWS) and the California Department of Fish and Game (DFG). The agencies are working together along with the California State Coastal Conservancy (Conservancy) and U.S. Army Corps of Engineers (USACE) to develop a cohesive approach to restoration and complying with Section 106 of the National Historic Preservation Act (NHPA). The project overlaps five USGS 7.5' topographical quadrangle maps: Newark, Redwood Point, Palo Alto, Milpitas, and Mountain View. The SBSPRP's goal is to restore the industrial salt production ponds in South San Francisco Bay to a more natural mix of tidal wetland habitats and managed ponds. The SBSPP is composed of three noncontiguous units, including Eden Landing on the east side of the Bay near the San Mateo bridge; the Alviso unit at the southern end of the bay; and the West Bay-Ravenswood unit located on the west side of the Bay near the Dumbarton Bridge (Figure 1 and Appendix A).

Description of Undertaking

The SBSPRP is partially funded with federal funds and many of the activities will occur on lands managed by the U.S. Fish and Wildlife Service, therefore the project is considered an undertaking with the potential to affect historic properties pursuant to the National Historic Preservation Act (1966 as amended, 16 U.S.C. 470f). The process for complying with NHPA is provided in the implementing regulations, Section 106 of 36 CFR 800. The initial step of the Section 106 process is to determine the Area of Potential Effects (APE). For the SBSPRP the APE includes the three salt pond units and comprises more than 15,000 acres. The project boundaries are determined by legal boundaries associated with the Don Edwards San Francisco Bay National Wildlife Refuge (NWR) and the DFG Eden Landing Ecological Reserve. Portions of the salt industry ponds, outside of the SBSPRP, will remain in private ownership and are not included in this study. The APE boundary was submitted for review to the SHPO in 2004 and the definition of the three units was accepted as meeting the regulations set forth in 36 CFR 800.16(d) (Donaldson to Kolar, November 11, 2004).

A portion of the project is on State land, therefore, state laws are applicable, such as the California Environmental Quality Act (CEQA). However, the USFWS and California DFG have signed a Memorandum of Understanding (MOU) and agree that the USFWS will be the lead agency responsible for complying with NHPA and that California DFG will provide access to DFG lands, review the results of the identification effort, reach consensus with USFWS regarding evaluations for historic properties, and assist with the mitigation plan (see Appendix B). Compliance with Section 106 for the entire project offers a more consistent approach, rather than reviewing a portion of the project under different historic preservation standards. Consultation with interested parties and Native American tribes and individual's was initiated in 2004 and the list is included as Appendix C.

Restoration of a natural environment is complex and will take many years with a variety of treatments to be successful. Solar salt ponds will be taken out of production and each pond or group of ponds will be developed as part of a mosaic landscape of open water, salt brine ponds,

and tidal marsh that will create habitat for a variety of endangered species along the South Bay shoreline. Project activities include grading/filling ponds, managing ponds for habitat, building/maintaining levees, dredging/deepening ponds, ditches, and waterways, removing or constructing water impoundment structures, and restoring stream channels. Recreation within this urban interface will include trails, water trails, and interpretive kiosks and exhibits. Salt marsh restoration and public interpretation will occur incrementally over the next 50 years.

The SBSPRP is a large-scale project encompassing thousands of acres and requires an equally broad approach to identifying cultural resources within the project area. The SBSPRP's comprehensive approach to planning suggests that a landscape-level appraisal is the most suitable for identifying resources, evaluating historic properties, and assessing project effects. The following discussion provides the mechanism for defining the solar salt works landscape within the SBSPRP. However, each of the three units has a unique history and each is evaluated separately below.

Identification of the South Bay Solar Salt Works

Inventory level survey for cultural resources has been conducted on approximately 50 percent of the SBSPRP, with 21 sites identified – 18 within the Eden Landing tracts, three in the Alviso pond area, and no resources in the Ravenswood unit (EDAW EIS/EIR Table 3.8-1; Busby 2008). A variety of researchers have conducted surveys in portions of the salt ponds, the USFWS has reviewed the previous surveys and conducted additional pedestrian surveys within the project APE. The majority of the recorded sites are related to the historic period of salt production in the Eden Landing Unit, 16 of the 18 recorded. One additional site was recorded by FWS archaeologists, bringing the total number of resources identified to 22. Prehistoric sites are not found in the salt ponds, but are more commonly located along the current shoreline, on ground that was above tidal influence, and along freshwater tributaries (EDAW EIS/EIR 3.8-3). The predominant historic use of the area for salt production is reflected by the landscape features and remnants of the salt manufacturing process such as archaeological sites, along with secondary usages including waterfowl hunting.

Because the predominant activity that has shaped the landscape of the southern San Francisco Bay is the solar salt industry, a historic context for the South Bay solar salt works was prepared under contract with EDAW, see attached Appendix C. Important elements presented in the context are summarized below. The geographic extent of the context is the southern portion of San Francisco Bay, the theme or area of significance is the solar salt industry, with three distinct time periods. The first period of significance is related to initial salt production during the nineteenth century, essentially 1850 to 1900; the second period is defined by the consolidation and growth of the industry between 1901 and 1953; and the last period from 1954 to the present encompasses the modern-era of salt production by one corporation. A slightly different set of dates was devised by Robin Gossinger, director of the Historical Ecology Program at the San Francisco Estuary Institute but with the same general developmental stages: "Prehistory to 1850s is the first generation Ohlone/Spanish period; 1850s-1920s is the second generation traditional American period; and 1920s-2003 is the third generation industrial" (Santa Clara Valley Water District 2005:49). Although the time periods vary slightly, the evolution of the salt industry is consistently presented (Figure 2).

South Bay Salt Pond Restoration Project

Project Overview and APE Map

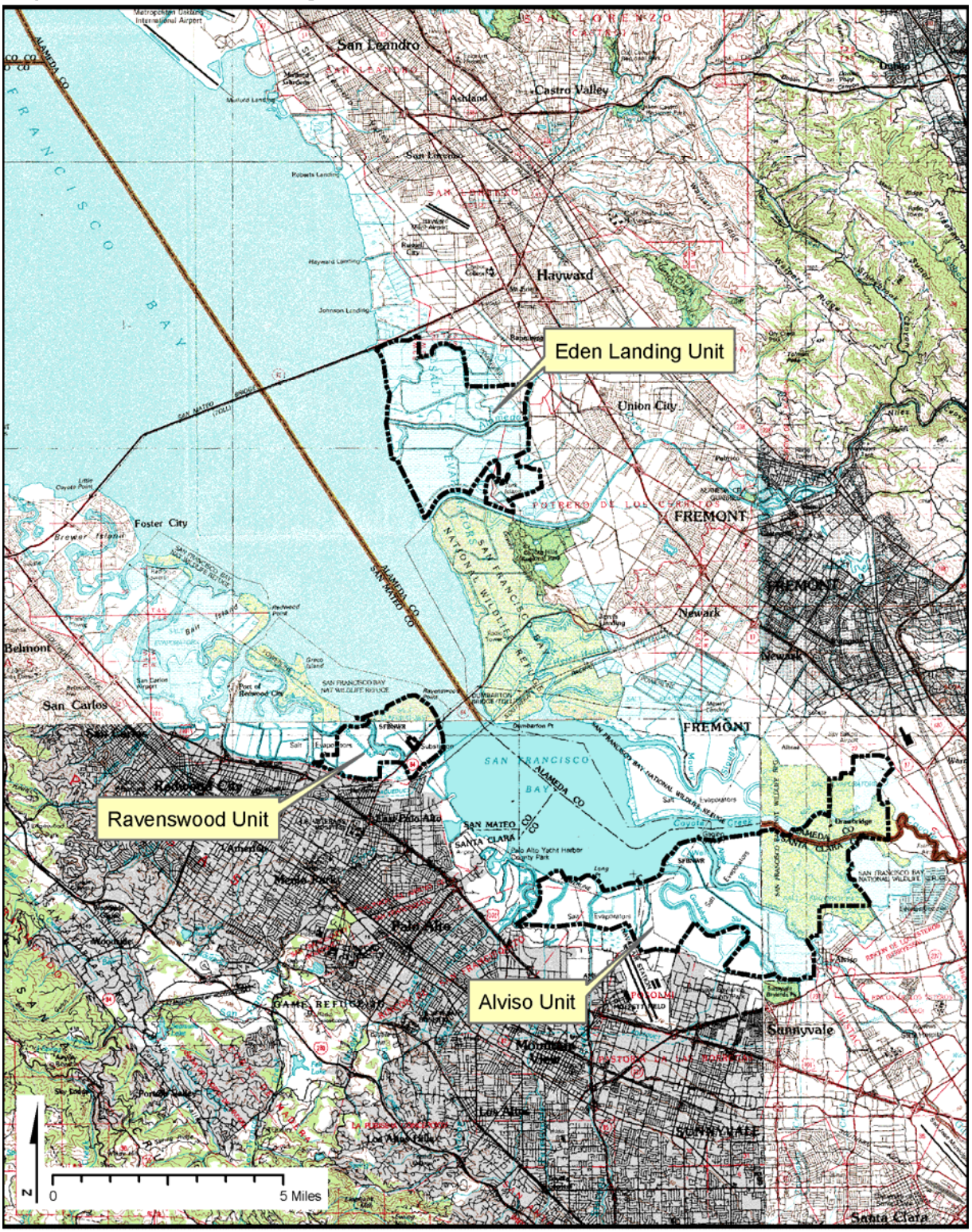

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Figure 1. Project Overview and Area of Potential Effects Map.

Solar salt production had its beginnings when Native Americans collected the naturally occurring salts along the bay front. Salt was scraped off rocks or sticks were used as tools for recovering salt. Little manipulation of the shoreline was required to recover enough salt to meet the pre-European demand. Spanish missionaries used salt to cure meat and fish which they sold to ships. The missionaries wanted to increase the amount of salt recovered and augmented the salt production processes by using the shallow marsh along the bay front. The initial salt extraction methods used by Native Americans and Spanish missionaries did not alter the natural environment and no evidence of these early efforts is represented on the landscape within the SBSPRP APE.

Discovery of gold and the increasing population in San Francisco spurred development of the salt works. Additional demand for salt occurred when Nevada Comstock silver mines began using salt to process ore. With mining interests requiring salt, capitol resources were directed toward expanding the solar salt industry.

The natural characteristics of the south bay are perfect for producing salt. The shallow, flat marsh lands along the bay front combined with warm, dry summers created an environment perfectly suited to producing salt. Small scale, nineteenth century salt producers simply diked the low-lying marsh lands to create ponds. Ponds were connected by gates, siphons, and pumped flumes to move salt water through the series of evaporation ponds and into a final crystallizing pond where salt was produced. Salt works and milling plants were located adjacent to the ponds and often included housing for workers. Wharfs and landings were developed for transporting salt by ships across the bay.

The small individual salt farms were consolidated as industrial demands for salt required increased production and the equipment developments allowed for larger ponds. By the 1930s the industry had progressed from family operated plots of 20-40 acres, to extensive production ponds forming the crazy-quilt appearance that we see today. Large processing plants and enormous piles of salt are also signature features of the modern salt industry. Salt pond expansion in the 1950s and 1960s required reclaiming even more acres of the bay's salt marsh and tidally influenced mud flats. Constructing levees, excavating, and filling were all activities used to create the ponds.

The current configuration of ponds reflects the development from 1953 to the 1990s. Industrial salt production dominates the South Bay landscape and provides a colorful mosaic to air travelers flying over the bay. However, do the salt ponds constitute a historic cultural landscape? The characteristics of a cultural landscape are presented below.

