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MARSH PLANT ASSOCIATIONS OF SOUTH SAN FRANCISCO BAY: 2007 COMPARATIVE STUDY

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21 December 2007 Project No. 477-28

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EXECUTIVE SUMMARY

Large-scale plant community changes in the remaining marshes of South San Francisco Bay were first observed in the 1970's. Early studies conducted for the South Bay Dischargers Authority in 1984 confirmed those habitat changes. In 1989, as part of a monitoring program required by the San Francisco Bay Regional Water Quality Control Board, the City of San Jose commissioned a more detailed study of the marshes potentially affected by the freshwater discharge from the Water Pollution Control Plant (WPCP). Subsequent mapping studies were conducted in 1991, 1994, and annually thereafter. These studies documented changes in the distribution and aerial extent of salt, brackish and freshwater marsh. This study is the continuation of the WPCP monitoring program.

The 2007 plant association mapping was done on digital 1-meter Multi-spectral (4-bands) color infrared (CIR) & True Color IKONOS® satellite imagery. Vegetation associations in Segments 1, 2, and 8 have remained consistent from year to year. Consequently, these segments were mapped in-house in 2007 and spot-checked in the field. The remainder of the segments was mapped in the field by H. T. Harvey & Associates biologists. The entire vegetation mapping area was then spot-checked by senior biologists. Acreage calculations by plant associations, dominant species and habitat type maps and acreage tables were produced in Geographic Information Systems (GIS) software. Comparisons were made between the 2007 mapping and the 1989 and 2006 mapping.

The total marsh area mapped in 2007 was 1786 acres for the Main Study Area and 276 acres for the Reference Area. Brackish marsh plant associations dominated the Upper Reaches of the Main Study Area. Large-scale plant association shifts from brackish dominated to saline dominated marshes were observed throughout the Main Study Area and similar but less extensive shifts were noted in the Reference Area in 2007. This was particularly evident in the Transition Reach segments of the Main Study Area, where a substantial shift occurred. The Lower Reach segments of the Main Study area continued to be primarily dominated by salt marsh plant species, with some shifts from brackish to salt marsh also occurring in this area in 2007. While an increase in saline marsh species occurred in the Reference Area in 2007, this area continued to be dominated by brackish marsh species in 2007.

The surface area of marsh habitat within the Main Study Area (Upper, Transition and Lower Reaches combined), increased by 368.1 acres between 1989 and 2007. During the same period, 84.6 acres of new marsh formed in the Reference Area. This equates to a 28% increase in marsh acreage in the Main Study Area and a 50% increase in marsh acreage in the Reference Area between 1989 and 2007.

Prior to this year, there was a net conversion from salt to brackish marsh since 1989, with decreases in this conversion between 1994 and 1995 and again in 2002. However, for the first time this year, we saw a large-scale conversion of brackish marsh to salt marsh (221.5 acres) across the entire Main Study Area. Similarly, in the Reference Area, there was a net conversion of brackish to salt marsh of 7.1 acres in 2007.

Marsh conversion in both the Main Study Area and the Reference Area appear to be related to a combination of factors in 2007. This year there was a major dieback of alkali bulrush. The combination of very low winter/spring rains, low local tributary freshwater flows, increased tidal prism from the Island Pond breaching, low mean sea level, decreased soil moisture, and low temperatures in January are all factors affecting germination and plant establishment that may have contributed to the observed dieback. In the more saline and transition marshes, pickleweed flourished in place of alkali bulrush. In the fresher/upstream areas of the brackish marshes, spearscale and pepperweed dominated the marsh conversion. The large-scale vegetation shifts and conversions between marsh types in the Main Study Area between 2005 and 2007, and especially the large conversion from brackish to salt marsh in 2007 (during a period when WPCP discharges have remained relatively constant), indicate that interannual variations in rainfall, surface water salinities, temperature, mean sea level, and changes in tidal prism play a large role in species distribution in the South Bay.

INTRODUCTION

Large-scale plant community changes in the marshes of South San Francisco Bay were first observed in the 1970's (H. T. Harvey & Associates 1984). Brackish marsh plants were colonizing areas that had previously been vegetated with salt marsh plants. Based upon those observations, causal mechanisms for the vegetation change were reviewed. A potential cause of that change was freshwater input from the San Jose/Santa Clara Water Pollution Control Plant (WPCP).

Early studies confirmed the observed changes in plant species composition (H. T. Harvey & Associates 1984). Efforts were made to determine the extent of these changes through time by examining historical aerial photography (CH2MHill 1989). These studies relied on aerial photographs of different scales, and since they were historical, could not be field-truthed. However, the data indicated that large-scale vegetation changes (both marsh type conversion and new marsh formation) were occurring in the marshes of South San Francisco Bay.

In 1989, as part of a monitoring program required by the San Francisco Bay Regional Water Quality Control Board (RWQCB), the City of San Jose commissioned a more detailed study of the marshes potentially affected by the freshwater discharge from the WPCP (H. T. Harvey & Associates 1990). Simultaneously, and also at the behest of the RWQCB, the Sunnyvale WPCP commissioned a study of the vegetation of the marshes in Guadalupe and Alviso Sloughs. Both of these studies included the collection of new aerial photography and detailed mapping of dominant plant species in the field. These data now provide the baseline for comparison of changes in plant species distribution in the marshes of South San Francisco Bay. This study continues the vegetation monitoring of the marshes in South San Francisco Bay that began in 1989. The vegetation mapping conducted by this study determines the spatial location and extent of change in plant communities. This study does not monitor or experimentally manipulate variables that can be responsible for the observed changes. Therefore, the vegetation mapping of the marshes in South San Francisco Bay tracks any changes over time; comparisons are limited to interannual rates of change between the Main Study Area and the Reference area.

Subsequent mapping studies were conducted by the City of San Jose in 1991, 1994, and annually thereafter. These studies documented changes in the distribution and extent of salt, brackish and freshwater marsh (CH2MHill 1989, H.T. Harvey & Associates 1990, 1991, 1995, 1997, 1998, 1999, 2000, 2001, 2002a, 2003, 2004, 2005, and 2006). Yearly mapping has been important in detecting inter-annual vegetation shifts that might not have been detectable otherwise. A similar study in Georgia by Higginbotham and others (2004) detected significant inter-annual changes over a 40-year time period.

Vegetation changes that were noted in the early mapping efforts proved difficult to analyze as to whether the changes were due to discharge from the WPCP. Alviso Slough, which had been mapped in 1989 and 1991, and which has freshwater inflow from the Guadalupe River, was chosen as a reference area. In order for it to be an effective reference area, one that was representative of larger scale changes, changes in that slough vegetation needed to be independent of the flow of the WPCP. A dilution study performed in Alviso Slough that found increased dilution of discharge waters with increased distance from the WPCP discharge site and very little entrainment of WPCP waters into Alviso Slough, supported the selection of Alviso Slough as the Reference Area (CH2MHILL 1990). Therefore, all mapping efforts since 1995 have included the Main Study Area and this additional reference area (Alviso Slough).

The dominant plant species of tidal salt marshes in South San Francisco Bay includes pickleweed (mainly *Sarcocornia pacifica*, formerly known as *Salicornia virginica*) and cordgrass (*Spartina foliosa*.). Pickleweed dominated salt marsh provides habitat for a unique assemblage of animal species including the federally and state-endangered salt marsh harvest mouse (*Reithrodontomys raviventris raviventris)* and California Clapper Rail (*Rallus longirostris obsoletus*). (An expanded description of the habitat requirements for these wildlife species can be found in the Discussion section at the end of the report.) Therefore, it is important to determine the area of vegetation change as well as to identify the factors responsible for the observed conversion of salt marsh habitat to brackish and freshwater marsh habitats. Furthermore, it is important to understand the extent that this conversion may be caused by natural, region-wide environmental change versus anthropogenic changes such as freshwater discharge from the WPCP and dry-weather releases from local reservoirs.

Research has shown that a number of variables control the distribution of plant species in coastal marshes. The most obvious of these factors, surface water and soil salinity, have been shown to correlate significantly with vegetation distributions (Espinar et al. 2005, Reardon 1996, Callaway and Sabraw 1994, Allison 1992, Callaway et al. 1989, Zedler 1983, Zedler and Beare 1986). For example, Zedler (1983) documented the conversion of a pickleweed-dominated salt marsh to a cattail-dominated (*Typha domingensis*) freshwater marsh along the San Diego River. Zedler found that the conversion was highly correlated with prolonged reservoir discharges that continued well beyond the normal rainy season, thereby decreasing salinities. Salinity tolerance is also important in relation to species life history stages.

However, many other factors also influence marsh species composition including: depth and duration of flooding over the marsh surface (Webb and Mendelssohn 1996, Webb et al. 1995, Pennings and Callaway 1992, Mendelssohn and McKee 1988, Mall 1969), accumulation of phytotoxins such as hydrogen sulfide in marsh soils (Webb and Mendelssohn 1996, Webb et al. 1995, Koch and Mendelssohn 1989, DeLaune et al. 1983, King et al. 1982), interstitial nutrient concentrations (Koch et al. 1990, Bradley and Morris 1980, Koch and Mendelssohn 1989, Morris 1980), and soil mineral and organic matter content (Nyman et al. 1990, DeLaune et al. 1979). Natural variability in abiotic factors such as precipitation, tidal fluctuation, and evapotranspiration, as well as anthropogenic changes to those factors such as freshwater discharges, non-point source pollution (nutrients and sediments), and regional/global climate changes (drought, temperature, sea level) influence these variables. Alexander and Dunton (2002) found that timing and quantity of freshwater inputs strongly dictated halophyte response to precipitation in two marshes in Louisiana. Warren and Niering (1993) found increased flooding frequency from sea level rise altered tidal marsh plant associations in the northeastern United States. Wisser et al (2006) used an 18-year record of end-of season biomass to evaluate multiple stressor effects (flooding duration, salinity, air temperature, precipitation deficits, nutrient availability and cloud cover) in Louisiana salt marshes and found that when surface water and cloud cover were optimal, larger flooding durations reduced peak biomass. Espinar inundation, may effect seed germination and growth affect and the resulting plant species distributions.

Competition between different plant species (interspecific) with similar environmental tolerances also influences their distributions. Although environmental tolerance and competitive ability are inversely related (Grace and Wetzel 1981, Zedler 1982, Bertness 1991), competition still plays a role among species with similar tolerances. For example, Zedler (1982) found that competitive interactions occur in salt marshes, and concluded that pickleweed does compete with cordgrass for light and to some extent, nutrients. Leininger (2006) used a model to examine rain, drought, and disturbance scenarios along with marsh conditions at three marsh study sites in San Francisco Bay and found that invasion potential of perennial peppergrass (*Lepidium latifolium)* varies with site disturbance and rainfall conditions. In particular, perennial peppergrass spread was inhibited in years of increased moisture and also with increased salinity.

This report shows that a number of factors, including a lack of late season rainfall contributing to higher ambient Bay salinities, lower overall precipitation resulting in decreased freshwater runoff from both local inputs and Delta flows, lower mean sea level, prolonged low temperatures in January and the localized effect of the SBSP restoration in the Island Ponds area on tidal prism are all contributing to marsh species distribution in 2007.

SURVEY METHODS

STUDY AREA

For the purposes of data collection and analysis, we divided the study area into 28 segments as defined in the 1989 study (H. T. Harvey & Associates 1990; Figure 1). We then sub-divided the study area into four Reaches (Upper Reach segments, Transition Reach segments, Lower Reach segments, and Alviso Slough segments [Reference Reach]) to provide a more easily comprehensible method of analyzing the data and presenting the results (Figure 1). The Upper (approximately 460 acres), Transition (approximately 390 acres), and Lower Reach (approximately 850 acres) segments, referred to as the Main Study Area are located within the Coyote Creek watershed and include Segments 1-5 and 8-26 (Figure 1). Segments 27-30 (Reference Area - approximately 275 acres) are located along the lower Guadalupe River, also known as Alviso Slough (Figure 1). This study assumes that the WPCP discharge does not significantly influence the Reference Area, and therefore provides a suitable control site for documenting vegetation changes in South San Francisco Bay.

BASE IMAGERY

The City of San Jose acquired IKONOS® imagery from a satellite pass that occurred at 11:00 a.m. on June 17, 2007. The tidal elevation at this time was -0.4 feet Mean Lower Low Water (MLLW) near the Calaveras Point Station. The 1-meter Multispectral (4-bands) color infrared (CIR) & True Color orthorectified IKONOS® satellite imagery is projected in StatePlane NAD83 Zone III (feet).

VEGETATION ASSOCIATION MAPPING AND AREA CALCULATIONS

Habitat mapping was based upon the imagery obtained and completed at a scale to 1:2400 (one inch = 200 feet) using the IKONOS® imagery as a base layer. Habitat mapping was assisted using two laptop computers (Panasonic Toughbook 18) equipped with geographic information systems (GIS) software (ArcView 9.1). These computers and software allow the IKONOS® imagery to be used for mapping in the field or in the office.

The initial mapping was conducted in-house; habitat boundaries and classifications were identified using the IKONOS® imagery and were based on the signatures of the photographic imagery. Topographic features, marsh boundaries, and tentative habitat types (based on photographic signatures) were mapped in the office prior to field visits.

Complete ground-truthing of the preliminary mapping was conducted during site visits to the project area during July and August 2007. Because of the habitat consistency seen in segments 1, 2, and 8 during past mapping years, these three segments were mapped in-house in 2007. Marsh vegetation was observed primarily from areas directly adjacent to the marshes in order to maintain consistency with the methods employed in previous years and also to follow U.S. Fish and Wildlife Service (USFWS) guidelines and regulations. Therefore, marshes were observed primarily from levee roadways, railroad beds, unimproved salt pond levees and Pacific Gas and

Electric (PG&E) walkways. Boat access also increased observation of the marsh edge in Segments 11, 12, 13, 15, and 21. Only when necessary and allowed by USFWS regulations were vegetation associations verified by walking in those marshes areas that were not clearly visible from adjacent levees and upland areas. Access to the Study Area was obtained from the USFWS San Francisco Bay National Wildlife Refuge (Clyde Morris 510.792.4275), Cargill Salt Division, Newark, CA (Pat Mapelli 510.790.8610), and the Newby Island Landfill (Mr. Gil Cheso 408.945.2802).

The GIS database was downloaded and backed-up weekly. The digitized boundaries of habitat areas were reviewed for consistency and quality. Plant association acreages and color-coded figures for the entire Study Area were generated in GIS (ArcView 9.1). Plant association acreages and color-coded figures for the entire Study Area were generated by GIS systems ArcInfo and ArcView.

VEGETATION ASSOCIATION CATEGORIZATION METHODS

Any species that occurred as a dominant, co-dominant or sub-dominant as defined below, in any portion of the study area was mapped. For the purposes of this study a dominant species had a percent cover of 51-100%, co-dominant species have roughly equal percent coverage, and sub-dominant species have between 15 and 49 percent cover.

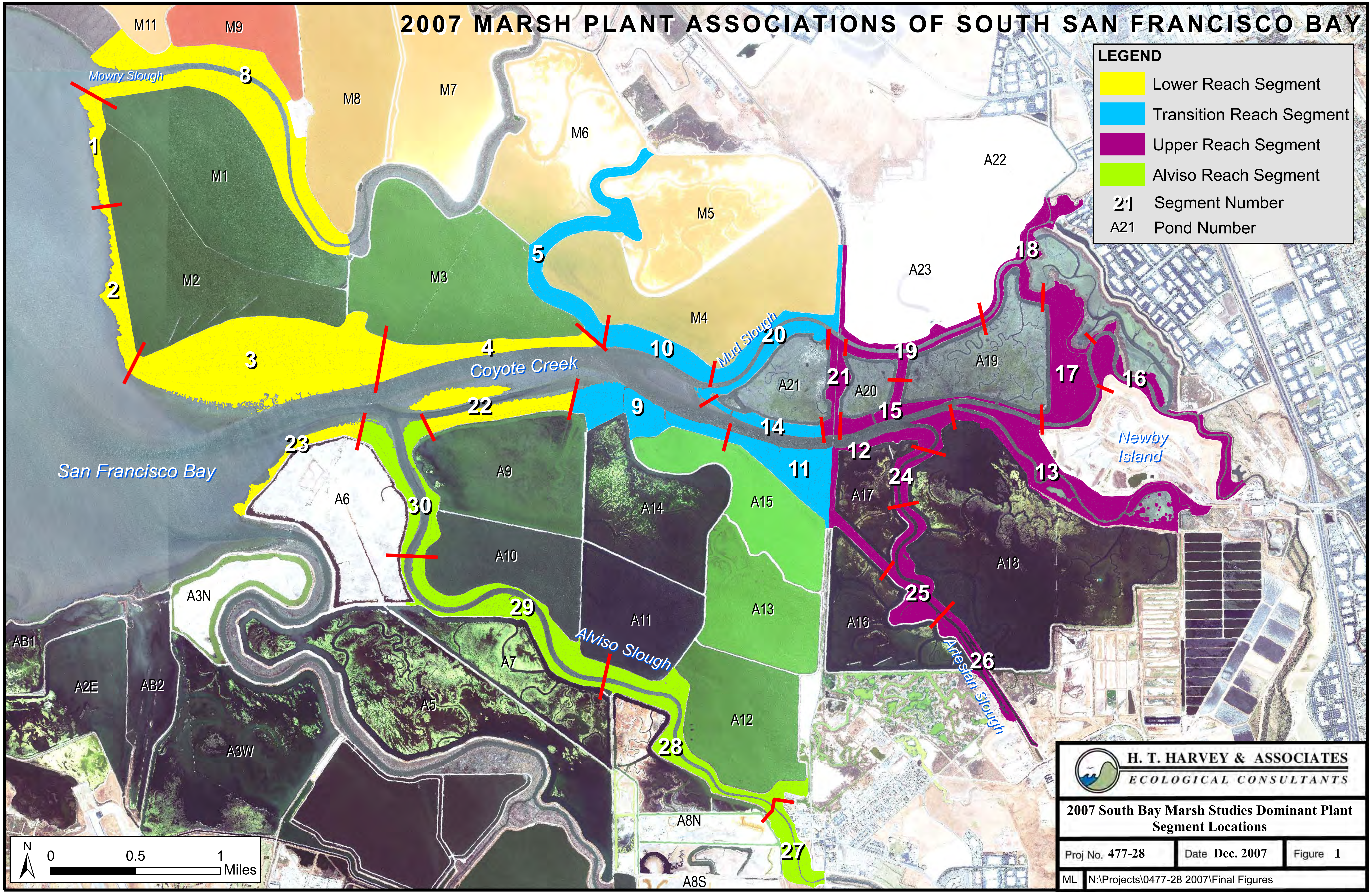
Each species was then assigned to a vegetation association comprised of one dominant, a dominant and subdominant, or two or more co-dominant species. The three types of vegetation associations are described below:

Dominant – An area that consists of one dominant species that comprises approximately 85-100% of the cover is named solely for that species, so that the vegetation association called pickleweed consists of from 85-100% pickleweed and less than 15% of other unspecified species.

Dominant/sub-dominant – If one species comprises between approximately 51-85% of the cover in a particular area, and another species comprises 15-49% cover in that same area, then this is dominant/sub-dominant vegetation association. The association is named for both species, with the more abundant species listed first. The category called pickleweed/alkali bulrush could therefore consist of 51-85% cover of pickleweed and 15-49% cover of alkali bulrush.

Co-dominant – Two co-dominant associations were identified in 2007: Pickleweed-Cordgrass Mix and Spearscale-Picklweed Mix. Co-dominant mixes are defined as having approximately equal amount of each species with combined total coverage of the two species exceeding 85%.

The upland species category consists of species not considered by the USFWS (1988) to be wetland indicators. These include ruderal species such black mustard (*Brassica nigra*), ripgut grass (*Bromus diandrus*), sweet fennel (*Foeniculum vulgare*), and coyote brush (*Baccharis pilularis*). The peripheral halophyte category consists of a patchwork of species that occur along salt marsh edges, such as levee slopes. This mixture, in which no one species generally exceeds 15% of the cover, includes pickleweed and various peripheral halophyte species such as alkali



2007 MARSH PLANT ASSOCIATIONS OF SOUTH SAN FRANCISCO BAY
LEGEND
Lower Reach Segment
Transition Reach Segment
Upper Reach Segment
Alviso Reach Segment
21 Segment Number
A21 Pond Number
Mowry Slough
Coyote Creek
Mud Slough
Alviso Slough
Artesian Slough
San Francisco Bay
Newby Island
M11
M9
M8
M7
M6
M5
M4
M3
M2
M1
A22
A23
A21
A20
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A17
A18
A16
A15
A14
A13
A12
A11
A10
A9
A7
A6
A5
A3N
A3W
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2007 South Bay Marsh Studies Dominant Plant Segment Locations
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heath (*Frankenia salina*), Australian saltbush (*Atriplex semibaccata*) and slender-leaved iceplant (*Mesembryanthemum nodiflorum*).

Plant species associations were grouped into dominant species categories (e.g., alkali bulrush/peppergrass association is an alkali bulrush dominant species category). These dominant species categories were then assigned to one of four habitat types: salt marsh, brackish marsh, freshwater marsh and upland. In addition, stands of dead vegetation were also included in the 2007 mapping as a distinct habitat type. A number of assumptions about grouping dominant species into appropriate habitat types were made. These include:

- Relative salt tolerance of dominant plant species;
- Edaphic characteristics of the South Bay Marshes that may control plant species distribution;
- Historic relationships within this study, and;
- Relationships between dominant plant species and wildlife use.

Certain plant species for which salinity tolerance data are lacking (e.g., spearscale) were categorized into habitat types based on relative location in the marsh plain or known wildlife use. This assumption and the potential uncertainties related to assigning plant species to habitat type categories has been understood throughout the study period and was stated in the 1989 (baseline) study (H. T. Harvey & Associates 1990). The habitat classification scheme first used in the baseline study is carried through to this study to collect comparable data.

AREA COMPARISONS

Analysis of marsh conversion within the Main Study and Reference Areas involved a multi-step process that began at a total marsh area level and proceeded to a more specific, segment-level analysis. The first task involved comparing the relative acreage change in marsh type and dominant species categories between years. The current year's results are compared to baseline year 1989. When a significant shift in marsh acreage occurred, the dominant species categories responsible for that shift were also identified.

In order to identify where significant acreage changes had occurred, the marsh was divided into four areas based upon segment location: Upper, Transition, Lower and Reference (Alviso Slough) (Figure 1) as described earlier. These are outlined in Table 1.

Table 1. South Bay Marsh Segments and Their Reaches.

Reaches	Segments
Lower (Mouth of Coyote Creek)	1, 2, 3, 4, 8, 22 and 23
Transition (Drawbridge)	5, 9, 10, 11, 14 and 20
Upper (Newby Island)	12, 13, 15, 16, 17, 18, 19, 21, 24, 25 and 26
Reference (Alviso Slough)	27, 28, 29 and 30

A comparison of marsh habitat acreage data from all years (1989, 1991, 1994, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006 and 2007) was also conducted by Reach.

The final step in the analysis involved overlaying the habitats from the 1989 mapping onto 2007 data in ArcView to determine, with confidence, the location and size of change in marsh area and habitat type. The habitats for 2006 were also overlaid onto 2007 data to determine the changes between 2006 and 2007. Dominant species and habitat maps were produced for each of the four Reaches. The maps were produced from an ArcView database and the full mapping for all segments by plant species association is available electronically.

EDAPHIC CHARACTERISTICS

In 2005, several small areas of dead alkali bulrush were observed during mapping. In 2006, and in 2007, substantial areas of dead vegetation were observed and mapped within both the Reference Area and the Main Study Area (formerly alkali bulrush and pickleweed habitats). In 2007, many of these areas of dead vegetation exhibited substantial shifts in species distribution from the previous year.

In order to better understand the processes resulting in these large-scale changes and the die-offs seen in 2006, soil bulk density and interstitial soil salinity cores were sampled at six locations in the Reference Area in Spring 2007 and compared with cores taken at the same locations in 2006. In Fall 2007, twelve locations were sampled. These twelve locations were selected to include the six sites sampled in the Reference Area during Fall 2006 and Spring 2007, and to also include six sites sampled during edaphic studies in the Main Study Area during 2001 and 2001. (Appendix G, Figure G-1). Of the twelve sites sampled in September 2007, 10 of these were permanent stations previously used for sampling edaphic characteristics in 2000 and 2001 (H. T. Harvey & Associates 2002b). The remaining two sites were added in Fall 2006 when sites where selected to characterize the alkali bulrush die-off. Each soil core consisted of a 15cm long core with a diameter of 5.25cm. A depth of 15cm was chosen since this is the approximate depth of the root zone for most tidal wetland plants. Once the cores were extracted, they were delivered directly to the laboratory for analysis. H. T. Harvey & Associates performed the field collection and data analysis, and Soil Control Lab completed the soil analysis.

Interstitial Salinity and pH

Interstitial soil salinity and pH cores were collected and analyzed in May 2007 and September 2007. To obtain porewater, the sediment cores were centrifuged in a refrigerated ultra-sonic centrifuge (Sorvall Super T21) at 6000 RCF (relative centrifugal force) for approximately 15 minutes each. Some samples required a slightly longer centrifuge to obtain sufficient porewater. Conductivity was measured on the undiluted porewater using a Cole Palmer 19101-00 Conductivity Meter. Conductivity readings were then converted to salinity (parts per thousand) using the USGS algorithm. Porewater pH was measured on the undiluted samples using a Fisher Accumet 15 pH meter.

Secondary Indicators of Inundation

Soil cores were analyzed for secondary indicators of inundation by examining the soil for redoximorphic features including the presence of gleying and oxidized rhizospheres. Soil color was determined using a Munsell Color Book. General observations also included the presence of root matter and water content. The type, density, and distribution of these features can provide important information regarding the frequency and duration of soil saturation.

Soil Bulk Density

Soil bulk density samples were collected and analyzed in September 2007. The soil bulk density samples were dried at 105º C for at least 48 hours, longer if necessary, to drive off all of the water. The cores were then weighed using a Mettler PJ3000 top loading balance. Bulk density was calculated by dividing the weight by the known volume of the sampling cylinder, typically expressed as g/cm^3.

RESULTS

The vegetation mapping results can be found in the detailed habitat maps and raw data in the Appendices of this report:

- Appendix A. Vegetation and Marsh Habitat Maps from 2007
- Appendix B. Spatial Analysis (marsh conversion and gain/loss) from 1989 to 2007
- Appendix C. Detailed Acreage Matrices by Segment and Species
- Appendix D. Plant List of Species Observed During Vegetation Mapping
- Appendix E. Dominant Species Categories, Marsh Type and Vegetation Associations for 1989 and 2007.

GENERAL SPECIES DISTRIBUTION, DOMINANT SPECIES CATEGORY AND HABITAT ACREAGES FOR 2007

Main Study Area

This year, 78 overall vegetation associations (e.g., alkali bulrush/peppergrass) were mapped. For the purposes of this report, the vegetation associations were grouped by dominant species into 21 vegetation categories (e.g., alkali bulrush) (Figures A1-A4). The spatial distribution of dominant plant species and habitat types (see Appendix E for habitat classifications) for the 2007 data are presented in Appendix A for each of the three marsh Reaches within the Main Study Area (figure scales vary). The acreages of habitat types and associated dominant plant species for the Main Study Area are shown in Table 2. The dominant plant species within the Main Study Area is pickleweed, comprising approximately 48% of the marsh in the Main Study Area (Table 2). Alkali bulrush, which is the dominant plant species of brackish marsh associations in South San Francisco Bay, comprises approximately 11% of the marsh in the Main Study Area in 2007. Peppergrass (*Lepidium latifolium*) and spearscale (*Atriplex triangularis*) are most abundant in the Upper and Transition Reach segments and each comprise approximately 10% of the marsh in the Main Study Area (Appendix A, Figures A-1 through A-3).

Lower Reach. The segments within the Lower Reach (nearest San Francisco Bay; Appendix A, Figures A-1 and A-5) are comprised primarily of single-species stands or mixtures of salt marsh plant species dominated by pickleweed and cordgrass. Cordgrass and pickleweed are most abundant in the Lower Reach segments.

Transition Reach. The Transition Reach, intermediate to the furthest upstream and downstream Reaches, supported substantial amounts of both salt and brackish species, which sometimes occurred in mixed associations (both brackish and salt marsh plant species) (Appendix A, Figures A-2 and A-6). However, large stands of pickleweed occurred in the Transition Reach, especially in the segments north of Coyote Creek (Segments 5, 10, 14, and 20) in 2007. Large areas of pickleweed also occurred in segments south of Coyote Creek (Segments 9 and 11), but these pickleweed-dominated areas were also intermixed with spearscale, peppergrass, and alkali bulrush dominated associations (Figure A-2).

Upper Reach. The uppermost segments within the Upper Reach (Appendix A, Figures A-3 and A-7) consist primarily of brackish marsh associations dominated by either pure stands or mixtures of alkali bulrush, peppergrass, and spearscale. However, the lower segments (Segments 19 and 21) of the Upper Reach are dominated by pure stands or mixtures of pickleweed (*Salicornia virginica*), alkali bulrush, or spearscale. Both cordgrass and pickleweed occur at low abundance even in the furthest upstream segments (although sometimes in patches too small to map).

Table 2. Summary of Acreages of the Main Study Area by Dominant Species Categories for Each Habitat Type for 2007.

Dominant Species Category	2007 (Acres)
Salt Marsh Categories	
Cordgrass	169.7
Pickleweed	856.3
Pickleweed-Cordgrass Mix	90.8
Alkali Heath	15.5
Gumplant	27.4
Jaumea	2.0
Peripheral Halophytes	25.2
Dead Vegetation	7.7
Sub-Total	**1194.6**
Brackish Marsh Categories	
Alkali Bulrush	188.1
Peppergrass	186.7
Spearscale	106.1
Dead Vegetation	20.4
Sub-Total	**501.3**
Freshwater Marsh Categories	
California Bulrush	70.8
Cattail	20.8
Misc. Others	<0.1
Sub-Total	**90.7**
TOTAL	**1786.6**

Reference Area (Alviso Slough)

The spatial distribution of dominant plant species and marsh habitat types in the Reference Area are presented in Appendix A. The 2007 plant association areas for Alviso Slough are presented in Table 3. Plant species within the Reference Area have a general distribution similar to the Main Study Area in terms of a progression from salt marsh to brackish to freshwater species extending upstream from the confluence with Coyote Creek. Segment 30 (nearest Coyote Creek) is comprised primarily of cordgrass and pickleweed dominated associations. The lower portions of Segment 29 are dominated by cordgrass, pickleweed, and dead vegetation associations, which generally transition in the upper portions of Segment 29 to alkali bulrush, pickleweed, peppergrass, and dead vegetation associations. With the exception of the lower portion of Segment 28, Segments 27 and 28 are comprised primarily of freshwater vegetation including California bulrush (*Schoenoplectus americanus,* formerly known as *Scirpus californicus*), *Typha* sp., and grass-leaved goldenrod (*Euthamia occidentalis*) (Figures 1 and A-4).

Salt marsh habitat in Alviso Slough has increased gradually since 2000, largely in the form of new marsh created near the confluence with Coyote Creek. Much of this new marsh at the mouth of Alviso Slough was dominated by cordgrass in recent years and this continues to be the case in 2007. Salt marsh associations dominate the downstream areas. Brackish marsh associations occur throughout Alviso Slough. Patches of alkali bulrush occur as far downstream as Segment 30 (near the confluence with Coyote Creek). Freshwater marsh associations are concentrated in the upstream portions of the slough (nearest the Union Pacific Railroad [UPRR] crossing).

Vegetation Die-Back

This year, there was a major dieback of alkali bulrush. Most of this area converted to pickleweed as described below. Other (fresher) areas converted to spearscale and peppergrass. In 2005, approximately 3-5 acres of alkali bulrush was died back in a large marsh plain on the slough about 4000 feet downstream from the Alviso Marina. Additional small patches of dieback were also noted throughout the Main Study Area as well (Appendix F, Figures F-1, F-2, F-8). Because no species replacement or conversion occurred in these areas, they were mapped in 2005 as alkali bulrush habitats. In 2006, these areas expanded instead of recovering as anticipated. Additional large patches of dead vegetation (primarily alkali bulrush or alkali bulrush vegetation associations) were mapped in the Reference Area in Segments 27, 28, and 29, as well as in the Main Study Area in Segment 5. Dead vegetation also occurred in pickleweed-dominated habitat in Segment 13 of the Main Study Area. In 2007, approximately 28 acres of dead vegetation were mapped in the Main Study Area and the approximately 26 acres of dead vegetation were mapped in the Reference Area. Much of this dead brackish vegetation was replaced by pickleweed-dominated habitat in 2007.

