**Golden Gate National Recreation Area/
Point Reyes National Seashore**

National Park Service
US Department of the Interior

Vegetation Communities Report

Giacomini Wetland Restoration Project

Golden Gate National Recreation Area/
Point Reyes National Seashore

Marin County, California

Prepared By:

Lorraine Parsons and Leslie Allen
Point Reyes National Seashore
Division of Natural Resources Management
Water Resources Section
Point Reyes Station, CA 94956

January 20, 2004

TABLE OF CONTENTS

INTRODUCTION

The purpose of this report is to provide background information regarding vegetation communities, including sensitive ones such as wetlands, riparian areas, serpentine areas, and coastal prairies that might occur within the Giacomini Wetland Restoration Project Area. Point Reyes National Seashore (Seashore), a unit of the National Park Service (Park Service), will be preparing an Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for this Project. Background information in this report will be used to guide development and assess potential environmental impacts of the Project. As part of the EIS/EIR, the Seashore must consider whether this Project could impact sensitive vegetation communities, as well as special status wildlife and plant species. This study addresses not only the Project Area, but areas adjacent to the Project Area (Study Area).

Some preliminary mapping of vegetation communities within the Project Area occurred as part of the Seashore's Park-wide mapping efforts during the late 1990s. Additional vegetation mapping was performed in 2002-2003 within the Study Area to increase the resolution and scope of these preliminary mapping efforts. This information was used to determine the extent and location of sensitive vegetation communities such as wetland and riparian areas, as well as rare Natural Communities designated by the California Natural Diversity Database (NDDB).

Legislative/Regulatory Background

Many native vegetation communities within the United States have been adversely impacted by introduction of non-native plant species, as well as a host of other anthropogenic factors such as commercial, residential, and agricultural development, resource extraction, etc. The most highly publicized and pervasive threats are perhaps those to wetland and riparian communities: in California, more than 95 percent of coastal wetlands have been lost to development, and losses for the rest of the country are estimated at 50 percent (USFWS). Other communities such as California coastal prairie have received less national attention, but the introduction of non-native annual and perennial grasses of European origin have almost extirpated this unique habitat, which may have once dominated large expanses of California's coastline. In recognition of these threats, the California Department of Fish and Game (CDFG) has designated certain types of vegetation communities as deserving of special consideration, although these designations do not carry the same regulatory implications as federal or state listing as endangered, threatened, rare, or species of special concern. Many special status plant and wildlife species either reside in or use some of these sensitive vegetation communities for all or part of their life cycle.

The Council of Environmental Quality Regulations for Implementing the National Environmental Policy Act (Section 1508.27) requires considering if an action may violate federal, state, or local laws or requirements imposed for the protection of the environment. Sensitive vegetation communities such as wetlands and riparian areas are often subject to regulatory oversight under the Clean Water Act (federal) or other state and local legislative mandates, including so-called riparian "setbacks" or development buffers implemented by many county and municipal agencies.

Beyond regulatory mandates, the Park Service Management Policies (2001) require parks to implement a "no net loss of wetlands" policy and to strive over the long term for a net gain in wetland acreage. As part of this effort, the Park Service has been urged to conduct parkwide wetland inventories to ensure proper planning with respect to management and protection of wetland resources. The Park Service is also required to avoid "impacts to watershed and riparian vegetation" and other aquatic habitats (Management Policies 2001). In general, the Park Service is directed to "perpetuate native plant life as part of natural ecosystems" (Management Policies 2001).

Project Background

The Park Service is proposing a 563-acre wetland restoration project at the Waldo Giacomini Ranch (Giacomini Ranch) in the southern end of Tomales Bay in Marin County, California (Figure 1). The Park Service acquired the 563-acre Giacomini Ranch in February 2000 through a combination of Congressional appropriations and funding from the California Department of Transportation (CalTrans). The Giacomini Ranch is located in the north district of the Golden Gate National Recreation Area (GGNRA), which is administered by the Seashore. As part of the purchase agreement with the Giacominis, the Giacomini family was granted a reservation of use agreement until 2007 on approximately 463 acres. The remaining 100 acres are already under Park Service management. These 100 acres are located in the northwestern corner of the Project Area in the northern portion of the West Pasture: Lagunitas Creek bisects the pasturelands into two pasture areas that have been termed the East and West Pastures (Figure 1). The Seashore anticipates that restoration alternatives could include a phased approach that would enable restoration to proceed on these 100 acres before 2007.

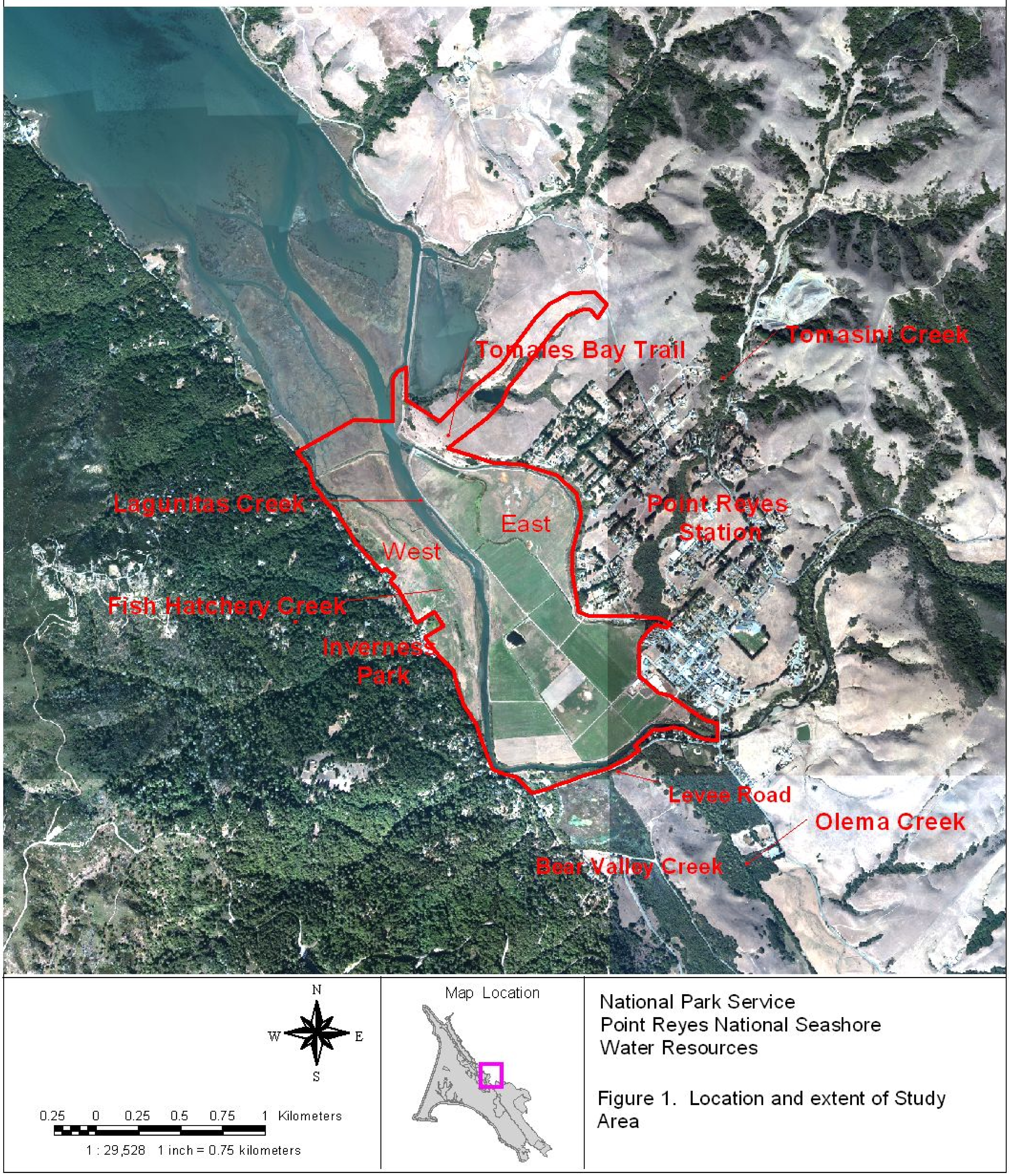
Since purchase of the property in 2000, the Seashore has been moving forward with the environmental planning process. Baseline studies on existing wildlife, vegetation, wetland, and cultural resources have been or are being conducted**.** Through integration of this baseline information with restoration science tenets, Park Service directives and management policies, and mitigation and contractual obligations, the Seashore has identified one primary project objective -- specifically, restoration of natural hydrologic tidal and freshwater processes, thereby enabling restoration of ecological processes and functions.