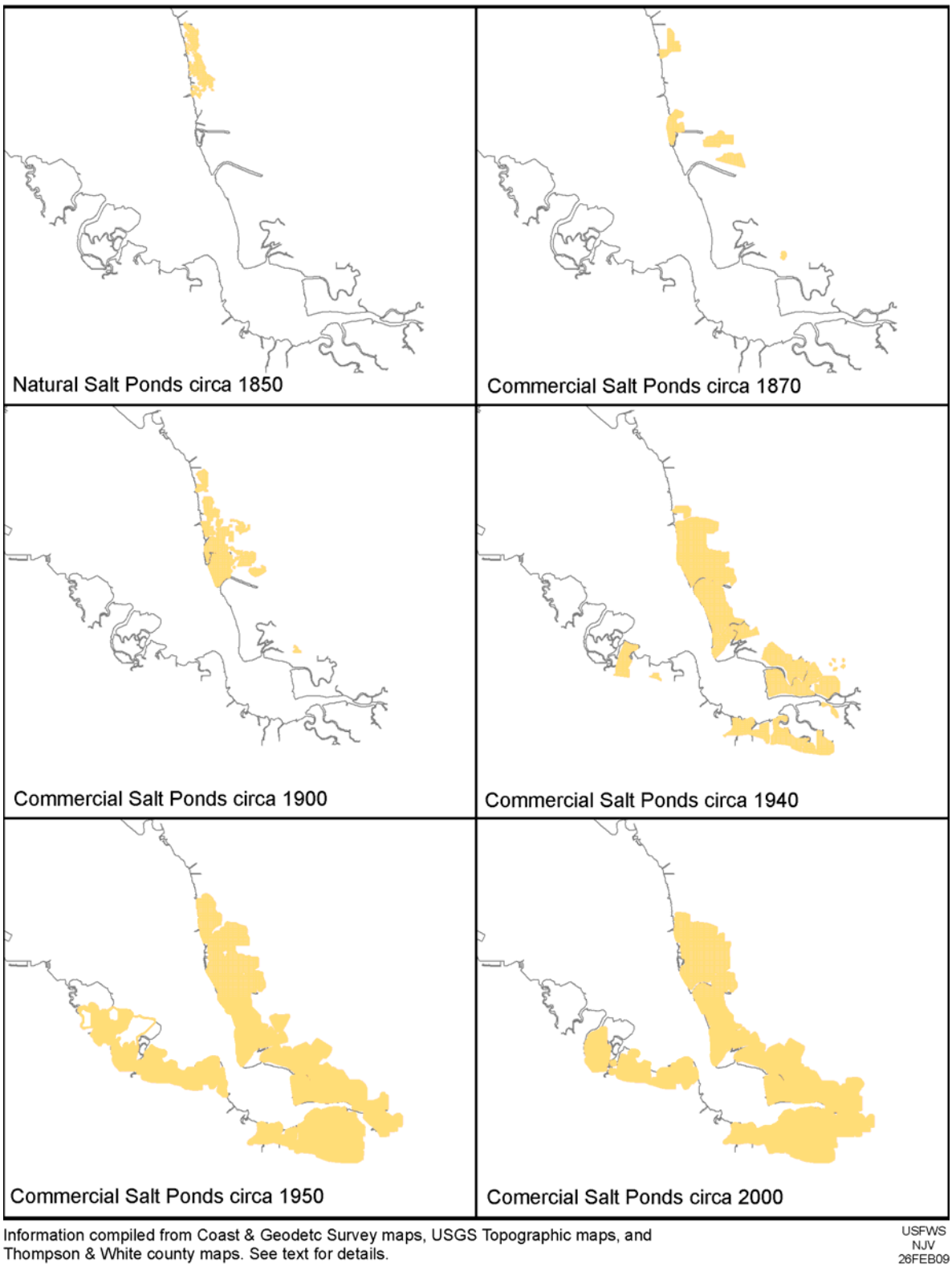

Figure 2. Salt Pond Eras.

Cultural Landscape Analysis of the South Bay Solar Salt Works

National Park Service (NPS) Bulletin #30 *Guidelines for Evaluating and Documenting Rural Historic Landscapes* (revised 1999), Preservation Briefs #36 *Protecting Cultural Landscapes: Planning, Treatment and Management of Historic Landscapes* (Birnbaum 1996), the *Cultural Landscapes Inventory Professional Procedures Guide* (Page 2001), and *Historic American Landscape Survey* provide guidance for cultural landscape studies. As defined by the NPS, a cultural landscape is:

> a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values (Birnbaum 1996; Page 2001).

The NPS defines four general types of cultural landscapes, not mutually exclusive: historic sites, historic designed landscapes, historic vernacular landscapes, and ethnographic landscapes (Birnbaum 1996; Page 2001).

The solar salt industry fits the description of a historic vernacular landscape: "one whose use, construction, or physical layout reflects endemic traditions, customs, beliefs, or values; expresses cultural values, social behavior, and individual actions over time; is manifested in physical features and materials and their interrelationships, including patterns of spatial organization, land use, circulation, vegetation, structures, and objects (Page 2001). Examples include rural villages, industrial complexes, and agricultural landscapes (Birnbaum 1996).

For the purposes of the National Register, a rural historic landscape is defined as a geographical area that historically has been used by people, or shaped or modified by human activity, occupancy, or intervention, and that possesses a significant concentration, linkage, or continuity of areas of land use, vegetation, buildings and structures, roads and waterways, and natural features. Rural landscapes commonly reflect the day-to-day occupational activities of people engaged in traditional work such as mining, fishing, and various types of agriculture. Often, they have developed and evolved in response to both the forces of nature and the pragmatic need to make a living.

The NPS has developed a list of eleven cultural landscape characteristics to provide a consistent method of recognizing and documenting this resource and each of the elements are addressed for the SBSPRP.

Landscape Characteristics of the South Bay Solar Salt Works

The South Bay salt ponds were created and altered over the past 150 years as the industry grew, technology changed, and transportation shifted from water to land-based routes. The first step to identifying a historic landscape is to compare the extensive salt industry landscape of the SBSPRP with the 11 characteristics defined by the NPS (Birnbaum 1996).

1. *Land Uses and Activities*

Salt marshes and mud flats in South San Francisco Bay were considered nearly worthless until salt production began large-scale alterations of the natural landscape. Initial salt production efforts were limited to naturally occurring shallow ponds and mud flats adjacent to settled areas. Capitalization increased the scale of salt production which quickly outpaced the natural limits of the environment. In order to increase production, the broad flat salt marsh was reclaimed, changing it into salt ponds. Water was controlled by diking areas to create even larger salt ponds. The production capacity of the bay increased dramatically through these efforts.

Levee construction began in the 1850s to restrict and control the flow of tidal bay water into the ponds. The initial levees were hand built and fairly low. Often the levees washed out during storms. After the 1906 earthquake many of the levees were destroyed and were subsequently rebuilt and enlarged to meet engineering standards. During the consolidation of ponds and greater industrialization, levees were built around the large ponds with roads on top of them. The levee structures of the salt ponds have changed through the years, but they are important elements and reflect the land use activities.

The solar salt industry began in the 1850s in the Eden Landing area and expanded around the southern end of San Francisco Bay by the turn of the century. Evidence of the small-scale nineteenth century salt operations in the Eden Landing Unit has been largely overprinted by later industrial development. Features that might leave behind a trace include the salt processing plants, landings, residences, water control structures, pumps, pipes, and piers that were used by the salt industry. The Alviso and Ravenswood units were developed in the twentieth century. A 1953 map of the salt ponds provides the historic boundary of the industry at a peak level of activity and is used in this study as a baseline for the modern pond development footprint (Ver Planck 1958) (Figure 3).

2. *Patterns of Spatial Organization*

The solar salt industry is distinguished by its spatial organization as defined by levees that divide the concentrating ponds. Key components of the solar salt industry organization are the various ponds divided by levees, berms, and dikes and the flow of water through the ponds. The evaporation system depends on a series of ponds to slowly increase the salinity of the water until it reaches the saturated brine or pickle stage. The crystallizing pond is the final step in the evaporation process. The crystallizing pond is managed to a specific gravity by withdrawing bittern and replacing it with fresh pickle until the correct depth of salt deposits is reached (Ver Planck 1958:41).

The arrangement of ponds is defined by levees and berms with water control structures to manipulate the filling and discharge of salt water. “Typically, the concentrating ponds are arranged in a series of about 10. . .Crystallizing ponds are rectangular in shape and have flat bottoms. . .The ratio of concentrating ponds to crystallizing ponds ranges from 15 to 1…In

size they range from 10 acres or less to 50 or 60 acres. . .Evaporation takes place only during the spring, summer, and fall. During the winter the concentrating ponds remain full, and at some plants the crystallizing ponds are left full also" (Ver Planck 1958:41).

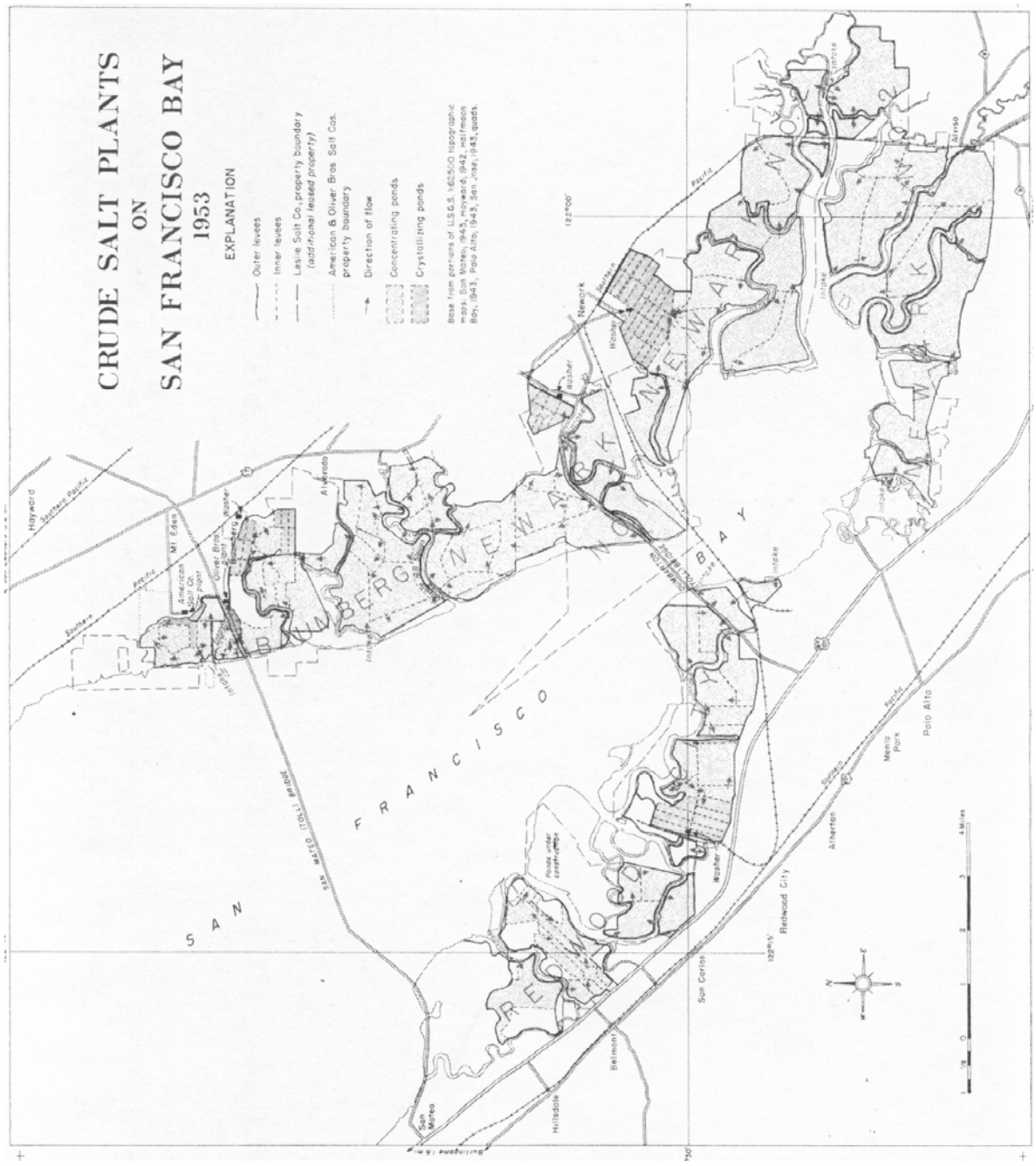

Figure 3. Solar Salt Industry in South San Francisco Bay in 1953 (From Ver Planck 1958:Plate1).

The "outside levees are 40 feet wide at the base, 12 feet wide at the top and 3 ½ feet high. To prevent leakage between the base of the levee and the old surface, the levee is keyed to solid

material by coring. In coring a trench is dug through the grass and peat along the center line of the levee and filled with clean mud. Cross levees, or levees that separate one pond from another, may be slightly lower and usually are not cored" (Ver Planck 1958:46). Other features of the large exterior levee are the borrow pit alongside the exterior of the levee where clean mud is gathered for topping the levee and in some areas sheet metal pilings may be used to keep the levees from eroding (Ver Planck 1958:47).

The spatial structure of the salt works is difficult to comprehend at ground level, but is visually striking from an elevated vantage. The ponds are not only clearly divided by berms, but the color of the water changes as the salinity increases, producing ponds of pink to magenta, and white.