Table 3. Summary of Acreages of the Reference Area (Alviso Slough) by Dominant Species Categories for Each Habitat Type for 2007.

Dominant Species Category	2007 (Acres)
Salt Marsh Categories	
Cordgrass	37.7
Pickleweed	45.6
Peripheral Halophytes	4.7
Saltgrass	0.9
Gumplant	0.1
Jaumea	0.1
Alkali Heath	0.1
Dead Vegetation	10.8
Sub-Total	**100.0**
Brackish Marsh Categories	
Alkali Bulrush	55.3
Peppergrass	53.2
Spearscale	8.5
Dead Vegetation	15.1
Sub-Total	**132.1**
Freshwater Marsh Categories	
California Bulrush	20.9
Cattail	17.3
Grass-leaved goldenrod	5.7
Smartweed	0.3
Sub-Total	**44.2**
TOTAL	**276.3**

Dominant Species Summary

The Upper Reach of the Main Study Area is dominated by brackish marsh species (75%) with the remainder of the vegetation comprised of saline (17%) and freshwater species (8%). The Transition Area is dominated by salt marsh species (70%) and brackish (30%) marsh habitats. A similar distribution of habitats is noted in the Reference Area; brackish marsh habitats dominate a greater proportion of the Reference Area (50%), than salt (39%) or freshwater (11%) habitats.

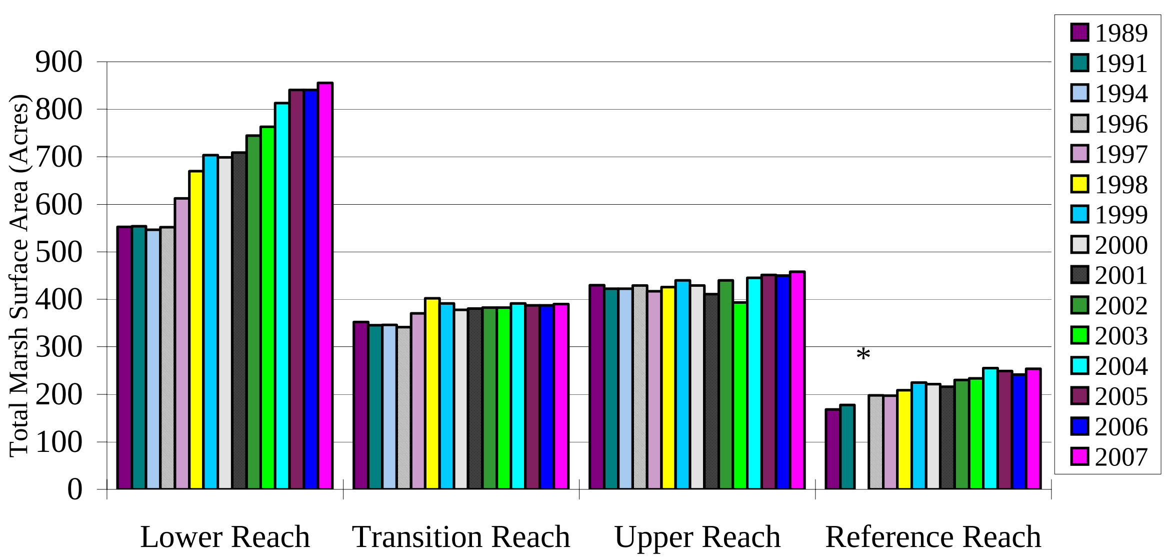
TEMPORAL AND SPATIAL CHANGES IN MARSH HABITAT ACREAGES FROM 1989 THROUGH 2007

This comparison does not include data from segments 24, 25 and 26 (Artesian Slough) of the Main Study Area and segment 27 (vicinity of the Gold Street Bridge) of the Reference Area since those segments were not mapped in 1989. Additionally, the Reference Area was not mapped in 1994; therefore only data from the Main Study Area in 1994 is included in the temporal and spatial evaluation. Data from 1991, 1994 and 1996 – 1999 are not derived from orthorectified images. In 2003, baseline data (1989) was digitized and rectified to the 2001 orthophotos to improve area comparisons and precision of the baseline data (H.T. Harvey & Associates 2003).

New Marsh Formation (Salt, Brackish, and Freshwater Marsh Combined)

Marsh area remained relatively stable from 1989 to 1996 in the Main Study Area (Figure 2). The formation of new marsh habitat in the Main Study Area occurred primarily between 1996 and 2007 in the Lower Reach and between 1996 and 1998 in the Transition Reach (Figure 2). Gains in marsh area between 1989 and 2007 were greatest in the Lower Reach (approximately 302 acres), while only 38 acres of new marsh formation occurred in the Transition Reach. The majority of new marsh formation occurred in the Lower Reach along the north and south sides of Coyote Creek, immediately upstream of Calaveras Point. Marsh area increased steadily in the Lower Reach from 1996 through 2007 with a slight decrease occurring between 1999 and 2000. There was little new marsh created between 2005 and 2006 (Figure 2). In contrast, in the Transition Reach marsh area increased in 1997 and 1998 but decreased slightly in 1999 and 2000 (Figure 2). Since 2000, marsh area in the Transition Reach has remained relatively stable, with a slight increase in 2004. The surface area of marsh in the Upper Reach has increased since 1989 with brief declines in 1997, 2001, and 2003 (Figure 2).

Figure 2. Total Marsh Acreage Comparison between 1989 and 2007, by Reach.



*****No data collected in 1994 within Reference Area.

A trend of increasing marsh area is apparent from 1989 through 2007 in the Reference Area (Figure 2). However, declines in total marsh acreage in the Reference Area occurred between 1999 and 2001, and between 2005 and 2006.

Total marsh area in the Lower Reach of the Main Study Area increased beyond 2005 and 2006 levels. Total marsh area in the Transition Reach remained relatively stable, while total marsh area in the Upper Reach increased slightly from 2006. Within the Main Study Area in 2007 (Upper, Transition and Lower Reaches combined) the surface area of marsh habitat increased by 368.1 acres between 1989 and 2007 (Table 4). During the same period, 84.6 acres of new marsh formed in the Reference Area (Table 5). This equates to a 28% increase in marsh acreage in the Main Study Area and a 50% increase in marsh acreage in the Reference Area between 1989 and 2007.

Table 4. Summary of Acreages of the Main Study Area[a] by Dominant Species Categories for Each Habitat Type for 1989, 2006, 2007 and Percent Change from 1989-2007.

Dominant Species Category	1989 (Acres)	2006 (Acres)	2007 (Acres)	Percent Change (1989-2007)
Salt Marsh Categories				
Cordgrass	84.2	172.0	169.7	101%
Pickleweed	669.1	644.4	854.7	28%
Pickleweed-Cordgrass Mix[b]	-	95.1	90.8	-
Alkali Heath[b]	-	11.2	15.3	-
Gumplant[b]	-	27.8	27.4	-
Peripheral Halophytes	25.6	24.0	24.1	
Misc Others	0.1	2.2	2.0	-6%
Dead Vegetation			7.6	-
Sub-Total	**779.0**	**976.7**	**1191.6**	**53%**
Brackish Marsh Categories				
Alkali Bulrush	489.6	462.3	177.5	-64%
Peppergrass	66.1	140.4	174.7	164%
Spearscale[b]	-	58.3	104.7	-
Dead Vegetation	-		19.9	
Sub-Total	**555.7**	**661.2**	**476.8**	**-14%**
Freshwater Marsh Categories				
California Bulrush	-	25.0	21.5	-
Cattail	-	14.7	12.9	-
Misc. Others	-	<0.1	<0.1	-
Sub-Total	-	**39.7**	**34.4**	-
TOTAL	**1334.7**	**1678.3**	**1702.8**	**28%**

[a]Comparison consists of segments 1-5 and 8-23 only, since segments 24-26 were not mapped in 1989.
[b]Not a dominant species category in 1989.

Table 5. Summary of Acreages of the Reference Area (Alviso Slough)[a] by Dominant Species Categories for Each Habitat Type for 1989, 2006, 2007 and Percent Change from 1989-2007.

Dominant Species Category	1989 (Acres)	2006 (Acres)	2007 (Acres)	Percent Change (1989-2007)
Salt Marsh Categories				
Cordgrass	28.3	37.3	37.7	33%
Pickleweed	43.6	37.3	45.0	3%
Peripheral Halophytes	3.1	5.9	4.3	39%
Misc. Others	-	0.1	0.1	-
Dead Vegetation	-		10.8	-
Sub-Total	**75.0**	**80.5**	**97.9**	**31%**
Brackish Marsh Categories				
Alkali Bulrush	72.3	80.1[b]	50.9	-29%
Peppergrass	20.4	43.7	53.0	160%
Spearscale[b]	-	14.9	8.5	-
Dead Vegetation	-		15.1	-
Sub-Total	**92.7**	**138.7**	**127.5**	**38%**
Freshwater Marsh Categories				
California Bulrush	0.3	16.0	15.0	>100%
Cattail	-	6.5	6.4	-
Grass-leaved goldenrod	-		5.7	-
Misc. Others	-	0.1	0.1	-
Sub-Total	**0.3**	**22.6**	**27.2**	**>100%**
TOTAL	**168.0**	**241.8**	**252.6**	**50%**

[a]Comparison consists of segments 28-30.
[b]Not a dominant species category in 1989.

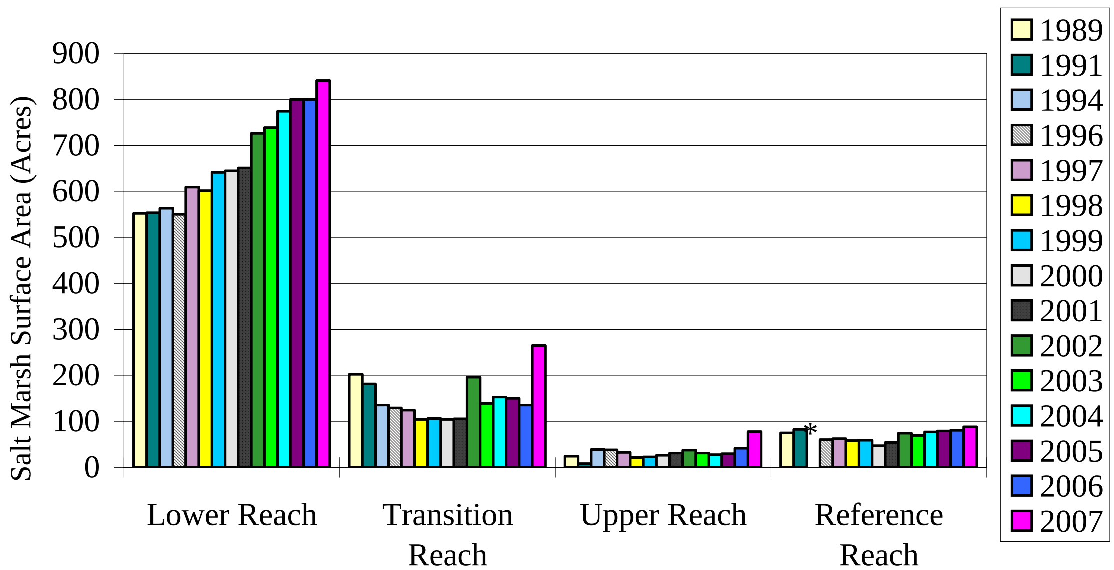
Changes in Surface Area of Salt, Brackish, and Freshwater Marsh Habitats

Salt Marsh. Figure 3 presents the total acreage of salt marsh habitat by year and location (Reach). Salt marsh area has continually increased in the Lower Reach from 1989 through 2007 with the largest increases occurring from 1996 to 1999, 2001 to 2005, and again from 2006 to 2007. Much of this increase is due to new marsh formation along the north side of Coyote Creek within segments 3 and 4. There has been a net change in salt marsh habitat area within the Main Study Area from 1989 to 2007 (412.6 acres) (Table 4). In 2002 we observed substantial gains in salt marsh habitat from both new marsh formation (which has been occurring steadily since 1997) and conversion of brackish marsh habitat to salt marsh habitat. Some conversion back to brackish marsh in 2003 persisted into 2006. We continue to see gains in salt marsh habitat resulting from new marsh formation in 2007.

Salt marsh area decreased in the Transition Reach from 1989 through 2001; the decrease in salt marsh area was greatest between 1989 and 1994 (Figure 3). However, an increase in salt marsh habitat has occurred since 2001, with a large increase in salt marsh habitat in 2002 and a substantial increase again in 2007(Figure 3).

Salt marsh area in the Upper Reach has increased since 1989 with decreases in 1991, 1998 and 1999. A large increase in salt marsh habitat occurred in the Transition Reach in 2007.

Figure 3. Salt Marsh Acreage Comparison between 1989 and 2007, by Reach.



*No data collected in 1994 within Reference Area.

The Reference Reach experiences interannual variation, with a net gain of 22.5 acres salt marsh habitat between 1989 and 2007, and a gain of 17.4 acres between 2006 and 2007 (Table 5). The majority of salt marsh decline in the Reference Reach occurred early in the study period between 1991 and 1996 (Figure 3). Salt marsh habitat remained relatively stable between 2004 and 2006. The recent increases in 2004 through 2007 are predominantly from new marsh formation near the mouth of Alviso Slough.

Brackish and Freshwater Marsh. Figures 4 and 5 present the total acreage of brackish and freshwater marsh habitats by year and location. Total brackish marsh area increased by a total of 105.5 acres (19% increase) in the Main Study Area between 1989 and 2006 (Table 4). However, large areas of brackish marsh converted to salt marsh habitat in 2007. Between 2006 and 2007, approximately 184.4 acres converted from brackish marsh to salt marsh habitat. These changes in 2007 resulted in a net loss of 78.9 acres of brackish marsh between 1989 and 2007 (14% decrease). Most of this decrease can be attributed to the conversion of dead alkali bulrush habitat to salt marsh habitat in the Main Study Area. Alkali bulrush habitat in the Main Study Area decreased by 284.8 acres, while pickleweed habitat increased by 210.3 acres.

Acreage of two other brackish marsh species (peppergrass and spearscale) in the Main Study Area increased between 2006 and 2007. Peppergrass increased by 34.3 acres and spearscale increased by 46.4 acres. Between 1989 and 2007 peppergrass acreage has increased by 108.6 acres (164%).

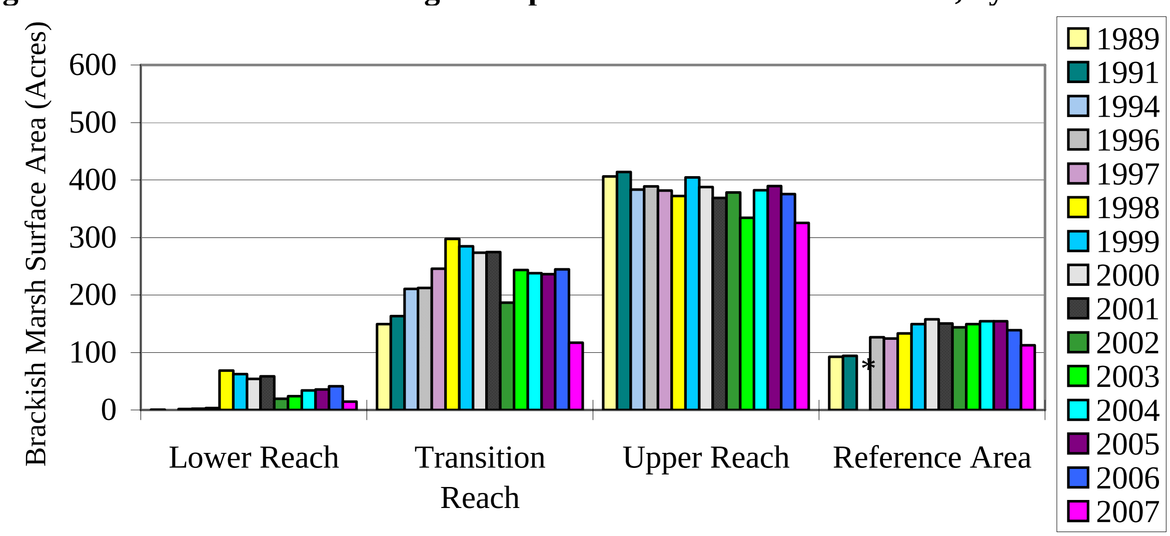
In the Lower Reach of the Main Study Area, brackish marsh increased dramatically in 1998, after which it declined through 2002, with a notable decrease in 2002 (Figure 4). From 2002 to 2006, brackish marsh has steadily increased but has not reached 1998 levels. In 2007, brackish marsh acreage in the Lower Reach of the Main Study Area decreased by 26.6 acres.

The pattern is similar in the Transition Reach with increases in brackish marsh from 1989 through 1998. Since 1998 there has been a steady trend of decreasing brackish marsh, with large decreases in 2002 and 2007. Between 2006 and 2007, brackish marsh acreage in the Transition Reach decreased by 127.6 acres.

The Upper Reach of the Main Study Area has been relatively stable with an overall trend of decreasing brackish marsh from 1989 through 2007, with periods of increasing brackish marsh between 1998 and 1999 and between 2004 and 2006. In 2007, brackish marsh in the Upper Reach of the Main Study Area decreased by 49.9 acres (Figure 4).

Overall, brackish marsh has increased by 34.8 acres (38%) in the Reference Area between 1989 and 2007 (Table 5). However, most of this increase occurred between 1989 and 2005. Most of this increase was due to marsh conversion (from salt to brackish). Since 2005, brackish marsh has declined to acreages just above 1991 levels (Figure 4). Brackish marsh in the Reference Area decreased in 2006 by 15.4 acres and in 2007 by 26.3 acres.

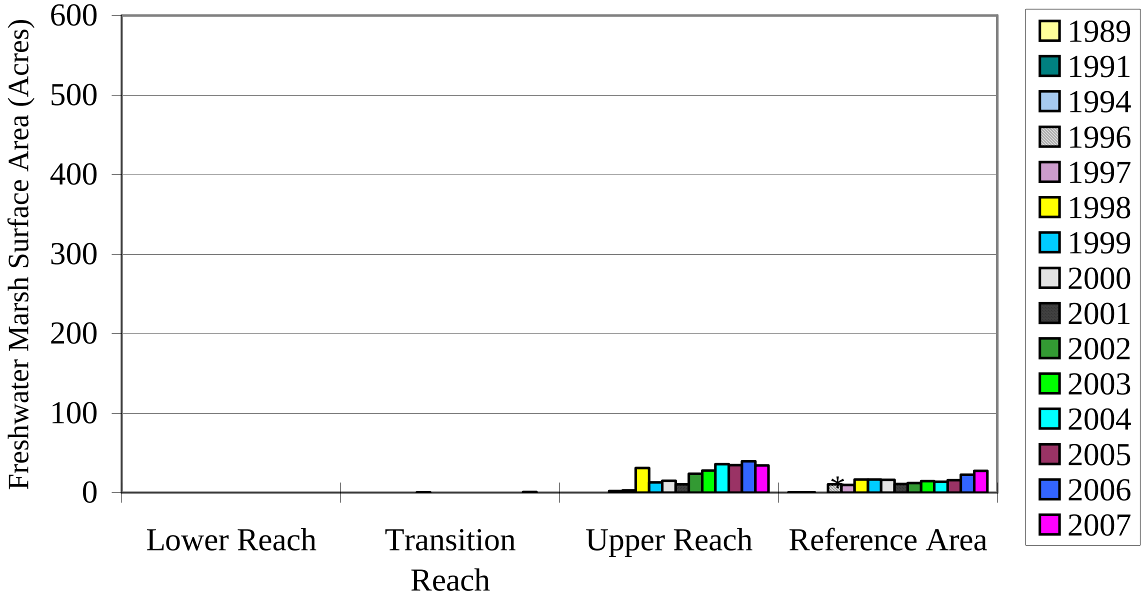
Figure 4. Brackish Marsh Acreage Comparison between 1989 and 2007, by Reach.



*No data collected in 1994 within Reference Area.

The only increases in freshwater marsh habitat since 1989 have occurred in the Main Study Area (primarily in the Upper Reach) (Figure 5) and in the Reference Area (Tables 4 and 5). There was a slight decline in freshwater marsh acreage (5.2 acres) in the Upper Reach in 2007.

Figure 5. Freshwater Marsh Acreage Comparison between 1989 and 2007, by Reach.



*No data collected in 1994 within Reference Area.

Habitat Type Conversion

Detailed comparisons by segment location were performed by overlaying the 2007 data on the 1989 data in ArcView. Table 6 provides a summary of the segment locations and shifts in acreage by marsh type from 1989 to 2007. This table differs from Tables 4 and 5 in that the changes are defined by Reach. The area calculations in Table 6 were derived from a segment level analysis (by Reach) in ArcView for 1989-2007 (Appendix B).

Table 6. Detailed Evaluation of Marsh Type Conversion (in Acres) by Project Reach, 1989 to 2007*.

Project Reach	Salt to Brackish or Fresh (Acres)	Brackish to Salt (Acres)	Net Conversion of Salt to Brackish (Acres)	Proportion of Salt Marsh Converted	Proportion of Total Marsh Converted
Lower	7.48	0.01	7.48	8.9%	8.7%
Transition	43.07	86.81	-43.74	-16.5%	-11.2%
Upper	12.86	35.88	-23.02	-29.5%	-5.0%
Reference	20.84	5.23	15.61	17.7%	6.2%

*Dead vegetation is not included in this analysis.

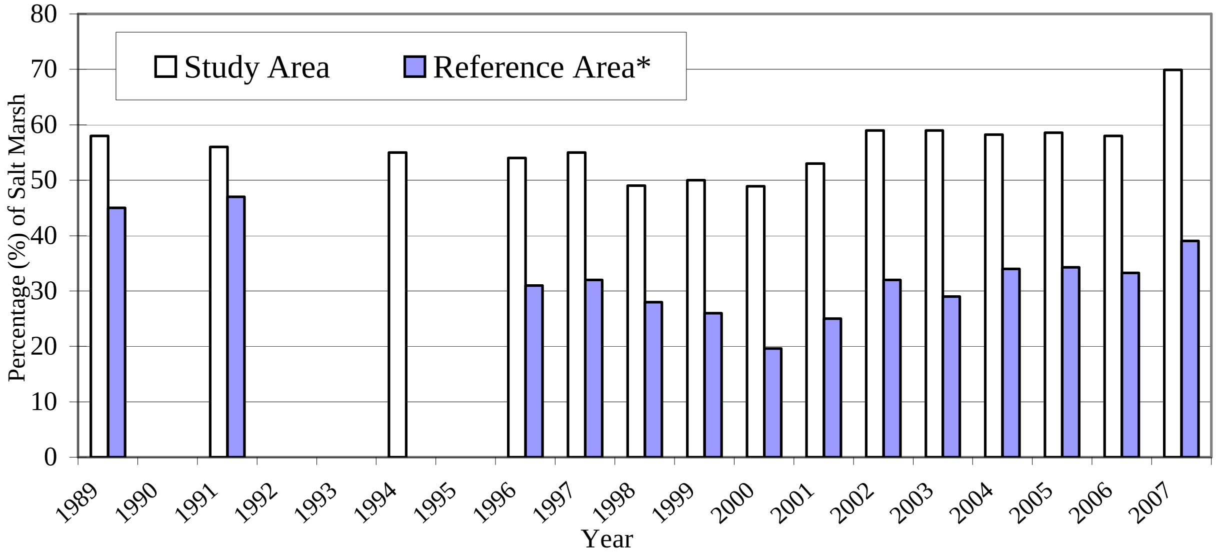
From 1989 to 2007, a total of 63.5 acres of salt marsh habitat has converted from salt to brackish marsh habitat in the Main Study Area, and 20.8 acres of salt marsh habitat converted to brackish marsh in the Reference Area. Brackish marsh to freshwater marsh conversion between 1989 to 2007 was 10.9 acres in the Main Study Area and 8.4 acres in the Reference Area. However, during the same time period, 123.9 acres of brackish marsh has converted to salt marsh habitat in the Main Study Area and 5.2 acres in the Reference Area. Much of this conversion from brackish to salt marsh habitat occurred between 2006 and 2007 with large areas of brackish to salt marsh habitat conversion occurring in the Transition Reach of the Main Study Area (Figures B9 - B12). Therefore, within the Main Study area 60.3 acres of net conversion from brackish to salt marsh habitat has occurred since 1989. In contrast, 15.6 acres of net conversion from salt marsh habitat to brackish marsh habitat has occurred in the Reference Area since 1989.

Temporal Changes in Proportional Area of Salt and Brackish Marsh between the Main Study and Reference Areas

The proportion of salt marsh and brackish marsh area relative to total marsh area was compared between the Main Study and Reference Areas from 1989 through 2007 (Figures 6 and 7). This analysis was performed to control for the difference in size between the Main Study and Reference Areas as well as to compare temporal trends in salt marsh conversion between these two areas. The percentage of salt marsh in the Main Study Area remained relatively stable from 1989 through 1997 with a decline between 1998 and 2000 (Figure 6). The percentage of salt marsh in the Main Study Area increased in 2002 and then declined slightly through 2006. In 2007, there was a substantial increase in salt marsh in the Main Study Area.

The relative decline in the percentage of salt marsh between 1989 and 2000 was greater in the Reference Area compared to the Main Study Area (Figure 6) but follows a similar temporal pattern. After increases in the percentage of salt marsh in the Reference Area in 2001 and 2002 similar to increases seen in the Main Study Area, a decrease in the relative percentage of salt marsh was observed in 2003, which was not seen in the Main Study Area. The relative percentage of salt marsh in the Reference Area recovered in 2004, and remained stable in 2005, with a slight decline in 2006. However, a similar increase in percentage of salt marsh was seen in both the Reference Area and the Main Study Area in 2007.

Figure 6. Temporal Comparison of the Proportion of Salt Marsh Area between the Main Study and Reference Areas.

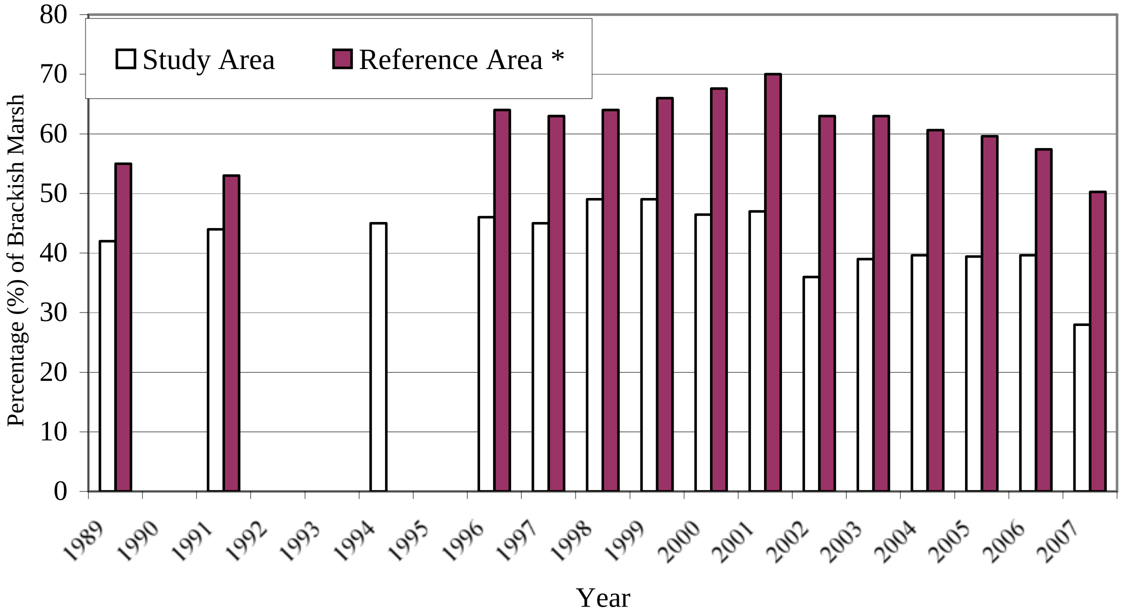


*No data collected in 1994 within Reference Area.

The proportion of the Main Study Area that is brackish marsh remained relatively constant between 40% and 50% until 2002 (Figure 7). The 2002 sampling showed the first significant decrease in the percentage (10%) of brackish marsh since the study began. The percentage of brackish marsh increased in 2003 and remained stable through 2006 (Figure 7). The percentage of brackish marsh in the Main Study Area decreased substantially in 2007.

The Reference Area showed a steady increase in brackish marsh until 2001; a larger increase in the percentage of brackish marsh was observed in the Reference Area than in the Main Study Area (Figure 7) between 1989 and 2001. This increase in the proportion of brackish marsh area to total marsh area in the Reference Area occurred primarily between 1991 and 1996 and between 1998 and 2001 (Figure 7) during the same time that the percentage of salt marsh declined (Figure 6). The percentage of brackish marsh in the Reference Area decreased in 2002 and remained stable in 2003. From 2003 to 2007, the percentage of brackish marsh has been declining, with a substantial decline in 2007.

Figure 7. Temporal Comparison of the Proportion of Brackish Marsh Area between the Main Study and Reference Areas



*No data collected in 1994 within Reference Area.

EDAPHIC CHARACTERISTICS

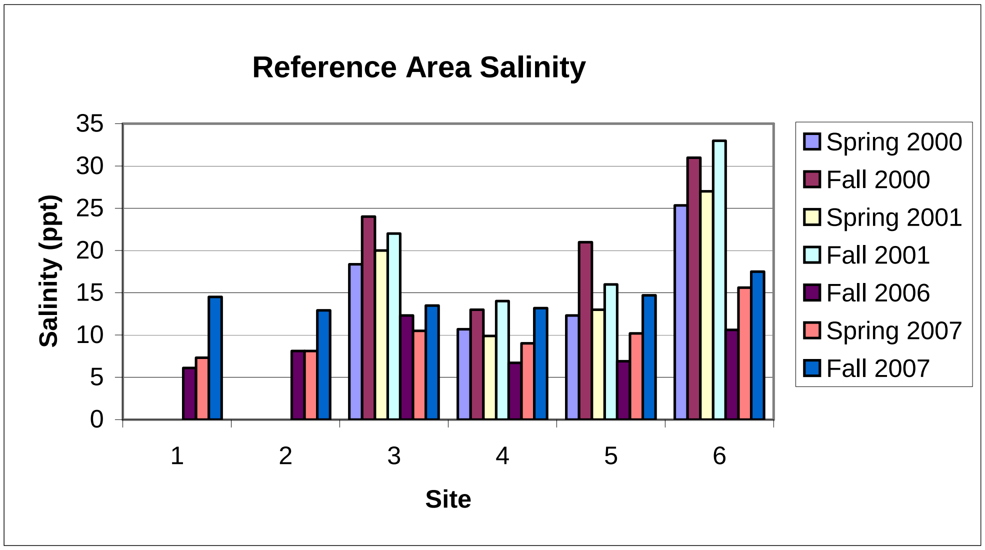
Edaphic (or soil) properties are important in understanding the physical parameters that can determine the spatial distribution of plant communities. Results of limited edaphic sampling in the Main Study Area and in the Reference Area in response to observed vegetation die-off and vegetation shifts are included here. Data analysis for all parameters (bulk density, pH, conductivity, and salinity) is included in Appendix G (Figures G2-G9).

Interstitial Salinity

In Spring 2007, soil core samples were collected at six Reference Area sites previously sampled in 2006. Soil core sampling was repeated in Fall 2007, with the inclusion of six additional sites located in the Main Study Area. All sites were previously sampled during edaphic studies performed in 1999, 2000, and 2001 (H. T. Harvey & Associates 2000b and 2002b) with the exception of Site 1 and Site 2.