Public and agency scoping for the EIS/EIR ended in December 2002. In January 2003, the Seashore held a series of Alternative Workshops with Park Service staff and wetland and wildlife experts. These workshops resulted in development of a conceptual framework for qualitative prioritization of identified critical resource goals that will be used to guide design of restoration alternatives. These critical resource goals build upon the project's stated primary objective of restoring natural hydrologic and ecological processes and functions by providing some specific concrete measures or goals by which the Park Service can gauge the success of its future restoration efforts.

Giacomini Wetland Restoration Project

Golden Gate National Recreation Area

Vegetation Communities Report



National Park Service
Point Reyes National Seashore
Water Resources

Figure 1. Location and extent of Study Area

Plot date: September 4, 2003 nil

While alternative design is still in preliminary stages, the Park Service anticipates that the alternatives that will be incorporated into the EIS/EIR will involve some type of hydraulic and/or topographic alterations, such as partial levee breaching, lowering levee elevations, and creation of high marsh or upland areas to serve as high tide refugia habitat for bird species such as black rails and the California clapper rail. Another series of Alternative Workshops to introduce conceptual alternative designs started in fall 2003. Preparation of the environmental document will begin in spring 2004.

METHODS

Literature Review

A preliminary assessment of the Study Area was conducted by performing a literature review. The assessment included review of the Soil Survey of Marin County, California (U.S. Soil Conservation Service, 1985) to determine soil types and special geologic features (e.g. serpentine, seeps) present in the Study Area. It should be noted that soil mapping in many areas of Marin County has been restricted to identification of soil complexes or mixture of soil types rather than individual soil types, which decreases the ability to pinpoint locations of special geologic features. We also reviewed the USFWS National Wetland Inventory (NWI) maps to assess the potential extent of existing wetlands. In areas such as California, NWI maps typically represent only a fraction of the wetlands potentially present, because the reliance on high altitude aerial photographic interpretation traditionally underestimates acreage of smaller features and those with seasonal or ephemeral hydrology. As part of the Park Service's emphasis on inventorying natural resources, the Seashore has also conducted some broad-scale vegetation mapping within its lands and that of GGNRA based on aerial photographic interpretation (PORE 2003). These maps were used as a guide during our mapping efforts, which were conducted at a much finer scale. Lastly, we conducted a search of the California Natural Diversity Database (NDDB) for occurrences of special status habitats in all quadrangles within the Seashore and the north district of the GGNRA.

Field Surveys

Vegetation mapping was conducted in accordance with guidelines that were established by the Seashore during the 1997-2003 Vegetation Mapping Project. Incorporating both aerial photographic interpretation and ground-truthing surveys, the Vegetation Mapping Project focused on mapping vegetation communities within the Seashore, the GGNRA, and adjacent lands, including Mt. Tamalpais State Park, Samuel P. Taylor State Park, San Francisco Municipal Water District Lands, Audubon Canyon Ranch, and Tomales Bay State Park. True color aerial photographs taken in spring 1994 were used at a scale of 1:24,000, and photographic interpretation efforts were calibrated by training of photointerpreters using approximately 361 "training points" calibrated in the field. Initial drafts of the map were refined using ground-truthing accuracy assessment efforts between 1999-2001. Because of its reliance on 1:24,000 aerial photography, the Vegetation Mapping Project specified a minimum mapping unit of 0.5 hectares.

This vegetation map was later used to assist with inventory wetlands within the Seashore and the north district and other selected portions of the GGNRA. The first step involved assessing whether the USFWS NWI maps adequately represented the extent of wetlands within the Park Service units. A reassessment of a selected portion of one quadrangle (Tomales Point) by the USFWS during 2000 using interpretation of a different set of aerial photographs suggested that the initial NWI efforts may have underestimated wetland acreage by as much as 53 percent (David Schirokauer, *pers comm*.). A second component of assessing the adequacy of NWI for the Seashore's wetland inventory involved conducting field investigations of polygons that appeared likely to have wetlands based on the plant communities present (e.g., predominance of rushes and sedges) despite the fact that NWI had mapped no wetlands in the area. As with the USFWS remapping, these field efforts again suggested a significant underestimation of wetlands within the Seashore and GGNRA by NWI. This information was used, then, to develop an enhanced approach relative to NWI to inventorying and mapping wetlands within the Seashore and GGNRA (Schirokauer and Parravano 2003). The Seashore utilized this enhanced approach to map wetlands initially in the Seashore's Abbotts Lagoon watershed, which supports many special status plant and wildlife species, and later to other watersheds or portions of watersheds in the Seashore and GGNRA (Schirokauer and Parravano 2003). The minimum mapping unit for the wetlands inventory was either $10m^2$ or $100m^2$, with the former reserved exclusively for dune swales (Schirokauer and Parravano 2003). Because of the habitat complexity that appeared to be present, we elected to use a $10m^2$ minimum mapping unit for this project. This mapping unit would also provide the level of detail needed to assess vegetation changes, particularly in the type of species present, once the Project Area is restored.

The Seashore has been mapping vegetation communities using a Seashore-specific version (Keeler-Wolf February 1999) of a new vegetation classification system introduced in *A Manual of California Vegetation* by Sawyer and Keeler-Wolf (1995). The Sawyer and Keeler-Wolf (1995) system separates vegetation into Alliances and Associations based on species dominance. For example, marshes dominated by bulrush (*Scirpus californicus*) are grouped in the Bulrush Alliance. This classification system was intended to replace an earlier one developed in *Preliminary Descriptions of the Terrestrial Natural Communities of California* (Holland 1986). Holland was actually modifying an earlier system developed by Cheatham and Haller (1975), so that a uniform system for describing communities in which sensitive plant and animal species are found could be developed for the NDDB.

As the NDDB until recently relied exclusively on the Holland classification system to characterize special habitats, we initially attempted to describe vegetation communities using both the Holland and Sawyer and Keeler-Wolf systems. However, many of the communities present in the Study Area were composed primarily of non-natives or grasses, which were not treated as in as much detail in Keeler-Wolf (February 1999), or the communities observed were simply not included in that classification scheme. For this reason, we relied more heavily on a modified version of Holland (1986) that incorporated an expanded number of aquatic vegetation communities (e.g., Moist Grassland) into a category called Sub-Alliance. A list and accompanying description of the Sub-Alliances used in this mapping effort is provided in Appendix A. It should be noted that, in September 2003, the CDFG Wildlife and Habitat Data Analysis Branch published a list of terrestrial natural communities that, to some degree, merges the Holland classification system into the Sawyer and Keeler-Wolf systems in order to rank communities by their significance and rarity (CDFG 2003).

Vegetation mapping classified polygons according to three levels: Cluster, Sub-Alliance, and Sub-Association. Some differences in terminology were used to ensure that there was no confusion with the Keeler-Wolf system (February 1999), which, as noted earlier, characterizes polygons by Alliance or Association. Giacomini Clusters typically lump polygons into larger, more basically descriptive units described as Riparian, Marsh, Pasture, etc (Appendix A). Sub-Alliance represents the modified version of Holland alluded to earlier and includes designations such as Wet Pasture, Freshwater Marsh, Scrub-Shrub Riparian, Diked Salt Marsh, Ruderal, and Open Water (Appendix A). Sub-Associations characterize polygons by the dominant and/or characteristic plant species within each polygon (Appendix A). As noted earlier, the minimum mapping unit was $10m^2$, which resulted ultimately in mapping of nearly 700 polygons within the approximately 613-acre Study Area. Sub-Associations with slashes (*Salix lasiolepis*/*Rubus discolor*) between species' names refers to riparian polygons where the co-dominant species occurred in different strata, with the former typically in the overstory, whereas Sub-Associations with a hyphen in the species' names (*Salix lasiolepis-Rubus discolor*) represent areas where both co-dominant species occurred in the same strata. Areas with distinct vegetation associations that were smaller than the minimum-mapping unit were noted as "inclusions" within larger polygons and described either on a separate datasheet or on the same datasheet.