3. *Response to the Natural Environment*

The solar salt industry is dependent on the perfect assemblage of natural environmental features for the production of sea salt. While sea salt may be produced nearly anywhere that salt water is present, the areas where the production can reach an industry-level are few. On the West Coast, only San Francisco Bay and San Diego Bay possess the exact conditions to allow the industry to thrive. In order for the solar salt industry to flourish several natural features need to occur: a protected bay; large expanses of flat, shallow water shoreline; abundant salt water; months of dry, sunny weather; and periods of rain. "The land ideally should be absolutely level and at or close to sea level. Above all, it should be impervious to prevent leakage of brine. Salt marshes most nearly fulfill these conditions" (Ver Planck 1958:14-15, 42). All of the necessary qualities are present in the South San Francisco Bay.

Initially the salt industry simply augmented the naturally occurring conditions, but to achieve greater capacity and purer salt the natural tidal marsh and mud flats were improved by building levees to create a network of evaporation ponds. The twentieth century industrial expansion of the salt industry has largely overprinted the initial nineteenth century salt pond structures.

The ponds vary in size and are shaped, in part, by the existing land forms, such as slough or creek channels and the edge of the mud flat. In most instances the ponds have sinuous edges. The crystallizing ponds are usually smaller than the evaporation ponds and are more likely to be rectangular in shape. Once established the ponds are usually maintained because the cost of building the levees and requirement to create an impervious seal for the bottom of the ponds takes about five years to develop.

Major natural features of the solar salt industry include environmental conditions, available salt water, large parcels of flat land, impervious mud, and fresh water streams and sloughs.

4. Cultural Traditions

The solar salt industry is not clearly associated with a cultural tradition or ethnic group. The earliest, family-owned operations may have had designed buildings that followed an ethnically inspired architecture, but no buildings remain in the project area. This element does not apply to the salt industry landscape.

5. Circulation Networks

The system of water circulation is critical to the solar salt industry. The 1953 map (Refer to Figure 3) of the salt works includes arrows depicting the direction that water was flowing, from intake, through the ponds, to the washer. Ponds are interconnected, moving bay water and brine through the ponds as the salinity is gradually increased. Water control structures, gates, winches, pumps, and Archimedes Screw pumps were all used to move water between the ponds.

"Bay water is taken in through automatic gates that open at high tide and close when the tide drops below the pond level. Where possible the gates are placed in north or northwesterly facing levees to take advantage of the prevailing wind. The intake at some points is by means of pumps" (Ver Planck 1958:47). Concentrating bay water requires passing the brine slowly through a series of ponds, the flow is regulated by gates and pumps, and the salinity level is checked often. The stages of salt production include: "1) bay water reduced to a salinity level of 12.9 Be and reduced the volume to nearly half of that taken in, suspended matter settles, carbonates precipitate begins; 2) evaporation continues until at 25.6 Be, the brine is saturated with respect to salt; 3) by 25.0 Be the brine is transferred to the pickle pond where it is reduced to about ten percent of the volume of bay water taken in" (Ver Planck 1958:47).

Crystallizing ponds are provided with an elaborate system of ditches and pumps for rapid filling and emptying…Pickle flows from the supply ditch to the concentrating ponds, and from thence bittern ditches carry bittern away. Close control is required to prevent, as far as possible, the precipitation of either gypsum or bittern salts in the crystallizing ponds (Ver Planck 1958:51). Brine ditches may be constructed with wood and have the appearance of a flume, except that it looks essentially level. Another conveyance structure is a brine bridge which carries brine across a canal (Ver Planck 1958:63).

"Pickle enters the crystallizing pond at 25.6 Be, and bittern is withdrawn at 29 Be. An effort is made to keep the specific gravity within these limits by continuously drawing off a small amount of bittern. Two to five times during the season, however, it is necessary to empty the ponds and refill them with fresh pickle. As evaporation occurs, tiny seed crystals of salt form on the surface and are supported by surface tension. As their weight increases, they sink deeper…During the season 4 to 6 inches of salt forms, and about 70 percent of the salt in the pickle is extracted…Bittern is withdrawn from the crystallizing ponds to bittern ponds where the specific gravity increases and it is sold to chemical companies" (Ver Planck 1958:51).

Water conveyance is an important element of the landscape of the solar salt works. Sea water is used as the primary material in producing salt. Sea water is transported through headgates into a series of ponds that concentrate the salt water into a brine solution. “Pumping, which cannot be entirely eliminated, required perhaps the first use of machinery in the solar salt industry. Originally all pumps were powered by windmills. The Union Pacific works in 1880 employed a windmill-driven paddle wheel running in an inclined wooden trough to raise brine the necessary few inches between ponds. Another type of windmill pump, built before 1900, may be seen at the American Salt Company plant. Two vertical pistons were driven through a crank and gear system. The more familiar Archimedes screw pumps were used at a later date and have been displaced by gasoline and electric pumps only within the past 25 years” (Ver Planck 1958:113).

Principal features of the circulation system include the intake gates, pump stations, siphons, and Archimedes Screw pumps. All of the pump stations have been converted to electricity. Roads are located on top of the levees to access the water control structures. Only the water control structures that are more than 50 years old are considered to be contributing features.

6. Boundary Demarcations

The solar salt industry rings the southern half of the San Francisco Bay. There are three separate units that are defined by land ownership. The three separate project areas include the same general landscape features, but have unique histories, and are treated as discrete units in this analysis.

The three units are Eden Landing on the east side of the Bay near the San Mateo bridge (Figure 4); the Alviso unit at the southern end of the bay (Figure 5); and the West Bay-Ravenswood unit (Figure 6) located on the west side of the Bay near the Dumbarton Bridge. The Alviso and Ravenswood ponds are managed by the U.S. Fish and Wildlife Service as part of the Don Edwards San Francisco Bay National Wildlife Refuge. The Eden Landing ponds are managed by the California Department of Fish and Game as part as the Eden Landing Ecological Reserve.

7. *Vegetation Related to Land Use*

There is no vegetation related to the solar salt industry landscape.

8. Buildings, Structures, and Objects

The earliest, family-owned operations probably included a processing plant, sheds, and a residence or bunkhouse for workers near the ponds. Landings along the sloughs and streams were used for transporting salt across the bay until the railroad was constructed. There were approximately five landings in the Eden Landing Unit and five or six landings in the Alviso and Ravenswood units (Johnck 2008:89-90). One landing operated by the Oliver Brothers at Eden Landing has been recorded as an archaeological site, but is outside of the project APE. Five salt works, where salt was processed, have been identified within the Eden Landing

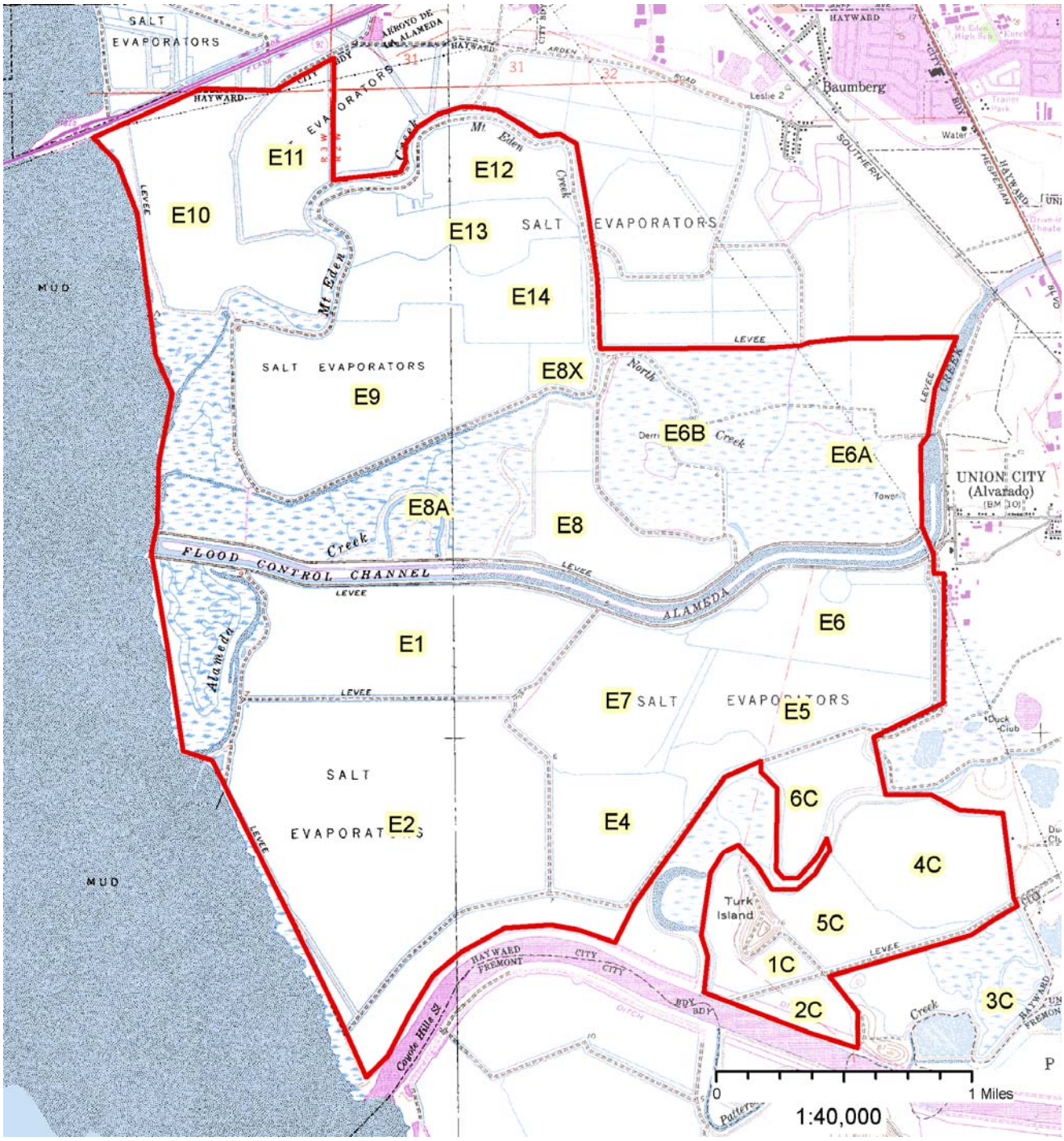

Figure 4. Eden Landing Unit APE and current salt pond configuration.

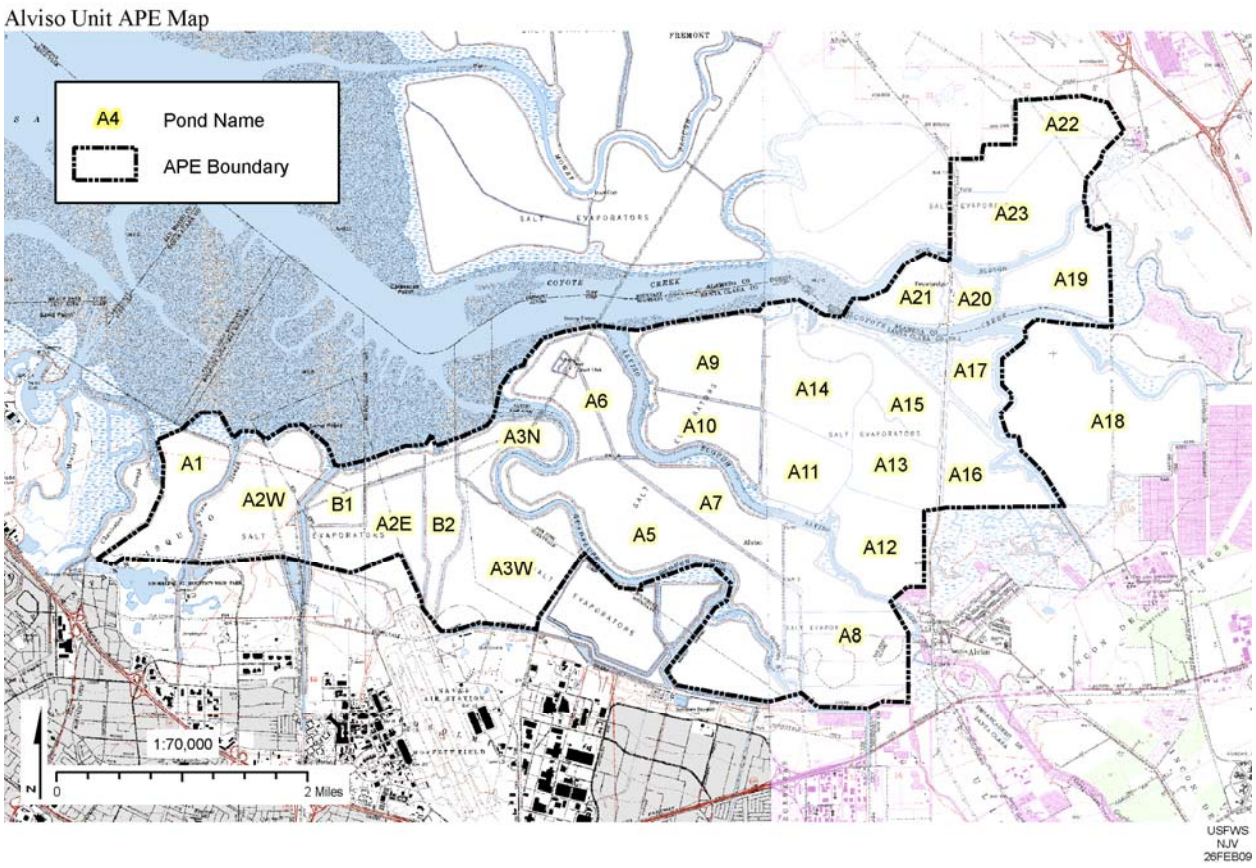

Figure 5. Alviso APE and current salt pond configuration.