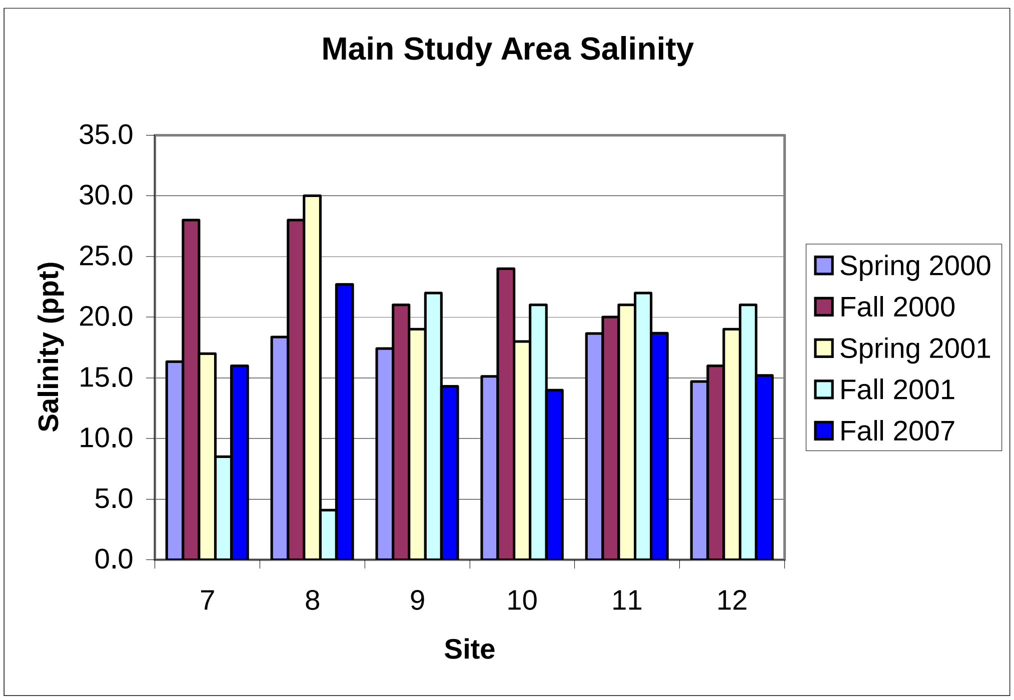
Interstitial salinity data for Fall 2007 was compared with data from 1999, 2000, and 2001 (Figure 8 and Figures G-1, G-5, and G-8). Sites 1-6 are located in the Reference Area and demonstrate a predictable increase in salinity from at the most upstream location (Site 1), toward higher salinities at the furthest downstream location (Site 6). Sites 7-12 are located in the Main Study Area and the salinity is generally similar between sites and years at these sites, with the exception of Sites 7 and 8, where the salinity demonstrates strong variability between years.

Figure 8. Interstitial Soil Salinity at Six Sample Locations Located Within the Reference Area in 2000, 2001, 2006 and 2007*.



*Sites 1 and 2 were new in 2006.

Figure 9. Interstitial Soil Salinity at Six Sample Locations Located Within the Main Study Area in 2000, 2001, and 2007.



Secondary Indicators of Inundation

Soil cores for all twelve sites were analyzed for the presence of redoximorphic features as secondary indicators of inundation. Such features may include iron and manganese, mottling, sulfitic odor and gleyed soil colors. All of the soil cores were gleyed and exhibited low chroma;

some samples contained oxidized root channels, although to varying degrees and with no apparent difference between saline versus brackish samples. No apparent differences were found in soil redoximorphic features between saline versus brackish marshes. All of the samples contained relatively little soil moisture, which is consistent with notes taken during field sampling indicating that the soil was relatively dry and difficult to sample using the coring mechanism.

Soil Bulk Density and pH

Bulk Density. In comparing bulk density over time, there were no apparent differences between the years 2000 through 2007 (Figures G-2 and G-6). Analysis of soil bulk density showed a tendency for bulk density to be somewhat lower in the Reference Area sites as compared to the Main Study Area, with the exception of Spring 2007, in which there appeared to be high variability between Sites 1-6.

pH. The pH between sites (Figure G-3) and between years (2000, 2001, 2001, and 2007) (Figure G-7) remains fairly consistent, with slightly higher pH values seen in the Fall 2001.

DISCUSSION

MARSH CONVERSION

There had previously been a net conversion from salt to brackish marsh since the beginning of this study in 1989, with decreases in this conversion between 1994 and 1995 and again in 2002. However, for the first time since this study began, we observed a large-scale conversion of brackish marsh to salt marsh (221.5 acres) during the 2007 monitoring year, and that conversion was prevalent across the entire Main Study Area (Figures B9 - B12). This large-scale conversion comprises the largest such shift seen since the study began in 1989. In this discussion we evaluate this conversion within the historical context of marshes in South San Francisco Bay and offer possible explanations for these large-scale changes.

Historical Context

Historically, tidal marshes were the dominant habitats throughout much of the South San Francisco Bay. The vast area dominated by marshes included the entire Study Area and the Reference Area. Coyote Creek and the adjacent channels, subject to tidal action, had abundant water flow in from, and out to, the Bay. This water flow continually scoured the channels and kept them relatively free of sediment. Prior to the 1940s, these channels were quite broad with extensive salt marshes on either side. After levees were built in the 1940s to create salt ponds, the dynamics of water flow began to change. The levees sealed off much of the South Bay from tidal action and in turn water flow in the channels decreased, causing them to fill in with sediment.

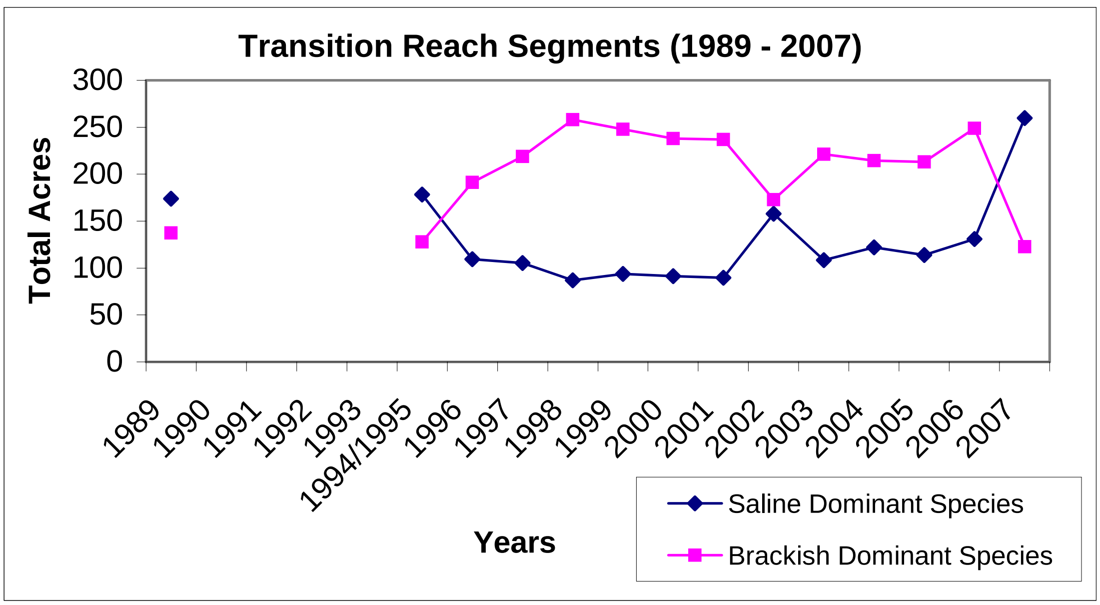
In the 65 or so years since the construction of the levees, Coyote Creek has undergone dynamic changes, both physical and biological. After the levees were built, groundwater pumping led to subsidence throughout the region and a corresponding rising relative sea level. As a result, land around the town of Alviso sank up to 10 feet. In the South Bay, this sinking caused some channels to deepen to a point where it could no longer sustain marsh plants. Additionally, the levees themselves sank. The Santa Clara Valley Water District (SCVWD) and the salt pond operators repeatedly raised the height of the levees to counteract this trend. Subsidence began to slow starting in 1965 and the channels slowly refilled with sediment, though it took years for marsh plants to re-establish. As our long-term monitoring has shown, the marshes in the South Bay are quite dynamic and respond annually to changes in the physical environment, and geomorphic changes play a critical role in the distribution of marsh vegetation.

The dynamic nature of these marshes has been most apparent during the period 2005 - 2007. In 2005, and again in 2006, large patches of dead alkali bulrush were observed in both the Main Study Area and the Reference Area (Appendix A; Figures A-2, A-3 and A-4). These die-offs occurred simultaneously with changes in species distributions observed throughout the Bay. In 2006, alkali bulrush was observed growing in North Bay salt marshes (such as China Camp) at the transition zone between pickleweed and cordgrass where it had not been seen in the preceding years. This sudden appearance of alkali bulrush was short-lived, as most of these observed stands were dead in 2007 (pers. comm. Crooks 2007). This anecdotal evidence corresponds with the trends observed in the Main Study Area. Early mapping reconnaissance in 2007 indicated that the die-off observed in 2006 throughout the Main Study Area and in the Reference Area persisted, and in some areas greatly expanded in 2007. Detailed vegetation mapping confirmed this die-off and in many of the areas where die-off occurred, the distribution of brackish marsh species shifted to salt marsh dominant species, most notably pickleweed (Figures B9 - B12).

Marsh Conversion in 2007

The conversion of brackish marsh to salt marsh mapped in 2007 is particularly evident in the Transition Reach of the Main Study Area. As shown graphically in Figure 10, brackish marsh acreage in the Transition Reach has increased between 1989 and 1998. Since 1998, the amount of brackish and salt marsh in the Transition Area has remained relatively stable, with a noticeable shift in 2002 which may be related to a corresponding decrease in mean sea level (Figure 10). However in 2007, a substantial decline in brackish marsh species to 1989 levels was replaced by a corresponding increase in saline marsh species (Figure 10).

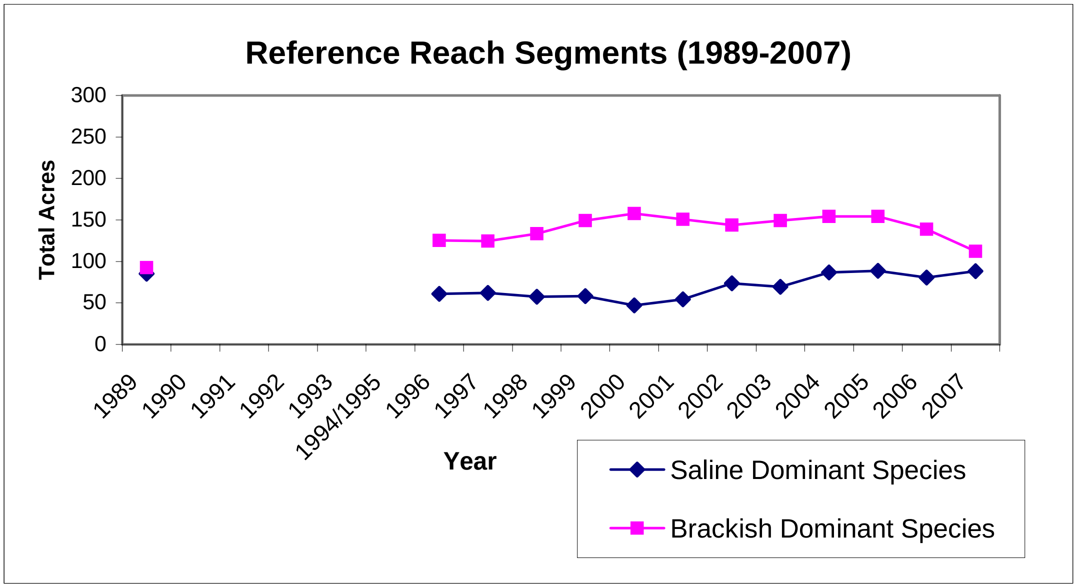
Figure 10. Transition Reach Saline and Brackish Dominant Species Acreages (1989 – 2007).



Changes in the Main Study Area between 2006 and 2007 were not limited solely to changes in marsh type; there was also a shift in species composition within the remaining brackish marsh component. Between 2006 and 2007, there was a total increase of 46.4 acres (2.6%) of spearscale (Figure F-7), and an increase of 34.3 acres (1.9%) of peppergrass in the Main Study Area.

The conversion from brackish to salt marsh in the Reference Area in 2007, while not as dramatic, shows a similar pattern to the conversion mapped in the Transition Reach segments of the Main Study Area (Figure 11). In the Reference Area, there was a net conversion of salt to brackish marsh between 1989 and 2007 of 15.6 acres (5.6%). However, between 2006 and 2007, there was a net conversion of brackish to salt marsh of 7.1 acres (2.6%). Shifts in species composition within the brackish marsh component also occurred in the Reference Area. The acreage of spearscale in the Reference Area increased by 9.3 acres (3.4%). The acreage of peppergrass in the Reference Area decreased by 6.4 acres (2.3%) (Tables 5 and 6, Figure F-6).

Figure 11. Reference Reach Saline and Brackish Dominant Species Acreages (1989 – 2007).



New Marsh Formation

New marsh formation in the Main Study area between 2006 and 2007 (24.5 acres) was greater than the new marsh formation between 2005 and 2006 (5.8 acres). Much of this new marsh formation occurs as mudflats along Coyote Creek near Calaveras Point. These mudflats likely reached an elevation that would support wetland plant species in 1996/1997 and were rapidly colonized thereafter. The large mudflat in Coyote Creek just upstream of the confluence with Alviso Slough is now at an elevation that supports wetland plant species and this area continues to be dominated primarily by saline species, primarily cordgrass.

There has been a net increase of 368.1 acres (28%) of overall marsh area (new marsh formation less marsh loss) since 1989 in the Main Study Area. Historically, the majority of this increase is due to sediment accretion along slough and river channels and subsequent vegetation colonization to form new marsh area. The majority of new marsh formation is located in the Main Study Area in the Lower Reach (Segments 2, 3 and 4 near the mouth of Coyote Creek, Segment 8 near the mouth of Mowry Slough, as well as Segments 22 and 23 near the mouth of Alviso Slough) (Figure B-5). New marsh is also located along Coyote Creek in Segments 9 and 10. The majority of new marsh formation in the Reference Area is located in Segment 30 near the mouth of Alviso Slough (Appendix B, Figures B-5 through B-8).

Despite the anticipated scour resulting from the breaching of the Island Ponds in Spring 2006, the anticipated scour of the existing mudflats and possibly some fringing marshes was not reflected by a corresponding loss of new marsh acreage. However, scour and undercutting along the banks was observed along the tidal edge of Segments 11, 12, 14, and 21 while mapping vegetation from the boat in 2007 (Figures F-3 – F-5). In subsequent years we will continue to evaluate the potential affect of levee breaching on new marsh formation in the South Bay (see below for further discussion on the Island Pond breaches).

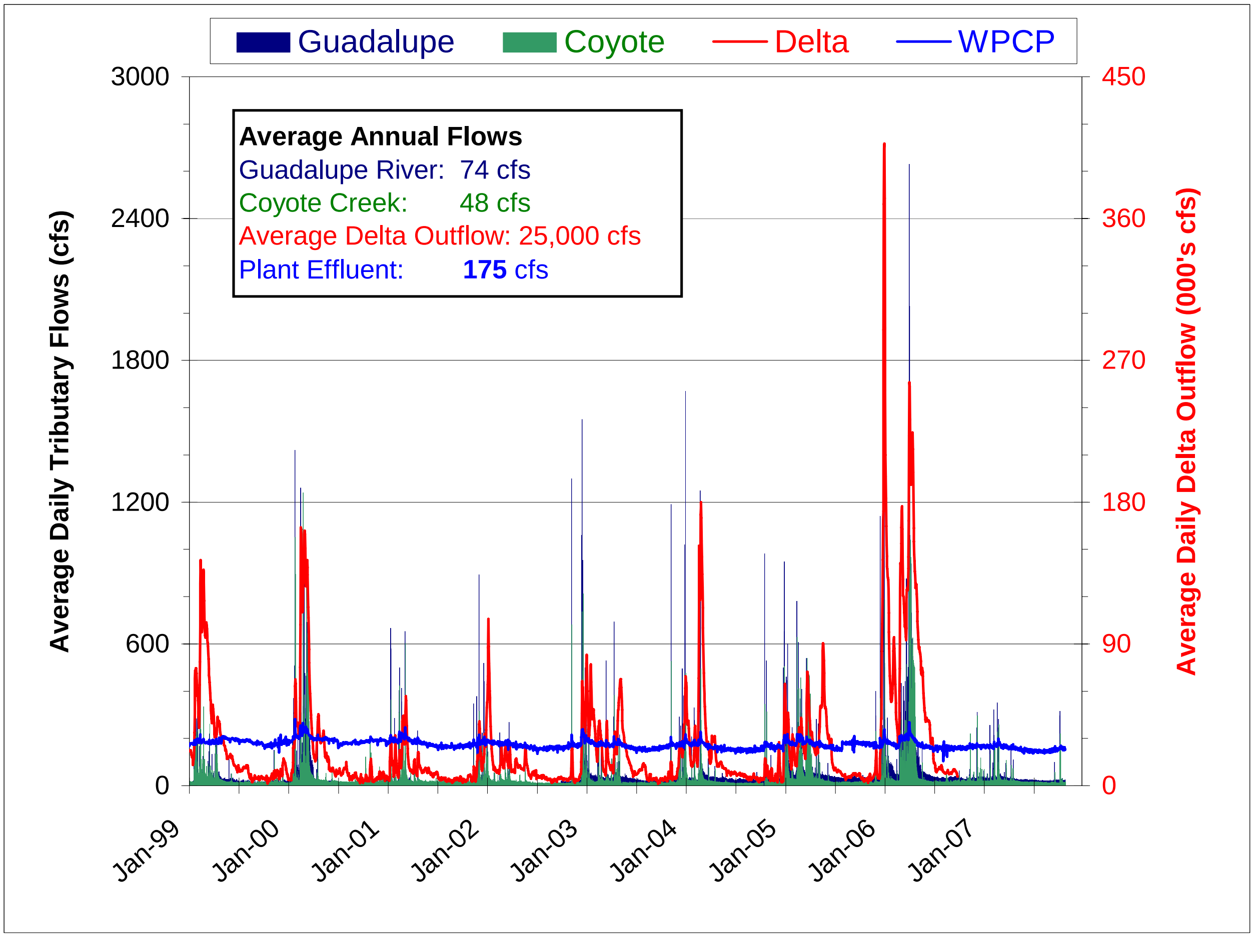
Evaluation of Marsh Conversion

As described in the Introduction Section of this report, research has shown that a number of variables control the distribution of plant species in coastal marshes. Depth and duration of flooding over the marsh surface can influence marsh species composition (Webb and Mendelssohn 1996, Webb et al. 1995, Pennings and Callaway 1992, Mendelssohn and McKee 1988, Mall 1969) and surface water and soil salinity have been shown to correlate significantly with vegetation distributions (Reardon 1996, Callaway and Sabraw 1994, Allison 1992, Callaway et al. 1989, Zedler 1983, Zedler and Beare 1986). Espinar et al. (2005) found that the salinity and flooding regime of a site can influence the germination process of alkali bulrush, showing that an increase in salinity and prolonged inundation during germination results in decreased germination.

Natural variability in abiotic factors such as precipitation, tidal fluctuation, and evapotranspiration, as well as anthropogenic changes to those factors such as freshwater discharges, non-point source pollution (nutrients and sediments), and regional/global climate changes (drought, temperature, sea level) can also influence plant species distribution. The sections below evaluate and discuss the potential contributions of each of these inputs and their influence on vegetation distribution in the South Bay marshes.

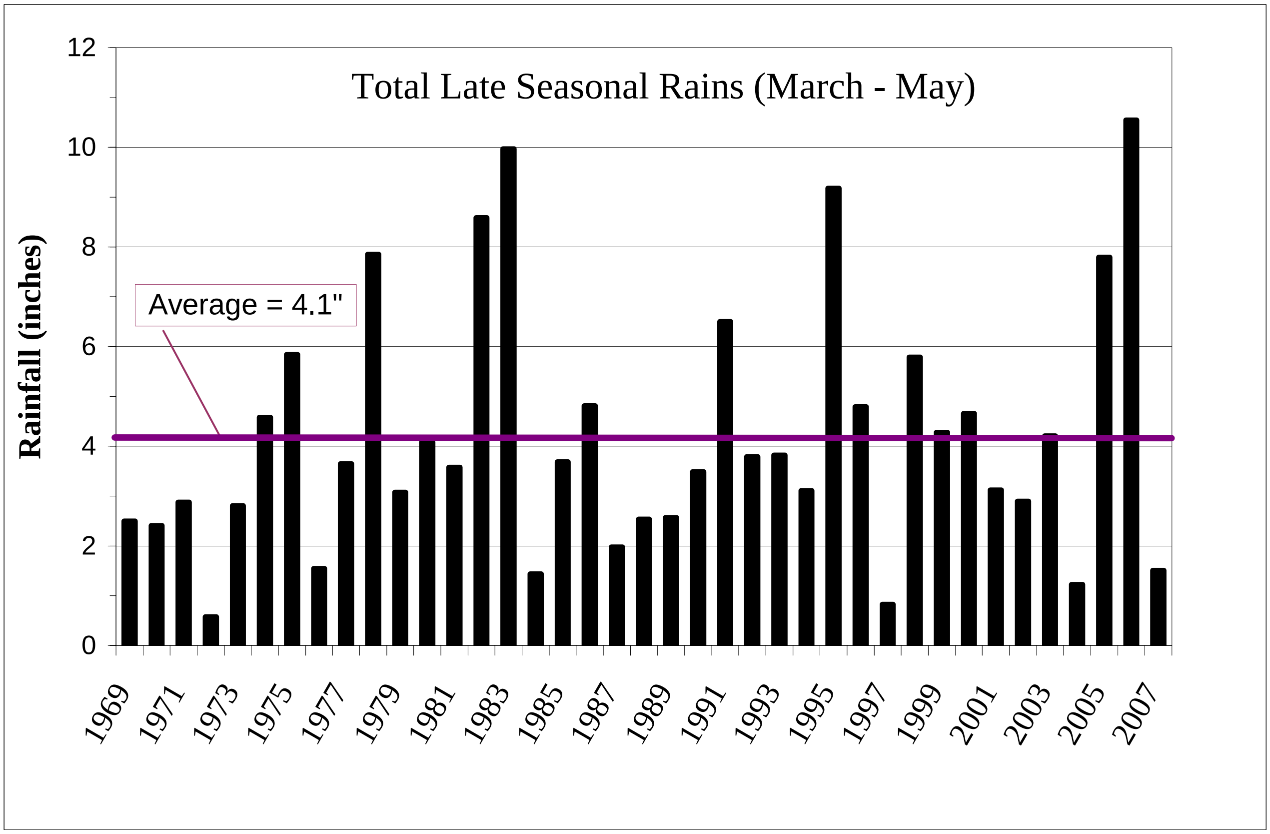
WPCP Discharges and Freshwater Flows. Figure 12 shows the relative contribution of the freshwater inputs to the Bay from the WPCP Discharge, the Guadalupe River (Alviso Slough), Coyote Creek and the Sacramento/San Joaquin Delta (courtesy of the City of San Jose). The average local freshwater flows in the South Bay and from the Delta have fluctuated between years. However, the WPCP discharges have been relatively constant since 1989 (~180 cfs ±30%). While the WPCP effluent dominates the dry season flows, freshwater input from the local drainages (Coyote Creek and Guadalupe River) during the winter are much larger, and all are dwarfed by the overall influence of the inputs from the Delta. These larger overall inputs contribute to variations in bay-wide salinities.

Figure 12. South San Francisco Bay Average Freshwater Flows (Courtesy of the City of San Jose).



Rainfall. In addition to WPCP effluent flow and regional freshwater inputs, vegetation distribution is also driven by the distribution and amount of rainfall. Total rainfall and timing at critical times of the year can affect salinity, thereby influencing vegetation distribution. Figure 13 shows that late season rains were higher than average in Spring 2005 and Spring 2006 and may have resulted in prolonged inundation of marsh surfaces. Prolonged inundation as described by Espinar (2005) can significantly alter germination success of alkali bulrush. Above-average late season rains in 2005 and 2006 likely resulted in prolonged inundation during the critical germination period, and in combination with decreased Bay salinities contributed to the die-offs of alkali bulrush seen in the Main Study Area and the Reference Area during the past two years.

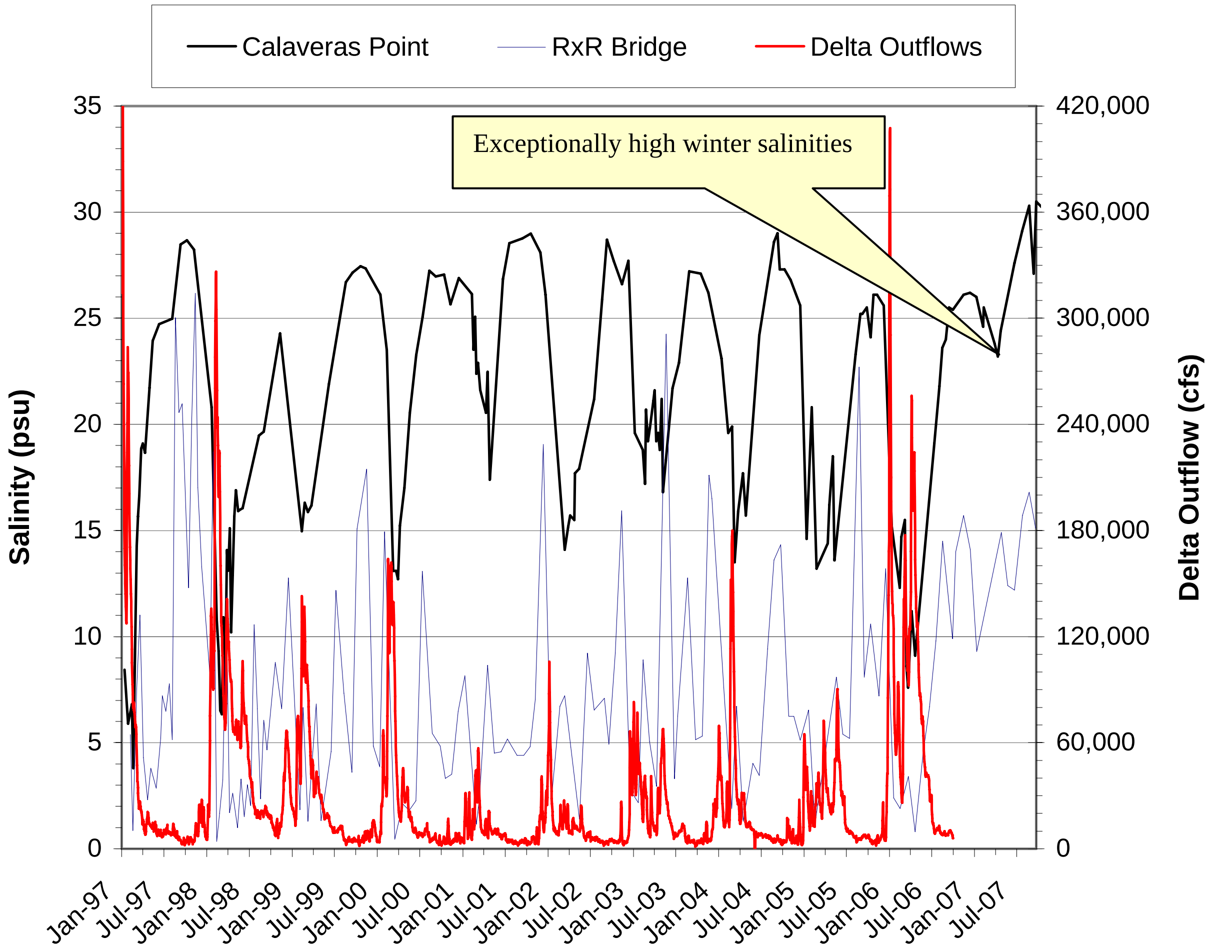
Figure 13. Total late season rains (March, April, and May) for San Jose, California from 1968-2007 (National Weather Service station at San Jose).



In contrast, below-average late season rains occurred in Spring 2007 (Figure 13), resulting in decreased freshwater input from local drainages and from the Delta.

Decreased freshwater input can influence surface water salinities in the local drainages. The lowest surface water salinities in the South Bay typically occur in the period from January through April. However, surface water salinities in January 2007 at Calaveras Point were the highest recorded salinities for the period from January 1997 through January 2007 (Courtesy of the City of San Jose) (Figure 14). In addition, the lowest salinities at Calaveras Point for 2007 occurred in April and are only slightly below Fall salinities for both 2005 and 2006.

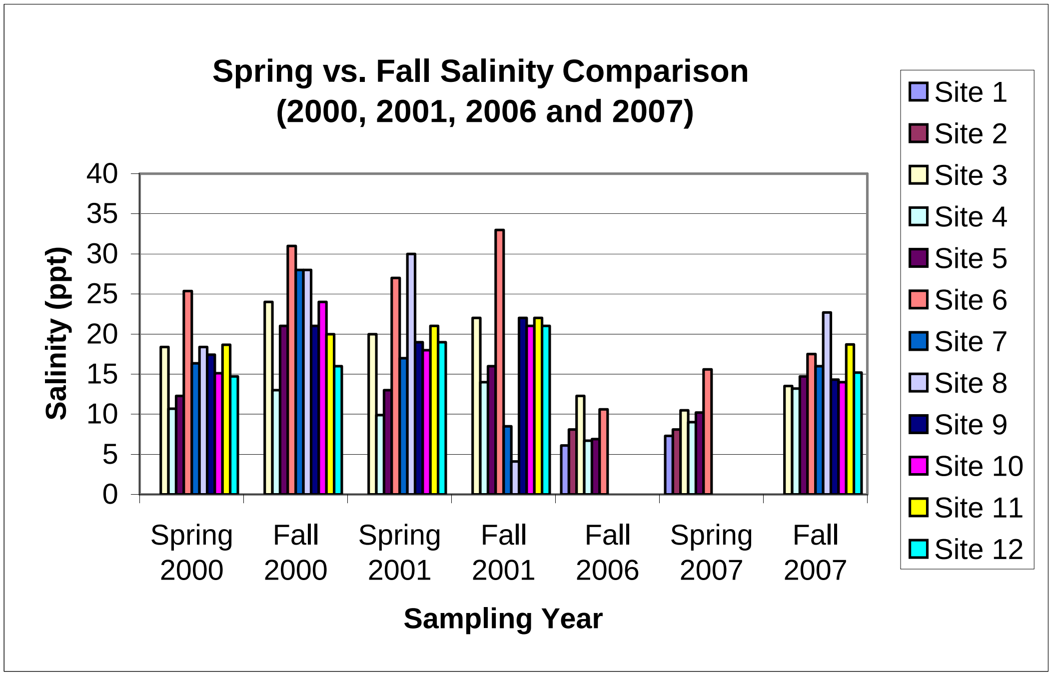
Figure 14. South San Francisco Bay Surface Water Salinities and Delta Outflows.



Interstitial Salinity. The increased surface water salinities during Spring and Fall 2007 are reflected in the soil porewater salinities sampled during the edaphic studies of 2006 and 2007. Results from soil sampling in Fall 2006 found that salinity levels at the four permanent sample sites (Sites 3, 4, 5, and 6) in the Reference Reach declined between 2000 and 2006 (Figure 8). In 2006, salinity in the areas of dead alkali bulrush was lower than in the areas of live alkali bulrush indicating that low salinity (concomitant with prolonged inundation) was likely a factor in the observed die-off and vegetation shifts during 2006 (Figure 9 and Figure 12).