Within each polygon, all plant species present were noted, and the percent cover of each species was assigned to a cover class (Table 1). We also noted all strata (e.g., herb, shrub, sub-canopy tree, and overstory tree) in which the plant species occurred (Table 1). This information particularly proved valuable in separating the Forested and Scrub-Shrub Riparian Sub-Alliances. Associations were determined by assessing which species or combination of species had the highest percent cover within the polygon. Polygons with a species that was two cover classes higher than any other species were described as being dominated by a single species. Polygons with no-clear dominance trends were incorporated into the Sub-Association, "Mixed," or, if a single, uncommon species was dominant, it was lumped into the Sub-Association, "Other." Some of the Sub-Associations included non-plant designations such as Urban or Ditch Excavation Spoils, however, most of the polygons with sparse to no plant cover received no Sub-Association designation.

TABLE 1. Cover class and strata designations used in Giacomini Wetland Restoration Project vegetation mapping.

Cover Classes	1	<1%
	2	1-5%
	3	6-15%
	4	16-25%
	5	51-75%
	6	76-100%
Strata	Herb	<0.75m
	Shrub	0.75 – 5m
	Subcanopy Tree	5 – 15m
	Overstory Tree	>15m

Lorraine Parsons and Leslie Allen, wetlands ecologists at the Seashore, conducted most of the vegetation mapping from July to November 2002, with some follow-up work conducted by Leslie Allen, Lorraine Parsons, Amelia Ryan (Biologist, Seashore), and Chelsea Donovan (Biologist, Seashore) in August and September 2003. During field surveys, meandering transects were walked throughout the Study Area to ensure that all habitats present were surveyed. All plant species observed were identified to the level necessary to ensure that any special status species present would be detected. When necessary, specimens from the herbarium at PORE or other herbariums in the San Francisco Bay area are examined to resolve any taxonomic ambiguities. While several taxonomic keys were used to identify plant species observed (e.g., Hickman 1993, Mason 1969, Howell 1970, Beidleman and Kozloff 2003), scientific and common nomenclature followed *The Jepson Manual* (Hickman 1993). These surveys and other fieldwork (e.g., water quality monitoring) were also used to qualitatively characterize hydrologic sources and influences throughout the Study Area (Figure 3).

Polygons were mapped onto 2001 multispectral images (1:12,000 or $1m^2$ pixel) either using heads-up digitizing or GPS field data in ArcView 3.3 (ESRI). Polygons were later edited, and shapefiles were converted into covers using ArcInfo (ESRI). Information about the polygon, including Wetlands Code, Giacomini ID Number, and classification as Cluster, Sub-Alliance, and Sub-Association were entered into the ArcView 3.3 attribute table. The complete list of species observed for each polygon, along with surveyors, Cover Class, Strata, Wetland Indicator Status, and any comments were entered in a version of the PORE Vegetation Mapping database (Microsoft Access 97) that was modified for this particular project.

Study Area Background

The nature of the Study Area has been sharply defined by this region's unique geologic and land-use history. The San Andreas Fault, responsible for the 1906 Earthquake that devastated San Francisco, runs directly through the Study Area and Tomales Bay. Movement of the Pacific and Continental Plates has produced striking differences in the geologic nature of the lands on the west and east sides of Tomales Bay by displacing lands along this major fault as much as several hundred miles (Shuford and Timossi 1989).

The eastern portion of the Tomales Bay watershed is dominated by the Franciscan formation, composed of sandstone, graywacke, shale, some volcanic and metamorphic rock, and greenstone (U.S. Soil Conservation Service 1985). Within Marin County, serpentine areas occur almost exclusively in the Franciscan Formation and are strongly linked with the Henneke and Montara soil series (U.S. Soil Conservation Service 1985). Serpentine areas are somewhat unique in that the unusual chemical composition of this rock creates harsh conditions for plants that results in sparse vegetation cover and yet, conversely, also occurrence of a high number of endemic and special status plant species. The Franciscan Formation is typically associated with the higher elevation ridges, mountains, and hills that run along Marin County's western perimeter. Directly adjacent to the Study Area lies a lower-elevation coastal terrace known as the Point Reyes Mesa. Soil types mapped along this terrace include Olompali loam and the Saurin-Bonnydoon complex (U.S. Soil Conservation Service 1985; Figure 2). These soil units are not characterized by serpentinite or granitic or rock outcroppings (U.S. Soil Conservation Service 1985). However, fragrant fritillary (*Fritillaria lilacea*; FSC), which is described as being "often on serpentine soils," has been recorded near the eastern end of the Tomales Bay trailhead near Highway 1, northeast of the Study Area.

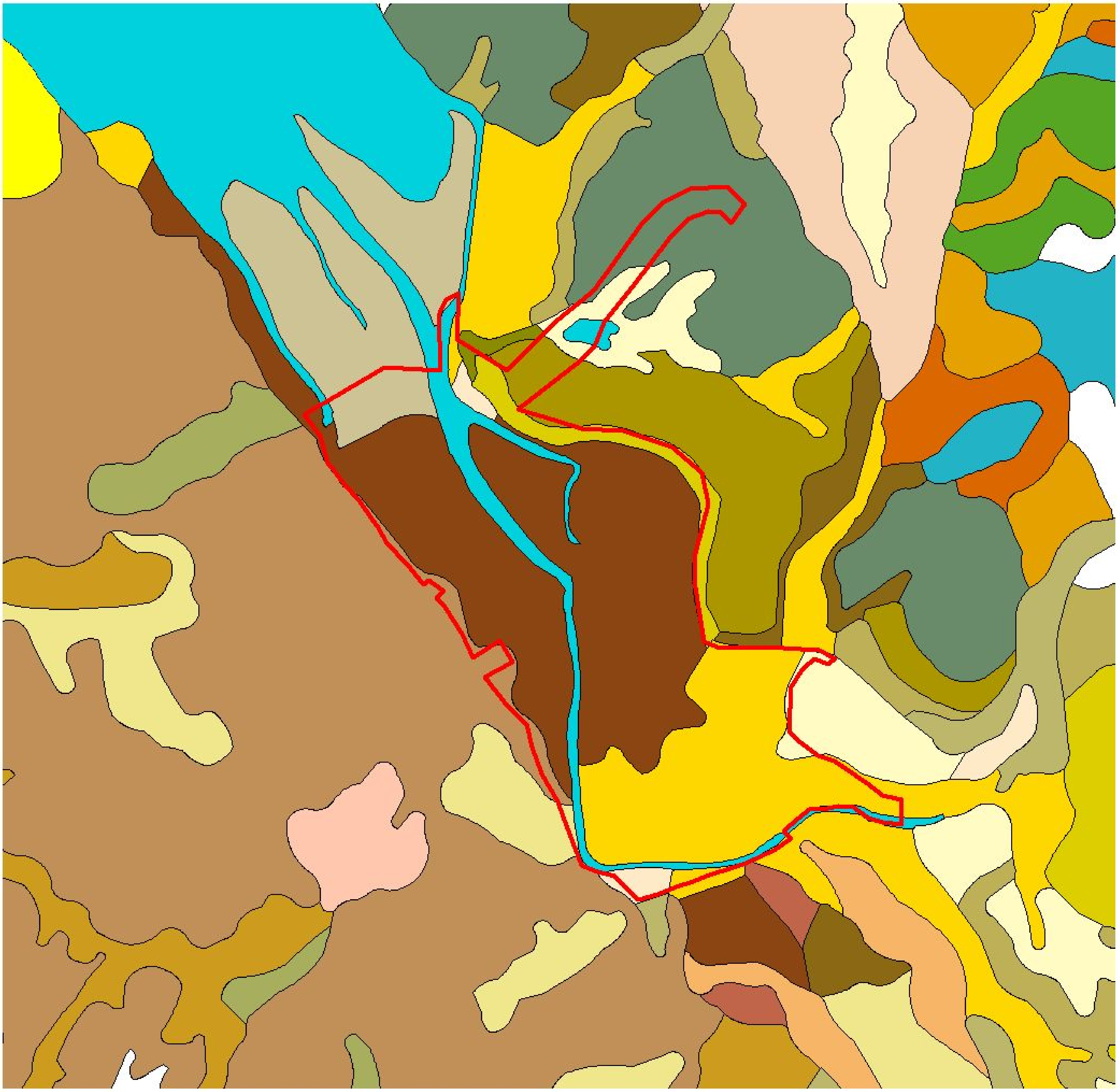
West of Tomales Bay on the steeply sloped Inverness Ridge – and within most of the Seashore – granitic rock such as quartz-diorite and granodiorite dominate, forming the backbone of the Point Reyes Peninsula (U.S. Soil Conservation Service 1985). Overlying the granitic rock in most areas are shale, sandstone, porcelainite, and chert, but, in some areas, the dominant parent material is mudstone, siltstone, and greenish sandstone that is referred to as the Drakes Bay or Purisma Formation (U.S. Soil Conservation Service 1985). Soils on the portion of the Inverness Ridge directly adjacent to the western boundary of the Study Area are mainly comprised of the Inverness loam series, ranging from 15 to 75 percent slopes (U.S. Soil Conservation Service 1985; Figure 2). This soil unit is not characterized as having serpentine inclusions, but small rock outcroppings are occasionally found, mainly on the ridgetops (U.S. Soil Conservation Service 1985).