Unit, two of which have been determined eligible to the National Register of Historic Places (NRHP). The salt ponds associated with the Union City Alvarado Company were recorded in 2007, but were determined to be ineligible to the NRHP. However, the ponds are included in this landscape study of the Eden Landing Unit.

By the 1940s ponds were operated by large corporations that constructed processing plants outside of the pond units and did not provide housing for the workers. All of the buildings associated with the nineteenth century salt works have been removed. Today, the only buildings and structures within the SBPBRP are the pump stations and water control structures that are regularly replaced and none of which are more than 50 years old.

South Bay Salt Pond Restoration Project

Ravenswood Unit APE Map

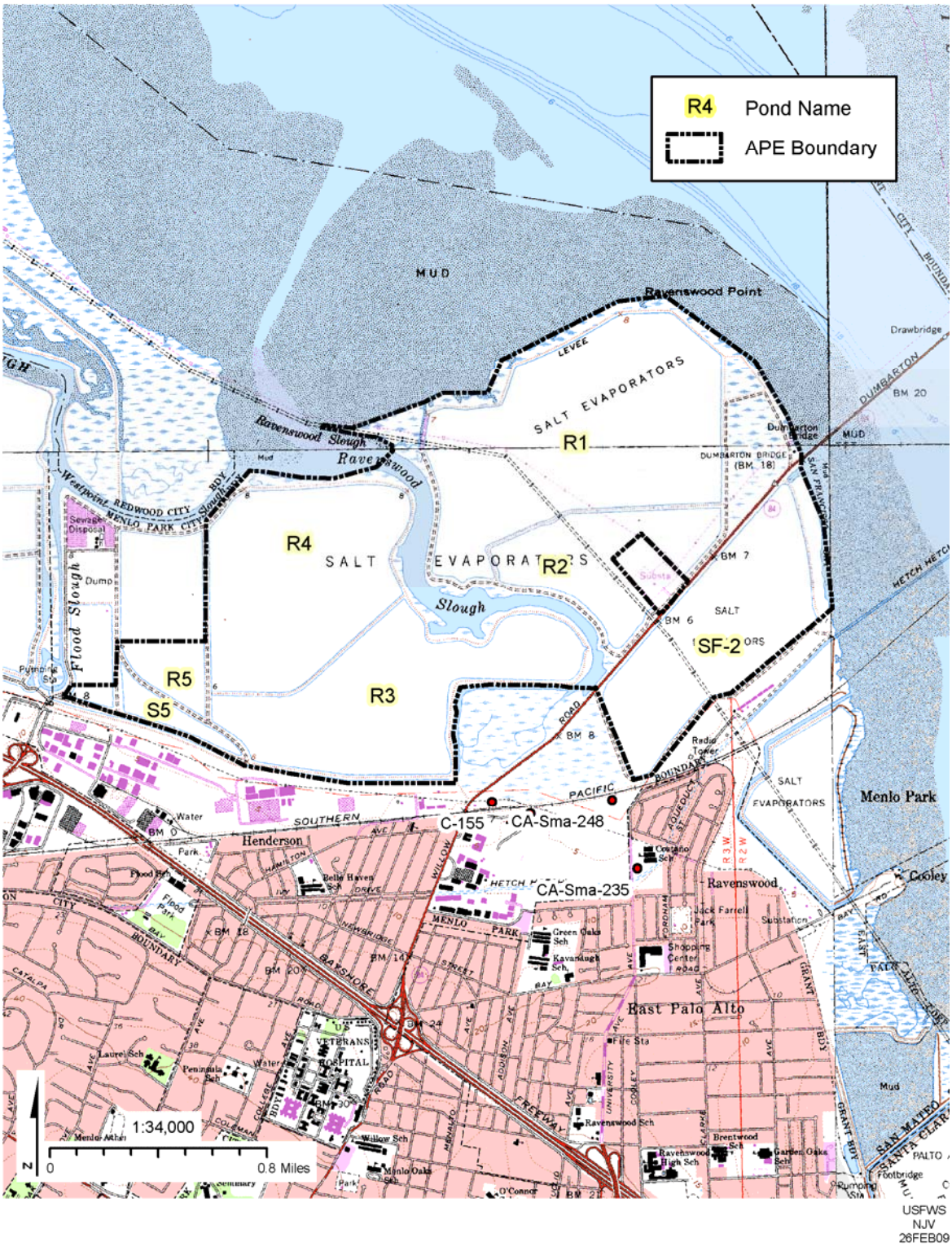

Figure 6. West Bay-Ravenswood APE and current salt pond configuration.

9. Clusters

The solar salt industry's cluster arrangement is associated with the refining processes. Initially, salt processing required only simple storage sheds near the crystallization pond. The salt was harvested by collecting it into rows or small piles. The salt was allowed to cure for about a year and to be cleaned by the seasonal rains. "Technological advances in the processing of salt improved when machinery was developed to wash the salt with brine, followed by fresh water sprays. The salt is always stacked in the open to dry" (Ver Planck 1958:42). In 1917 both the Union Pacific Salt Company and the Oliver Salt Company prepared some salt in rotary steam heated driers" (Ver Planck 1958:114). The salt was then either sold as crude salt or processed (ground) and screened for commercial purposes and packaged for shipment. A shipping wharf or rail line was located near the processing plant. The early salt processing plants are represented only by archaeological features in the form of dissolving tanks, brine treatment tanks, pipelines, brick and concrete foundations, pilings, and artifact scatters. All of the above ground buildings and equipment have been removed.

By the 1900s salt production had increased substantially and the piles of salt grew too large to store near the ponds. Processing plants were constructed in centralized locations away from the ponds and transportation changed to land-based trucks and trains. About 1910 the California Salt Company built a refinery near Alvarado. An affiliate of the Stauffer Chemical Company operated a refinery in San Francisco from the pre-World War I period into the 1920s. The San Mateo refinery operated until 1941, when the Leslie Salt Co. replaced it with a plant at Newark. Also at Newark was the Morton Salt Company's refinery, built in 1926 (Ver Planck 1958:83).

Refining salt requires a fairly large area to accomplish the various steps. Two types of refined salt are produced today. One is semi-refined or kiln dried salt with a sodium chloride content of about 99.8 percent. It is a moisture free, sterile product produced by heating rewashed crude undried salt in a kiln. The second general type is refined by the re-crystallization of a chemically treated brine prepared by dissolving crude salt in fresh water. The re-crystallization is usually done in vacuum pans, and the product is called vacuum salt. With a sodium chloride content of 99.95 percent or more, vacuum salt is the purest type commercially available. Not only is it possible with the vacuum pan to produce salt of high purity, but the particle shape and size can be controlled as well. The grains of vacuum salt are nearly perfect cubes. Some salt is re-crystallized in a type of open pan called a grainer"(Ver Planck 1958:83).

Property types associated with salt refining include the large piles of crude salt which is washed and allowed to weather for about a year along with the drying sheds, washers, buildings for boilers, dryers, and grinders. Salt from the stack is then used to supply the processing machinery. "In the vacuum process, brine is prepared by dissolving crude salt in fresh water and treating it chemically to remove some impurities. The treated brine is then evaporated by boiling with steam in a closed vessel called a pan. Salt of high purity

continuously crystallizes and falls to the bottom, leaving most of the remaining impurities in the mother liquor. The vapor pressure creates the vacuum" (Ver Planck 1958:85).

Kiln-dried salt begins with crude salt that is "first rewashed with treated brine. The washer consists of a drag-classifier with a perforated bottom section to allow drainage. Wash brine overflows and is recirculated. After several days of draining, the rewashed salt passes through a rotary hot air drier. The fuel is natural gas or butane. Traces of organic matter are charred by the firing and the moisture content is reduced to a few hundredths of a percent. After passing through a rotary cooler, the salt is processed into several sizes with hummer screens and roll crushers. Then the various sizes of salt are automatically weighed into paper or cloth bags" (Ver Planck 1958:85).

Steam boilers and evaporation tanks are used in processing salt. Pipes transport brine and condensed salt product. The equipment used in the salt industry is commonly made of wood, stainless steel, or copper. Maintenance and cleaning are imperative to keep metal from rusting from the corrosive elements. In the earlier plants, wood vats were used along with wood troughs or pipes. Metal vats, boilers, evaporation pans, and pipes deteriorated quickly after the plants were closed. Brick and concrete foundations were used to support the boilers, furnaces, and equipment.

All of the salt processing plants currently operating are outside of the SBSPRP.

10. Archaeological Sites

Archaeological remains related to the salt industry have been noted in the Eden Landing unit and are related to landings, early processing plants, and the residences of workers. However, most of the Alviso and Ravenswood ponds were created during the twentieth century industrialization, so the potential for archaeological sites related to landings, salt processing plants, or residences is very low.

Native American sites unrelated to salt collection may be found along the slough channels and what would have been the bay-front prior to industrial expansion.

11. Small-Scale Elements

Although not officially part of the solar salt industry landscape, the serendipitous attraction of waterfowl to the large salt ponds created a secondary use of the ponds for sport hunting. Private hunt clubs were popular in the early nineteenth century and the club members leased land or paid a fee to the salt company for the proprietary right to hunt on the property. The clubs built hunting blinds and even clubhouses within the salt pond landscape. "Blinds and small shanties were also rented to city duck club members and provided a fairly substantial income for very little effort or expense" (Sandoval 1988:194). Most of the small-scale features related to duck hunting have been removed, have deteriorated, or are recently constructed.

Not all of the 11 landscape characteristics are applicable to the solar salt pond landscape. Cultural traditions, vegetation, and buildings related to land use activities are topics that are not represented in the salt pond landscape. Each of the three pond units is compared with the applicable landscape characteristics and evaluated for significance and integrity (Table 1).

Table 1. Landscape Characteristics by Salt Pond Unit.

Landscape Characteristics	Ravenswood	Alviso	Eden Landing
1) *Land uses and Activities*	Exterior levee, salt ponds	Exterior levee, salt ponds	Exterior levee, salt ponds
2) *Patterns of Spatial Organization*	Concentrating ponds, levees, canal, water-control structures.	Concentrating ponds, levees, water-control structures.	Concentrating ponds, levees, water-control structures. Remains of Oliver Salt Works and Union Pacific Salt Works
3) *Response to the Natural Environment*	Flood control projects, sloughs, creeks, mud flats, salt marsh	Sloughs, creeks, local drainage channel, flood control, mud flats, salt marsh	Flood control projects, local drainage channel, creeks, mud flats, salt marsh
4) *Cultural Traditions*	N/A	N/A	N/A
5) *Circulation Networks*	1953 map	1953 map	1953 map
6) *Boundary Demarcations*	USFWS	USFWS	CA DF&G
7) *Vegetation Related to Land Use*	N/A	N/A	N/A
8) *Buildings and structures*	Pump station, water control structures	Pump station, water control structures	Pump station, water control structures
9) *Clusters*	Not within APE	Not within APE	Not within APE; except for archaeological evidence of historic salt works

Landscape Characteristics	Ravenswood	Alviso	Eden Landing
10) *Archaeological sites*	None	Yes, 4 Drawbridge; bridge; prehistoric; ship building facility	Yes, 18 including salt industry related and prehistoric
11) *Small-scale Elements*	None	Hunting club, blinds	Hunting blinds

Cultural landscapes are listed in the NRHP as sites or historic districts. To qualify for listing in the National Register, landscapes must meet one or more of the criteria presented in 36 CFR 60. A landscape may be significant at the local, state, or national level. An historic context statement provides background information for defining the history and temporal parameters within a particular geographic area. A historic context for the solar salt industry was prepared by EDAW. Equally important is an assessment of a landscape's integrity. The assessment of integrity requires an analysis of the: location, design, setting, material, workmanship, feeling, and association. A landscape must have both significance and integrity to be considered eligible for the NRHP.