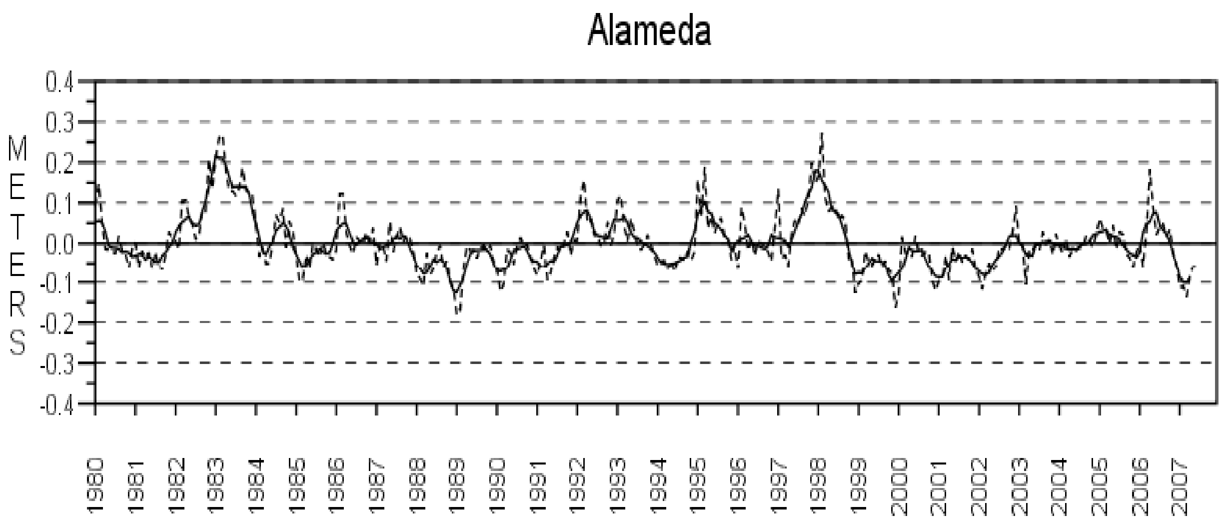
While salinities for Fall 2007 are higher than those recorded in Fall 2006 and Spring 2007, they are lower overall than Fall 2000 and Fall 2001 salinities (Figure 15). The mean interstitial salinity for alkali bulrush is 17.6 ppt., with a range of (1.1 – 35.0 ppt) (H. T. Harvey & Associates 2002b). Soil salinities in brackish marshes fell below this average in 2005, 2006, and early 2007. Decreased soil salinities may well be a significant contributing factor causing depressed germination of alkali bulrush in brackish marshes in these years, providing the opportunity for pickleweed to dominate these marshes in 2007.

Figure 15. Salinity Comparison by Year in the Main Study Area.



Mean Sea Level. The shift between alkali bulrush and pickleweed distribution does not appear to be solely related to interstitial salinities, surface water salinities, and inundation stress. In combination with these factors, shifts in vegetation are likely also related to additional environmental stress factors including interspecific competition and changes in average mean sea level. There has been a steady increase in the interannual variation of mean sea level since 1999 with higher than average mean sea level in both 2005 and 2006 (Figure 16). This increase in average mean sea level contributed to flooding over the marsh surface and inundation stress in brackish marsh communities in 2005 and 2006. However, interannual variation of mean sea level dramatically decreased between 2006 and 2007 (Figure 16). Lower mean sea level in 2007 decreased marsh inundation and may have contributed to increased salinities, in addition to less available porewater, causing additional plant stress and further suppressing alkali bulrush populations. A change of around 0.2 meters is roughly equivalent to 7.8 inches. This vertical difference translated into a relatively large horizontal difference within the relatively flat marsh plain and may have affected the moisture content of the soil as observed in the field during sediment coring. The deeper typical rooting depth of pickleweed (~18 in) versus the more shallow typical rooting depth of alkali bulrush (~8 in) may have increased the competitive advantage of pickleweed during 2007, because of the ability of pickleweed to tap into available porewater at increased depths during this period of lower mean sea level (Kantrud 1996).

Figure 16. Interannual Variation of Mean Sea Level for Alameda, California 1980-2007 (http://tidesandcurrents.noaa.gov/sltrends).



Note: The plot shows the monthly mean sea level with the average seasonal cycle and the linear trend removed (dashed curve) and the 5-month average (solid curve). The data are taken at Alameda and the graph is indicative of the trends in San Francisco Bay. However, it should be noted that the tidal amplitude in the South Bay is greater than the values reported above for Alameda.

Temperature

In January 2007, a prolonged period of below-freezing air temperatures in the San Francisco Bay region resulted in heavy frost in the area (CIMIS 2007). Low minimum air temperatures and heavy frost impacting the shallow rooting zone of alkali bulrush may have also contributed to the lack of germination success of this species in 2007.

Tidal Prism

The effect of sedimentation in the South Bay has resulted in narrower channels and deeper channel bank slope and the expansion of mudflats, which has provided additional area for gradual expansion of marsh vegetation. Much of the interannual variation in habitats within the Main Study Area is due to this ongoing resizing of channels and decreased in tidal prism in the South Bay. The Island Ponds breaching (see Figure 1, Ponds 19, 20, and 21) is projected to increase the tidal prism along Coyote Creek. Much of the Main Study Area is located adjacent to this area of increase, and an increase in tidal prism will likely result in vegetation shifts unrelated to the WPCP discharges.

Current research indicates that saline waters discharged from recently breached Pond A21 are retained along the northern portions of Coyote Creek near the Island Ponds, particularly on the ebb tide. This horizontal salinity stratification along this portion of Coyote Creek likely confines the flows from the WPCP freshwater outfall along the southern bank (pers. comm. Stacey 2007). A discernable difference between species distributions along the northern and southern shores in this stretch of Coyote Creek would likely indicate an effect related to the Island Ponds breaching.

No difference was observed in 2007, as conversion from brackish to saline marsh occurred in habitats bordering both the northern and southern shores of Coyote Creek. However, the effect of the Island Ponds breaching in contributing to the species shifts in the Transition Reach of the Main Study Area cannot be discounted as the tidal prism continues to increase and shift the tidal influence further upstream.

Sedimentation in the Reference Area has resulted in upstream portions of channels filling with estuarine sediment and sediment accumulation occurring along channel banks and fringing marshplain areas. Changing species composition and newly forming freshwater marsh upstream of the old Alviso marina, suggests a gradual reduction in tidal prism in the Reference Area (PWA 2007).

Main Study Area. As part of the Initial Stewardship Plan for the SBSP Restoration Project, three former salt ponds (Island Ponds 19, 20, and 21) adjacent to Segments 14, 15, and 21 in the Main Study Area were breached in the Spring of 2006. Long-term breach scenario modeling for the Island Pond restoration projected increased tidal flows in Coyote Creek and predicted that water column salinities in Coyote Creek would increase by 3-8 ppt after breaching (H. T. Harvey & Associates 2005).

Large-scale vegetation shifts in the Transition Reach of the Main Study Area, combined with increased water column salinities in Coyote Creek at Calaveras Point and the Railroad Bridge (Figure 13) suggest that Island Ponds (see Figure 1, Ponds 19, 20, and 21) restoration may be increasing the tidal prism along Coyote Creek. In addition, the increase in tidal prism resulting from the opening of these three former salt ponds to tidal action is anticipated to result in some scour of the existing mudflats and possibly some fringing marshes. Marsh edge scour was observed from the boat along the marsh edges of a number of segments along Coyote Creek during mapping in 2007. A normal rainfall year in the winter of 2007/2008 and continued monitoring in 2008 will help determine the effects of rainfall, freshwater inputs, and the potential increase in tidal prism on vegetation shifts.

Reference Area. Brackish to salt marsh conversion occurred in the Reference Area, but was mapped primarily in Segments 29 and 30 (Figure B-12), and this conversion was not as extensive as the marsh conversion observed in the Main Study Area. In fact, a large area of former brackish marsh converted to freshwater marsh in Segment 28 in 2007.

OVERALL CONCLUSION

Large-scale conversion of brackish marsh to salt marsh occurred across the entire Main Study Area between 2006 and 2007 (Figures B9 - B12). This large-scale conversion comprises the largest such shift seen since the study began in 1989 and emphasizes the dynamic nature of these marshes. The average local freshwater flows in the South Bay and from the Delta have fluctuated between years, but the WPCP flows have remained relatively constant (~180 cfs ±30%) since the inception of this study in 1989.

Salt marsh conversion fluctuates between years because much of the overall marsh conversion has historically been driven by large-scale influences (both environmental and anthropogenic) affecting the entire system. These include local and regional freshwater inputs, historic landscape-scale changes such as salt pond construction (SFEI 1999) and subsequent changes in channel morphology. Rainfall patterns and sea level rise have also contributed to marsh conversion, as well as changes in relative tidal height from historic groundwater pumping between 1919 and 1967 that resulted in widespread subsidence in the Alviso area.

Vegetation shifts in 2007 from alkali bulrush to pickleweed observed throughout the Main Study Area and in smaller sections of the Reference Area appear to be related to a combination of factors. The lack of late season rainfall in 2007, combined with other factors including increased surface water salinities, lower mean sea level and the localized effect of SBSP restoration in the Island Ponds area influenced marsh vegetation distribution in 2007.

The only other time period (since data collection began in 1989) where saline marsh species were more dominant than brackish marsh species in the Transition Reach of the Main Study Area was in 1989 and 1994 (Figure 10). In 1994, similar to 2007, there was a combination of low mean sea level (Figure 16) and comparable elevated salinities at Calaveras Point, with monthly mean salinities in the 20-30 ppt range for the first 4 months of each year. This combination of lower mean sea level and higher ambient salinities are likely the key contributors to the saline species dominance in these years.

While pickleweed growth in 2007 is healthy and vigorous, the dramatic differences in rainfall patterns, freshwater inputs, and soil salinities between recent years suggests that these marshes could shift back to alkali bulrush dominated habitats in 2008 if typical rainfall, runoff, and tidal patterns should resume.

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APPENDIX A.
2007 VEGETATION MAPS

2007 MARSH PLANT ASSOCIATIONS OF SOUTH SAN FRANCISCO BAY

LOWER REACH SEGMENTS DOMINANT SPECIES

SEGMENTS 1, 2, 3, 4, 8, 22 and 23

- Alkali Bulrush
- Alkali Heath
- Cordgrass
- Gumplant
- Jaumea
- Peppergrass
- Peripheral Halophytes
- Pickleweed
- Pickleweed-Cordgrass Mix
- Saltgrass
- Spearscale
- Upland Species
- Dead Vegetation
- Water
- Levee

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2007 South Bay Marsh Studies Dominant Plant Species By Reach

Proj No. **477-28**	Date **Dec. 2007**	Figure **A-1**

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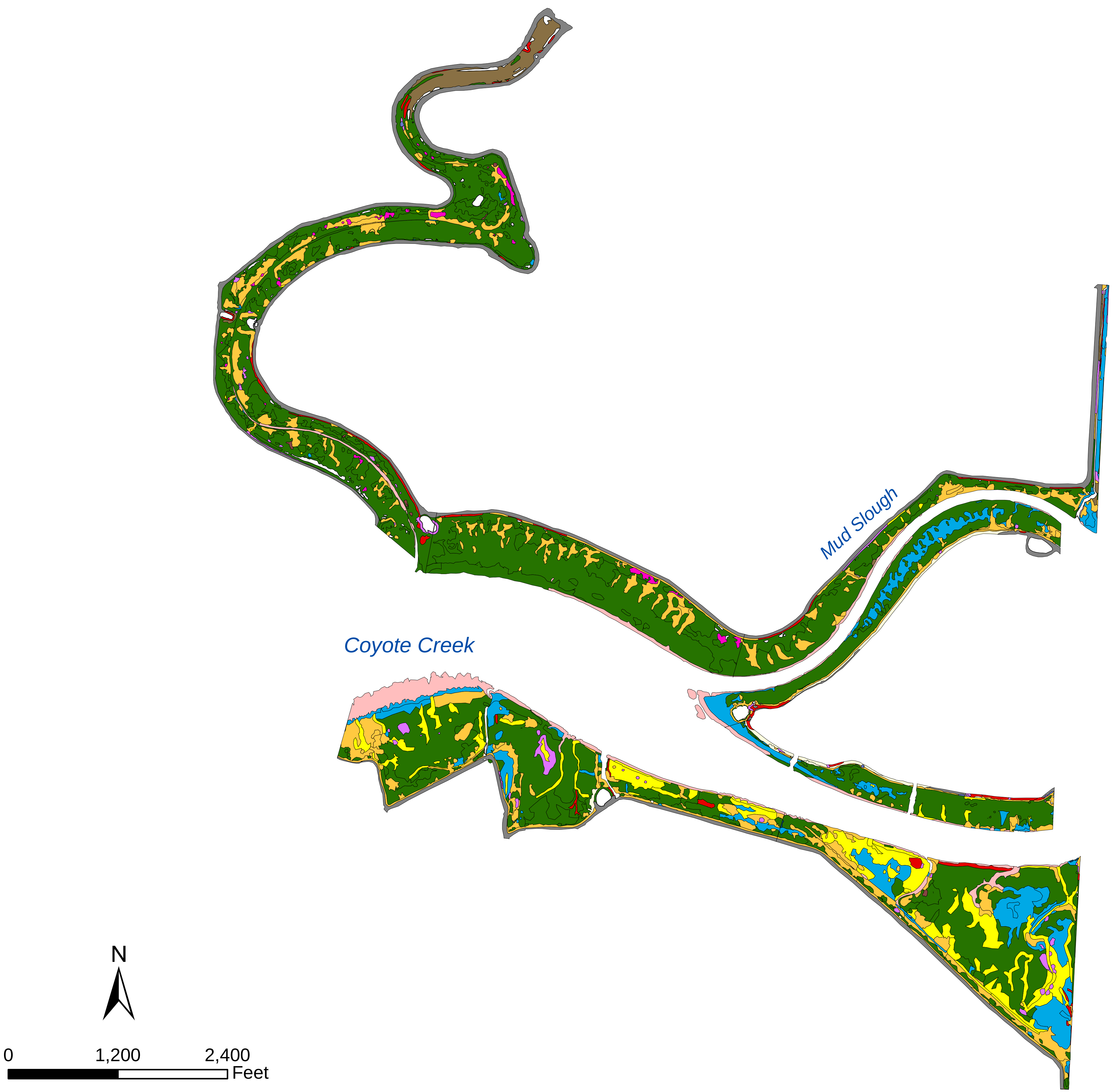
2007 MARSH PLANT ASSOCIATIONS OF SOUTH SAN FRANCISCO BAY

TRANSITION SEGMENTS DOMINANT SPECIES

SEGMENTS 5, 9, 10, 11, 14 and 20



- Alkali Bulrush
- Alkali Heath
- California Bulrush
- Cordgrass
- Gumplant
- Jaumea
- Peppergrass
- Peripheral Halophytes
- Pickleweed
- Pickleweed-Cordgrass
- Saltgrass
- Spearscale
- Upland Species
- Dead Vegetation
- Water
- Levee

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2007 South Bay Marsh Studies Dominant Plant Species By Reach

Proj No. **477-28**	Date **Dec. 2007**	Figure **A-2**
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2007 MARSH PLANT ASSOCIATIONS OF SOUTH SAN FRANCISCO BAY

UPPER REACH SEGMENTS DOMINANT SPECIES

SEGMENTS 12, 13, 15, 16, 17, 18, 19, 21, 24, 25 and 26

- Alkali Bulrush
- Alkali Heath
- Arundo
- California Bulrush
- Cattail
- Cordgrass
- Grass-leaved Goldenrod
- Gumplant
- Peppergrass
- Peripheral Halophytes
- Pickleweed
- Spearscale
- Water Primrose
- Upland Species
- Dead Vegetation
- Water
- Levee

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2007 South Bay Marsh Studies Dominant Plant Species By Reach

Proj No. 477-28	Date Dec. 2007	Figure A-3
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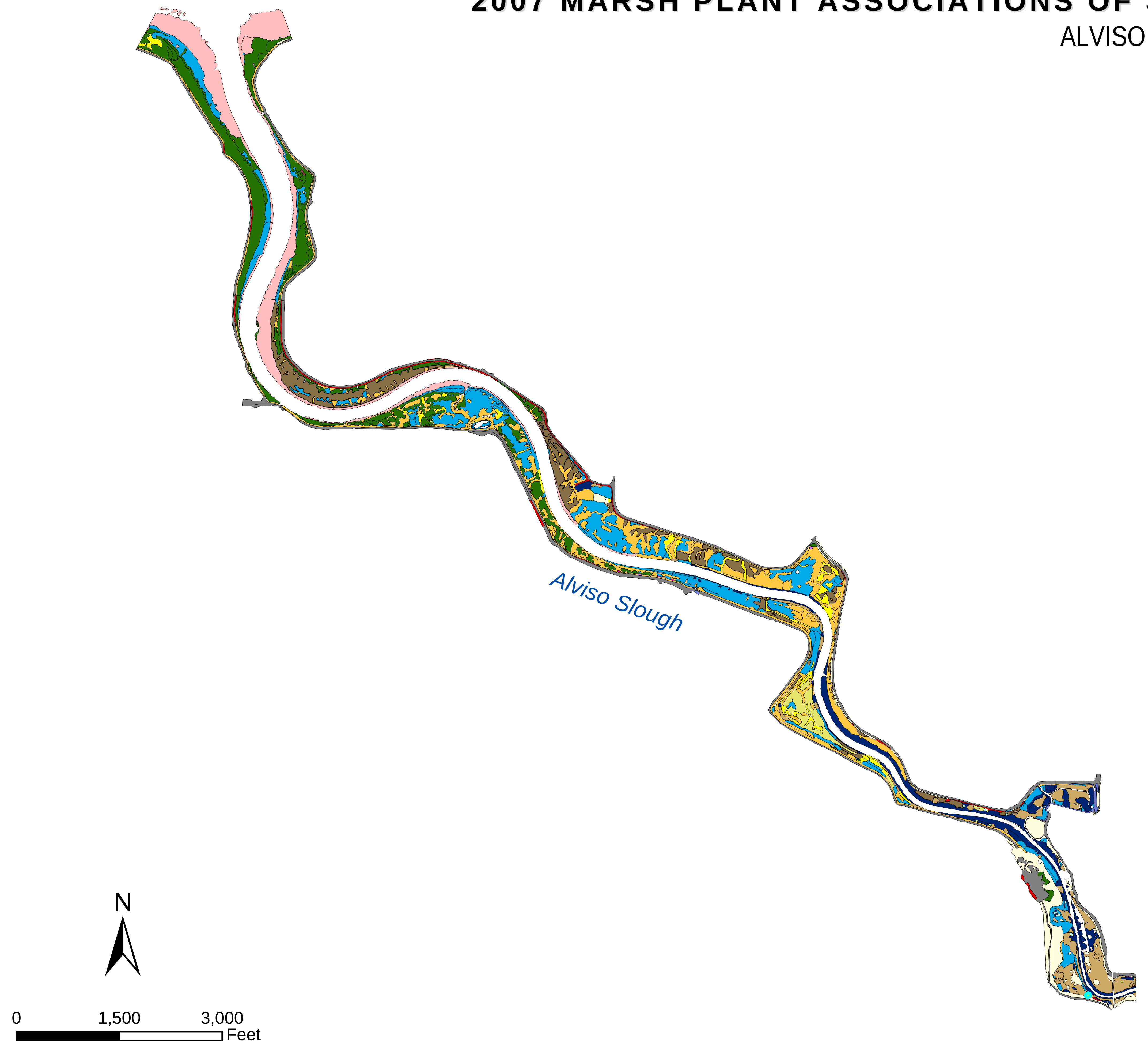
2007 MARSH PLANT ASSOCIATIONS OF SOUTH SAN FRANCISCO BAY

ALVISO SLOUGH SEGMENTS DOMINANT SPECIES

SEGMENTS 27, 28, 29 and 30



- Alkali Bulrush
- Alkali Heath
- Arundo
- California Bulrush
- Cattail
- Cordgrass
- Grass-leaved Goldenrod
- Gumplant
- Jaumea
- Olney's Bulrush
- Peppergrass
- Peripheral Halophytes
- Pickleweed
- Saltgrass
- Smartweed
- Spearscale
- Upland Species
- Dead Vegetation
- Water
- Levee

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2007 South Bay Marsh Studies Dominant Plant Species By Reach

Proj No. **477-28**	Date **Dec. 2007**	Figure **A-4**
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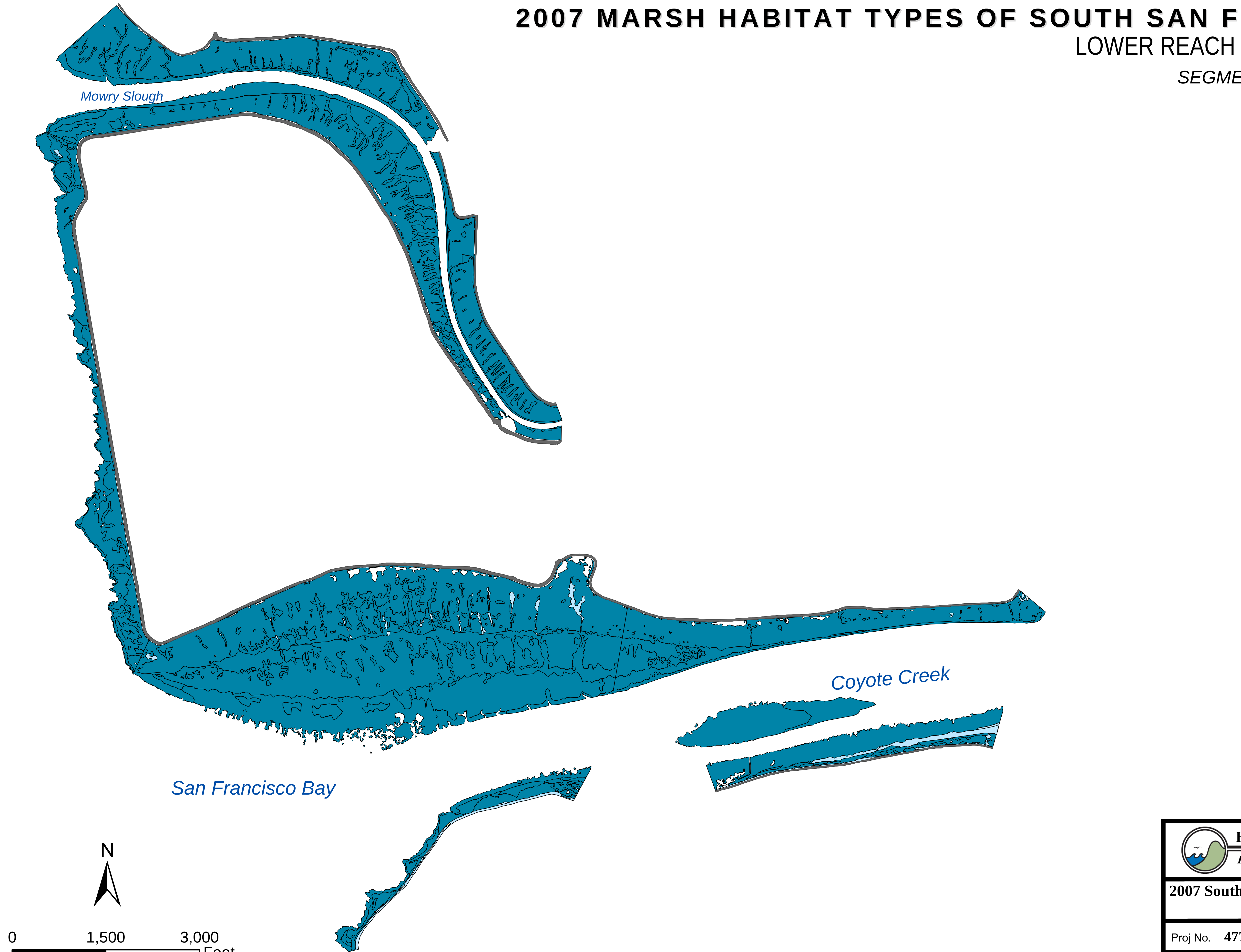
2007 MARSH HABITAT TYPES OF SOUTH SAN FRANCISCO BAY

LOWER REACH SEGMENTS HABITATS

SEGMENTS 1, 2, 3, 4, 8, 22 and 23



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2007 South Bay Marsh Studies Marsh Habitat Types By Reach		
Proj No. 477-28	Date Dec. 2007	Figure A-5
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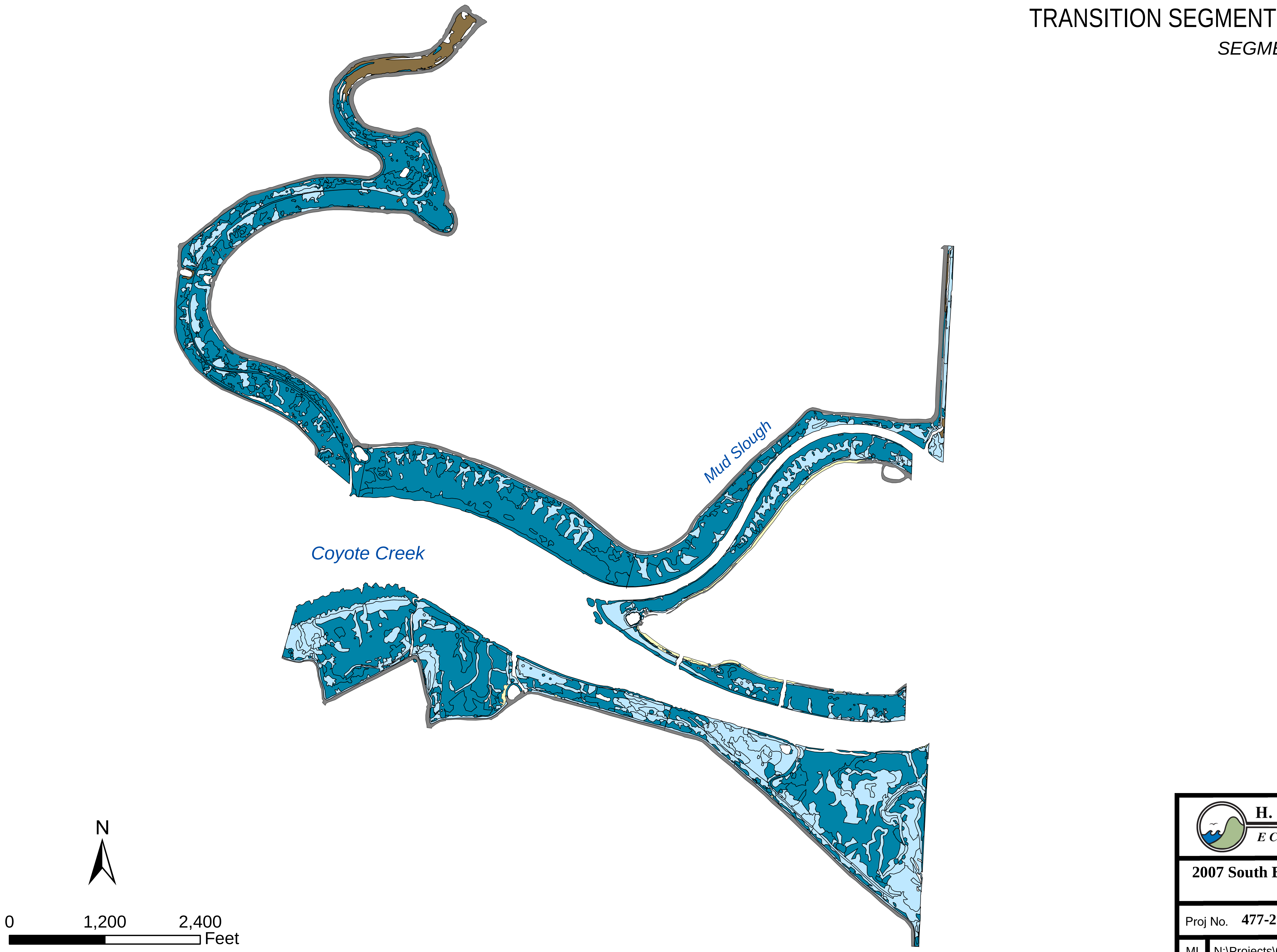
2007 MARSH HABITAT TYPES OF SOUTH SAN FRANCISCO BAY

TRANSITION SEGMENTS DOMINANT SPECIES

SEGMENTS 5, 9, 10, 11, 14 and 20



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2007 South Bay Marsh Studies Marsh Habitat Types By Reach

Proj No. 477-28	Date Dec. 2007	Figure A-6
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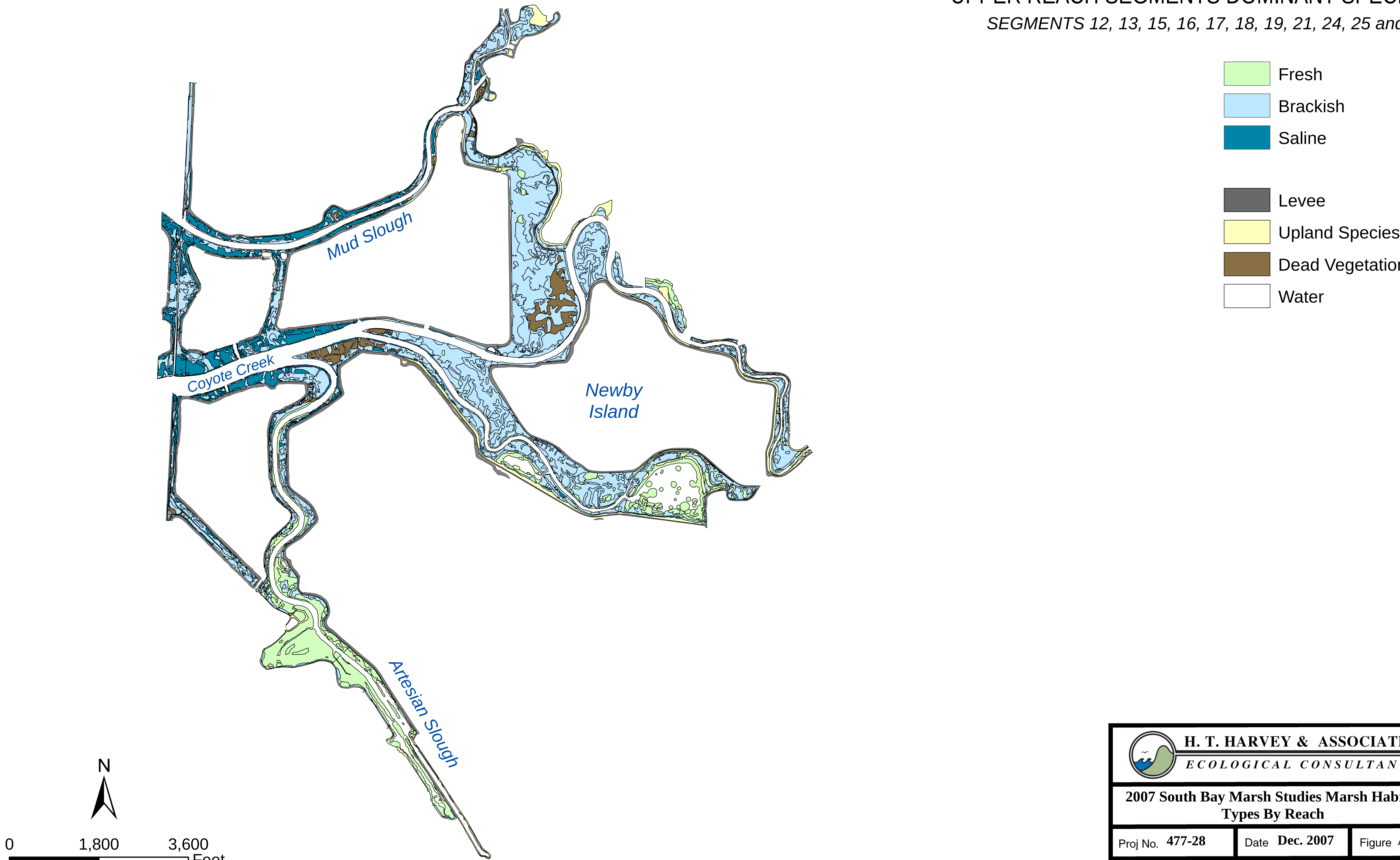
2007 MARSH HABITAT TYPES OF SOUTH SAN FRANCISCO BAY

UPPER REACH SEGMENTS DOMINANT SPECIES

SEGMENTS 12, 13, 15, 16, 17, 18, 19, 21, 24, 25 and 26



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2007 South Bay Marsh Studies Marsh Habitat Types By Reach