The Study Area is comprised primarily of low-elevation lands bounded by Inverness Ridge and the Point Reyes Mesa. Prior to the 1860s, approximately one-third to one-half of the Study Area was actually subtidal or unvegetated intertidal habitat (PWA et al. 1993, Niemi and Hall 1996).

Giacomini Wetland Restoration Project

Golden Gate National Recreation Area

Vegetation Communities Report

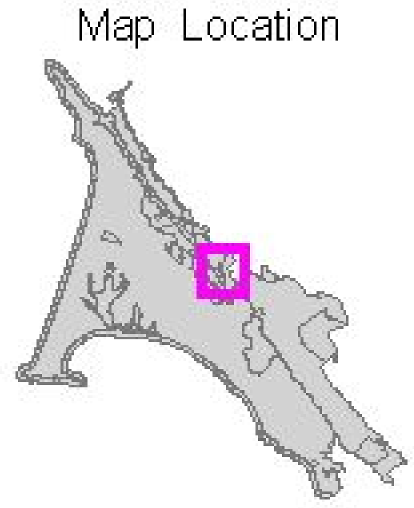


Soil Types

- Barnabe very gravelly loam (30-50)
- Blucher-Cole complex (2-5)
- Cortina gravelly sandy loam (0-5)
- Fluvents, channeled
- Hydraquents, saline
- Inverness loam (9-15)
- Inverness loam (15-30)
- Inverness loam (30-50)
- Inverness loam (50-75)
- Los Osos-Bonnydoon complex (15-30)
- Los Osos-Bonnydoon complex (30-50)
- Novato clay
- Olompali loam (2-9)
- Olompali (9-15)
- Olompali (15-30)
- Rock outcrop-Xerorthents complex (50-75)
- Saurin-Bonnydoon complex (2-15)
- Saurin-Bonnydoon complex (15-30)
- Saurin-Bonnydoon complex (30-50)
- Tocaloma-Saurin association, very steep
- Tocaloma-Saurin association, extremely steep
- Xerorthents, fill
- Yorkville clay loam (15-30)
- Yorkville clay loam (30-50)
- Water
- Study Area

N
W E
S

Map Location



National Park Service
Point Reyes National Seashore
Water Resources

Figure 2. Soil types within the Study Area and vicinity

Plot date: September 4, 2003 u:\natural\parsonsl\giacomini wetland restoration\gis\rare_plants_v2.apr

The historic coastal salt marsh was relegated to the southeastern corner of the Study Area near the existing dairy facility and in the Olema Marsh and Olema Creek floodplains (PWA et al. 1993). This marsh represented a significant percentage of the existing salt marsh present at that time in Tomales Bay. However, during the latter half of the 19^{th} century, sedimentation rates rose dramatically, resulting in rapid deltaic aggradation of coarse alluvium in the southern end of Tomales Bay. This increase in sedimentation probably resulted from an increase in logging and other changes in land use practices (PWA et al. 1993, Niemi and Hall 1996), but was undoubtedly exacerbated by the geologic instability characteristic of this region. It has been estimated that, between 1860 and 1950, approximately 5 vertical feet of sediment deposited within southern Tomales Bay, creating 650 acres of new vegetated intertidal habitat (PWA et al. 1993). The greatest sedimentation occurred between 1860-1910 (PWA et al. 1993). The 1906 Earthquake may have subsequently "drowned" some of this deltaic aggradation. There were reports in Bolinas Lagoon of subsidence of up to 1 foot, however, evidence of similar subsidence events in Tomales Bay were not as clear-cut (Gilbert 1908). Sedimentation continued to be high until at least the 1950s, when construction of several dams and reservoirs within the Marin Municipal Water District (MMWD)-owned portion of the Tomales Bay watershed began reducing sediment input (PWA et al. 1993, Niemi and Hall 1996).

Soil types mapped within the relatively level pastures of the Giacomini Ranch are consistent with this area's unique history (Figure 2). The northern 60 percent of the Project Area is comprised of Novato Clay (U.S. Soil Conservation Service 1985). Novato Clay is described as "very deep, very poorly drained soil…in saltwater marshes ...formed in alluvium derived from various kinds of rock" (U.S. Soil Conservation Service 1985). The historic coastal salt marsh in the southeastern corner of the Study Area and the portion of Lagunitas Creek along Levee Road is mapped as Blucher Cole complex (U.S. Soil Conservation Service 1985). The Blucher-Cole complex is also formed in alluvium from various kinds of rock, although this mapping unit is typically found in basins and on alluvial fans. Both components of this mapping unit are characterized as very deep soils that are somewhat poorly drained with seasonally high water tables and occasional periods of flooding (U.S. Soil Conservation Service 1985).

Soil borings conducted in 2003, however, indicate that soil patterns within the Project Area are much more complex than the soil map would suggest. The historic salt marsh areas in the southern and eastern portions of the East Pasture typically have deep, intermixed estuarine clays and peats overlain with a thin (~0.3 –0.5 m) loam or clayey loam layer (Greg Kamman, Hydrologist, *pers comm*.). The loams probably date to the period in which the Project Area was isolated from tidal and freshwater flow influence and started being actively farmed. The very southern portion of the East Pasture has a very thick (2.5 m) layer of silts and sands that appears to have resulted from the Giacominis' efforts to deliberately direct flood overflows from Lagunitas Creek to this portion of the property (G. Kamman, *pers comm*.). Conversely, sediment in many of the historic subtidal areas directly adjacent to historic and current Lagunitas Creek channels are comprised of loam or silty loam overlain on interbedded silt, clays, and sands. This interbedded layer rests on a very deep layer of extremely permeable coarse-grained sands and gravels that were probably deposited by historic bedload and suspended sediment transport during storm events (G. Kamman, *pers comm*.).

The undiked marsh north of the Giacomini Ranch has been mapped as almost exclusively Hydraquents, saline, with slightly smaller pockets of Novato Clay and Xerorthents, fill, at the base of the Tomales Bay trailhead, directly north of the East Pasture and the outlet of Tomasini Creek into Tomales Bay (Figure 2). Hydraquent, saline, soil types consist of "nearly level soils along the coast" typified by "stratified deposits of silt and clay with thin layers of peat" that are "continuously waterlogged" (U.S. Soil Conservation Service 1985).

Unlike many of the diked salt marshes in San Francisco Bay, the Project Area does not appear to have subsided much and, in some areas, may have actually aggraded due to flood overflows and agricultural activities (e.g., filling, land-leveling). Subsidence or decreases in elevation may have been minimized by not only the coarse nature of the sediments present, but the relatively rapid pace of deltaic deposition, which probably prohibited substantial vegetation recruitment and dieback and, therefore, formation of undecomposed plant material or "peat" layers. When areas are drained through diking, fine-grained sediments compress, and peat is broken down, leading to compaction of soils and often substantial lowering of elevations. Topographic information suggests that elevations in the northern end are perhaps 1-2 feet lower than the adjacent undiked marsh, while elevations at the southern end are actually slightly above intertidal elevations.