Evaluation Criteria for the South Bay Solar Salt Industry Landscape

The San Francisco Bay solar salt industry landscape is massive in scale, superimposed over the southern half of the bay, with a nearly continuous patchwork of salt ponds. Starting on the east side of the San Mateo Bridge, the Eden Landing Unit extends south to the Coyote Hills Slough. South of Coyote Hills Slough are the Newark Ponds, which continue south to Coyote Creek/Mud Slough. The Newark Ponds will remain in private ownership and are not included in this project. The Alviso Unit begins at the boundary with the Newark Ponds to the north, extending south and west to Charleston Slough. The West Side-Ravenswood Unit begins on the south side of the Dumbarton Bridge and continues north, to the Bay Front Park.

The SBSPRP project includes only a fraction of the entire solar salt industry landscape, with more than half of the total acres still committed to salt production by the Cargill Salt Company (Figure 7). Because the three units are noncontiguous, each of the units will be discussed as individual historic landscapes. Evaluation of each unit is based on the landscape characteristics, salt industry historic context, and integrity values. An analysis of each of the salt pond units included a pedestrian survey and reviewing historic maps, aerial photographs, and historic drawings. Then the current circulation patterns, locations of water control structures, pond sizes, and pond shapes were compared with the historic period references. Several variables were identified as particularly important to the salt industry landscape, including: 1) land use activities represented; 2) patterns of spatial organization; 3) response to the natural environment; 4) circulation networks; 5) the integrity of design; and 6) special considerations.

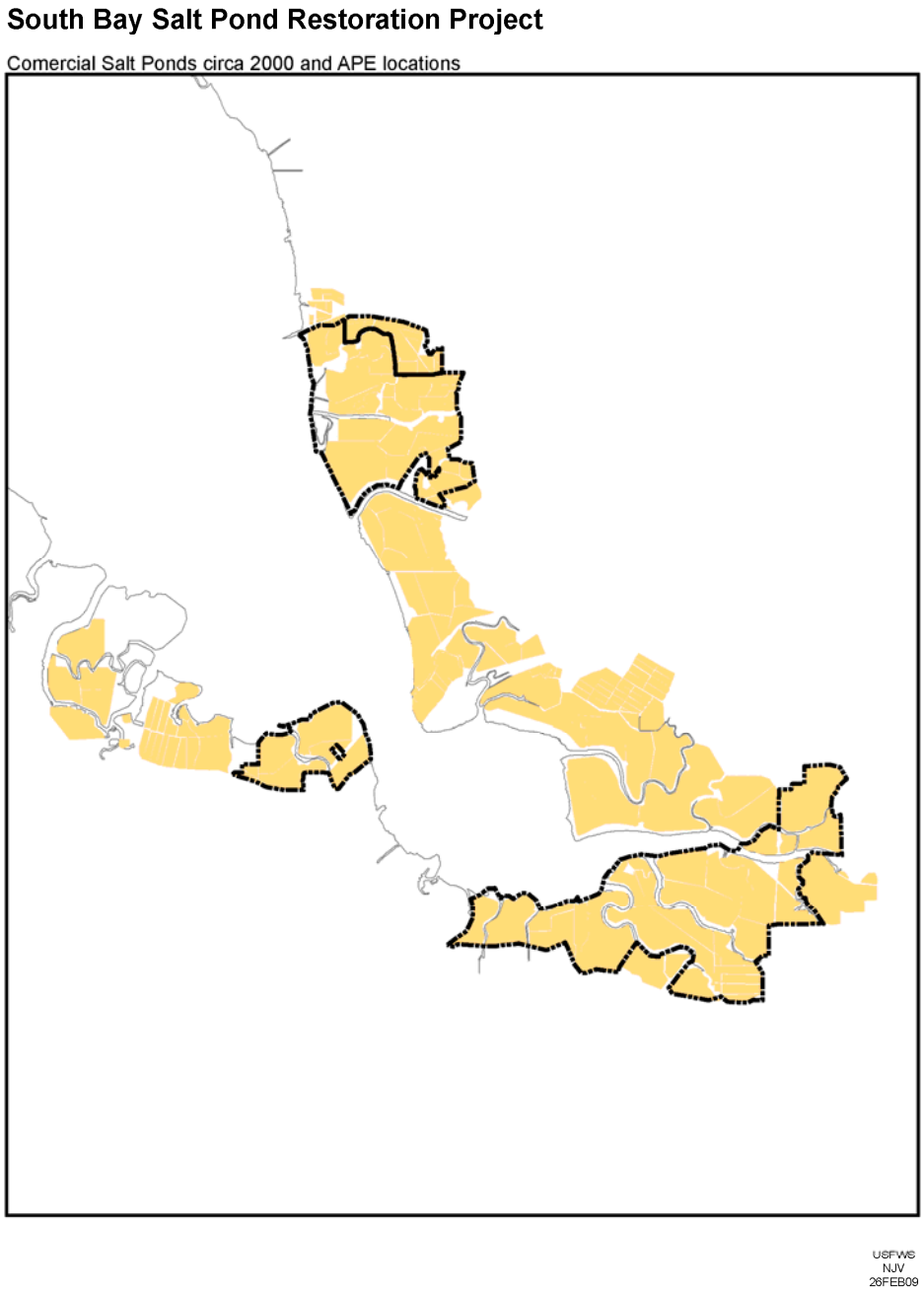

Figure 7. Salt Pond distribution as of 2000 and SBSP project footprint.

Land Uses and Activities: There are three main time periods that are important for evaluating the South Bay solar salt industrial development: 1850s-1900; 1901-1953; and post-1953.

Prior to the 1850s salt was collected, but no alteration of the landscape was necessary. There is no evidence of the pre-1850 period of salt collection represented within the SBSPRP.

The 1850s-1900 was the period of initial growth and development of the salt industry, especially after the discovery of silver in the Comstock Lode that required salt for processing the ore. With demand for salt dramatically increasing, small-scale salt farms sprang up on the east side of the bay. Improvements in shipping and transportation also facilitated the movement of commercial products such as salt. This salt production landscape is associated with small-scale, family-owned operations of less than 50 acres in size with residences, processing plants, and landings all located near the ponds.

Between 1901 and 1953 the salt production landscape shifted as the industrial scale of the solar salt works expanded. The 20 or so small operators were consolidated into just a handful of salt producing companies. The small ponds were altered to create larger ponds with higher dikes and levees. A 1953 map provides a reference point for the development of the salt works during this phase.

Between 1954 and the present modifications have occurred as the industry continues to change. Industry-wide adjustments include decreasing the amount of salt produced and consolidating the processing plants. With less salt needed to meet the demands, some of the evaporation ponds have been abandoned. Ponds not required for production were transferred for inclusion in the Don Edwards San Francisco Bay National Wildlife Refuge and Eden Landing Ecological Reserve.

Features or ponds relating to the 1850-1900 period are important and have a high value for interpreting the industry's beginnings. The second period, 1901-1953, is associated with the shift to a large industrial complex. Pond features built during the second period reflect the zenith of expansion of the salt production landscape. The 1953 to present period represents an industry that is waning, as noted by decreasing production and abandoned ponds.

Patterns of Spatial Organization: Each of the pond complexes were originally designed to include large evaporation ponds, smaller brine ponds and crystallizing ponds along with water conveyance systems, pump stations, levees, dikes, a processing plant, and shipping location.

The presence or absence of these elements was reviewed to determine the integrity of the landscape. If the district is missing elements or a portion of the process then the integrity is diminished, and if it is completely isolated from the production system, processing, or transportation then the integrity is critically compromised.

Response to the Natural Environment: Major natural features of the solar salt industry include environmental conditions, available salt water, large parcels of flat land, impervious mud, and fresh water streams and sloughs. The ponds are shaped, in part, by the existing land forms, such as slough or creek channels and the edge of the mud flat. In most instances the ponds have

sinuous edges and vary in size. The crystallizing ponds are usually smaller than the evaporation ponds and are more likely to be rectangular in shape. It takes about five years to develop an impervious seal for the bottom of the ponds.

The ponds that follow the slough channels with sinuous levees offer the greatest representation of the industry utilizing natural features. Fresh water streams and sloughs that cross through the salt ponds without being altered reflect a landscape that is tied to the environmental conditions. A landscape which utilizes straight lines, channelized streams, and pipes or siphons to move water reflects the modern industry's requirements and alteration of the natural conditions. The amount of natural environmental alterations is an integrity component; the least amount of alteration is defined as having good integrity while a higher amount of modifications is defined as poor integrity.

Circulation Networks: The flow of water through the ponds is an important element to the salt production process and includes water control structures, pump stations, siphons, canals, brine troughs, and interior pond divisions. The 1953 map includes the flow of water through the ponds, this graphic will be compared to each of the units to determine the continuity of the circulation patterns.

Pond circulation patterns provide a clear link to the 1950s flow regime. The Archimedes screw pumps near the Oliver Salt Works archaeological site are a good example of an early method of moving water between small ponds, even if they are no longer operational. Evidence of the early period small pond circulation pattern is an important element of the salt industry landscape. The circulation pattern exhibited in the 1950s should include the locations for intake gates, water-control structures, pump houses, siphons, and pipes to be considered as having good integrity. If the water control structures have been moved, modified, or abandoned then the landscape does not function in its historic capacity and the integrity of the circulation network is compromised.

Archaeological Sites: Archaeological evidence relating to the early salt manufacturing companies and processing plants has been identified in the Eden Landing Unit. The archaeological sites have been documented, many have been evaluated, and sites within the SBSPRP APE were reviewed for this study.

Small-Scale Elements: The small-scale elements within the solar salt industry landscape include the secondary activity of hunting. Duck hunting blinds, small docks, and hunting clubs are represented in each of the units. In order to be considered as a contributing element the feature must be at least 50 years old.

South Bay Solar Salt Pond Evaluations

Eden Landing Unit: (Alameda) (6612 acres)

The Eden Landing Salt Pond District encompasses 23 ponds along with 19 ponds that have been returned to salt marsh in 2006 as part of the Eden Landing Ecological Reserve (Refer to Figure 4). The district is drained by Mt. Eden, North, and Old Alameda creeks, the Alameda Federal Flood Control Channel marks the southern boundary of the district. To the south the project area are the Newark ponds operated by Cargill Salt along with their crude salt processing plant. The Cargill property is outside the project area.

Historical Setting: The solar salt industry really began in the Eden Landing area when John Johnson built levees to contain salt water in 1853. “There was, and probably is, a wide strip of land on the eastern side of the bay, in places two, and even three, miles wide. Without the works of man it would have been under water at high tide, and a mud flat at low tide. It had, however, been transformed into basins, or fields, several acres in extent, by the erection of mud dikes about two feet high. Each field, at some point of its perimeter, was adjacent to a canal containing sea water. At high tide the dike could be opened, thus flooding the field with sea water…That field of sea water then became the foundation of the next winter’s crop of salt” (Saunders 1973:69).

According to Ver Planck, roughly 28 different salt works were located within this unit between 1850 and 1910. Due to the large number of small operations, the area was divided into groupings of ponds over 30-50 acres. One of the largest salt operations was the Union Pacific Salt Company which “was in continuous production from 1872 to 1927. Union Pacific Salt Co. was the first to organize and consolidate the operations of individual salt families. It began leasing small neighboring ponds and drying sheds and guaranteeing the small producers a fixed price per ton, negotiated each year. By 1895 it was the largest producer and manufacturer of bay salt” (Sandoval 1988:152). In 1882 the plant, which represented an investment of $100,000 and employed 80 men, occupied 1200 acres of marsh land near the mouths of Alameda Creek and Mount Eden Slough, formerly called Union City Slough. The marsh land was divided by levees into five concentrating ponds of from 100 to 300 acres. Bay water was admitted at the highest tides through fifteen 12-foot hand-operated gates. Pickle (brine water) was transferred to a large number of crystallizing ponds six to eight acres in size. Many of the crystallizing ponds were floored with boards, and for preparing table salt the cleanest pickle available was evaporated in elevated wooden pans. After the bittern had been drained from the crystallizing ponds, the salt was ready for harvest (Ver Planck 1958:108).

“To harvest a field, we opened a dike and drained the brine into the adjacent field, where it became the start of the next winter’s crop in that field. Then we laid a narrow gauge railroad on the exposed salt crust. The track was made up in sections, all we had to do was drag them into place and hook them together. A little gasoline powered locomotive pushed little cars onto it, and we shoveled the salt into the cars. About a ton to the car. The locomotive then hauled it to the mill for washing and grinding. Enough salt went into the mill each day to keep it running. The balance we piled in great out-door piles” (Saunders 1973:70).

“The harvesting of this salt was our job. I worked at it from November 18, 1913, to January 14, 1914. There were about twenty of us in that crew. We were paid two dollars for a ten hour day, and worked six days a week. We slept in a bunk house, washed our clothes on Sunday, and the company deducted sixty cents a day from our pay for our board” (Saunders 1973:69).