Proj No. **477-28**	Date **Dec. 2007**	Figure **A-7**
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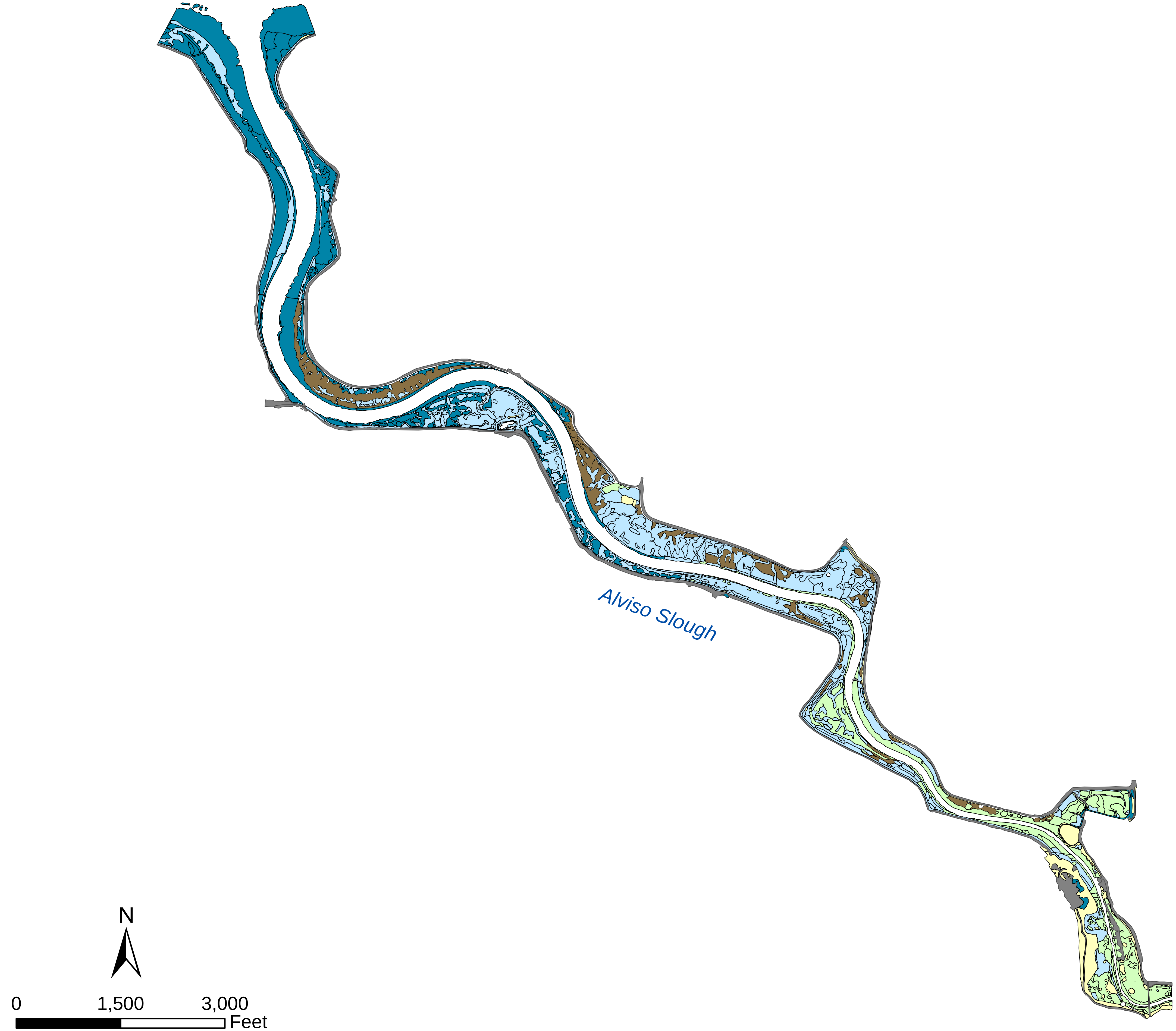
2007 MARSH HABITAT TYPES OF SOUTH SAN FRANCISCO BAY

ALVISO SLOUGH SEGMENTS HABITATS

SEGMENTS 27, 28, 29 and 30



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2007 South Bay Marsh Studies Marsh Habitat Types By Reach

Proj No. **477-28**	Date **Dec. 2007**	Figure **A-8**

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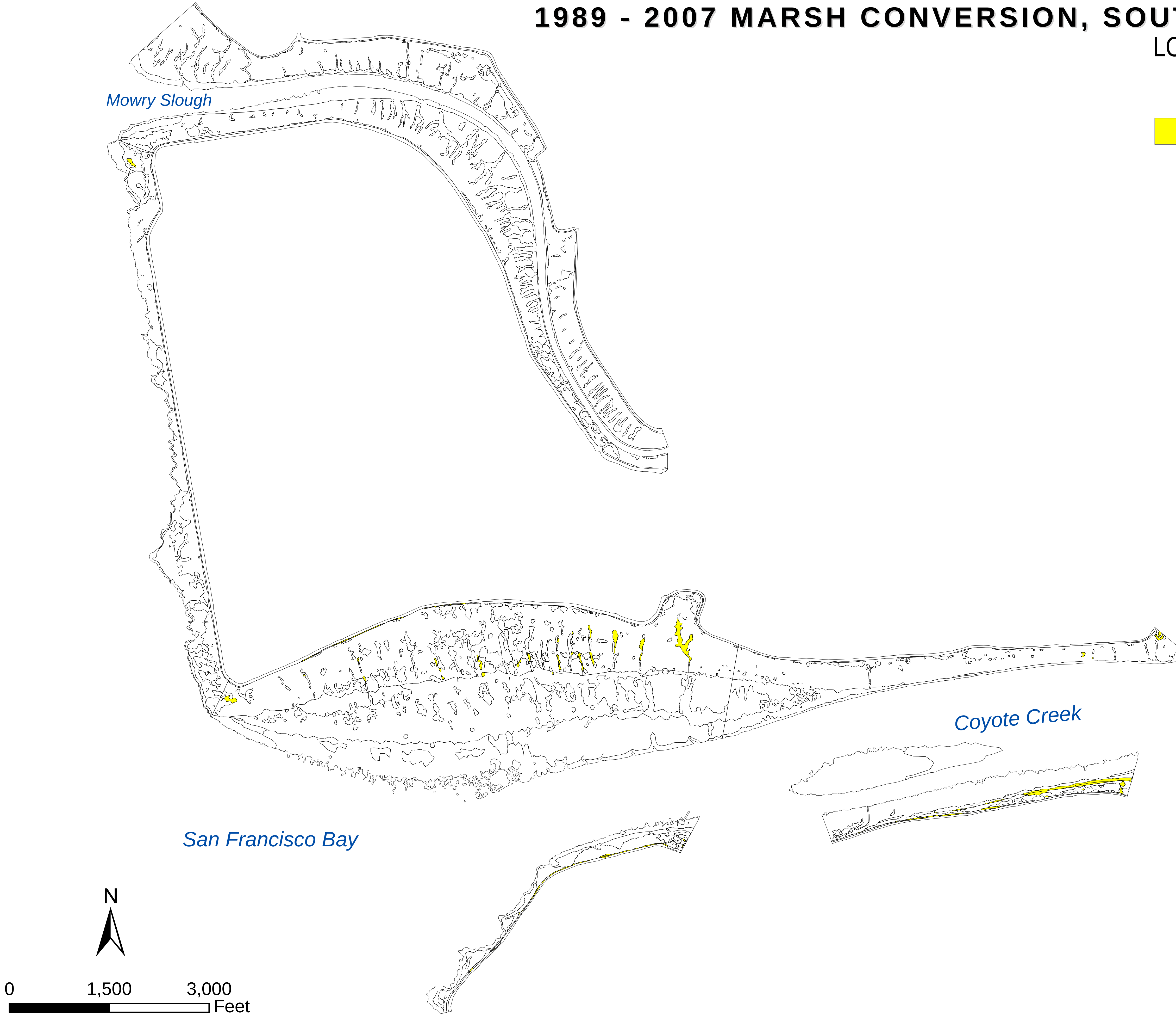
APPENDIX B.
1989/2007 SPATIAL ANALYSIS MAPS

1989 - 2007 MARSH CONVERSION, SOUTH SAN FRANCISCO BAY

LOWER REACH SEGMENTS HABITATS

SEGMENTS 1, 2, 3, 4, 8, 22 and 23

Saline Marsh Converted to Brackish Marsh



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1989 - 2007 Marsh Conversion By Reach

Proj No. 477-28	Date Dec. 2007	Figure B-1
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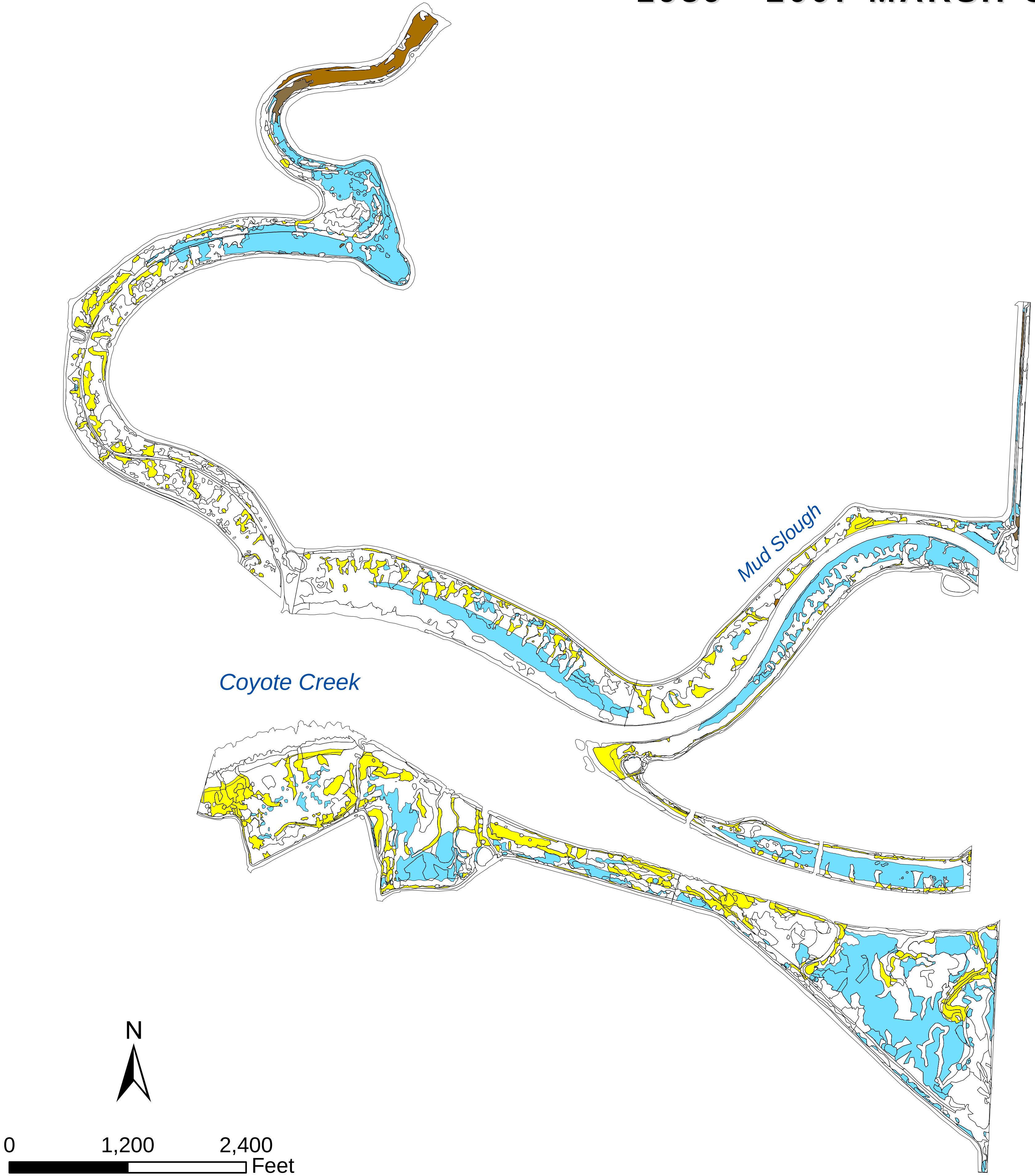
1989 - 2007 MARSH CONVERSION, SOUTH SAN FRANCISCO BAY

TRANSITION SEGMENTS HABITATS SPECIES

SEGMENTS 5, 9, 10, 11, 14 and 20

- Saline Marsh Converted to Brackish Marsh
- Brackish Marsh Converted to Saline Marsh
- Brackish Marsh Converted to Fresh Marsh
- Saline Marsh Converted to Dead Vegetation
- Brackish Marsh Converted to Dead Vegetation



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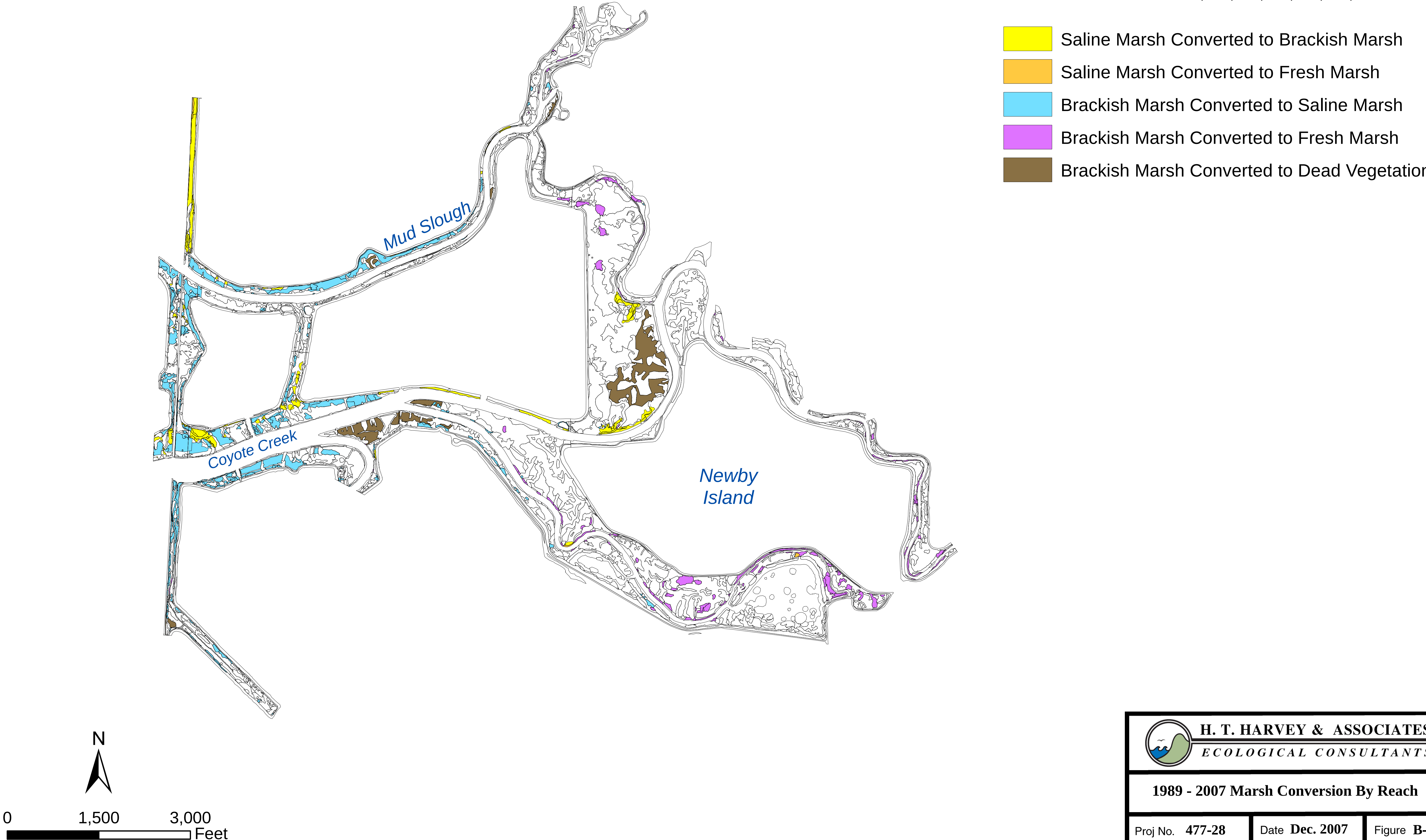
1989 - 2007 Marsh Conversion By Reach

Proj No. 477-28	Date Dec. 2007	Figure B-2
ML	N:\Projects\0477-28 2007\Final Figures	

1989 - 2007 MARSH CONVERSION, SOUTH SAN FRANCISCO BAY

UPPER REACH SEGMENTS DOMINANT HABITATS

SEGMENTS 12, 13, 15, 16, 17, 18, 19 and 21



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1989 - 2007 Marsh Conversion By Reach

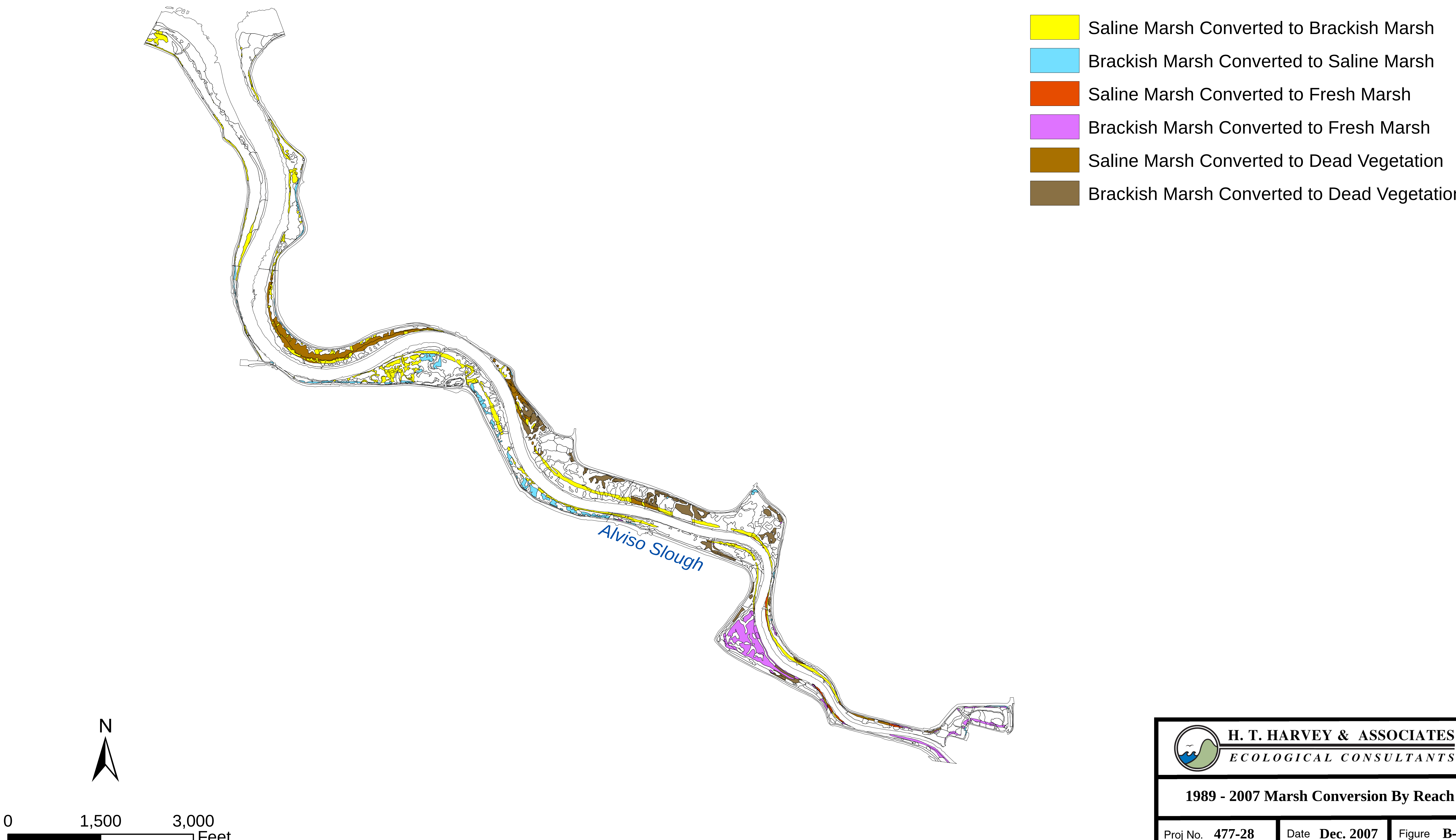
Proj No. 477-28	Date Dec. 2007	Figure B-3

ML N:\Projects\0477-28 2007\Final Figures

1989 - 2007 MARSH CONVERSION, SOUTH SAN FRANCISCO BAY

ALVISO SLOUGH SEGMENTS HABITATS

SEGMENTS 28, 29 and 30



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1989 - 2007 Marsh Conversion By Reach

Proj No. 477-28	Date Dec. 2007	Figure B-4

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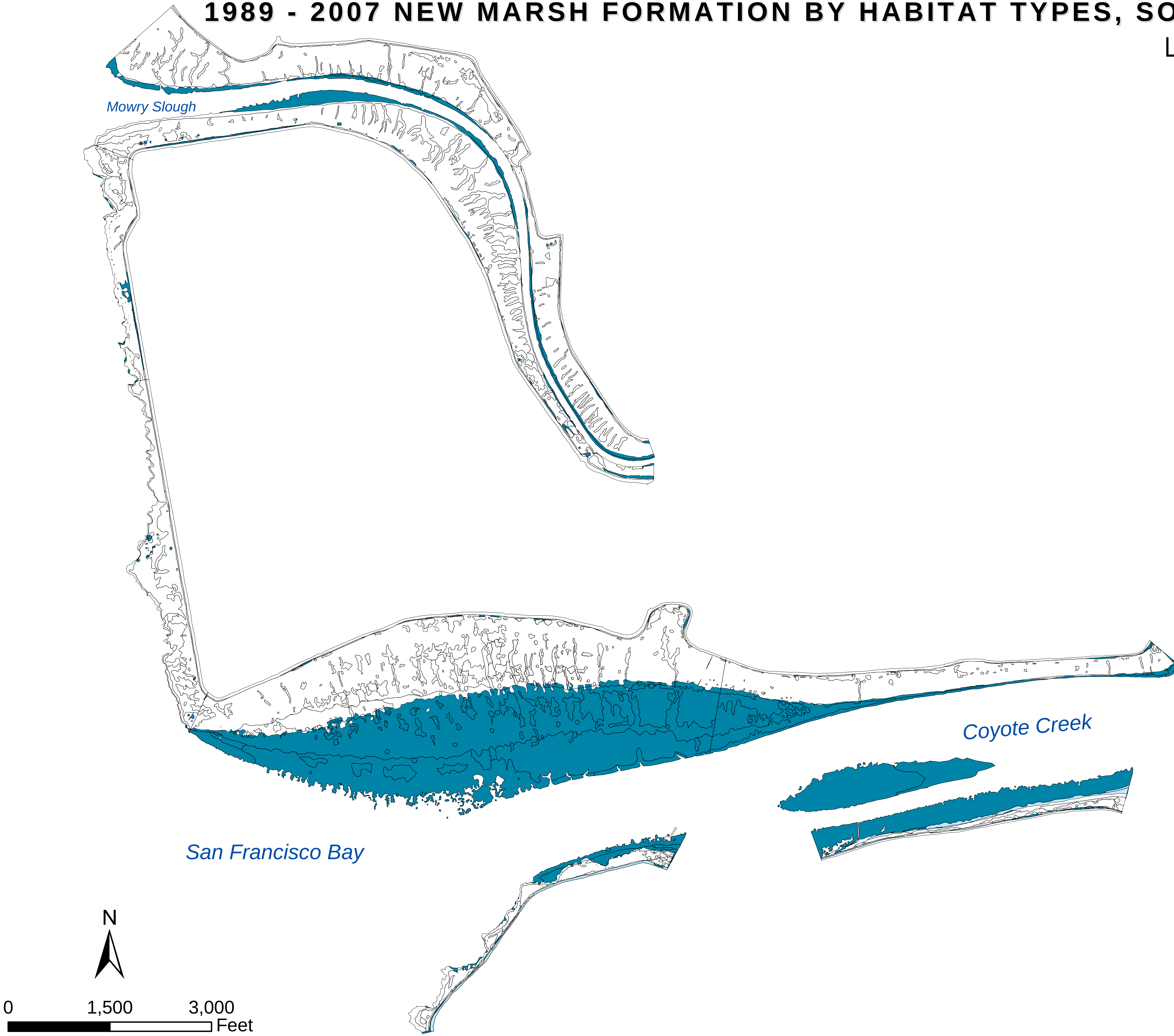
1989 - 2007 NEW MARSH FORMATION BY HABITAT TYPES, SOUTH SAN FRANCISCO BAY

LOWER REACH SEGMENTS HABITATS

SEGMENTS 1, 2, 3, 4, 8, 22 and 23



New Brackish Marsh

New Saline Marsh

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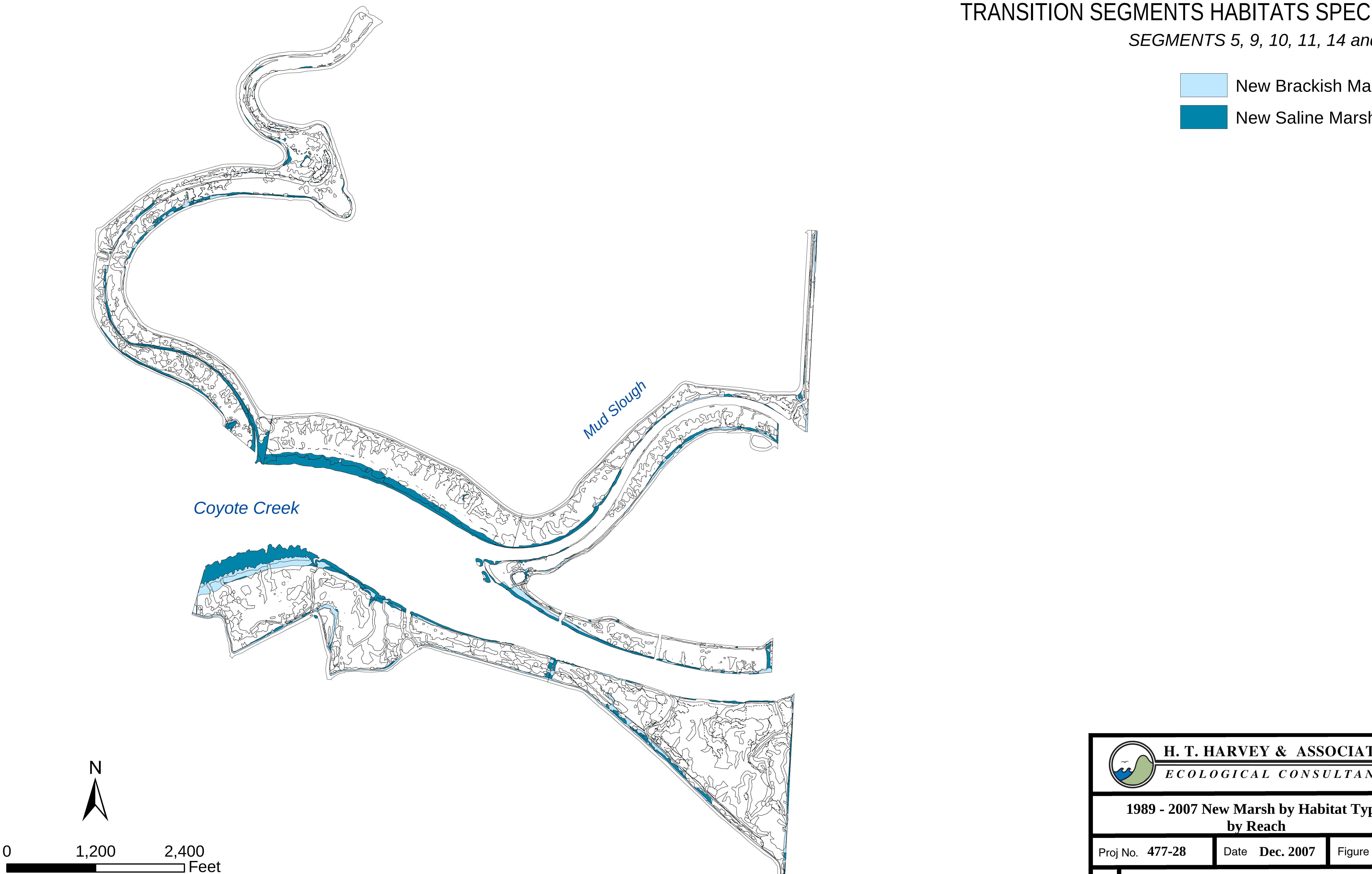
1989 - 2007 New Marsh by Habitat Type, by Reach

Proj No. **477-28**	Date **Dec. 2007**	Figure **B-5**
ML	N:\Projects\0477-28 2007\Final Figures	

1989 - 2007 NEW MARSH FORMATION BY HABITAT TYPES, SOUTH SAN FRANCISCO BAY

TRANSITION SEGMENTS HABITATS SPECIES

SEGMENTS 5, 9, 10, 11, 14 and 20



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1989 - 2007 New Marsh by Habitat Type, by Reach

Proj No. **477-28**	Date **Dec. 2007**	Figure **B-6**

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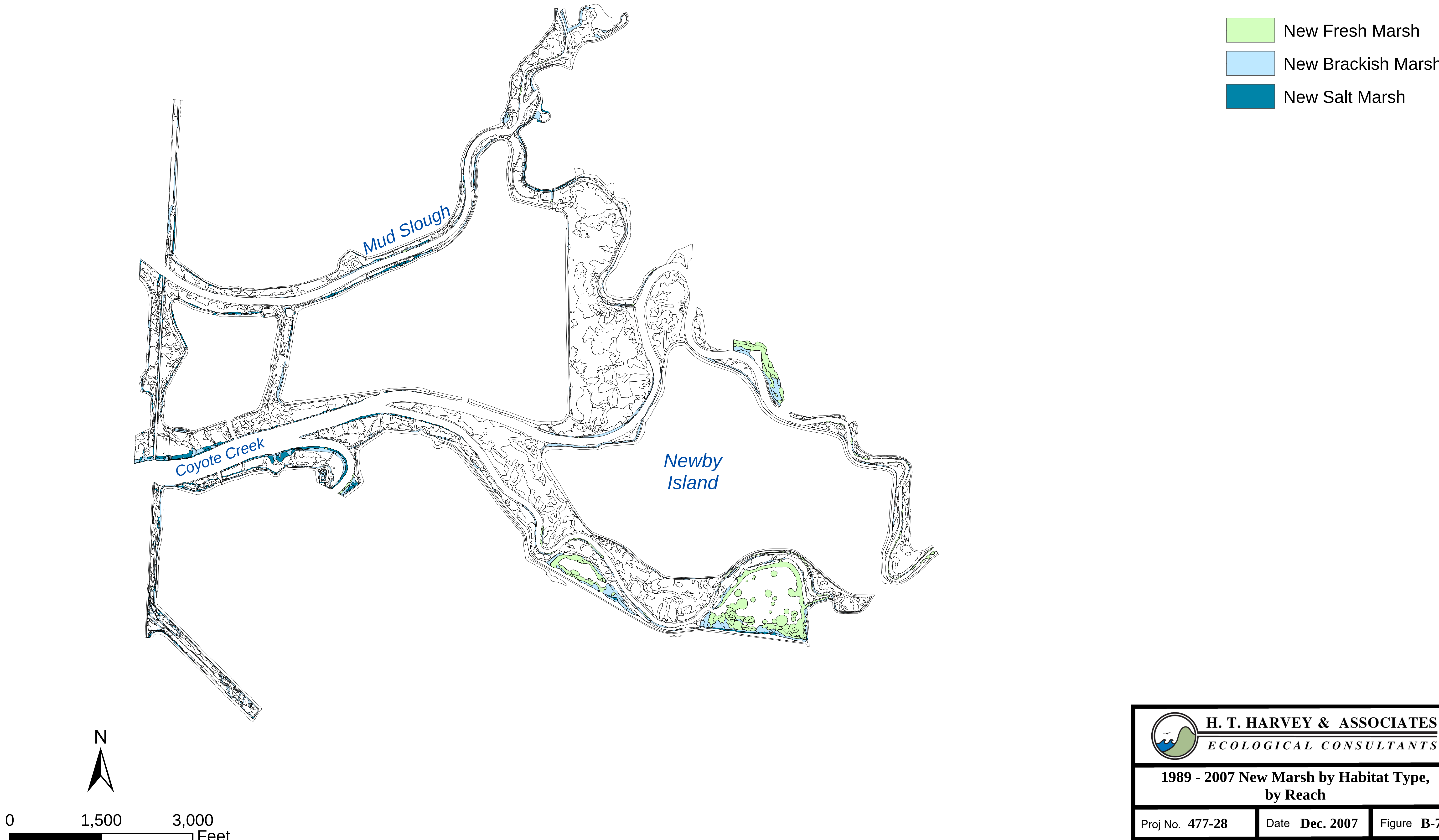
1989 - 2007 NEW MARSH FORMATION BY HABITAT TYPES, SOUTH SAN FRANCISCO BAY