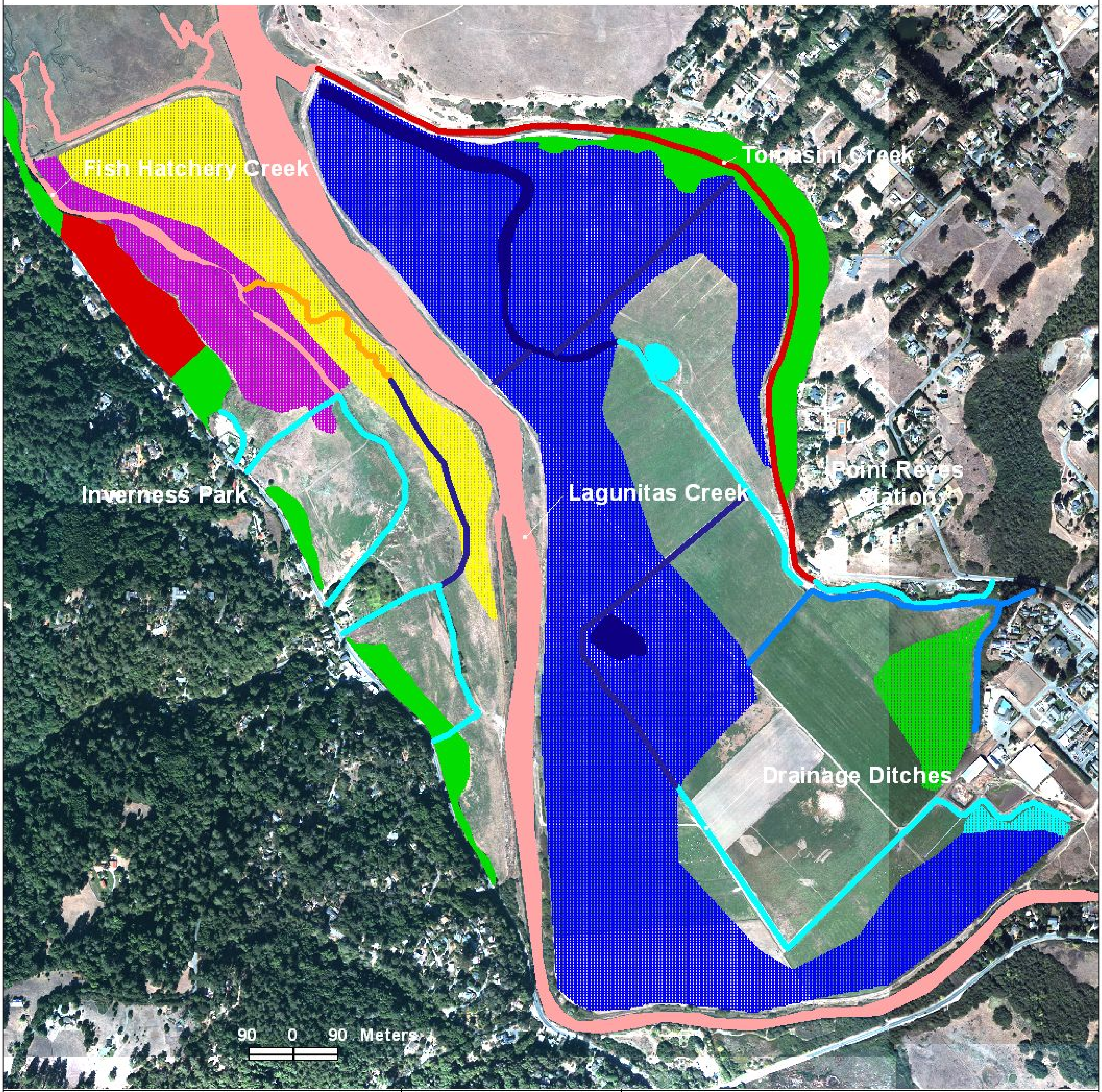
From an estuarine perspective, the Study Area represents the mixing zone for oceanic tides from the Pacific Ocean and freshwater fluvial flows from several perennial/seasonal creeks and drainages, including Lagunitas, Fish Hatchery, and Tomasini creeks, as well as several smaller, unnamed drainages (Figure 3). Tomales Bay is characterized as a typical "classic," winter-stratified estuary, with salinities ranging from freshwater near 0-5 ppt in the winter to brackish and even saline (15-30 ppt) in the summer and fall. Both Fish Hatchery and Tomasini Creeks, which flow through the diked West and East Pastures, respectively, are tidally influenced to some degree, because their so-called "one-way" tidegate or flashboard dam structures are malfunctioning, allowing tidal inflow. Another source of freshwater influences within the Study Area is seep flow from groundwater sources along Inverness Ridge and Point Reyes Mesa, which again relates strongly to this area's unique and unstable geologic history. These seeps emerge at the base of the higher elevation ridges and terraces and then sheetflow out onto the relatively level pastures or drainages (Figure 3). These freshwater influences appear to be mediated to some extent by subsidence and perhaps a strong groundwater connection between tidally influenced Lagunitas Creek and the pastures. Rapid deltaic formation through deposition of coarse alluvium appears to have created a very permeable soil substrate that promotes a strong groundwater connection between the brackish to saline Lagunitas Creek and the adjacent diked pastures (Figure 3).

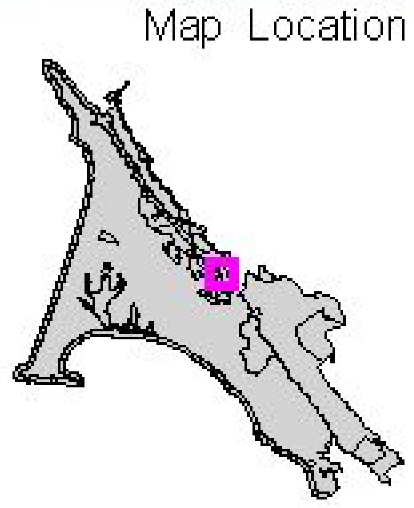
The Seashore/GGNRA vegetation mapping efforts prepared from aerial photographic interpretation characterized more than 80 percent of the Project Area as Active Pasture or Agriculture (Figure 4). While the Giacominis operate a dairy, which is often less intensive in terms of maintenance than row cropping, most of the East Pasture is actively spray or flood-irrigated to increase forage for cattle. Ditches and drainages are excavated on an as-needed basis
to ensure flow-through of irrigation waters and maintenance of drier conditions within pastures. Both the East and West Pastures are mowed at least once annually to provide additional forage

Giacomini Wetland Restoration Project

Golden Gate National Recreation Area

Vegetation Communities Report





National Park Service
Point Reyes National Seashore
Water Resources

Figure 3. Hydrologic sources and influences within the Project Area. Some areas have multiple sources of hydrologic sources and influences.

Plot date: September 3, 2003 u:\natural\parsonsl\giacomini wetland restoration\gis\hydro_influences.apr for the dairy herd and are treated with manure. Select areas in the southern portion of the East Pasture are also leveled.

Small to moderately sized inclusions of the Willow Mapping Unit occurred along the perimeter of the Project Area and along portions of Lagunitas Creek and in the Wildlife Conservation Board lands between the dairy facility and the Green Bridge (Figure 4). A thin strip of Red Alder Alliance (*Alnus rubra*/*Salix lasiolepis* Association) paralleled Sir Francis Drake Boulevard in the very northwestern portion of the Study Area (Figure 4). Pickleweed Alliance (*Salicornia virginica*/*Distichlis spicata*/*Jaumea carnosa* Association) was mapped in the lowest elevation portions of the Project Area, such as the Old Duck Pond, the outboard portion of the Lagunitas Creek levee, and the undiked marsh north of the Project Area (Figure 4). Saltgrass Alliance was depicted as occurring in large swaths through the northern part of the West Pasture, as well as along the alluvial and manmade levees on Lagunitas Creek (Figure 4). Near the New Duck Pond, which as shown as Open Water, there were patches of Pickleweed Alliance and Bulrush-Cattail-Spikerush Marsh Mapping Unit (Figure 4). Bulrush-Cattail-Spikerush Marsh Mapping Unit was also shown as occurring in the East Pasture Old Slough and Tomasini Creek (Figure 4).

Directly south of Lagunitas Creek near Levee Road, the Wildlife Conservation Board lands that have been leased to the County of Marin Open Space and Parks District are mapped as a mixture of Built-up Urban Disturbance, Rush Alliance, and Arroyo Willow Alliance (Figure 4). A large patch of Introduced Perennial Grassland occurred just south of the dairy facility between the dairy and the Green Bridge (Figure 4). The sloped portions of the Point Reyes Mesa were dominated by the Coyote Brush Alliance (*Baccharis pilularis* ssp. *consanguinea*/*Toxicodendron diversilobum*), with pockets of the Arroyo Willow Alliance, California Annual Grasslands with Native Component, and *Eucalyptus* sp. Alliance: the top of the mesa is heavily developed(Figure 4). Conversely, Inverness Ridge supported a more highly forested vegetation community, comprised of a diverse mix of Douglas Fir Alliance (*Pseudotsuga*/*Quercus agrifolia* and *Pseudotsuga*/*Umbellularia californica*/*Polystichum munitum* and unspecified Associations), California Bay Alliance (*Umbellularia*/*Quercus agrifolia*/*Toxicodendron diversilobum* and unspecified Associations), and Built-up Urban Disturbance where homes occur along the ridge.