“There were two or three times as many Japanese working there, but we had no contact with them. They never worked in the same field with us. They had their own quarters and prepared their own food. They were paid by the ton for the salt they harvested. Really they were paid by the cubic foot…They stacked their salt in neat, geometric piles, so that accurate measurement could be made of it” (Saunders 1973:69).

"The Oliver Salt Company was not the only producer of salt in that area. Those tent-piles, and those four bladed windmills, were the main features of the landscape for as far as the eye could see, in all directions" (Saunders 1973:69) (Figure 8).

Figure 8. Overview of salt harvest operation at Oliver Salt Works, ca. 1910s (Courtesy Hayward Historical Society, Neg #79.033.4939b).

The Oliver Salt Company was among the few nineteenth century salt producers that continued operation in to the 1920s. "The company was founded by Andrew Oliver…He came to California in about 1854, and in 1872, after a period spent at mining and farming, purchased 120 acres of salt land near Mount Eden. Here he settled and brought his family" (Ver Planck 1958:110). After Andrew's death his wife directed her son's in the operation of the business, Adolph Oliver became the general manager with help from his three younger brothers. "In 1909 the E.A. Oliver Salt Company included in addition to the original holdings the neighboring Mount Eden Salt Works of H. L. Petermann, the Rock Springs Salt Works of Mrs. Mary Nielsen (Peter Michelson), the L.N. Whisby Works, and the Ohlsen and Cox Works. By 1915 the Oliver property included in addition the Occidental Salt Works of J.W. Sinclair, the Paradise Salt Works of F. Lund, and salt land that had belonged to the Liguori family. About 1920 the Commercial Salt Company of James Baumberger was absorbed. All were small salt works that dated from the pre-1900 period" (Ver Planck 1958:110). In 1919 the Arden Salt Company was formed by A. Schilling in the Alviso area. And in "1927 Arden Salt Company purchased the Union Pacific Salt Company and its 1880s plant. No improvements to the plant were made and the operation was closed in 1929. The wood-floored crystallizing ponds were in use up to the 1920s" (Sandoval 1988:162).

In September 1927 the Oliver Salt Company purchased the Pioneer Salt Works of B. F. Barton that had been in operation at least as early as 1885. This plant, near the mouth of Alameda Creek, was originally known as the Solar Salt Works; and it was not until some years after Barton's death that the name Pioneer Salt Works was used" (Ver Planck 1958:110).

"The Leslie-California Salt Company leased the Oliver Salt works late in 1927 and purchased the property in 1931. The Company was now able to consolidate its widely scattered operations…including the greater part of the land occupied by the 19th century salt works" (Ver Planck 1958:110). "The Union Pacific Salt Company's plant with 1200 acres and an annual production of around 10,000 tons was considered large in 1880. Today the Baumberg plant of the Leslie Salt Co., into which most of the 19th century plants have been merged, contains over 4500 acres and has a design capacity of 180,000 tons a year…Crystallizing ponds of one acre were common before mechanization, and few were as large as 10 acres. By the mid-1930s 15 acres was considered to be the maximum practical size where hand shoveling was practiced, or, if loading machines were used, 30 acres. Some of the crystallizing ponds of the new Redwood City plant are over 50 acres in size" (Ver Planck 1958:114). The larger sized operations completely overshadow the earlier production companies to the point where an entire nineteenth century-sized salt plant could be contained within a single evaporation pond of the modern companies.

The period from 1910 through the later 1920s represents a major consolidation of the industry from 28 operators to only four or five operators; this was further reduced in the 1930s and 1940s as Leslie became the only major operator (EDAW 2005:14).

Survey Results: Eleven cultural resources have been recorded within the Eden Landing Salt Pond District, all of which are related to the historic period of salt manufacturing. Four sites have been determined eligible, five sites have been determined ineligible, and one site is unevaluated (Table 1). And, one architectural resource, the Archimedes Screw Windmills, were determined ineligible (Krase 2001), however, the USFWS does not concur with that determination and is recommending that the Archimedes Screw Windmills be included within the Oliver Salt Works archaeological site, CA-ALA-494H, as a contributing element of the historic landscape. "The Archimedes screw pumps originally designed and built by Andrew Oliver in the 1870s were the longest surviving wind-powered pumps and were used until electric pumps came into general use beginning early in the twentieth century" (American Society of Mechanical Engineers 1984:n.p.). The original pump had 20-foot diameter fan blades turning a 22-foot long redwood shaft. . . The Archimedes screw pump consists of a continuous spiral chamber formed around an inclined enclosed redwood shaft which raises the water as the shaft is rotated by the four-bladed wooden windmill. With full sail and a wind of 25 miles per hour, the pump, turning at 60 rpm, will raise 1,500 to 2,000 gallons of water per minute " (American Society of Mechanical Engineers 1984:n.p.). The Archimedes Wind-Powered Screw Pumps was nominated as a Regional Historic Mechanical Engineering Landmark.

Remnants of the Union Pacific Salt Works (CA-ALA-496H), have been determined eligible (Baxter and Allen 2001), but are largely over-grown with vegetation. The ponds in this area have been returned to a more natural tidal flow and the vegetation has rebounded.

Recordation of the Union City Alvarado Salt Ponds (P-01-010834) was recently completed (Shoup and Baker, 2007). The features associated with the salt ponds include levees, board retaining walls, and a water control gate. As noted by the authors, "The historic cultural landscape, represented by the salt ponds/levees and related features that were recorded during this survey, does not have enough historic authenticity or enough integrity to be able to convey its importance during the period of significance (1862-1896)" (Shoup and Baker 2007:5). The landscape was determined to be ineligible to the NRHP because the levees and ponds were built between 1924 and 1931 and the flood control levees were constructed between 1955 and 1959. They included the caveat that "If, in the future, the overall Alameda County Leslie Salt Company operations are evaluated as an historic landscape, it is conceivable that some of the levees/ponds discussed here may be considered contributing elements" (Shoup and Baker 2007:5). The USFWS agrees with this assessment and is including the Union City Alvarado Salt Ponds within the Eden Landing Unit salt pond landscape evaluation.

Additionally, one archaeological site (FWS-07-12-1) with a domestic scatter, railroad ties, and a boardwalk was recorded by the USFWS during a survey in December 2007. The site is in the vicinity of the J. Quigley Alvarado Salt Works operated by John Quigley, "who built a salt works near Barron's Landing in the vicinity of Alvarado in 1862 and was the first to improve the quality of the natural salt. The Quigley works was an independent operation until 1909" (Ver Planck 1958:107). After 1909 the salt works were absorbed during the consolidation of the salt works companies. Not much is known about Quigley, he was apparently not very active in the community of Alvarado or Eden Landing because his family history does not appear in the Ver Planck or Sandoval references. Ceramic tableware fragments, rice bowls Japanese characters, and glass food container fragments were observed at site FWS-07-12-1. As noted by Ver Planck, "For lifting the salt, hand shoveling was the only method until after World War I, and commonly Japanese and Chinese contract labor was employed…The Leslie Salt Co. abandoned hand shoveling after 1940 when the Alvarado plant was closed" (Ver Planck 1958:113). It is possible that site FWS-07-12-1 is associated with a short-term camp inhabited by the Japanese or Chinese contract laborers working at the Alvarado Salt Works. The site is located within the Union City Alvarado Salt Ponds (P-01-010834) recorded by Shoup and Baker (see above).

Table 2. Recorded cultural resources within the Eden Landing Salt Pond District.

Trinomial Site No.	Primary Site No.	P/H	Eligibility	Description
CA-ALA-489H, -501H	P-01-000217	H	E	Eden Landing historic shipping station (warehouses, wharves, associated developments)
CA-ALA-494H	P-01-000210	H	E	Oliver Salt Co. piling and foundations
-	P-01-010740	H	NE	Archimedes Screw Windmills
CA-ALA-495H	P-01-000211	H	NE	Location of former Rocky Point Saltworks (pre-1898, absorbed by Oliver Salt Company by 1909); no surface remains
CA-ALA-496H	P-01-000212	H	E	Pilings and foundation of former Union Pacific Salt (ca. 1872-1927)

CA-ALA-497H	-	H	NE	Peterman's Salt Works (no surface indications)
CA-ALA-498H	P-01-214	H	NE	Salt works, not relocated in 2001
CA-ALA-499H	P-01-215	H	NE	Modern refuse scatter
-	PF-1	H	E	Whisby Salt Works refuse scatter
-	P-01-010834	H	NE	Union City Alvarado Salt Ponds
-	FWS-07-12-1	H	Uneval	J. Quigely Alvarado Salt Works, domestic refuse scatter

Landscape Characteristics: The Eden Landing area reflects the dynamic evolution of the solar salt industry in the South San Francisco Bay. Beginning in the 1850s salt was produced when small ponds were created on the naturally occurring flat, tidal salt marsh lands. The industry developed until the Eden Landing area was filled with small ponds, family owned processing plants, and a few residential bunkhouses for the workers. The zenith of this early period was probably reached in the 1910s. In the 1920s and 1930s salt works were consolidated and the industry shifted to fewer operators overseeing large evaporation ponds.

Historical maps were used to delineate the small, family-owned ponds created in the nineteenth century in Eden Landing. The early pond structure was compared with the 1953 map and the location of water control structures were plotted on the current USGS quad map. The analysis revealed that the most recent development has destroyed much of the earlier salt landscape and changed many of the water control points. Today, the landscape primarily reflects the 1954 to present pond structure. Water control structures that are common to all salt pond periods are limited to a few of the intakes and exterior dike crossing locations. And, it appears that all of the water control structures have been replaced with modern facilities. The strongest association with the early period is represented by archaeological sites related to the processing plants and a few of the pond shapes that retain the general shape of the initial ponds.

Statement of Eligibility: The Eden Landing Unit encompasses some of the earliest salt ponds that were developed for salt production from the naturally suitable tidal salt marsh lands. Remnant features of the salt works of the Oliver family, the Barton family's Union Pacific Salt Works, and J. Quigley's Alvarado Salt Works are represented by archaeological sites that are determined to be eligible. Overprinting by the modern evolution of the solar salt industry has altered the nineteenth century landscape, raising levees, combining small ponds into much larger evaporation ponds, and changing the flow of water. The levees, water control structures, intakes, and pump stations have all been altered over the years to accommodate the increased production capacity. Yet, the distinctive pond landscape and remnant features reflect the evolving solar salt production industry.

Integrity, Changes, and Threats: The Eden Landing area salt farms were over-printed in the twentieth century when small-scale operators were bought-out and ponds were consolidated. Remnants of several ponds, two processing plants, and a habitation site are still visible on the landscape as archaeological sites. The integrity of the pre-1950 Eden Landing Unit salt pond landscape is compromised by the later twentieth century industrialization, yet remnants of the nineteenth century landscape are present and are important to preserve.

Recommendations: The Eden Landing Unit meets eligibility criteria A and D as defined by the National Register of Historic Places (NRHP) as a historic landscape. The integrity of the district is diminished by over-printing and removal of the processing plants, residences, landings, and small-scale features. Yet, the overall Eden Landing Salt Pond Historic Landscape provides an opportunity to interpret the evolution of the solar salt industry.

Distinctive features of the Eden Landing Salt Pond Historic Landscape are reflected by the pattern of spatial organization, circulation networks, and adapting the natural environmental conditions. Creation of the solar salt manufacturing landscape required building levees, harnessing the tidal surge, and transporting water among the ponds. The landscape characteristics are conveyed by the levees, water flow system, and sinuous boundary of the salt ponds along the Mt Eden Creek and other natural slough channels. Character defining elements of the historic landscape are the perimeter levees, interior pond divisions, archaeological sites associated with the family-owned processing plants and landings, and the Archimedes screw pumps (Figures 9-14). Non-contributing elements include the modern water-control structures, pump stations, and hunting blinds (Figures 15-16).

The boundaries of the Eden Landing Salt Pond Historic Landscape are established by legal ownership and natural features. The area is managed by the California Department of Fish and Game as the Eden Landing Ecological Reserve (refer to Figure 4).

Figure 9. Overview of Eden Landing Salt Pond District, view to N (2007-12-01:55).

Figure 10. Historic view of Oliver Salt Works plant (Courtesy of the Hayward Historical Society, #790334924-2).

Figure 11. Remnants of the Oliver Salt Works (CA-ALA-494H), view to W (2007-12-01:22).

Figure 12. Archimedes screw pumps at Oliver Salt Works, view to W (2007-12-01:60). Note hunting blind in background.

Figure 13. Union Pacific Salt Works, brick furnace, view to N (2007-12-01:74).

Figure 14. Overview of site FWS 07-12-01 (FWS 2007-12-01:109).