UPPER REACH SEGMENTS HABITATS SPECIES

SEGMENTS 12, 13, 15, 16, 17, 18, 19 and 21



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1989 - 2007 New Marsh by Habitat Type, by Reach

Proj No. **477-28**	Date **Dec. 2007**	Figure **B-7**

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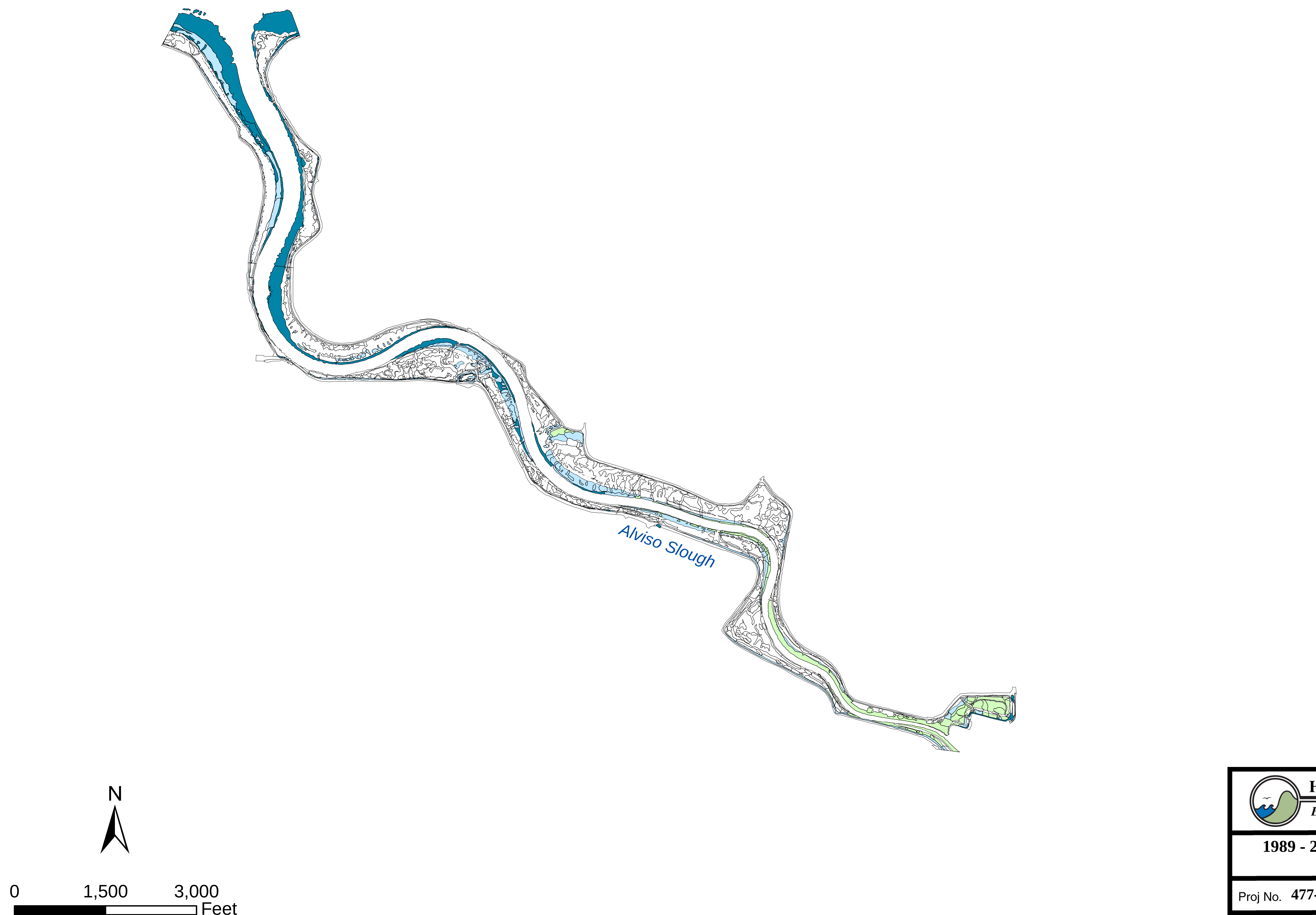
1989 - 2007 NEW MARSH FORMATION BY HABITAT TYPES, SOUTH SAN FRANCISCO BAY

ALVISO SLOUGH SEGMENTS HABITATS

SEGMENTS 28, 29 and 30



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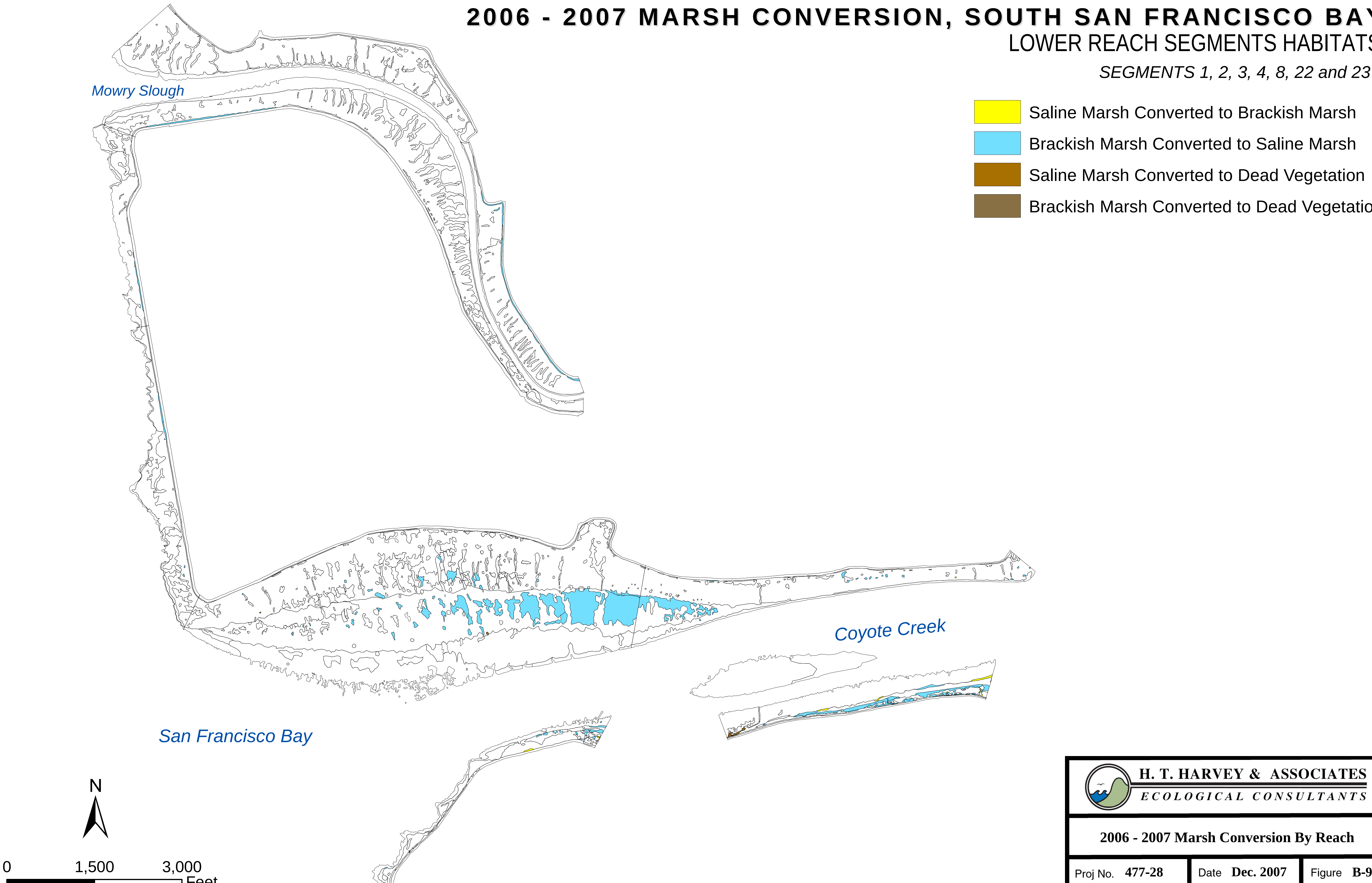
1989 - 2007 New Marsh by Habitat Type, by Reach

Proj No. 477-28	Date Dec. 2007	Figure B-8
ML	N:\Projects\0477-28 2007\Final Figures	

2006 - 2007 MARSH CONVERSION, SOUTH SAN FRANCISCO BAY

LOWER REACH SEGMENTS HABITATS

SEGMENTS 1, 2, 3, 4, 8, 22 and 23



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2006 - 2007 Marsh Conversion By Reach

Proj No. **477-28**	Date **Dec. 2007**	Figure **B-9**

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2006 - 2007 MARSH CONVERSION, SOUTH SAN FRANCISCO BAY

TRANSITION SEGMENTS HABITATS SPECIES

SEGMENTS 5, 9, 10, 11, 14 and 20

Saline Marsh Converted to Brackish Marsh
Saline Marsh Converted to Dead Marsh
Brackish Marsh Converted to Saline Marsh
Fresh Marsh Converted to Brackish Marsh
Fresh Marsh Converted to Saline Marsh

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2006 - 2007 Marsh Conversion By Reach

Proj No. 477-28	Date Dec. 2007	Figure B-10

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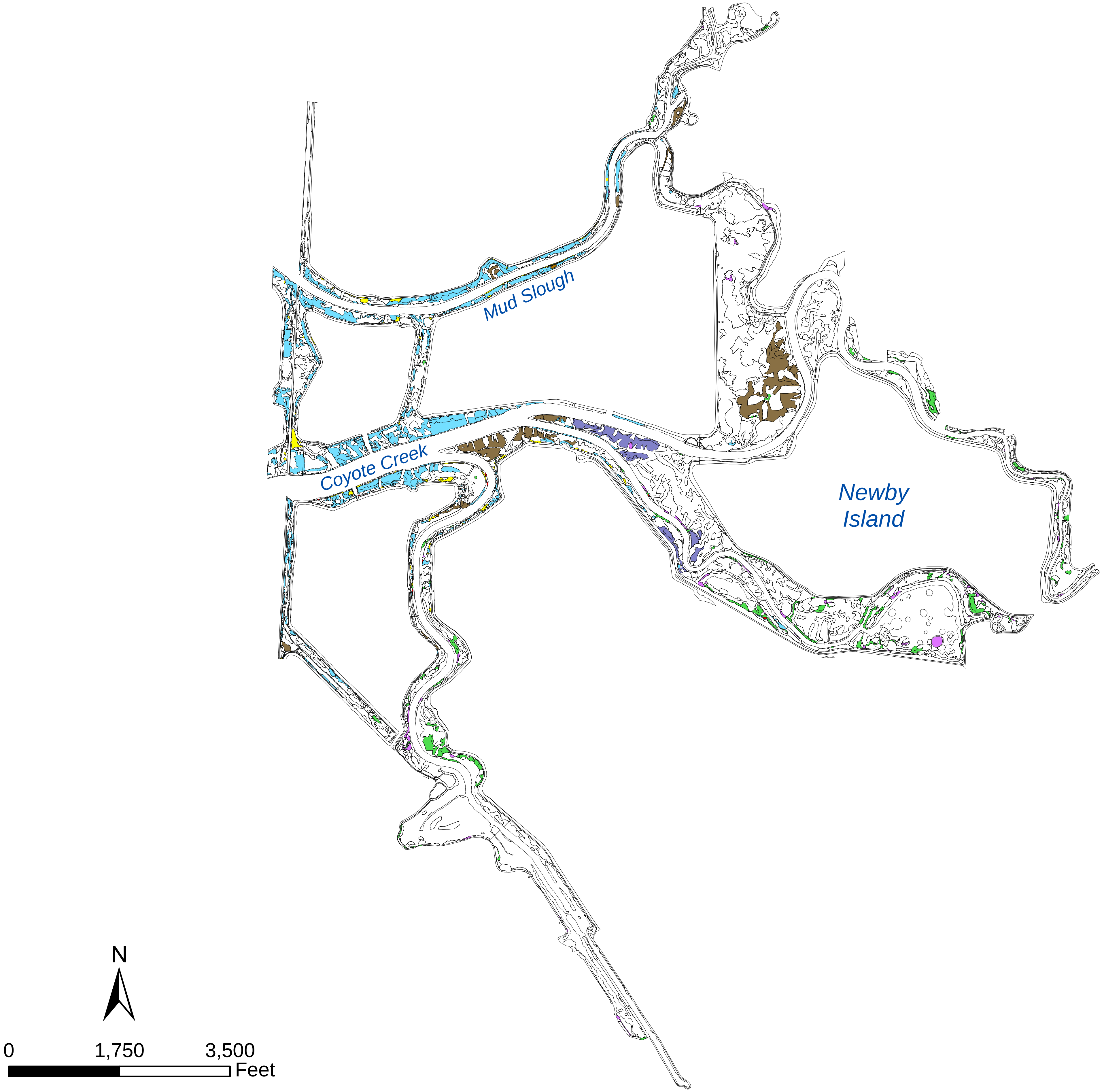
2006 - 2007 MARSH CONVERSION, SOUTH SAN FRANCISCO BAY

UPPER REACH SEGMENTS DOMINANT HABITATS

SEGMENTS 12, 13, 15, 16, 17, 18, 19 24, 25 and 26

- Saline Marsh Converted to Brackish Marsh
- Saline Marsh Converted to Dead Marsh
- Brackish Marsh Converted to Saline Marsh
- Brackish Marsh Converted to Fresh Marsh
- Brackish Marsh Converted to Dead Vegetation
- Fresh Marsh Converted to Brackish Marsh
- Fresh Marsh Converted to Saline Marsh
- Dead Marsh Converted to Brackish Marsh



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2006 - 2007 Marsh Conversion By Reach

Proj No. **477-28**	Date **Dec. 2007**	Figure **B-11**
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2006 - 2007 MARSH CONVERSION, SOUTH SAN FRANCISCO BAY

ALVISO SLOUGH SEGMENTS HABITATS

SEGMENTS 27, 28, 29 and 30

- Saline Marsh Converted to Brackish Marsh
- Saline Marsh Converted to Dead Marsh
- Brackish Marsh Converted to Saline Marsh
- Brackish Marsh Converted to Fresh Marsh
- Brackish Marsh Converted to Dead Vegetation
- Fresh Marsh Converted to Brackish Marsh
- Fresh Marsh Converted to Dead Marsh
- Dead Marsh Converted to Brackish Marsh
- Dead Marsh Converted to Saline Marsh
- Dead Marsh Converted to Fresh Marsh

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1989 - 2007 Marsh Conversion By Reach

Proj No. **477-28**	Date **Dec. 2007**	Figure **B-12**

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2006 - 2007 MARSH CONVERSION, SOUTH SAN FRANCISCO BAY

ALVISO SLOUGH SEGMENTS HABITATS

SEGMENTS 27, 28, 29 and 30

- Saline Marsh Converted to Brackish Marsh
- Saline Marsh Converted to Dead Marsh
- Brackish Marsh Converted to Saline Marsh
- Brackish Marsh Converted to Fresh Marsh
- Brackish Marsh Converted to Dead Vegetation
- Fresh Marsh Converted to Brackish Marsh
- Fresh Marsh Converted to Dead Marsh
- Dead Marsh Converted to Brackish Marsh
- Dead Marsh Converted to Saline Marsh
- Dead Marsh Converted to Fresh Marsh

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ECOLOGICAL CONSULTANTS

1989 - 2007 Marsh Conversion By Reach

Proj No. **477-28**	Date **Dec. 2007**	Figure **B-12**

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APPENDIX C.
VEGETATION MATRICES

Table C1. Acreage Summary of Segment 1 for 1989, 1994/1995, 1996-2007.

DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	13.3	19.2	27.2	18.6	12.2	12.6	16.3	18.7	24.2	23.1	22.9	22.5	22.6	21.9
Cordgrass	9.0	1.4	3.4	2.8	9.7	1.94	0.9	1.5	0.5	0.6	0.6	0.6	0.8	0.8
Pickleweed-Cordgrass Mix	14.1	0.0	0.0	1.3	0.8	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.3	0.3	0.3
Gumplant	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.4	0.5
Peripheral Halophytes	1.0	1.5	1.7	0.0	1.4	1.43	1.2	4.4	0.3	0.5	0.5	0.5	0.5	0.6
Total Saline Dominant Species:	**37.4**	**22.1**	**32.3**	**22.7**	**24.3**	**16.8**	**18.5**	**24.8**	**25.2**	**24.4**	**24.5**	**24.2**	**24.6**	**24.1**
Brackish Marsh Vegetation														
Alkali Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peppergrass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spearscale	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.3	0.3
Total Brackish Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.2**	**0.2**	**0.3**	**0.3**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**37.4**	**22.1**	**32.3**	**23.3**	**26.5**	**27.1**	**24.4**	**24.8**	**25.2**	**24.4**	**24.7**	**24.4**	**24.9**	**24.4**

Table C2. Acreage Summary of Segment 2 for 1989, 1994/1995, 1996- 2007.

DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	26.1	35.5	32.9	32.4	19.0	36.2	36.4	32.5	39.3	37.7	38.0	37.9	35.7	35.6
Cordgrass	13.7	2.3	2.6	3.8	10.5	3.1	1.5	3.1	0.4	0.6	0.5	0.5	2.8	1.7
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	1.8	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.4	0.3	0.4	0.4	0.4
Gumplant	0.0	0.0	0.0	0.2	0.2	1.4	1.0	1.6	1.3	1.2	1.4	1.4	1.4	1.1
Peripheral Halophytes	3.9	2.3	1.6	0.7	3.0	2.2	2.0	5.0	0.6	0.8	1.0	1.0	1.0	1.0
Total Saline Dominant Species:	**43.7**	**40.1**	**37.1**	**38.9**	**32.7**	**42.9**	**41.6**	**42.1**	**41.8**	**41.7**	**41.2**	**41.2**	**41.3**	**39.8**
Brackish Marsh Vegetation														
Alkali Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peppergrass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spearscale	0.0	0.0	0.0	0.4	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Brackish Dominant Species:	**0.0**	**0.0**	**0.0**	**0.4**	**7.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**43.7**	**40.1**	**37.1**	**39.8**	**41.2**	**42.9**	**41.7**	**42.1**	**41.8**	**41.7**	**41.2**	**41.2**	**41.3**	**39.8**

Table C3. Acreage Summary of Segment 3 for 1989, 1994/1995, 1996-2007.

DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	160.1	114.7	79.3	95.1	98.7	118.3	187.4	163.7	149.7	179.3	210.6	212.8	188.5	217.2
Cordgrass	0.6	3.4	2.9	86.6	104.6	15.9	46.3	70.6	42.1	57.8	37.0	45.5	45.7	47.7
Pickleweed-Cordgrass Mix	0.0	69.9	98.8	36.0	0.0	83.3	0.0	0.0	102.1	66.8	67.4	67.4	87.7	84.0
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0
Jaumea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Gumplant	0.0	0.0	2.7	6.9	2.2	7.4	6.6	7.6	4.6	4.8	6.0	6.0	4.7	4.8
Peripheral Halophytes	0.4	2.6	1.1	1.0	2.2	1.0	1.3	0.7	0.7	1.2	0.8	0.8	0.8	0.8
Total Saline Dominant Species:	**161.1**	**190.6**	**184.8**	**225.6**	**207.9**	**225.9**	**241.5**	**242.6**	**299.4**	**310.0**	**321.9**	**332.6**	**327.5**	**354.6**
Brackish Marsh Vegetation														
Alkali Bulrush	0.0	0.0	0.1	0.0	49.2	50.8	39.9	44.2	13.2	17.6	19.0	19.0	25.8	0.2
Peppergrass	0.0	1.1	1.2	1.6	1.8	1.8	1.5	2.6	1.8	2.4	3.7	3.7	3.0	3.0
Spearscale	0.0	0.0	0.0	0.2	2.4	0.0	0.0	0.0	0.0	0.0	0.9	0.9	0.9	0.9
Total Brackish Dominant Species:	**0.0**	**1.1**	**1.3**	**1.8**	**53.4**	**52.6**	**41.4**	**46.7**	**15.0**	**20.0**	**23.6**	**23.6**	**29.7**	**4.1**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**161.1**	**191.7**	**212.3**	**227.6**	**262.1**	**278.5**	**282.9**	**289.4**	**314.4**	**330.0**	**345.5**	**356.2**	**357.2**	**358.7**

Table C4. Acreage Summary of Segment 4 for 1989, 1994/1995, 1996-2007.
DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	49.1	43.9	46.9	50.1	49.8	47.6	57.5	53.3	53.2	55.3	54.8	55.1	52.4	63.7
Cordgrass	6.2	6.2	4.1	5.6	12.9	17.1	9.9	6.5	12.6	8.8	11.0	11.1	12.7	5.9
Pickleweed-Cordgrass Mix	0.0	3.4	6.2	7.2	0.1	0.0	0.0	9.8	10.0	12.2	8.2	9.9	11.3	6.8
Alkali Heath	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.1	0.5	0.2	0.2	0.2	0.3	0.3
Gumplant	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.1
Peripheral Halophytes	0.6	2.4	1.5	0.9	1.7	1.7	1.8	0.5	0.4	0.6	0.7	0.7	0.7	0.7
Total Saline Dominant Species:	**55.9**	**55.9**	**58.7**	**64.0**	**64.6**	**66.5**	**69.4**	**70.5**	**77.0**	**77.4**	**75.1**	**77.2**	**77.6**	**77.5**
Brackish Marsh Vegetation														
Alkali Bulrush	0.0	0.0	0.0	0.0	4.8	6.2	7.2	5.5	0.5	0.2	2.6	0.6	0.1	0.1
Peppergrass	0.4	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.0	0.2	0.2	0.2	0.2
Spearscale	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Brackish Dominant Species:	**0.4**	**0.1**	**0.1**	**0.1**	**5.0**	**6.4**	**7.3**	**5.6**	**0.6**	**0.2**	**2.8**	**0.8**	**0.3**	**0.3**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**56.3**	**56.0**	**58.8**	**64.0**	**70.0**	**72.9**	**76.7**	**76.1**	**77.6**	**77.6**	**77.9**	**78.0**	**77.9**	**77.8**

Table C5. Acreage Summary of Segment 5 for 1989, 1994/1995, 1996-2007.
DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	60.4	62.3	30.5	36.6	34.4	41.6	44.5	43.4	47.4	45.4	49.9	49.1	42.2	66.2
Cordgrass	0.3	2.1	2.7	2.6	3.6	2.3	2.0	0.9	1.6	1.7	1.7	1.7	1.7	1.5
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	18.9	7.9	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.2	0.1	0.4	0.2	0.3	1.2	1.3	0.8	0.8	0.8	0.8
Jaumea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.2	1.2	1.2
Gumplant	0.0	0.0	0.0	0.1	0.0	0.3	0.2	0.9	0.8	0.9	0.7	0.7	0.7	0.3
Peripheral Halophytes	1.2	0.5	1.0	2.8	3.2	6.6	4.2	2.6	1.8	1.9	3.2	1.8	1.8	1.8
Dead Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.8	6.9
Total Saline Dominant Species:	**61.9**	**64.9**	**53.1**	**50.2**	**43.5**	**52.3**	**51.2**	**48.1**	**52.8**	**51.2**	**57.5**	**55.3**	**55.2**	**78.7**
Brackish Marsh Vegetation														
Alkali Bulrush	24.4	19.2	27.3	32.1	34.7	32.0	31.4	32.6	26.3	26.8	23.5	23.7	24.5	0.2
Peppergrass	0.8	1.4	2.4	4.0	3.4	7.5	7.5	8.1	9.4	10.6	10.3	10.9	11.1	12.5
Spearscale	0.0	0.0	0.0	3.7	13.6	0.1	0.6	0.2	0.1	0.5	0.2	0.4	0.4	0.1
Total Brackish Dominant Species:	**25.2**	**20.6**	**29.7**	**39.8**	**51.7**	**39.6**	**39.5**	**40.8**	**35.8**	**37.9**	**34.0**	**35.0**	**36.0**	**12.8**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**87.1**	**85.5**	**82.8**	**90.0**	**95.2**	**91.9**	**90.7**	**89.0**	**88.6**	**89.1**	**91.5**	**90.3**	**91.2**	**91.5**

Table C6. Acreage Summary of Segment 8 for 1989, 1994/1995, 1996-2007.

DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	199.7	204.9	151.8	149.4	101.0	171.1	182.4	181.5	199.2	199.1	203.0	202.3	199.1	195.9
Cordgrass	23.1	11.7	10.2	22.5	98.0	32.5	17.8	16.7	14.9	15.8	20.2	24.6	27.8	29.6
Pickleweed-Cordgrass Mix	0.0	0.0	49.0	25.7	0.0	0.0	0.0	4.8	0.8	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.0	0.0	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.1	0.0	0.3	0.0	0.0	1.2	1.5	2.3	2.3	2.3	3.4
Gumplant	0.0	0.0	0.0	23.8	25.7	27.5	29.7	32.1	29.2	26.9	19.4	19.8	20.0	20.2
Saltgrass	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.7	0.0	0.0	0.0	0.0
Peripheral Halophytes	11.1	10.0	7.8	6.0	10.1	7.7	5.8	6.5	3.3	3.7	4.4	4.4	4.5	5.2
Total Saline Dominant Species:	**233.9**	**226.6**	**218.8**	**227.5**	**234.8**	**245.7**	**239.0**	**241.5**	**248.6**	**247.7**	**249.3**	**253.4**	**253.7**	**254.3**
Brackish Marsh Vegetation														
Alkali Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peppergrass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spearscale	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Brackish Dominant Species:	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**233.9**	**226.6**	**215.3**	**228.5**	**239.1**	**248.7**	**239.0**	**241.5**	**248.6**	**247.7**	**249.3**	**253.4**	**253.7**	**254.3**

Table C7. Acreage Summary of Segment 9 for 1989, 1994/1995, 1996-2007.

DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	46.0	32.4	15.4	10.0	3.5	6.0	5.4	7.7	31.8	12.8	11.5	14.7	7.5	42.1
Cordgrass	4.4	8.9	3.9	6.6	7.3	4.7	2.6	3.4	5.1	6.5	6.2	6.8	8.5	8.7
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.1	0.0	0.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.4	0.2	1.8	2.0	1.2	1.6
Gumplant	0.0	0.0	0.0	0.0	0.0	0.3	0.6	0.5	0.2	0.0	0.0	0.0	0.0	0.0
Peripheral Halophytes	0.0	0.0	1.3	2.0	3.3	1.2	1.3	0.4	0.1	0.8	0.4	0.5	0.0	0.5
Total Saline Dominant Species:	**50.4**	**41.3**	**20.9**	**19.2**	**14.1**	**12.6**	**10.3**	**12.1**	**37.6**	**20.3**	**19.9**	**24.0**	**17.2**	**52.9**
Brackish Marsh Vegetation														
Alkali Bulrush	15.4	22.2	44.1	50.4	67.0	60.2	56.9	56.7	33.0	50.4	51.8	47.4	51.4	6.4
Peppergrass	0.6	1.3	1.2	1.7	1.4	4.3	4.8	5.7	6.2	5.4	7.7	7.9	9.0	13.1
Spearscale	0.0	0.0	0.0	1.5	1.9	3.0	2.1	0.5	0.1	0.0	0.0	0.6	2.5	9.1
Total Brackish Dominant Species:	**16.0**	**23.5**	**45.3**	**53.6**	**70.2**	**67.5**	**63.8**	**62.8**	**39.3**	**55.8**	**59.5**	**55.9**	**62.9**	**28.6**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**	**0.0**
Total Segment Acreage	**66.4**	**64.8**	**66.2**	**72.8**	**84.3**	**80.1**	**74.1**	**74.9**	**76.9**	**76.1**	**79.4**	**79.8**	**80.9**	**81.5**

Table C8. Acreage Summary of Segment 10 for 1989, 1994/1995, 1996-2007.

DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	24.2	21.2	10.7	10.4	8.3	8.0	9.2	9.0	35.6	28.1	24.0	23.8	22.0	42.5
Cordgrass	6.4	11.0	8.4	8.3	5.0	3.6	1.5	2.0	1.4	1.5	8.1	4.3	4.3	1.5
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.1	0.7	1.3	0.0	0.0	0.0	0.0	0.0	0.0
Jaumea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Peripheral Halophytes	0.7	0.1	0.6	0.6	1.6	0.2	0.4	0.1	0.2	0.0	0.4	0.4	0.4	0.4
Total Saline Dominant Species:	**31.3**	**32.3**	**19.7**	**19.3**	**14.9**	**12.0**	**11.8**	**12.4**	**37.2**	**29.6**	**32.6**	**28.6**	**27.5**	**45.2**
Brackish Marsh Vegetation														
Alkali Bulrush	10.2	5.8	19.7	24.3	37.1	30.7	30.4	32.0	9.2	17.0	17.2	17.3	18.0	0.0
Peppergrass	2.5	1.7	1.6	2.7	1.7	6.3	5.4	5.8	4.7	5.2	5.9	5.9	6.4	6.4
Spearscale	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Brackish Dominant Species:	**12.7**	**7.5**	**21.3**	**27.0**	**38.9**	**37.0**	**35.9**	**37.8**	**13.9**	**22.2**	**23.1**	**23.2**	**24.4**	**6.4**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**44.0**	**39.8**	**41.0**	**46.3**	**53.8**	**49.0**	**47.7**	**50.2**	**51.1**	**51.8**	**55.7**	**51.8**	**51.9**	**51.6**

Table C9. Acreage Summary of Segment 11 for 1989, 1994/1995, 1996-2007.
DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	17.4	22.4	3.8	3.9	1.7	1.8	3.0	2.9	20.6	2.3	9.3	9.1	8.8	32.2
Cordgrass	0.0	1.6	1.1	1.1	1.6	2.3	0.6	1.1	1.6	1.0	0.1	0.9	0.8	2.2
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Jaumea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	1.9	1.1	1.4	0.9
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1
Peripheral Halophytes	1.0	0.0	0.4	1.1	1.5	1.2	0.2	0.3	0.0	0.3	0.0	0.6	0.5	1.2
Total Saline Dominant Species:	**18.4**	**24.0**	**5.4**	**6.4**	**5.0**	**5.3**	**3.9**	**4.4**	**22.4**	**3.9**	**11.5**	**11.7**	**11.5**	**36.6**
Brackish Marsh Vegetation														
Alkali Bulrush	51.0	48.8	63.4	64.4	68.5	68.6	65.9	64.8	47.9	63.4	57.4	54.3	53.1	14.4
Peppergrass	6.2	5.6	6.2	6.4	5.5	8.2	10.4	10.7	9.9	10.3	11.2	12.9	12.9	11.3
Spearscale	0.0	0.0	0.0	1.2	1.1	0.4	0.2	0.0	0.0	2.0	0.4	1.6	3.7	18.0
Total Brackish Dominant Species:	**57.2**	**54.4**	**69.6**	**72.0**	**75.1**	**77.2**	**76.5**	**75.6**	**57.8**	**75.7**	**69.0**	**68.8**	**69.7**	**43.7**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.1
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.2**	**0.1**
Total Segment Acreage	**75.6**	**78.4**	**75.1**	**78.3**	**80.1**	**82.5**	**80.4**	**80.0**	**80.2**	**79.6**	**80.5**	**80.6**	**81.4**	**80.4**

Table C10. Acreage Summary of Segment 12 for 1989, 1994/1995, 1996-2007.

DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	0.2	2.8	0.6	2.0	0.7	0.5	2.1	0.8	2.7	0.4	1.5	2.6	2.9	10.0
Cordgrass	0.0	2.2	1.1	1.1	0.7	1.4	0.2	0.0	0.8	1.3	1.0	1.4	1.9	2.4
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.5
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0
Saltgrass-Gumplant Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peripheral Halophytes	0.0	0.0	1.7	1.1	10.2	2.2	2.4	0.0	1.7	0.8	1.0	1.1	1.0	0.8
Total Saline Dominant Species:	**0.2**	**5.0**	**3.8**	**4.3**	**11.7**	**4.1**	**4.8**	**0.8**	**5.4**	**2.6**	**3.5**	**5.2**	**6.0**	**13.7**
Brackish Marsh Vegetation														
Alkali Bulrush	25.7	21.2	25.4	24.1	19.0	24.2	26.4	22.0	21.0	20.3	21.8	22.9	23.2	7.4
Peppergrass	12.2	17.5	13.4	14.5	9.9	18.4	14.3	22.1	18.4	22.1	21.9	16.8	16.2	18.1
Spearscale	0.0	0.0	0.0	0.5	1.7	0.0	0.1	0.0	0.2	0.3	0.1	1.6	1.2	3.1
Dead Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7
Total Brackish Dominant Species:	**37.9**	**38.7**	**38.8**	**39.0**	**30.6**	**42.6**	**40.8**	**44.1**	**39.6**	**42.7**	**43.8**	**41.3**	**40.6**	**33.3**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.7	0.5	0.3
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.1**	**0.2**	**0.2**	**0.2**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.7**	**0.7**	0.4
Total Segment Acreage	**38.1**	**43.7**	**43.1**	**43.5**	**44.5**	**47.4**	**46.0**	**45.2**	**45.3**	**45.6**	**47.6**	**47.2**	**47.3**	**47.4**

Table C11. Acreage Summary of Segment 13 for 1989, 1994/1995, 1996-2007.

DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	0.0	0.4	0.8	1.5	0.5	0.4	0.5	0.0	0.4	0.2	0.0	0.2	0.7	1.8
Cordgrass	0.0	0.4	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.3	0.1	0.1	0.1	1.1
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Peripheral Halophytes	0.4	0.0	11.9	7.0	4.0	3.1	1.8	0.0	0.4	1.5	0.1	0.1	0.5	0.1
Total Saline Dominant Species:	**0.4**	**0.8**	**12.7**	**8.7**	**4.5**	**3.5**	**2.4**	**0.1**	**1.0**	**2.0**	**0.3**	**0.5**	**1.5**	**3.1**
Brackish Marsh Vegetation														
Alkali Bulrush	95.3	79.9	84.8	73.3	63.0	76.1	83.8	78.7	80.5	76.9	68.2	77.1	48.7	42.9
Peppergrass	15.8	26.8	13.6	15.6	7.0	23.6	14.4	15.9	20.2	19.8	20.4	15.4	10.0	21.6
Spearscale	0.0	0.0	0.0	9.0	6.3	0.0	0.3	3.4	2.7	1.1	4.0	6.2	25.4	33.5
Dead Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.3	2.1
Total Brackish Dominant Species:	**111.1**	**106.7**	**98.4**	**97.9**	**76.2**	**99.7**	**98.5**	**98.0**	**103.4**	**97.8**	**92.6**	**98.7**	**95.4**	**100.1**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	1.3	4.3	26.7	7.0	5.7	4.4	13.7	16.6	23.5	18.0	18.8	16.5
Cattail	0.0	0.0	0.1	0.2	1.8	1.1	2.2	0.8	2.2	2.4	3.9	6.3	8.7	8.3
Total Freshwater Dominant Species:	**0.0**	**0.0**	**1.4**	**4.5**	**28.5**	**8.1**	**7.9**	**5.2**	**15.9**	**19.0**	**27.4**	**24.3**	**27.5**	**24.8**
Total Segment Acreage	**111.5**	**107.5**	**112.5**	**111.1**	**109.2**	**111.3**	**108.8**	**103.2**	**120.3**	**118.8**	**120.3**	**123.5**	**124.4**	**128.0**

Table C12. Acreage Summary of Segment 14 for 1989, 1994/1995, 1996-2007.

DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	5.9	8.9	3.4	2.5	0.5	0.8	6.7	0.5	8.4	5.6	6.8	6.3	6.1	15.0
Cordgrass	3.2	2.0	1.5	2.1	2.0	2.4	1.4	2.1	1.6	1.9	1.6	1.4	1.3	1.4
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Salt grass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Peripheral Halophytes	0.7	0.0	0.0	0.6	0.9	1.4	1.0	0.7	1.3	0.5	0.5	0.6	0.6	0.6
Total Saline Dominant Species:	**9.8**	**10.9**	**4.9**	**5.2**	**3.4**	**4.6**	**9.1**	**3.4**	**11.3**	**8.0**	**8.9**	**8.4**	**8.2**	**17.1**
Brackish Marsh Vegetation														
Alkali Bulrush	10.6	9.1	14.6	16.7	19.3	18.5	13.8	18.4	11.0	14.2	12.5	13.2	13.0	3.1
Peppergrass	0.0	0.1	0.5	0.3	0.1	0.4	0.3	1.1	1.3	1.3	1.8	1.9	1.9	2.1
Spearscale	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Total Brackish Dominant Species:	**10.6**	**9.2**	**15.1**	**17.0**	**19.4**	**18.9**	**14.0**	**19.5**	**12.3**	**15.5**	**14.3**	**15.1**	**14.9**	**5.8**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	0.0
Total Segment Acreage	**20.4**	**20.1**	**20.0**	**22.2**	**22.9**	**23.5**	**23.2**	**22.9**	**23.6**	**23.5**	**23.2**	**23.5**	**23.1**	**22.9**

Table C13. Acreage Summary of Segment 15 for 1989, 1994/1995, 1996-2007.

DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	9.1	4.2	2.0	1.2	0.4	0.2	5.2	8.2	9.0	6.2	6.3	3.9	3.7	15.3
Cordgrass	0.0	0.7	0.4	0.7	0.2	0.8	0.1	0.3	0.0	0.0	0.0	0.2	0.2	0.2
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1
Peripheral Halophytes	0.0	0.0	0.2	0.5	0.8	1.4	0.1	0.2	0.9	0.6	1.3	1.3	0.5	1.7
Total Saline Dominant Species:	**9.1**	**4.9**	**2.6**	**2.3**	**1.3**	**2.4**	**5.3**	**8.8**	**9.9**	**6.8**	**7.7**	**5.4**	**4.5**	**17.36**
Brackish Marsh Vegetation														
Alkali Bulrush	20.2	16.7	18.7	17.9	22.5	21.0	15.6	11.5	10.8	13.3	13.1	15.2	16.0	3.3
Peppergrass	0.0	7.8	7.4	8.9	6.1	9.8	9.6	10.2	10.2	10.7	10.7	10.9	9.5	8.5
Spearscale	0.0	0.0	0.0	0.3	0.7	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.9	1.2
Total Brackish Dominant Species:	**20.2**	**24.5**	**26.1**	**27.2**	**29.2**	**31.0**	**25.2**	**21.7**	**21.0**	**24.0**	**23.8**	**26.2**	**26.4**	**13.05**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**29.3**	**29.4**	**28.7**	**29.5**	**30.5**	**33.4**	**30.6**	**30.5**	**30.9**	**30.8**	**31.5**	**31.6**	**30.9**	**30.41**

Table C14. Acreage Summary of Segment 16 for 1989, 1994/1995, 1996-2007.

DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1	0.1	0.0	0.0
Cordgrass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.2	0.2	0.3	0.3	0.3	0.4
Peripheral Halophytes	0.0	0.0	2.1	1.1	0.0	0.0	0.0	0.4	0.1	0.4	0.0	0.0	0.1	0.0
Total Saline Dominant Species:	**0.0**	**0.1**	**2.1**	**1.3**	**0.0**	**0.0**	**0.0**	**0.5**	**0.3**	**0.6**	**0.4**	**0.4**	**0.4**	**0.4**
Brackish Marsh Vegetation														
Alkali Bulrush	37.2	29.4	35.3	18.2	33.6	28.2	26.9	23.4	26.7	25.7	23.0	22.4	21.2	19.4
Peppergrass	11.0	14.8	5.7	4.0	0.9	12.3	11.5	16.2	10.9	13.4	13.5	9.3	7.4	14.0
Spearscale	0.0	0.0	0.0	18.4	5.7	0.9	2.1	1.1	3.2	0.2	3.2	6.9	9.6	7.6
Total Brackish Dominant Species:	**48.2**	**44.2**	**41.0**	**40.6**	**40.2**	**41.4**	**40.4**	**40.7**	**40.8**	**39.3**	**39.7**	**38.6**	**38.2**	**40.9**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.3	0.7	0.7	3.4	3.7	3.4	4.4	4.8	4.7	4.5	4.9	4.1
Cattail	0.0	0.0	0.1	0.1	0.0	0.1	0.6	0.4	0.5	0.6	1.3	2.0	2.8	1.8
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.4**	**0.9**	**0.7**	**3.5**	**4.3**	**3.8**	**4.9**	**5.4**	**6.0**	**6.5**	**7.7**	**5.9**
Total Segment Acreage	**48.2**	**44.2**	**45.1**	**43.3**	**42.8**	**54.8**	**44.7**	**45.1**	**46.0**	**45.3**	**46.1**	**45.5**	**46.3**	**47.1**

Table C15. Acreage Summary of Segment 17 for 1989, 1994/1995, 1996-2007.
DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	0.0	1.8	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
Cordgrass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	1.8	2.3	0.0	0.1	0.0	0.0	1.8	2.2	2.0	2.7	2.1	2.4
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Peripheral Halophytes	3.3	0.0	0.0	1.1	2.1	1.8	0.0	0.0	0.0	5.2	0.9	0.9	0.8	0.8
Total Saline Dominant Species:	**3.3**	**1.8**	**1.8**	**3.5**	**2.1**	**1.9**	**0.0**	**0.0**	**1.9**	**7.4**	**2.9**	**3.6**	**3.0**	**3.3**
Brackish Marsh Vegetation														
Alkali Bulrush	90.1	75.9	75.9	44.5	76.3	68.3	66.5	63.9	63.6	61.2	59.8	62.6	60.3	44.0
Peppergrass	8.8	18.9	18.9	21.1	11.7	28.4	29.4	29.0	22.9	29.7	30.8	28.2	26.3	29.1
Spearscale	0.0	0.0	0.0	26.6	11.3	0.0	1.8	0.3	7.6	0.5	3.5	5.3	10.2	11.8
Dead Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1
Total Brackish Dominant Species:	**98.9**	**94.8**	**94.8**	**92.2**	**99.3**	**96.7**	**97.8**	**93.2**	**94.1**	**91.4**	**94.1**	**96.1**	**96.8**	**96.0**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.1	0.2	0.1	0.1	0.2	0.2
Cattail	0.0	0.0	0.0	0.5	0.7	0.2	1.2	0.9	1.0	2.2	1.6	1.6	1.8	2.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.5**	**0.8**	**0.2**	**1.3**	**0.9**	**1.1**	**2.4**	**1.7**	**1.7**	**2.0**	**2.2**
Total Segment Acreage	**102.2**	**96.6**	**96.6**	**96.2**	**102.2**	**98.8**	**99.2**	**94.1**	**97.1**	**101.2**	**98.7**	**101.4**	**101.8**	**101.6**

Table C16. Acreage Summary of Segment 18 for 1989, 1994/1995, 1996-2007.
DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	1.0	2.1	0.8	1.6	0.6	0.7	1.3	0.7	0.6	0.2	0.5	0.6	0.7	2.8
Cordgrass	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.9	0.1	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.3	0.2	0.3	0.1	0.1	0.2	0.0	0.4	0.3	0.4	0.4	0.4	0.4
Peripheral Halophytes	0.0	0.0	0.6	1.7	1.3	2.1	1.0	1.1	1.1	3.7	3.0	3.0	3.7	4.4
Dead Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Total Saline Dominant Species:	**1.0**	**2.4**	**2.5**	**3.8**	**3.5**	**2.9**	**2.5**	**1.8**	**2.1**	**4.2**	**3.9**	**4.0**	**4.8**	**7.8**
Brackish Marsh Vegetation														
Alkali Bulrush	33.5	24.2	24.7	13.4	24.2	22.9	23.9	21.1	20.9	20.3	20.7	20.7	20.3	9.2
Peppergrass	3.3	8.2	7.2	4.4	2.3	8.3	6.2	10.4	8.2	9.2	10.7	10.5	7.4	10.4
Spearscale	0.0	0.0	0.0	12.1	3.7	1.3	1.5	0.2	3.2	1.3	0.3	1.7	4.8	9.8
Dead Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	1.2
Total Brackish Dominant Species:	**36.8**	**32.4**	**31.9**	**29.8**	**30.3**	**32.5**	**31.7**	**31.6**	**32.3**	**30.8**	**31.7**	**32.9**	**32.5**	**30.5**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.0	0.1	0.1	0.0	0.3	0.2	0.3	0.4	0.3	0.3	0.4	0.3
Cattail	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.3	0.0	0.4	0.1	0.1	0.5	0.4
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.2**	**0.3**	**0.1**	**0.3**	**0.5**	**0.3**	**0.8**	**0.4**	**1.4**	**1.4**	**0.8**
Total Segment Acreage	**37.8**	**34.8**	**34.5**	**33.8**	**34.1**	**35.5**	**34.5**	**33.9**	**34.7**	**35.8**	**36.0**	**38.3**	**38.7**	**39.0**

Table C17. Acreage Summary of Segment 19 for 1989, 1994/1995, 1996-2007.

DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	7.0	11.3	2.6	2.1	30.9	1.0	2.7	10.4	7.2	1.6	1.6	1.6	5.4	16.0
Cordgrass	0.0	2.0	1.8	0.7	0.1	0.5	0.0	0.0	0.1	0.2	0.0	0.0	0.3	0.3
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.6	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.4	0.2	0.3	0.0	0.1	0.2	0.0	0.4	0.3	0.4	0.4	0.5	0.5
Saltgrass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Peripheral Halophytes	0.0	0.5	1.5	2.8	3.6	3.8	3.1	2.7	2.3	1.5	1.5	1.5	1.9	1.7
Dead Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total Saline Dominant Species:	**7.0**	**14.2**	**6.7**	**6.0**	**34.8**	**5.6**	**6.0**	**13.1**	**10.0**	**3.6**	**3.5**	**3.5**	**8.2**	**18.7**
Brackish Marsh Vegetation														
Alkali Bulrush	29.9	22.1	31.4	24.7	0.8	29.8	27.4	17.7	23.4	29.0	29.1	29.1	20.2	7.0
Peppergrass	0.5	1.1	1.7	1.2	0.3	2.0	2.3	2.2	2.0	2.2	3.4	3.4	3.1	4.0
Spearscale	0.0	0.0	0.0	4.2	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	4.1	5.3
Spearscale-Pickleweed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Dead Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
Total Brackish Dominant Species:	**30.4**	**23.2**	**33.1**	**30.1**	**1.7**	**31.9**	**29.7**	**19.9**	**25.4**	**31.2**	**32.5**	**32.5**	**27.4**	**17.3**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Cattail	0.0	0.0	0.0	0.2	0.0	0.6	0.6	0.0	0.0	0.0	0.1	0.1	0.6	0.2
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.2**	**0.0**	**0.6**	**0.6**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.7**	**0.3**
Total Segment Acreage	**37.4**	**37.4**	**39.8**	**36.2**	**36.5**	**38.1**	**36.3**	**33.0**	**35.4**	**34.8**	**36.1**	**36.1**	**36.3**	**36.3**

Table C18. Acreage Summary of Segment 20 for 1989, 1994/1995, 1996-2007.

DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	30.8	31.2	18.6	18.2	14.6	14.4	13.6	18.0	29.8	20.5	18.8	18.6	17.6	36.4
Cordgrass	2.4	6.0	5.0	4.7	2.7	2.6	1.7	1.6	2.5	3.0	3.0	3.2	3.2	3.1
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Spearscale Mix	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.1	0.2	0.0	0.3	0.1	0.0	0.0	0.4	0.4	0.4	0.8
Peripheral Halophytes	0.0	0.0	1.6	1.4	3.3	1.9	1.3	1.3	1.6	1.5	1.3	0.0	1.2	1.2
Dead Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Total Saline Dominant Species:	**33.2**	**37.2**	**25.2**	**24.5**	**20.9**	**18.9**	**16.9**	**21.6**	**33.9**	**25.0**	**23.5**	**22.2**	**22.4**	**41.8**
Brackish Marsh Vegetation														
Alkali Bulrush	26.5	17.0	28.9	33.1	36.4	37.9	36.8	31.4	22.0	30.4	30.0	29.7	29.9	9.8
Peppergrass	1.9	3.3	2.5	3.3	3.3	6.7	7.2	6.6	5.6	6.0	7.6	8.0	8.6	9.4
Spearscale	0.0	0.0	0.0	0.1	2.1	0.1	0.1	0.1	0.0	0.0	0.2	0.4	0.5	0.2
Dead Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Total Brackish Dominant Species:	**28.4**	**20.3**	**31.4**	**36.5**	**41.8**	**44.7**	**44.0**	**38.2**	**27.6**	**36.4**	**37.8**	**38.1**	**39.0**	**19.7**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	0.0
Total Segment Acreage	**61.6**	**57.5**	**56.6**	**61.0**	**62.7**	**63.6**	**61.0**	**59.7**	**61.5**	**61.4**	**61.3**	**60.3**	**61.4**	**61.5**

Table C19. Acreage Summary of Segment 21 for 1989, 1994/1995, 1996-2007.
DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	2.7	7.0	2.9	2.2	1.1	1.0	3.6	4.6	5.4	5.1	4.1	3.6	4.5	12.2
Cordgrass	0.5	0.4	0.3	0.4	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.2
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.2	0.1	0.2	0.2	0.3
Peripheral Halophytes	0.0	3.6	0.4	0.3	1.2	0.9	1.9	1.4	1.1	1.6	1.0	0.8	1.7	0.6
Total Saline Dominant Species:	**3.2**	**11.0**	**3.6**	**2.9**	**2.7**	**2.1**	**5.6**	**6.1**	**6.6**	**6.9**	**5.2**	**4.7**	**6.5**	**13.4**
Brackish Marsh Vegetation														
Alkali Bulrush	19.8	15.1	18.6	17.6	20.6	20.5	18.4	14.9	15.4	15.8	16.2	16.6	16.9	5.5
Peppergrass	2.9	3.7	4.1	5.3	3.4	6.2	5.1	0.1	5.9	5.5	6.5	6.5	5.3	6.0
Spearscale	0.0	0.0	0.0	0.8	1.0	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.3	2.4
Total Brackish Dominant Species:	**22.7**	**18.8**	**22.7**	**23.7**	**24.9**	**26.9**	**23.5**	**15.0**	**21.3**	**21.3**	**22.7**	**23.2**	**22.5**	**13.8**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**25.9**	**29.8**	**26.7**	**26.7**	**27.6**	**29.0**	**29.1**	**21.1**	**27.9**	**28.2**	**27.9**	**27.9**	**29.0**	**27.2**

Table C20. Acreage Summary of Segment 22 for 1989, 1994/1995, 1996-2007.

DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	7.5	6.1	7.3	6.1	5.2	5.0	5.5	4.9	4.9	5.1	5.1	4.2	4.8	16.7
Cordgrass	2.7	3.9	2.8	3.8	3.5	4.7	2.3	4.1	4.1	8.3	32.8	42.6	49.0	50.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Peripheral Halophytes	0.4	0.0	0.5	1.0	1.2	0.9	0.9	0.0	0.0	1.2	1.0	0.0	0.0	0.0
Dead Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Total Saline Dominant Species:	**10.6**	**10.0**	**10.6**	**10.9**	**9.9**	**10.7**	**8.7**	**9.0**	**9.0**	**14.6**	**39.0**	**46.8**	**53.9**	**67.0**
Brackish Marsh Vegetation														
Alkali Bulrush	0.0	0.0	0.2	1.0	2.9	2.7	4.6	2.3	2.3	3.8	6.3	8.9	8.2	4.7
Peppergrass	0.0	0.2	0.4	0.0	0.0	0.6	0.7	3.6	3.6	0.2	1.2	1.6	2.0	1.8
Total Brackish Dominant Species:	**0.0**	**0.2**	**0.6**	**1.0**	**2.9**	**3.3**	**5.4**	**6.0**	**5.9**	**4.0**	**7.5**	**10.5**	**10.2**	**6.5**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	0.0
Total Segment Acreage	**10.6**	**10.2**	**11.2**	**11.9**	**12.8**	**14.0**	**14.1**	**14.9**	**14.9**	**18.6**	**46.5**	**57.3**	**64.1**	**73.5**

Table C21. Acreage Summary of Segment 23 for 1989, 1994/1995, 1996-2007.

DOMINANT SPECIES CATEGORY

	Year													
Saline Marsh Vegetation	1989	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	8.8	14.1	14.1	11.1	10.2	10.2	10.9	10.5	8.8	13.1	10.3	13.2	12.4	11.9
Cordgrass	7.9	3.7	3.6	4.8	6.2	5.9	6.2	7.4	7.9	8.4	10.5	9.9	10.8	11.8
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.1	0.0	1.3	0.2	0.0	0.0	0.0	0.9	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.2	0.0	0.0	0.2	0.3	0.0	0.0	0.3	0.2	0.0	0.0	0.0
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Saltgrass	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.2	0.0	0.0	0.0	0.0
Peripheral Halophytes	1.9	0.0	0.8	1.4	1.7	1.5	1.7	2.6	1.9	1.2	1.7	1.7	1.7	0.5
Total Saline Dominant Species:	**18.6**	**17.8**	**18.7**	**17.4**	**18.1**	**19.1**	**20.0**	**20.5**	**18.6**	**23.2**	**23.6**	**24.9**	**25.0**	**24.3**
Brackish Marsh Vegetation														
Alkali Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	0.4	0.4	0.0
Peppergrass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	3.3
Spearscale	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Total Brackish Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**4.0**	**0.0**	**0.4**	**0.5**	**3.4**
Freshwater Marsh Vegetation														
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**18.6**	**17.8**	**18.8**	**17.4**	**18.1**	**19.1**	**20.1**	**20.5**	**18.6**	**27.2**	**23.6**	**25.3**	**25.5**	**27.7**

Table C22. Acreage Summary of Segment 24* for 1994/1995, 1996-2007.

DOMINANT SPECIES CATEGORY

	Year												
Saline Marsh Vegetation	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	0.8	0.2	0.6	0.6	0.2	1.3	0.6	0.8	0.0	0.7	1.1	0.9	1.5
Cordgrass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.2
Peripheral Halophytes	1.5	2.2	0.7	0.8	0.5	1.0	0.0	0.0	0.0	0.1	0.0	0.4	0.2
Dead Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total Saline Dominant Species:	**2.3**	**2.4**	**1.3**	**1.4**	**0.7**	**2.3**	**0.6**	**0.8**	**0.1**	**0.8**	**1.1**	**1.3**	**1.9**
Brackish Marsh Vegetation													
Alkali Bulrush	1.5	2.0	1.8	2.2	2.4	2.7	2.0	2.1	2.7	1.9	3.4	3.7	1.8
Peppergrass	7.0	6.0	5.7	7.1	7.1	4.6	7.5	6.6	6.6	7.7	5.5	4.9	5.5
Spearscale	0.0	0.0	0.0	0.5	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.3
Dead Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
Total Brackish Dominant Species:	**8.5**	**8.0**	**7.5**	**9.7**	**9.6**	**7.4**	**9.5**	**8.8**	**9.3**	**9.6**	**8.9**	**8.7**	**8.2**
Freshwater Marsh Vegetation													
California Bulrush	1.4	1.6	1.9	2.0	2.6	2.8	2.2	2.9	3.1	2.7	2.8	3.0	2.8
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**1.4**	**1.6**	**1.9**	**2.0**	**2.6**	**2.8**	**2.2**	**2.9**	**3.1**	**2.7**	**2.8**	**3.0**	2.8
Total Segment Acreage	**12.2**	**12.0**	**10.7**	**13.1**	**12.9**	**12.4**	**12.3**	**12.5**	**12.5**	**13.1**	**12.8**	**13.0**	**12.8**

*** Segment 24 not mapped in 1989**

Table C23. Acreage Summary of Segment 25* for 1994/1995, 1996-2007.

DOMINANT SPECIES CATEGORY

	Year												
Saline Marsh Vegetation	1994/ 1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0
Cordgrass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Peripheral Halophytes	5.3	4.0	2.6	0.0	1.0	0.0	0.0	0.1	0.1	1.3	1.5	1.9	1.0
Dead Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total Saline Dominant Species:	**5.3**	**4.0**	**2.6**	**0.0**	**1.0**	**0.1**	**0.0**	**0.1**	**0.2**	**1.5**	**1.6**	**1.9**	**1.1**
Brackish Marsh Vegetation													
Alkali Bulrush	2.9	4.3	3.4	3.3	5.8	6.5	4.9	5.7	3.6	4.7	7.1	6.8	8.6
Peppergrass	10.4	7.7	6.5	48.6	7.6	7.1	8.8	7.6	7.2	5.8	3.8	3.0	5.0
Spearscale	0.0	0.0	0.3	0.5	0.1	0.1	0.0	0.3	0.0	0.0	0.0	0.3	1.0
Dead Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total Brackish Dominant Species:	**13.3**	**12.0**	**10.3**	**52.3**	**13.5**	**13.7**	**13.7**	**13.6**	**10.8**	**10.5**	**10.9**	**10.1**	**14.7**
Freshwater Marsh Vegetation													
California Bulrush	29.8	30.3	31.3	0.1	38.6	36.2	35.9	34.2	34.0	33.9	32.4	31.2	29.6
Cattail	0.2	0.8	1.5	0.2	2.0	1.3	2.1	2.2	4.6	4.4	5.6	7.7	6.5
Total Freshwater Dominant Species:	**30.0**	**31.1**	**32.8**	**0.3**	**40.6**	**37.5**	**38.0**	**36.4**	**38.6**	**38.3**	**38.0**	**38.9**	**36.1**
Total Segment Acreage	**48.6**	**47.1**	**45.7**	**52.7**	**55.1**	**51.3**	**51.7**	**50.1**	**49.6**	**50.3**	**50.5**	**50.9**	**51.9**

***Segment 25 not mapped in 1989**

Table C24. Acreage Summary of Segment 26* for 1994/1995, 1996-2007.
DOMINANT SPECIES CATEGORY

	Year												
Saline Marsh Vegetation	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cordgrass	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peripheral Halophytes	1.3	1.3	0.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Saline Dominant Species:	**1.3**	**1.3**	**0.8**	**0.1**	**0.0**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Brackish Marsh Vegetation													
Alkali Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3
Peppergrass	2.5	2.6	0.6	0.1	2.9	3.3	0.5	0.3	0.0	0.9	0.9	1.3	1.5
Spearscale	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Brackish Dominant Species:	**2.5**	**2.6**	**0.6**	**0.2**	**3.0**	**3.3**	**0.5**	**0.3**	**0.0**	**0.9**	**0.9**	**1.5**	**1.7**
Freshwater Marsh Vegetation													
California Bulrush	17.8	18.7	17.5	18.8	18.0	18.4	18.4	18.8	19.1	17.5	17.0	17.1	16.9
Cattail	0.1	0.2	0.4	0.3	0.1	1.0	0.6	0.9	0.4	1.3	2.0	2.1	1.4
Water Primrose	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4
Arundo	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Grass-leaved goldenrod	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Water Primrose	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total Freshwater Dominant Species:	**17.9**	**18.9**	**17.9**	**19.1**	**18.1**	**19.4**	**19.0**	**19.7**	**19.5**	**18.8**	**19.0**	**19.3**	**18.8**
Total Segment Acreage	**21.7**	**22.8**	**19.2**	**19.4**	**21.1**	**22.8**	**19.5**	**20.0**	**19.5**	**19.7**	**19.9**	**20.8**	**20.6**

***Segment 26 not mapped in 1989**

Table C25. Acreage Summary of Segment 27* for 1994/1995, 1996-2007.

DOMINANT SPECIES CATEGORY

	Year											
Saline Marsh Vegetation	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	0.0	0.9	0.0	0.0	0.9	1.0	0.8	0.5	0.6	0.0	0.6	0.6
Cordgrass	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Peripheral Halophytes	1.0	2.1	2.3	0.0	0.3	0.0	0.0	0.0	0.3	0.3	0.3	0.3
Total Saline Dominant Species:	**1.0**	**3.0**	**2.3**	**0.0**	**1.2**	**1.0**	**0.8**	**0.5**	**0.9**	**0.3**	**0.9**	**1.0**
Brackish Marsh Vegetation												
Alkali Bulrush	11.4	9.1	8.9	7.4	7.7	7.4	7.9	5.4	4.9	5.5	3.0	4.5
Peppergrass	0.6	1.7	0.1	1.2	1.9	1.2	1.9	0.0	0.0	0.2	0.2	0.2
Spearscale**	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0
Dead Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0
Total Brackish Dominant Species:	**12.0**	**10.8**	**9.1**	**8.6**	**9.6**	**8.6**	**9.9**	**5.6**	**4.9**	**5.7**	**3.2**	**4.7**
Freshwater Marsh Vegetation												
California Bulrush	3.3	4.4	6.7	4.7	5.8	6.2	5.5	5.8	5.3	6.4	6.8	5.8
Cattail	7.6	7.8	8.4	10.8	9.8	9.5	8.7	9.3	10.6	9.4	10.9	11.0
Smartweed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Giant Reed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Total Freshwater Dominant Species:	**10.9**	**12.2**	**15.2**	**15.5**	**15.6**	**15.8**	**14.2**	**15.1**	**15.9**	**15.8**	**17.7**	**17.0**
Total Segment Acreage	**23.8**	**26.0**	**26.6**	**36.5**	**26.5**	**25.4**	**24.9**	**21.2**	**21.7**	**21.8**	**21.8**	**22.7**

***Segment 27 not mapped in 1989 and 1994/1995**

**Not a Dominant Species Category in 1996

Table C26. Acreage Summary of Segment 28* for 1994/1995, 1996-2007.

DOMINANT SPECIES CATEGORY

	Year												
Saline Marsh Vegetation	1989	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	0.0	0.5	0.2	0.1	0.1	0.0	0.1	0.0	0.1	0.2	0.2	0.1	0.1
Cordgrass	8.6	1.6	1.8	0.8	0.0	0.0	1.1	0.0	0.0	0.0	0.2	0.1	1.0
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Peripheral Halophytes	0.0	0.3	1.4	4.0	3.4	1.6	0.6	0.0	0.0	0.4	0.0	0.2	0.6
Total Saline Dominant Species:	**8.6**	**2.4**	**3.4**	**4.8**	**3.5**	**1.6**	**1.8**	**0.0**	**0.1**	**0.6**	**0.4**	**0.4**	**1.7**
Brackish Marsh Vegetation													
Alkali Bulrush	47.7	53.7	49.8	61.9	57.0	55.8	59.2	56.2	52.3	55.9	46.6	13.2	18.3
Peppergrass	8.3	9.9	15.8	2.2	10.2	13.6	9.0	16.9	17.7	17.5	18.9	17.2	25.9
Spearscale**	0.0	0.0	0.1	0.2	0.0	0.1	0.0	0.0	0.0	0.1	5.0	13.7	5.9
Dead vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.7	8.3
Total Brackish Dominant Species:	**56.0**	**63.5**	**65.7**	**64.3**	**67.2**	**69.5**	**68.3**	**73.1**	**70.0**	**73.5**	**70.5**	**63.8**	**58.4**
Freshwater Marsh Vegetation													
California Bulrush	0.3	10.5	9.1	15.5	15.6	15.1	9.4	11.0	14.6	12.5	12.9	14.6	14.5
Cattail	0.0	0.3	0.4	0.5	0.6	0.5	1.4	0.9	0.7	0.3	1.9	6.4	6.3
Grass-leaved goldenrod	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7
Smartweed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Total Freshwater Dominant Species:	**0.3**	**10.8**	**9.5**	**16.0**	**16.2**	**15.6**	**10.8**	**11.9**	**15.3**	**12.8**	**14.8**	**21.0**	**26.5**
Total Segment Acreage	**64.9**	**76.7**	**78.6**	**85.1**	**86.9**	**86.8**	**80.9**	**85.0**	**85.4**	**86.9**	**85.7**	**85.2**	**86.7**

***Segment 28 not mapped in 1994/1995**

**Not a Dominant Species Category in 1996

Table C27. Acreage Summary of Segment 29* for 1989, 1996 - 2007.