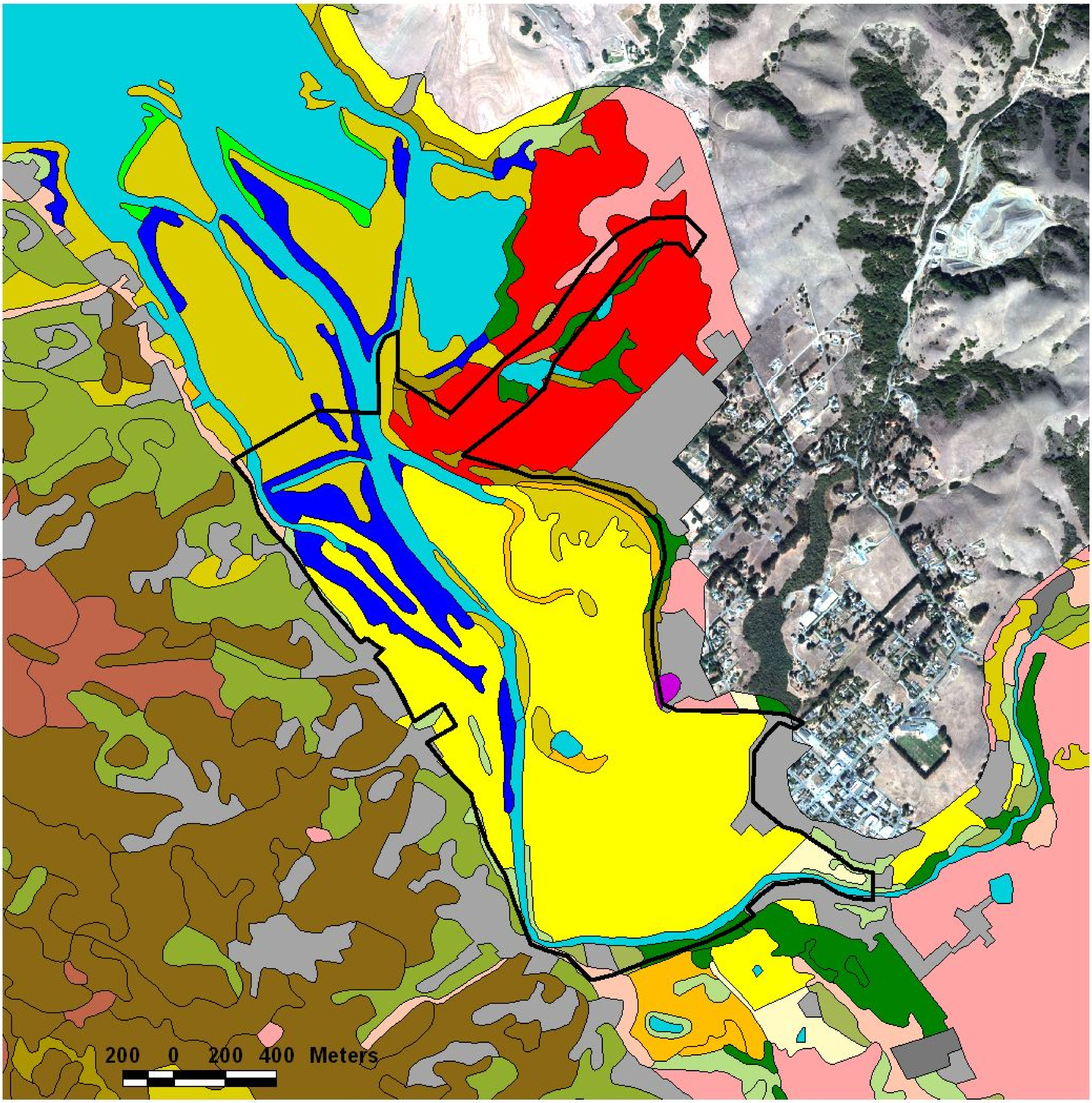
NDDB Special Habitats

The search of the NDDB identified two (2) special habitats or Natural Communities with potential to occur within the vicinity of the Study Area: coastal and valley freshwater marsh and northern coastal salt marsh (NDDB 2001). As noted earlier, in addition to special status plants, the NDDB also tracks occurrences of rare and significant vegetation communities (CDFG 2003). Coastal freshwater marsh are permanently flooded freshwater wetlands with deep, peaty soils dominated by perennial, emergent monocots approximately 4-5 m tall such as rush (*Scirpus* spp.) and cattails (*Typha* spp.; Holland 1986). It has been documented from a 34-acre marsh west of Drakes Beach (NDDB 2001). Northern coastal salt marsh is characterized by salt-tolerant halophytes that form moderate to dense cover approximately 1 m tall and is usually separated into “zones” based on tidal elevation – low marsh, mid marsh, and high marsh (Holland 1986). Northern coastal salt marsh is documented from the head of Tomales Bay (NDDB 2001).

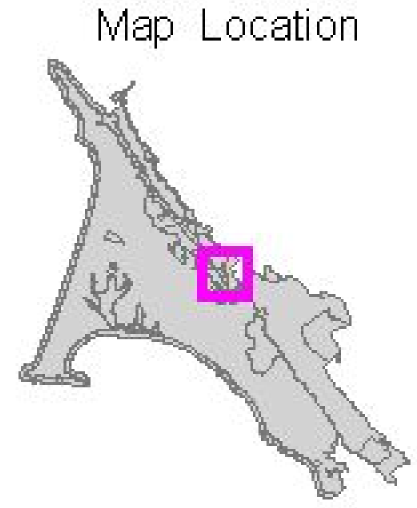
Giacomini Wetland Restoration Project

Golden Gate National Recreation Area

Vegetation Communities Report



Map Location



National Park Service
Point Reyes National Seashore
Water Resources

Figure 4. Vegetation communities mapped in Study Area and vicinity during the Seashore's 1994 mapping efforts.

RESULTS/DISCUSSION

The mapping of more than 80 percent of the Project Area as Active Pasture or Agriculture during initial vegetation mapping efforts conducted by the Seashore/GGNRA suggests that the Project Area is primarily a monotypic, pastoral forb-and herb-dominated vegetation community largely shaped by agricultural activities. However, our ground-based vegetation mapping efforts uncovered an incredible amount of habitat diversity in this highly managed landscape. There were approximately 27 Sub-Alliances mapped within the Study Area (Appendix A). Its hydrologic complexity undoubtedly accounts for the wide variety of habitats present, most of which were either wetland or riparian in nature and included glycophytic (freshwater), brackish, and halophytic (saline) hydrologic regimes (Figure 5). A list of Sub-Alliances and acreages is provided in Table 2. The following are the largest Sub-Alliances within the Study Area based on acreage:

1. Wet Pasture
2. Salt Marsh Pasture
3. Open Water
4. Ruderal
5. Mesic Coastal Scrub
6. Wet Meadow
7. Scrub-Shrub Riparian
8. Tidal Salt Marsh-High
9. Diked Salt Marsh-Mid
10. Disturbed
11. Freshwater Marsh
12. Forested Riparian
13. Diked Salt Marsh-Mudflat/Panne
14. Diked Brackish Marsh
15. Diked Salt Marsh-High

Most of the pre-dominant Sub-Alliances are discussed in more detail under one of the following three sub-sections: Glycophytic, Brackish, and Halophytic Regimes. Figures 6-11 at the end of this section provide a more detailed view of Sub-Alliances.

The predominance of communities such as Wet Pasture, Salt Marsh Pasture, Ruderal, and Disturbed strongly reflects the agricultural nature of the Project Area, although the diversity even within these highly managed habitat types is apparent in names such as "Wet" Pasture and "Salt Marsh" Pasture. The large areal extent of other communities such as Mesic Coastal Scrub and Scrub-Shrub Riparian is skewed to some degree by the inclusion of lands outside the Project Area, but within the Study Area, such as the Point Reyes Mesa bluff and lands along Levee Road near White House Pool and the Green Bridge.