Figure 15. Water control structure, pump station, and powerline, all are non-contributing elements (2007-12-01:82).

Figure 16. Hunting blind, non-contributing element (2007-12-01:62).

Alviso Unit: (Alameda and Santa Clara) (9677 acres)
The Alviso Unit encompasses 28 ponds (refer to Figure 5). The complex is drained, from east to west, by Mud Slough, Coyote Creek, Alviso Slough, Guadalupe Slough, Stevens Creek, Mtn View Creek, and Charleston Slough.

Historical Setting: The railway (SPCRR) line was built through the Alviso unit in the late 1870s, triggering the development of the town of Drawbridge. Drawbridge initially was a railroad construction crew's camp, which grew into a loosely organized community of seasonally occupied cabins for duck hunters and Victorian weekend-tourists. During Prohibition (1920-1933) the settlement became well-known for gambling and bootleg alcohol opportunities. By the 1940s residential use declined as the island began to subside (Morrow 1984:7). The Alviso area was popular primarily for duck hunting, fishing, and boating until the 1920s.

Between the 1890s and 1910s several attempts to reclaim lands for solar salt production failed when the levees washed away. Only two salt companies are associated with the Alviso unit: the Alviso Salt Company (associated with Continental Salt and Chemical Company), which operated on the land between Alviso and Mayfield Slough, and Schilling's Arden Salt Company, operating on lands from Alviso east and north up toward Dumbarton Point. Both companies appear to have built levees, developed salt ponds, and harvested salt from these lands during the 1920s. Arden acquired Alviso Salt in 1929, including its plant near the town of Alviso. Leslie Salt became the sole operator in the unit after 1936, until Cargill's acquisition in 1978 (EDAW 2005:14).

Survey Results: The Alviso Salt Pond District was surveyed by USFWS archaeologists in 2006 and 2007. The levees were walked and water conveyance structures were mapped with a GPS point, photographed, and described (Figures 17-18). The exterior levee and primary levees along the sloughs are mostly intact. Additionally, six segments, totaling 14.6 linear miles, of the south bay shoreline was surveyed in 2008 by Basin Research Associates, Inc. for the U.S. Army Corps of Engineers (USACE). The survey results included discovery of "52 resources with 22-23 appearing to be 50 years of age or older. The majority of the resources appear to have severe integrity issues especially for items and objects associated with flood control, recreation, and salt production" (Busby 2008:85). The shoreline survey encompasses areas that are outside of the SBSPRP APE, such as Moffett Field and the Rengstorff House and park. The shoreline survey documented pump stations, flood gates, bridges, wooden pier structures, hunting blinds, and culverts. Only two sites within the Alviso Salt Pond District are recommended for treatment as eligible properties, the town of Drawbridge (P-01-003291) and site CA-ALA-338 (P-01-002057) (Table 3).

Two archaeological sites, one townsite, and a bridge have been recorded within the Alviso unit, none of which are related to salt production (Table 3).

Figure 17. Overview of Alviso salt ponds and salt marsh, to NW (2007-03-04:37).

Figure 18. Overview of Alviso salt ponds, Newark Plant salt stack in distance, to N (2007-03-04:42).

Table 3. Recorded cultural resources within the Alviso Salt Pond District.

Trinomial Site No.	Primary Site No.	P/H	Eligibility	Description
CA-ALA-338	P-01-002057	P	Unevaluated	Disturbed remnants of shell midden; no surface evidence.
CA-SCL-810H	P-43-00110	H	Unevaluated	Port of Alviso ship building facility.
	P-01-003291	H	Unevaluated	Drawbridge townsite
	P-01-010205/P-43-001578	H	NE	Coyote Slough Bridge-installed in 2001.

Site CA-ALA-338 was originally noted in 1909 by Nels C. Nelson as a shell-midden mound site. The site was formally recorded in 1980 (Chavez 1980). "The site is described as a "grey powdery midden" surrounded by "…medium-brown clay" and characterized by "…extensive shell and some charcoal"…and is greatly disturbed (Chavez 1980; Busby 2008). The site is located at the confluence of Coyote Creek and Mud Slough, near what was the tidal marsh shoreline. Busby reviewed the site location during the recent shoreline survey but found no evidence of the site (Busby 2008). The site location has also been visited by USFWS archaeologist, Nick Valentine, with similar results. A review of historical maps indicates that the site location was originally on a small island until the 1930s when development of the salt ponds completely altered, dredged, and diked this area.

The WW II ship building facility was recorded as CA-SCL-810H in 1998 (Lower Guadalupe River Flood Control Project). The facility is in a ruined condition, and is outside of the project area. The site was compromised when concrete rubble collected after the Northridge Earthquake was deposited on the site and along the pond shore as riprap (Figure 19). The site is adjacent, but outside the APE of the Alviso salt ponds.

The current Coyote Creek Railroad Bridge (P-01-010205/P-43-001578) was installed in 2001. "Construction of the first bridge over Coyote Creek began in 1875 by the Santa Clara Valley Railroad…the bridge was completed by the South Pacific Coast Railroad in 1876…Southern Pacific Railroad purchased the route in 1896 and replaced the drawbridge in 1905 with a swing bridge when the track changed from narrow to standard gauge…in 1948 the bridge was replaced with a standard design wood trestle railroad bridge" (Busby 2008:29-30).

Landscape Characteristics: The history of solar salt production in the Alviso Unit dates from the 1920s and lacks many of the features identified in the Eden Landing Unit. The salt industry did not develop from small, family-owned salt farms, but rather, began as an industrial-level enterprise. The Alviso Unit is characterized by vast evaporation ponds, large levees, and robust water control devices. The levees were built along the sloughs and creek channels and follow the natural water course. The pattern of spatial organization has changed only slightly from the 1950s when the operation was controlled by the Leslie Salt Company. The Alviso Unit was developed for brine production there were no crystallizing ponds or processing plants within the unit. Scattered throughout the ponds are small-scale elements such as duck hunting blinds, constructed from plywood and set on stilts in the water or along low internal dikes. Most of the duck blinds are less than 30 years old. Remnants of piers are associated with the wood pilings.

Figure 19. Remnants of WW II shipyard (CA-SCL-810H) and concrete rubble, to SE (2007-03-04:07).

The secondary theme of duck hunting is represented by hunting blinds, the site of a duck clubhouse, and the town of Drawbridge (P-01-003291). Drawbridge was a small community of cabins that were used for duck hunting and weekend retreats (Figure 20). The isolated location also attracted bootleggers, gamblers, and prostitution in the 1920s and 1930s. Leslie's salt plant diked off parts of the east and west marshes at the southern end of San Francisco Bay, leaving Drawbridge in isolation and causing the ground to subside (Morrow 1984; EIS/EIR 2007 Report). Environmental conditions for the island have not improved since the 1940s and most of the cabins are in serious decline, are threatened by vandalism, or are sinking into the marsh. The community was essentially abandoned by the 1950s with the last resident staying until 1978 when the Don Edwards San Francisco Bay NWR was established. Drawbridge is within the refuge boundaries but many of the town's buildings are on land owned by the Southern Pacific Railroad and private entities. Access to the island requires permission from the Southern Pacific Railroad to cross on their tracks. Safety concerns with the access on an active railroad track, the deteriorated condition of the buildings, and the problem of continued subsidence of the island have sidelined a proactive preservation approach and implementation of a 1980s plan to open the site to visitors (Morrow 1984:136-137).

Statement of Eligibility: The Alviso Unit appears to meet eligibility standards under criterion A because it is associated with the twentieth century period of industrialization when one operator created a vast network of evaporation ponds to produce the large amount of brine necessary to meet production demands. Interpreting the Alviso Salt Pond landscape offers a different view of the salt industry than the Eden Landing Unit. The Alviso Unit landscape clearly reflects the

Figure 20. Drawbridge buildings (FWS 2002-05-09:01).

industrial zenith and development of huge tracks of salt marsh for salt brine production. The large exterior levees and vast ponds are the signature features of the Alviso Unit solar salt landscape. Alviso never had the crystallizing or finishing ponds, and the processing plant was always located outside of the ponds.

Integrity, Changes, and Threats: Alterations to the Alviso salt ponds are primarily linked with updating equipment and repairing the levees. New water control structures have replaced broken or outdated models. The hunting blinds are all fairly recently constructed. The duck club house was demolished soon after the refuge was established. Since the ponds were abandoned the interior small dividing dikes have degraded. Only the larger levees are maintained and used as public trails or refuge maintenance roads. The integrity of the Alviso salt pond landscape is tied to the large-scale industrialization period of the 1940s-1950s. The exterior levee defines the Alviso ponds and is an important character defining feature that can be interpreted.

The townsite of Drawbridge is associated with a colorful period in San Francisco history during the 1890s to 1930s, but the integrity of materials, design, and workmanship are critically diminished because the buildings are sinking into the marsh and several have burned or been vandalized. The townsite was recorded in 1978 and a Master's Thesis prepared to document the architecture and history of the site was completed in 1984 (Morrow). In 2008, Busby visited Drawbridge and noted that "a total of 37 standing or former structures in various states of disrepair were present compared to 90 private residences and two hotels listed in 1926. Substantial deterioration; from weathering, tidal activity and vandalism, has occurred….No furnishings were present within the buildings. All of the buildings were open to the elements, lacking doors, window glass, and occasionally pieces of or entire roofs" (Busby 2008:33).

Site CA-ALA-338 is no longer evident and appears to have been completely destroyed by salt pond development. While there is a possibility that a buried component may yet be found, the site's integrity is severely diminished.

Recommendations: The Alviso Unit reflects the land use activities of salt production, the spatial organization (levees and ponds), and circulation patterns unique to the solar salt industry and should be treated as a historic district, meeting NRHP eligibility Criterion A, with fair integrity.

Character defining features of the Alviso Salt Pond Historic Landscape are the perimeter levees, interior pond divisions, and locations of water control structures that are similar to the 1953 configuration. The water control structure mechanisms are located in the same places, but are generally replaced every 10-20 years because of the harsh conditions, therefore the structures themselves are not historically important. The water-flow network still reflects the solar salt industry development during the 1950s period. Drawbridge is listed on the Historic Properties Directory for Alameda County and is generally felt to be a unique feature in the San Francisco Bay. However, because the townsite began to deteriorate in the 1930s and was largely abandoned by 1950, the poor integrity continues to hamper the site's ability to convey a strong association with the historic theme of duck hunting. A formal evaluation of the site has not been completed, but it appears that integrity issues may preclude the site from being considered as a historic property. The site remains unevaluated and is off-limits to the public. The WW II ship building facility, CA-SCL-810H, remains unevaluated but is outside of the project area.

Non-contributing elements include the modern water-control structures, pump stations, hunting blinds, and piers or landings (Figure 21-22). As observed by the shoreline survey, "the majority of these resources appear to have severe integrity issues…many of the resources are fragmentary wooden structures that represent the remains of structures whose purposes cannot be determined from an inspection of the surviving materials or the historic records" (Busby 2008:88). No further work is recommended at site CA-ALA-338 which appears to be completely destroyed. The current Coyote Creek Railroad Bridge was installed in 2001 and is a non-contributing feature of the historic landscape.

The boundaries of the Alviso Salt Pond Historic Landscape are established by legal ownership and natural features. The area is managed as part of the Don Edwards San Francisco Bay NWR (Refer to Figure 5).

Ravenswood Unit: (San Mateo) (1854 acres)
The Ravenswood Salt Pond District includes seven ponds (refer to Figure 6). The entire west bay pond complex in 1953 encompassed about 35 ponds. Only the southern portion of the Ravenswood complex is included in this evaluation, the remaining salt producing ponds that are north of the Bayfront Park are privately owned and are not included in this identification and evaluation effort.

Figure 21. Hunting blind, non-contributing element (2007-03-04:12).

Figure 22. Temporary dock/landing in Alviso ponds, non-contributing elements (2007-03-04:108).

The Ravenswood Unit salt ponds are divided by the Dumbarton Road and Bridge, the Union Pacific Railway, and an over-head transmission line connecting through a PG&E Substation. Today, residential and commercial developments are encroaching on the south-side of the project area. The exterior levee and levees flanking Ravenswood Slough are intact. Water control structures are located along the levees along with pipes/siphons that were constructed to manipulate the flow of water through a series of large evaporating ponds.

Historical Setting: The west bay salt industry began in the 1890s after the eastern and southern bay regions were already well-established. The Dumbarton Land & Improvement Company (DL&IC) was initially developed by C.E. Whitney Company beginning in about 1892. After 1904 the name was changed to Leslie Salt Refining Company. Around the turn of the century the Stauffer Chemical Company acquired two of the three independent salt works in the west bay, the West Shore Salt Company and Redwood City Salt Company (Postel 1977). Soon after, in 1907, Schilling, Stauffer, and Whitney joined together to form the Leslie Salt Company, which also consolidated the Leslie and Stauffer salt holdings in the west bay under one name (EDAW 2005:7). Pond development in the Ravenswood Unit did not occur until the 1910s, after the Leslie Salt consolidation.