DOMINANT SPECIES CATEGORY

	Year												
Saline Marsh Vegetation	1989	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	20.1	14.8	12.1	9.0	9.3	6.6	8.0	14.6	6.3	15.0	12.5	10.8	17.1
Cordgrass	14.3	5.6	6.8	4.6	2.3	1.7	5.7	7.7	10.2	6.5	9.9	10.4	11.7
Peripheral Halophytes	0.0	2.2	4.3	5.8	5.6	4.4	0.0	4.3	4.8	4.1	2.3	3.5	3.5
Dead Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.8
Total Saline Dominant Species:	**34.4**	**22.5**	**23.2**	**19.4**	**17.2**	**12.7**	**13.6**	**26.6**	**21.3**	**25.6**	**24.7**	**24.7**	**43.1**
Brackish Marsh Vegetation													
Alkali Bulrush	24.6	48.4	47.2	58.7	65.5	62.2	61.6	50.5	55.8	46.6	50.4	42.9	23.8
Peppergrass	10.8	10.0	9.5	3.9	11.0	13.3	13.2	15.5	17.0	25.6	23.1	24.6	23.4
Spearscale**	0.0	0.0	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.6	1.9
Dead Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7	6.8
Total Brackish Dominant Species:	**35.4**	**58.3**	**57.0**	**62.6**	**76.6**	**75.5**	**74.8**	**66.0**	**72.8**	**72.3**	**73.5**	**71.8**	**55.9**
Freshwater Marsh Vegetation													
California Bulrush	0.0	0.0	0.0	0.0	0.3	0.4	0.0	0.0	0.0	0.5	0.7	1.5	0.6
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.5	0.1	0.1	0.1
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.3**	**0.4**	**0.0**	**0.1**	**0.1**	**1.0**	**0.8**	**1.6**	**0.7**
Total Segment Acreage	**69.8**	**80.8**	**80.2**	**82.0**	**94.1**	**88.6**	**88.5**	**92.7**	**94.2**	**98.9**	**99.0**	**98.1**	**99.7**

***Segment 29 not mapped in 1994/1995**

**Not a Dominant Species Category in 1996

Table C28. Acreage Summary of Segment 30* for 1989, 1996-2007

DOMINANT SPECIES CATEGORY

	Year												
Saline Marsh Vegetation	1989	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Pickleweed	23.5	26.5	23.1	19.7	21.0	24.7	26.4	32.1	32.8	34.3	27.6	26.5	27.8
Cordgrass	15.5	8.0	9.8	10.7	13.0	3.3	12.3	13.5	13.0	14.2	24.6	26.9	26.0
Pickleweed-Cordgrass Mix	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.6	0.0	0.0	0.0
Alkali Heath	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Saltgrass	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gumplant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Peripheral Halophytes	3.1	1.5	2.6	2.9	3.7	2.5	0.3	1.2	2.4	1.9	2.0	2.2	0.2
Total Saline Dominant Species:	**42.1**	**36.0**	**35.5**	**33.3**	**37.7**	**32.9**	**39.1**	**46.9**	**48.2**	**51.0**	**54.2**	**55.6**	**54.0**
Brackish Marsh Vegetation													
Alkali Bulrush	0.0	1.5	1.7	6.5	5.5	11.6	4.3	2.5	5.9	6.4	7.8	7.4	8.8
Peppergrass	1.3	2.0	0.0	0.0	0.0	1.1	3.3	2.1	0.6	2.2	2.3	1.9	3.7
Spearscale**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.7
Total Brackish Dominant Species:	**1.3**	**3.4**	**1.7**	**6.5**	**5.5**	**12.7**	**7.6**	**4.6**	**6.5**	**8.6**	**10.1**	**9.9**	**13.2**
Freshwater Marsh Vegetation													
California Bulrush	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cattail	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Freshwater Dominant Species:	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Total Segment Acreage	**43.4**	**39.4**	**37.2**	**39.9**	**43.2**	**45.7**	**46.7**	**51.5**	**54.7**	**59.6**	**64.3**	**65.5**	**67.2**

***Segment 30 not mapped in 1994/1995**

**Not a Dominant Species Category in 1996

APPENDIX D.
PLANT LIST

Appendix D. Plants Observed in the South Bay Marsh Project Site		
FAMILY NAME	**SCIENTIFIC NAME**	**COMMON NAME**
Aceraceae	*Acer negundo* ssp. *californica*	California box elder
Aizoceae	*Carpobrotus edulis*	iceplant
	Mesembryanthemum nodiflorum	slender-leaved iceplant
	Tetragonia tetragonioides	New Zealand spinach
Alismataceae	*Alisma plantago-aquatica*	water plantain
Apiaceae	*Conium maculatum*	poison hemlock
	Foeniculum vulgare	sweet fennel
Asteraceae	*Baccharis pilularis*	coyote brush
	Carduus pycnocephalus	Italian thistle
	Centaurea solstitialis	yellow star-thistle
	Conyza canadensis	horsetail
	Cotula coronopifolia	brass-buttons
	Euthamia occidentalis	grass-leaved goldenrod
	Grindelia angustifolia	gumplant
	Picris echioides	bristly ox-tongue
	Pluchea odorata	salt-marsh fleabane
Boraginaceae	*Heliotropium curassavicum* var. *oculatum*	heliotrope
Brassicaceae	*Brassica nigra*	black mustard
	Hirschfeldia incana	small-pod mustard
	Lepidium latifolium	perennial peppergrass
	Rorippa nasturtium-aquaticum	water cress
Caryophyllaceae	*Spergularia marina*	sand-spurrey
Chenopodiaceae	*Atriplex semibaccata*	Australian saltbush
	Atriplex prostrata (*Atriplex triangularis*)	spearscale
	Bassia hyssopifolia	five-hook bassia
	Chenopodium sp.	goosefoot
	Salicornia europeae	annual pickleweed
	Salsola soda	Russian thistle
	Salsola tragus	Russian thistle
	Sarcocornia pacifica (*Salicornia virginica*)	common pickleweed
Convolvulaceae	*Cressa truxillensis*	alkali weed
Cuscutaceae	*Cuscuta salina* var. *major*	salt marsh dodder
Cyperaceae	*Bolboschoenus maritimus* (*Scirpus maritimus*)	alkali bulrush
	Eleocharis macrostachya	common spikerush
	Schoenoplectus acutus (*Scirpus acutus*)	tule
	Schoenoplectus americanus (*Scirpus americanus*)	Olney's bulrush
	Schoenoplectus californicus (*Scirpus californicus*)	California bulrush
	Schoenoplectus robustus (*Scirpus robustus*)	Common bulrush
Dipsacaceae	*Dipsacus fullonum*	wild teasel
Equisetaceae	*Equisetum arvense*	common horsetail
Frankeniaceae	*Frankenia salina*	alkali heath
Juglandaceae	*Juglans californica*	California black walnut
Juncaceae	*Juncus balticus*	Baltic rush
	Juncus bufonius	toad rush
	Juncus effusus var. *brunneus*	bog rush
Juncaginaceae	*Triglochin maritima*	seaside arrow-grass

Appendix D. Plants Observed in the South Bay Marsh Project Site		
FAMILY NAME	**SCIENTIFIC NAME**	**COMMON NAME**
Lamiaceae	*Mentha spicata*	spearmint
Malvaceae	*Lavatera assurgentiflora*	malva rosa
Myoporaceae	*Myoporum laetum*	lollypop tree
Plantaginaceae	*Plantago subnuda*	plantain
Plumbaginaceae	*Limonium californicum*	western marsh-rosemary
Poaceae	*Agrostis sp.*	bentgrass
	Arundo donax	giant reed
	Avena fatua	wild oats
	Bromus diandrus	ripgut grass
	Bromus hordeaceus	soft chess
	Cortaderia jubata	pampas grass
	Distichlis spicata	saltgrass
	Hordeum sp.	barley
	Lolium multiflorum	Italian ryegrass
	Parapholis incurva	curved sicklegrass
	Paspalum distichum	knotgrass
	Phragmites australis	common reed
	Puccinellia nutkaensis	Nootka alkaligrass
	Spartina foliosa and *S. alterniflora* and hybrids	cordgrass
Polygonaceae	*Polygonum coccineum* var. *emersum*	water smartweed
	Polygonum punctatum	knotweed
	Rumex crispus	curly dock
Potamogetonaceae	*Potamogeton foliosus*	leafy pondweed
	Ruppia maritima	ditch-grass
Ranunculaceae	*Ranunculus aquatilus*	whitewater crowfoot
Salicaceae	*Populus fremontii*	Fremont’s cottonwood
	Salix sp.	willow
	Salix babylonica	weeping willow
Scrophulariaceae	*Kickxia elatine*	fluellin
	Veronica americana	American brooklime
Solanaceae	*Nicotiana glauca*	tree-tobacco
	Solanum americanum	deadly nightshade
Typhaceae	*Typha angustifolia*	narrow-leafed cattail
	Typha latifolia	broad-leaved cattail
The species are arranged alphabetically by family name for all vascular plants encountered during the plant survey. Plants are also listed alphabetically within each family. In some cases it was not possible to accurately identify a particular plant to the species level due to the absence of specific anatomic structures required for identification.		

APPENDIX E.
DOMINANT SPECIES CATEGORIES,
MARSH TYPE AND VEGETATION ASSOCIATIONS FOR 1989 AND 2007

DOMINANT SPECIES CATEGORY	HABITAT TYPE	VEGETATION ASSOCIATIONS	
		1989	**2007**
Cordgrass	Salt	Cordgrass	Cordgrass Cordgrass/Alkali Bulrush Corgrass/Dead Vegetation Cordgrass/Pickleweed
Pickleweed	Salt	Pickleweed Pickleweed, Alkali Heath, Fat Hen	Pickleweed Pickleweed/Alkali Bulrush Pickleweed/Alkali Heath Pickleweed/Cordgrass Pickleweed/Dead Vegetation Pickleweed/Gumplant Pickleweed/Jaumea Pickleweed/Peppergrass Pickleweed/Peripheral Halophytes Pickleweed/Saltmarsh Dodder Pickleweed/Saltgrass Pickleweed/Spearscale
Pickleweed-Cordgrass Mix	Salt	•	Pickleweed-Cordgrass Mix
Alkali Heath	Salt	•	Alkali Heath Alkali Heath/Alkali Bulrush Alkali Heath/Peppergrass Alkali Heath/Pickleweed Alkali Heath/Spearscale
Gumplant	Salt	•	Gumplant Gumplant/Pickleweed
Jaumea	Salt	•	Jaumea
Mint	Fresh		Mint
Peripheral Halophytes	Salt	Fat Hen, Alkali Heath	Peripheral Halophytes Peripheral Halophytes/Alkali Bulrush Peripheral Halophytes/Peppergrass Peripheral Halophytes/Spearscale Peripheral Halophytes/Upland Species
Russian thistle	Salt	•	Russian Thistle Russian Thistle/Alkali Bulrush Russian Thistle/Pickleweed Russian Thistle/Spearscale
Saltgrass	Salt		Saltgrass
Dead Vegetation	Salt/Brackish	Dead Vegetation	Dead Vegetation Dead Vegetation/Alkali Bulrush Dead Vegetation/Peppergrass Dead Vegetation/Pickleweed Dead Vegetation/Spearscale
Alkali Bulrush	Brackish	Alkali Bulrush	Alkali Bulrush Alkali Bulrush/California Bulrush

DOMINANT SPECIES CATEGORY	HABITAT TYPE	VEGETATION ASSOCIATIONS	
		1989	**2007**
			Alkali Bulrush/Cattail
			Alkali Bulrush/Cordgrass
			Alkali Bulrush/Dead Vegetation
			Alkali Bulrush/Peppergrass
			Alkali Bulrush/Peripheral Halophytes
			Alkali Bulrush/Pickleweed
			Alkali Bulrush/Russian Thistle
			Alkali Bulrush/Spearscale
Peppergrass	Brackish	Peppergrass	Peppergrass
			Peppergrass/Alkali Bulrush
			Peppergrass/Dead Vegetation
			Peppergrass/Peripheral Halophytes
			Peppergrass/Pickleweed
			Peppergrass/Spearscale
			Peppergrass/Upland Species
Spearscale	Brackish	•	Spearscale
			Spearscale/Alkali Bulrush
			Spearscale/California Bulrush
			Spearscale/Dead Vegetation
			Spearscale/Peppergrass
			Spearscale/Peripheral Halophytes
			Spearscale/Pickleweed
California Bulrush	Fresh	•	California Bulrush
			California Bulrush/Alkali Bulrush
			California Bulrush/Cattail
			California Bulrush/Dead Vegetation
			California Bulrush/Smartweed
Cattail	Fresh	•	Cattail
			Cattail/Alkali Bulrush
			Cattail/California Bulrush
Olney's Bulrush	Fresh		Olney's Bulrush/Cattail
Smartweed	Fresh	•	Smartweed
Arundo	Fresh		Arundo
Grass-Leaved Goldenrod	Fresh		Grass-Leaved Goldenrod
Water Primrose	Fresh	•	Water Primrose

• Not a Dominant Species Category in Analysis Year

APPENDIX F.
2007 PHOTOGRAPHS OF VEGETATION
IN REFERENCE AND MAIN STUDY AREA

Figure F-1. Large Expanse of Dead Vegetation (with Pickleweed Understory) in Main Study Area (Segment 13).

Figure F-2. Close-up of Large Area of Dead Alkali Bulrush With Dense Pickleweed Understory (Segment 9) (Note – some live alkali bulrush Intermittently returning to previously dead area)

Figure F-3. Close-up of Dead Vegetation Dominated by Pickleweed (Understory to Last Year's Dead Alkali Bulrush) (Segment 19).

Figure F-4. Scour Along Marsh Edge (Segment 15).

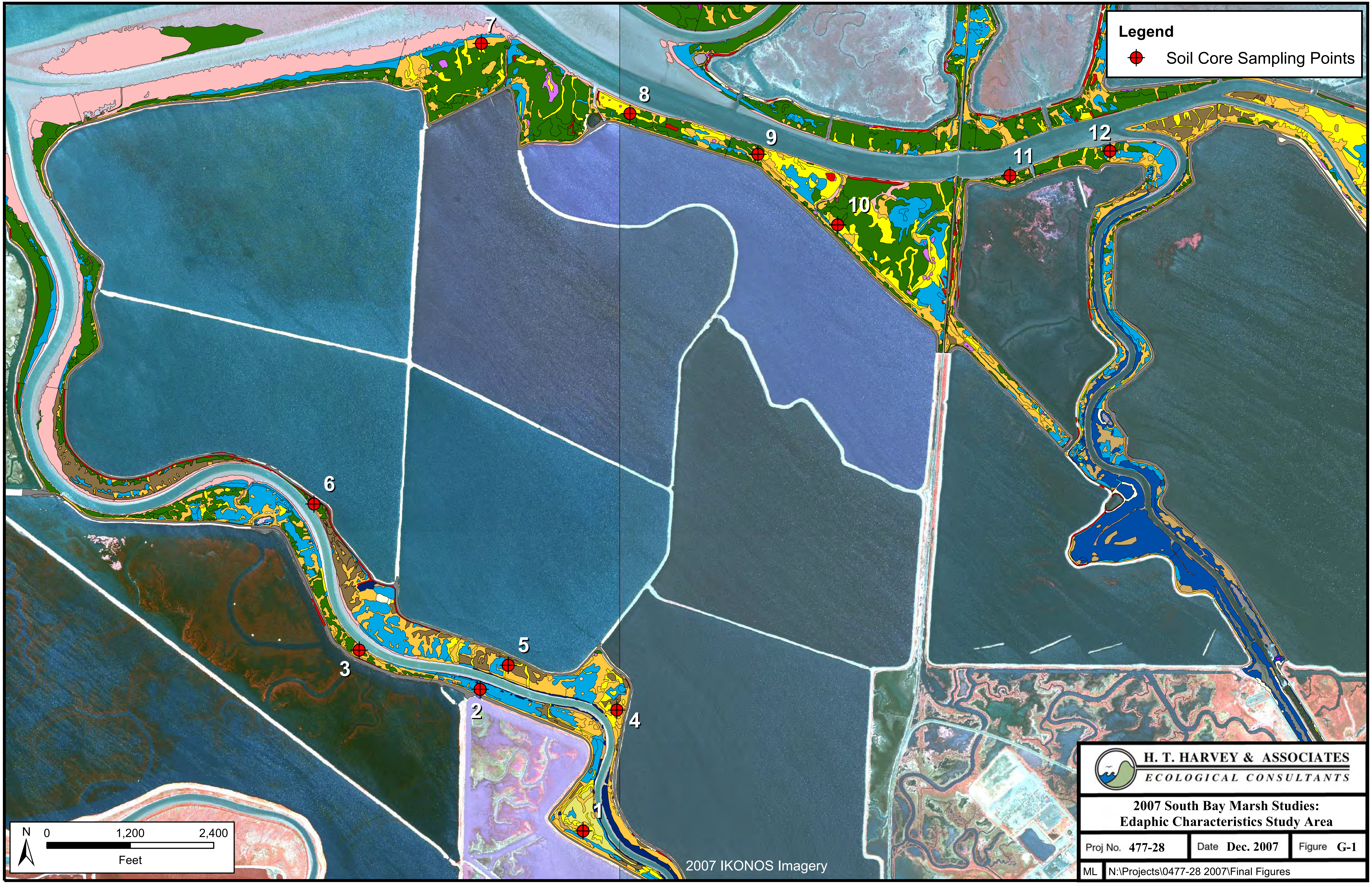
Figure F-5. Scour Along Marsh Edge Along Coyote Creek (Triangle Marsh (Segment 11).

Figure F-6. Pepperweed in the Reference Area (May 2007).

Figure F-7. Spearscale Colonizing Areas of Dead Alkali Bulrush (Segment 13).

Figure F-8. Pickleweed Dominated Marsh With Dead Alkali Bulrush and Healthy Cordgrass (Segment 23).

APPENDIX G.
2007 EDAPHIC CHARACTERISTICS STUDIES



Legend
Soil Core Sampling Points
1
2
3
4
5
6
7
8
9
10
11
12
N
0
1,200
2,400
Feet
2007 IKONOS Imagery
H. T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS
2007 South Bay Marsh Studies:
Edaphic Characteristics Study Area
Proj No. 477-28
Date Dec. 2007
Figure G-1
ML
N:\Projects\0477-28 2007\Final Figures

Appendix G. South Bay Marsh Edaphic Characteristics

For all graphs, Sites 1-6 are located in the Reference Area; Sites 7-12 are located in the Main Study Area; Sites 1 and 2 were not sampled in 2000 and 2001.

Figure G-2. Soil Bulk Density Comparison by Site

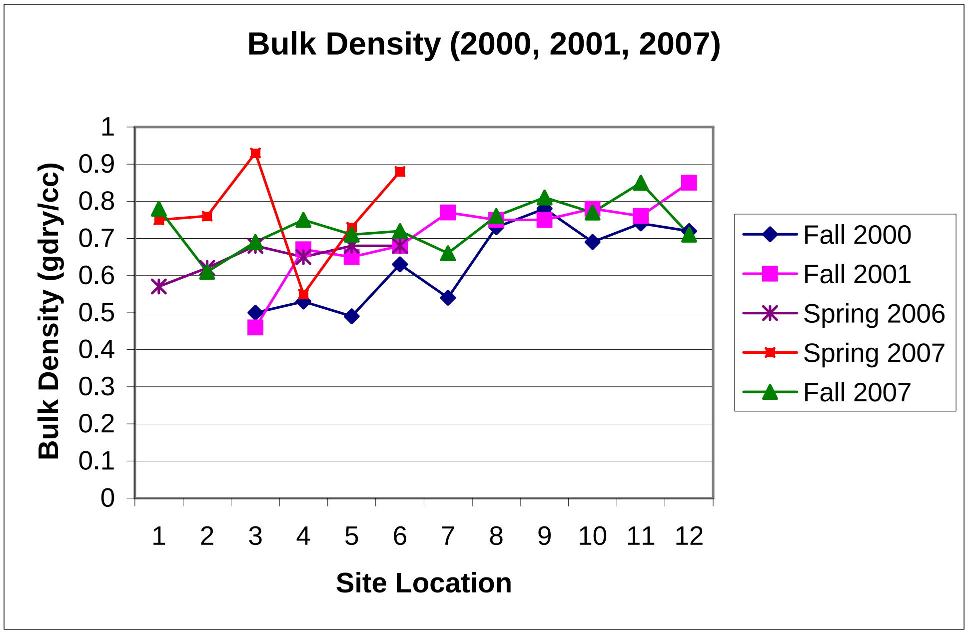


Figure G-3. Interstitial pH Comparison by Site

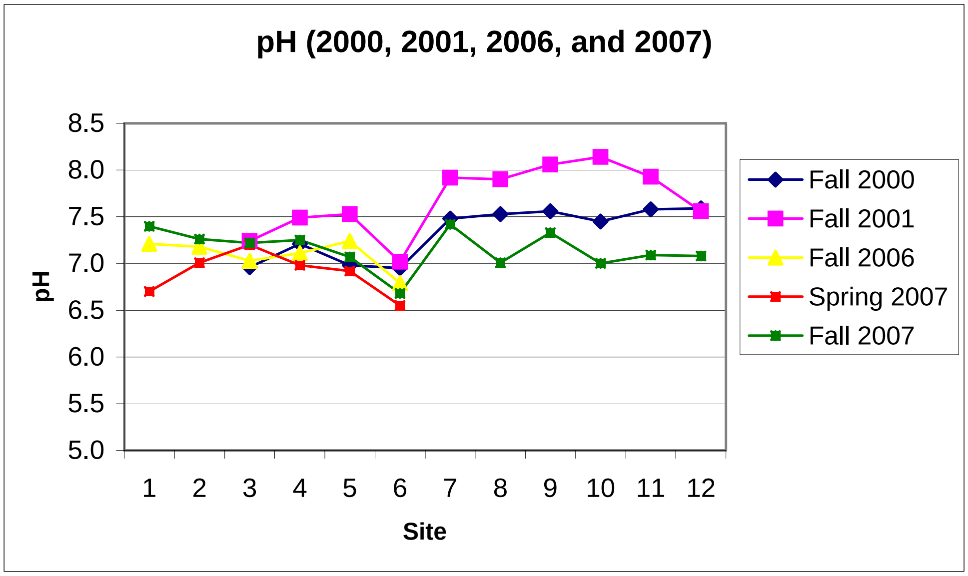


Figure G-4. Interstitial Conductivity Comparison by Site.

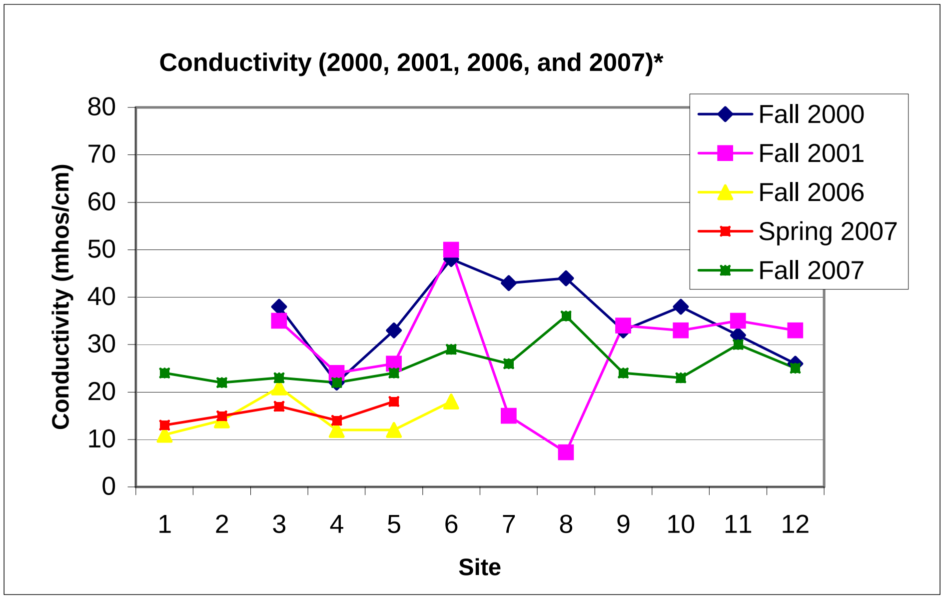


Figure G-5. Interstitial Salinity Comparison by Site.

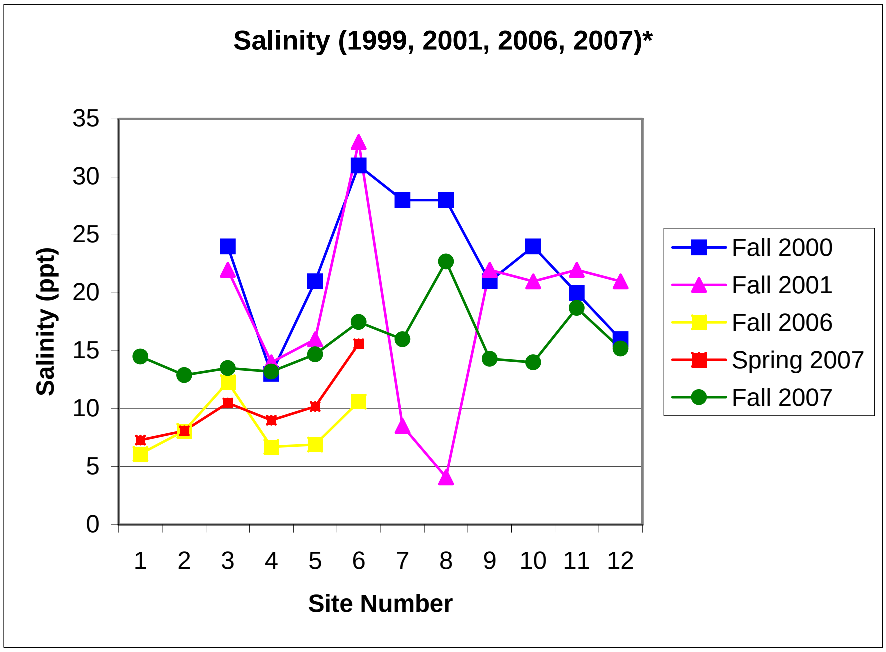


Figure G-6. Soil Bulk Density Comparison by Year

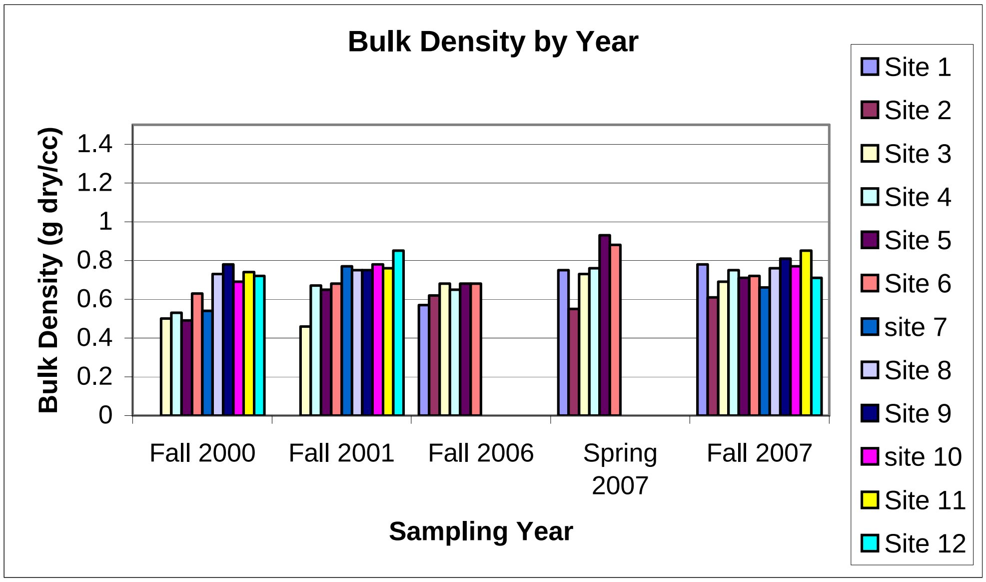


Figure G-7. Interstitial pH Comparison by Year

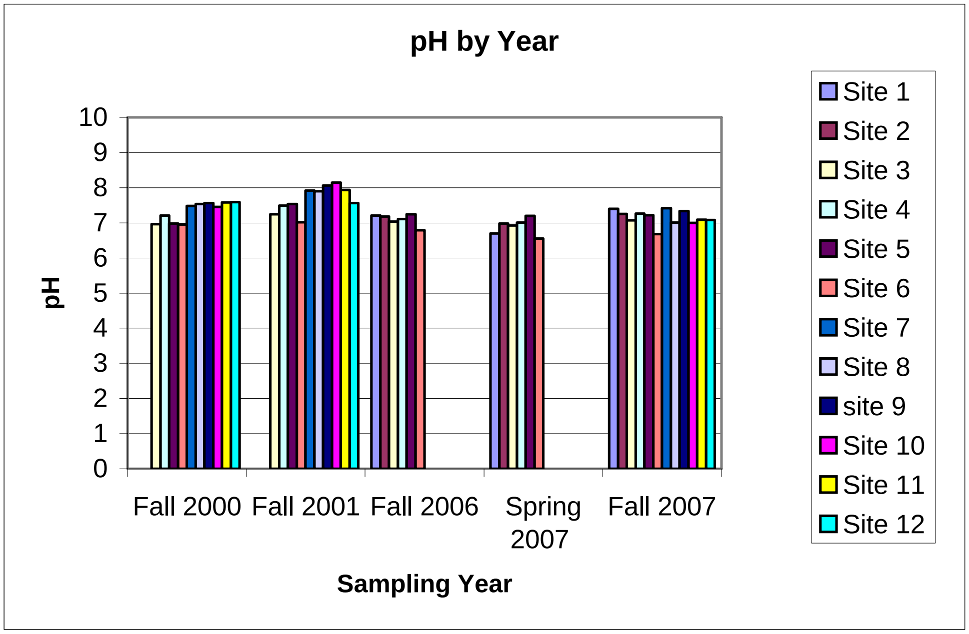


Figure G-8. Interstitial Conductivity by Year

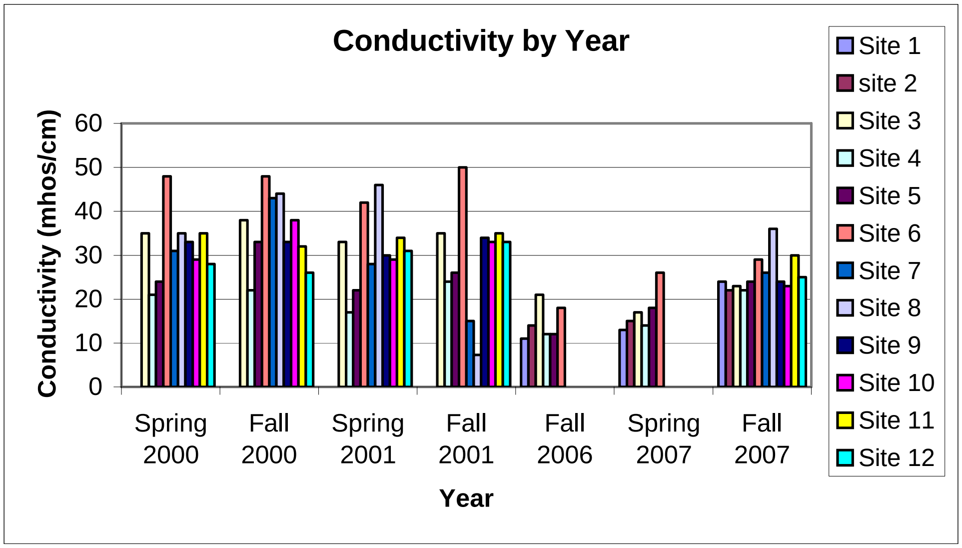


Figure G-9. Interstitial Salinity by Site