Representative of the diversity present in the Study Area, each of the Sub-Alliances typically had numerous Sub-Associations representing the dominant species or suite of species within that

Golden Gate National Recreation Area

Giacomini Wetland Restoration Project

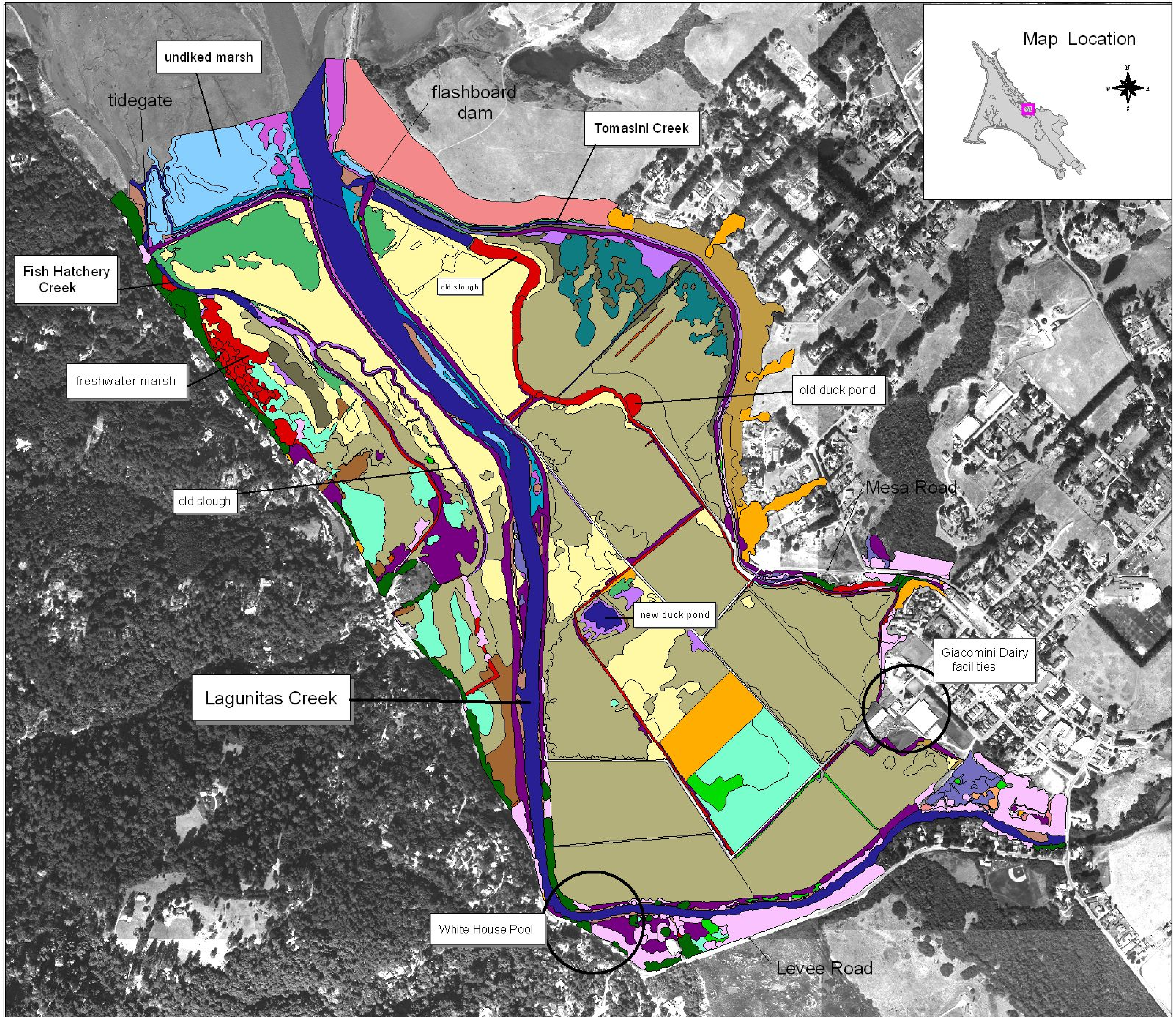


Figure 5. Vegetation communities mapped at Sub-Alliance level. View of entire Project Area.

1	Coyote Brush Coastal Scrub
2	Diked Brackish Marsh
3	Diked Salt Marsh-High
4	Diked Salt Marsh-Mid
5	Diked Salt Marsh-Mudflat/Panne
6	Disturbed
7	Dry Grassland
8	Dry Pasture
9	Forested Riparian
10	Freshwater Marsh
11	Mesic Coastal Scrub
12	Moist Grassland
13	Moist Meadow
14	Open Water
15	Ruderal
16	Salt Marsh Pasture
17	Scrub-Shrub Riparian
18	Seasonal Wetland
19	Tidal Brackish Marsh
20	Tidal Salt Marsh-High
21	Tidal Salt Marsh-High/Upland Ecotone
22	Tidal Salt Marsh-Low
23	Tidal Salt Marsh-Mid
24	Unvegetated
25	Vernal Marsh
26	Wet Meadow
27	Wet Pasture

National Park Service
Point Reyes National Seashore
Natural Resources

0.1 0 0.1 0.2 0.3 Miles

1 : 10,771 1 inch = 0.17 miles

Plot date: October 31, 2003 s:\gis\projects1\giacomini\giac_alliance.apr

TABLE 2. List of Giacomini Sub-Alliances, including Sub-Alliance number, ranking based on area, the number of polygons of that type mapped, and areal extent in hectares and acres.					
SUB-ALL NO.	RANKING NO.	GIACOMINI SUB-ALLIANCE	NO. OF POLYGONS	HECTARES	ACRES
1	24	Coyote Brush Coastal Scrub	4	0.12	0.30
2	14	Diked Brackish Marsh	24	3.81	9.43
3	15	Diked Salt Marsh-High	21	3.69	9.14
4	9	Diked Salt Marsh-Mid	11	6.48	16.00
5	13	Diked Salt Marsh-Mudflat/Panne	5	4.62	11.42
6	10	Disturbed	15	6.40	15.81
7	23	Dry Grassland	1	0.15	0.36
8	17	Dry Pasture	8	2.42	5.99
9	12	Forested Riparian	37	5.08	12.54
10	11	Freshwater Marsh	63	6.30	15.57
11	5	Mesic Coastal Scrub	5	12.73	31.47
12	20	Moist Grassland	18	2.03	5.02
13	21	Moist Meadow	16	1.33	3.28
14	3	Open Water	8	18.55	45.83
15	4	Ruderal	66	13.85	34.22
16	2	Salt Marsh Pasture	48	33.56	82.93
17	7	Scrub-Shrub Riparian	80	9.69	23.94
18	22	Seasonal Wetland	6	0.20	0.51
19	18	Tidal Brackish Marsh	40	2.12	5.24
20	8	Tidal Salt Marsh-High	17	7.72	19.07
21	19	Tidal Salt Marsh-High/Upland Ecotone	9	2.03	5.03
22	27	Tidal Salt Marsh-Low	11	0.04	0.10
23	16	Tidal Salt Marsh-Mid	16	2.57	6.35
24	25	Unvegetated	3	0.07	0.17
25	26	Vernal Marsh	3	0.06	0.14
26	6	Wet Meadow	24	11.23	27.75
27	1	Wet Pasture	79	93.55	231.15

habitat. There are 86 Sub-Associations generally comprised of one to three dominant plant species (Appendix A). Information on Sub-Associations is provided in Appendices A and B, while a list of all plant species in the Study Area is provided in Appendix C. Some Sub-Associations occurred within multiple Sub-Alliances (e.g., *Salicornia-Distichlis-Jaumea* in Diked Salt Marsh-Mid and Tidal Salt Marsh-Mid). Figures 12-14 at the end of this section show Sub-Associations within some portions of the Study Area.

Glycophytic Regimes

The historical extent of glycophytic or freshwater vegetation communities within the Tomales Bay watershed is unknown. As noted earlier, the 1863 U.S. Coast Survey maps portray the southern end of Tomales Bay as open water and intertidal mudflat with marsh in the southeastern end in what is today the Giacomini Ranch East Pasture, Olema Marsh, and Olema Creek floodplain. Some historical accounts refer to "Arroyo Olemus Lake" or Olema Lake, which most likely occurred along the low-lying floodplains of Olema Creek between the town of Olema and Lagunitas Creek (Niemi and Hall 1996). This "lake" may have been subsequently drained by construction of the Olema Canal, which straightened the section of Olema Creek between Olema and Lagunitas Creek (Niemi and Hall 1996).