Survey Results: Pedestrian survey of the Ravenswood Unit was conducted in December 2007 by USFWS archaeologists. The levees were walked and water conveyance structures were mapped with a GPS point, photographed, and described. The Bayfront Park was visited to determine the

location of the proposed interpretive kiosk that will overlook the ponds (Figure 23). No archaeological sites were identified in the Ravenswood Unit.

Landscape Characteristics: The Ravenswood Unit encompasses a compact ensemble of salt evaporation ponds that have been modified. The seven remnant salt ponds included in the Ravenswood Unit were initially constructed on tidally influenced salt marsh. A levee was constructed along the outer edge of the salt marsh and along each side of Ravenswood Slough to create four large salt evaporation ponds. A smaller crystallizing pond was built in the location of the current electric transmission sub-station (Figure 24). Additionally a levee was constructed around a pond on the south side of the Dumbarton Bridge, pipes connected the ponds on the north and south sides of the bridge (Figure 25).

Comparisons between the current landscape and 1953 map indicate that the Ravenswood District has been altered. The current spatial organization and circulation networks of the ponds do not reflect the historical period of use, from the 1910s. The Ravenswood Unit no longer supports the multi-step process of evaporation to crystallizing ponds that is depicted on the 1953 map. Intrusions on the salt pond landscape include, a power substation built within a pond, crystallizing and evaporation ponds taken out of production, and construction of Bayfront Park.

Four water control points were recorded during the survey by USFWS. The mechanical works of all four control points were built within the past 15 years (Figures 26-27). Older water control structures are present near the newer structures, although they are no longer functional and in poor repair (Figure 28-29). Water intakes were located at two points within the ponds: on Ravenswood Slough and on the south side of the Dumbarton Bridge. Water flowed through the exterior salt pond to an interior pond, beneath the bridge to the south, then back to the north side of the bridge, pumped through a pipe across Ravenswood Slough, and then to the north and west, ending at the Flood Slough. Today, the intake and flow regime has changed significantly. The water circulation pattern is no longer historically accurate, water control structures have been updated, and the function has changed to allow tidal waters to recharge the units and create salt marsh habitat. The ponds on the west side of Ravenswood Slough have been abandoned and returned to salt marsh/pickleweed habitat (Figure 30).

Statement of Eligibility: The Ravenswood Unit does not convey a strong association with the solar salt industry landscape. The ponds were developed in the 1910s, but the land uses and activities have changed, the spatial organization has been altered, and the water circulation pattern does not reflect the historic period of use. The Ravenswood ponds are not associated with an important person or family. No processing plants or residences were ever built on the Ravenswood Unit. There are no significant buildings or structures that are 50 years old within the ponds system.

Integrity, Changes, and Threats: The Ravenswood salt ponds were originally part of the vast network of ponds that were used to increase the salinity before moving the brine to the prepared crystallizing ponds. Without the typical recharge of water and siphoning of the brine water the ponds are changing to a salt marsh. The southern ponds of the Ravenswood Salt Pond complex are no longer connected with the entire process of evaporative salt production. The final brine

and crystallizing ponds have been covered by the Bayfront Park. The integrity of the ponds is critically diminished.

Recommendations: The Ravenswood salt ponds lack adequate integrity and do not convey a clear association with the salt industry, thus it does not meet the NRHP eligibility criteria for determination as a historic property. The Ravenswood Unit is ineligible to the NRHP.

The boundaries of the Ravenswood Salt Pond District are established by legal ownership and natural features. The area is managed as part of the Don Edwards San Francisco Bay NWR (Refer to Figure 6). The eastern boundary is defined by the San Francisco Bay; the southern and western boundaries are demarked by urban development; and the northern boundary is marked by the Bayfront Park and Flood Slough.

Figure 23. Ravenswood Ponds, from Bayfront Park, view to SE (2007-12-01:177).

Figure 24. Ravenswood remnant pond, near the sub-station with raised walkway, electrical transmission towers through project area (2007-12-01:150).

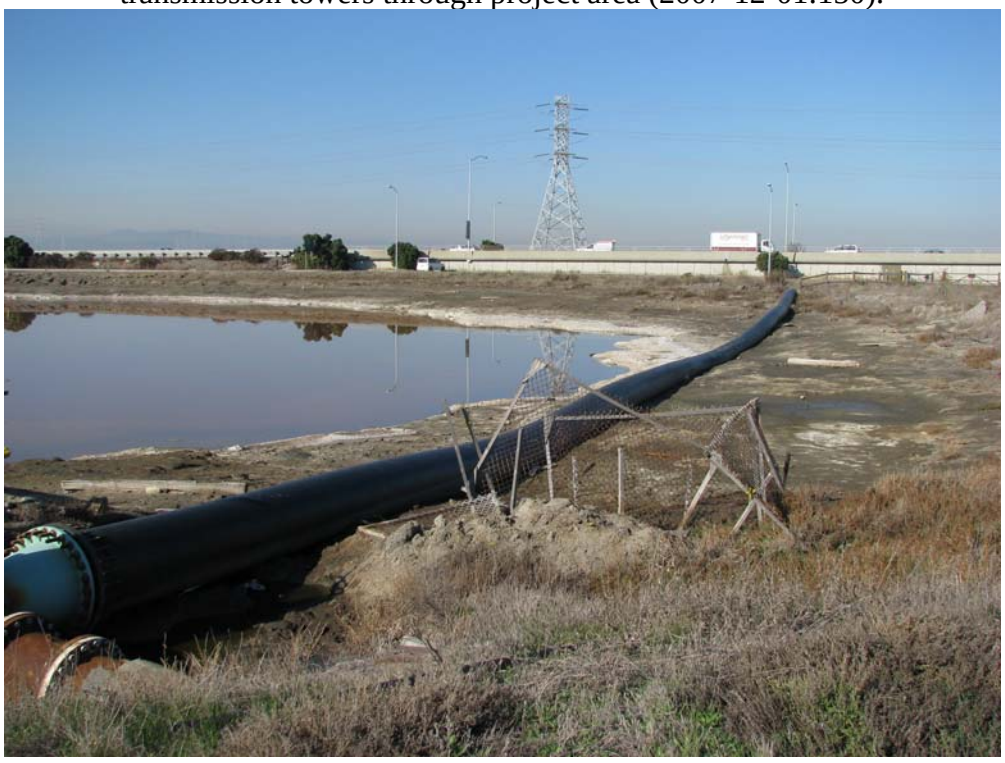

Figure 25. Pipe extending from drain to north side of freeway (2007-12-01:187).

Figure 26. Water control structure and siphon/pipe extending beneath freeway to south (2007-12-01:152).

Figure 27. New pump station and pipes (2007-12-01:155).

Figure 28. New water control structures on Ravenswood Slough side of levee (2007-12-01:163).

Figure 29. Abandoned water control structure, wooden headgate (2007-12-01:154).

Figure 30. Salt pond restored to marsh/pickleweed habitat (2007-12-01:168).

REFERENCES

American Society of Mechanical Engineers
1984 *The Archimedes/Oliver Wind-Powered Screw Pumps*. Historic Mechanical Engineering Landmark, Leslie Salt Co., Newark California.

Birnbaum, Charles and Christene Capella Peters (editors)
1996 *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes*. Cultural Resource Stewardship and Partnerships, Heritage Preservation Services, Historic Landscape Initiative, National Park Service, Washington D.C.

Busby, Colin I.
2008 *Cultural Resources Assessment: South San Francisco Bay Shoreline Interim Feasibility Study, Task Order 3*. Report prepared for U.S. Army Corps of Engineers, San Francisco. Report prepared by Basin Research Associates, Inc., San Leandro.

Cronon, William
1994 "*Landscapes of Abundance and Scarcity*" in Oxford History of the West.

Dewey, O. L. "Monty."
1989 *Drawbridge, California: A Hand-Me-Down History*. San Francisco Bay Wildlife Society Publication 2.

Dobkin, Marjorie and Robert Bruce Anderson
1994 *Historic Resource Evaluation Report for the Oliver Bros. Salt Co., Alameda County, CA.* Prepared for the Environmental Planning Branch, South District 4, California. Department of Transportation, Oakland.

Donaldson, Milford Wayne
November 19, 2004. Letter to Margaret T. Kolar, Refuge Complex Manager, San Francisco Bay National Refuge Complex.

EDAW, Philip Williams and Associates, Ltd., H.T. Harvey and Associates, Brown and Caldwell, and Geomatrix **(EDAW et al).**

2006 ADMINISTRATION DRAFT. South Bay Salt Pond Restoration Project Environmental Impact Statement/Report [EIS/EIR] Section 3.8. October 2006.

2007 *South Bay Salt Pond Restoration Project Environmental Impact Statement/Report [EIS/EIR], Executive Summary and Volume 1*. Submitted to U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and California Department of Fish and Game. December.

Galvan, P.M.
1967/68 People of the West: the Ohlone Story. *Indian Historian* 1(2):9-13.

Hundley, Jr., Norris
1992 *The Great Thirst: Californians and Water* 1770s – 1990s. Page 80.

Jones & Stokes
2001 *Cultural Resources Inventory Report for the Habitat Mitigation Planning Sites, San Francisco International Airport Proposed Runway Reconfiguration Program*. Prepared for San Francisco International Airport.

Johnek, Ellen Joslin
2008 *The South Bay Salt Pond Restoration Project: A Cultural Landscape Approach for the Resource Management Plan*. Master's Thesis, Sonoma State University, Sonoma.

Kolar, Margaret T.
July 16, 2004. Letter to Dr. Knox Mellon, California State Historic Preservation Officer.

Lopez, Claire
1971 "*Reclamation and Development: the Marsh and Overflowed Lands of the South San Francisco Bay.*" Report to Leslie Salt Company.

Manson, Marsden
1888 *The Swamp and Marsh Lands of California, Transactions of the Technical Society of the Pacific Coast*. November 26, 1888.

MacGregor, Bruce and Richard Truesdale
1982 *South Pacific Coast: A Centennial*. Pruett Publishing Company, Boulder, Colorado.

Melnick, Robert Z.
1984 *Cultural landscapes: Rural Historic Districts in the National Park System*. U.S. Department of the Interior, Washington, D.C.

Moratto, Michael J.
1984 *California Archaeology*. Academic Press, Orlando, Florida.

Morrow, Patrice
1984 *Drawbridge: Cause and Effect in the Development of a Unique Life Style*. Master's Thesis, California State University, Hayward.

Nelson, Nels C.
1909 Shellmounds of the San Francisco Bay Region. *University of California Publications in American Archaeology and Ethnology* 7(4):309-356.

Page, Robert R.
2001 *Cultural Landscapes Inventory Professional Procedures Guide*. Revision by Cari Goetcheus. U.S. Department of the Interior, Washington, D.C.

Postel, Mitch
1977 *More Than A Grain: The History of the Salt Industry in San Mateo County*. San Mateo County Historical Association.

Sandoval, John S
1988 *Mt. Eden: Cradle of the Salt Industry in California*. Mt. Eden Historical Publishers, Hayward, California.

Santa Clara Valley Water District
2005 *Guadalupe Watershed Stewardship Plan*. Supported in part by the CALFED Bay-Delta Program, San Jose, California.

Saunders, Robert S.
1973 Saunders, Robert S., Papers, 1893-1973. Western Historical Manuscripts Collection, University of Missouri, St. Louis.

Shoup, Laurence H., and Suzanne Baker
2007 Historic Resources Evaluation Report: Union City Bay Trail Project, Alameda County, California. On-file at the Northwest Information Center, Rohnert Park, CA.

Stilwell, Kristine
2004 "If you Don't Slip": The Hobo Life, 1911-1916. A Dissertation, University of Missouri-Columbia.

Thompson & West Atlas of Alameda County
1878 *Historical Atlas Map of Alameda County, California*. Reprinted 1976, Valley Publishers, Fresno, California.

U.S. Department of the Interior, NPS
1996 *Guidelines for the Treatment of Cultural Landscapes*. Government Printing Office, Washington, D.C.

U.S. Department of the Interior, NPS
1995 *National Register Bulletin #15: How to Apply the National Register Criteria for Evaluation.* Government Printing Office, Washington, D.C.

U.S. Department of the Interior, NPS
1998 *National Register Bulletin #30: Evaluating and Documenting Rural Historic Landscapes*. Government Printing Office, Washington, D.C.

Ver Planck, William E.
1958 *Salt in California*. California Division of Mines Bulletin 175.