While Olema Lake was probably freshwater marsh, coastal salt marsh actually appears to have extended as far south along its neighboring drainage, Bear Valley Creek, as Bear Valley or the Park Service's administrative headquarters (Evens 1993). This suggests that Olema Marsh, which Thomas Howell (1970) once described as "perhaps the best freshwater marsh in (Marin) County," may actually be an artifact of levee construction during the late 1800s along Sir Francis Drake Boulevard, also known as Levee Road. Bear Valley Creek flows through the Olema Marsh and then empties into Lagunitas Creek through two culverted drainages just upstream of White House Pool. This marsh, considered the most extensive in Marin County, supports the county's largest red alder (*Alnus rubra*)-willow (*Salix* spp.) stand, which grows alongside substantial patches of cattails (*Typha* sp.) and sedges (Shuford and Timossi 1989). As Evens (1993) noted, "by restricting tidal influence, man isolated fresh water from salt and created freshwater habitats ... where brackish marsh must have existed before." Certainly, construction of roads, berms, and levees appears to be associated with establishment or expansion of many of the freshwater marshes in the Seashore, including Olema Marsh and possibly Ledum Swamp. As with many artificial systems, functioning of Olema Marsh has deteriorated during recent years due to increased sedimentation within the marsh that has decreased hydraulic capacity and precluded flow through at least one of the culverted drainages.

The numerous perennial freshwater drainages and groundwater flow present in this region strongly suggest that freshwater habitat occurred in the Tomales Bay watershed historically. Groundwater, combined with freshwater drainages flowing off the Inverness and Bolinas Ridges, may have led to formation of extensive freshwater habitat in the Olema Valley upstream of tidal influence, particularly prior to European settlement. Perhaps, the most unique of these freshwater features in the Tomales Bay watershed (Olema Valley) and other areas of the Seashore are the fault sag ponds, which are depressional basins formed by trenching and sagging along the San Andreas and other faults. Even in areas where tidal influence is present, such as Tomales Point, extensive sand bar formation at the mouths of small perennial drainages has fostered establishment of small freshwater marshes directly adjacent to the highly marine-influenced waters of northern Tomales Bay. Where sand bar formation remains seasonal, Tomales Bay marshes exhibit some of the dynamics of other central California coastal lagoons, with dramatic salinity shifts from freshwater to brackish/saline throughout the year based on freshwater inflow and/or formation of sand bars (Peter Baye, *pers comm*.).

The interface between fresh and saline influences was probably even more dramatic historically in southern Tomales Bay, fostered by the combination of fluvial input from several major drainages (Lagunitas, Olema), small drainages (Tomasini, Fish Hatchery, etc.), and seep flow from the Inverness Ridge and Point Reyes Mesa. Lagunitas Creek is the largest subwatershed within Tomales Bay, providing two-thirds of the freshwater inflow into the estuary. However, at least within the Study Area, it is likely that the extent of freshwater habitat was historically lower than it is today. An artificially fresh regime has been reinforced, at least within the Project Area, by diking of Lagunitas Creek and minimization of tidal inflow into the pasturelands. In addition, freshwater influences have been augmented by spray and flood irrigation in the East Pasture and possible enhancement of groundwater flow from Inverness Ridge and Point Reyes Mesa by septic discharges. These increases have been offset to some degree by decreases in surface freshwater flows through authorized water rights diversions. However, the areal extent of glycophytic vegetation communities probably remains elevated relative to historic conditions.

Wet Pasture: A large percentage (40 percent or 93.5 hectares/231.1 acres) of the Study Area has been mapped as Wet Pasture, particularly the southern and eastern portions of the East Pasture (Table 2, Figures 5, 7-11). Wet Pasture is a glycophytic grassland community dominated (>50 percent) by grasses and herbs that are predominantly facultative or obligate hydrophytes or wetland species. Hydrologic sources for this community include bank overflow from small drainages, surface or subsurface movement of groundwater "seep" flow, surface runoff, artificial flooding by spray or flood irrigation, and precipitation. Wet Pasture areas are either actively managed as pasture through seeding, irrigation, mowing, leveling, etc., or contain some of the predominant pastoral or forage species such as creeping bent grass (*Agrostis stolonifera*), rough bluegrass (*Poa palustris*), white clover (*Trifolium repens*), and strawberry clover (*Trifolium fragiferum*). Other non-native grass species present included Mediterranean barley (*Hordeum marinum*), perennial ryegrass (*Lolium perenne*), annual ryegrass (*Lolium multiflorum*), and tall fescue (*Festuca arundinacea*; Appendix A). Some native plant species occurred, as well, such as meadow barley (*Hordeum brachyantherum*), water foxtail (*Alopecurus geniculatus*), meadow foxtail (*Alopecurus pratensis*), western mannagrass (*Glyceria occidentalis*), and blue wildrye (*Leymus triticoides*). Meadow barley was very common in the northeastern portion of the East Pasture in pasturelands adjacent to Tomasini Creek (Sub-Association 5 in Figure 14). Another native


Wet Pasture in the East Pasture, looking north.

species typically observed in more brackish or saline areas, spearscale (*Atriplex triangularis*), also grew within some of the Wet Pasture polygons (Sub-Association 5 in Figure 14). Of these Sub-Associations, the greatest areal extent occurred for those dominated by *Festuca arundinacea*-Other (13.6 hectares/33.6 acres), *Agrostis-Trifolium-Lolium* (13.4 hectares/33.1 acres), *Agrostis-Atriplex*-Other (12.5 hectares/30.9 acres), *Agrostis*-Other (11.7 hectares/28.9 acres), and *Lolium*-Other (4.3 hectares/10.6 acres; Appendix B). It should be noted that the extent of rough bluegrass (*Poa trivialis*) within Wet Pasture vegetation communities is grossly underestimated, because this species had already senesced by the time formal vegetation mapping was conducted (late spring-summer-fall). However, rough bluegrass typically overlapped to a considerable extent with creeping bent grass.

Freshwater Marsh: The minimization of tidal flow through levees and tidegates, combined with strong freshwater influences from drainages, seeps, and irrigation, has encouraged establishment of Freshwater Marsh in some portions of the Study Area. Freshwater Marsh is characterized as glycophytic areas dominated by more than 70 percent of persistent sedges, rushes, and other non-clover herbs that are inundated or saturated nearly year-round. Most of the freshwater marshes within the Study Area have developed in slow-moving drainages, drainage ditches, and ponds that have been highly disturbed by cattle or other agricultural activities. The size of this vegetation community is relatively small, totaling only 6.3 hectares (15.6 acres) or 2.7 percent of the Study Area. In the East Pasture, Freshwater Marsh occurred in drainage ditches (including the Old Slough), the Old Duck Pond, and in a drainage along the base of the dairy facility that is fed by both perennial seep- and drainage flow (Sub-Alliance 10 in Figures 5, 9, 10, and 11). In the West Pasture, Freshwater Marsh occurred principally in small- to moderate-sized drainages that have sustained or perennial flow, such as the slow-moving, low-gradient portions of Fish Hatchery Creek (Sub-Alliance 10 in Figures 5, 7, and 8).

Low-growing, hydrocotyle-dominated Freshwater Marsh in upstream portions of Fish Hatchery Creek in West Pasture

More than 60 percent of these marshes support low-growing emergent species such as hydrocotyle (*Hydrocotyle ranunculoides*) and lemna (*Lemna* sp.) and occasionally other relatively low-growing glycophytic species such as lady's thumb (*Polygonum persicaria*) knotweed (*Polygonum punctatum*), water parsley (*Oenanthe sarmentosa*), etc. Tall emergent species occur in a few areas, including some portions of the Old Sloughs in the East and West Pastures, Fish Hatchery Creek, Tomasini Creek, drainage ditches, and in the so-called Freshwater Marsh in the West Pasture.

The "Freshwater Marsh" is a large seep– and drainage-fed marsh dominated by tall emergent freshwater marsh species such as bulrush (*Scirpus californicus*), cattails (*Typha spp.),* bur-reed (*Sparganium erectum* var. *stoloniferum*), rush (*Scirpus americanus*), as well as low-growing species such as rush (*Juncus balticus* and *phaeocephalus*), hydrocotyle, water parsley, creeping bent grass (*Agrostis stolonifera*), western mannagrass, and sedges (*Scirpus pungens* and *microcarpus*; Sub-Alliances 2, 9, 10, 17, 25, 26, 27 in Figures 5 and 7). The tall emergent species such as cattails, bulrush, bur-reed, etc., typically occur in dense, almost monotypic clumps that are spatially separated from each other by a dense blanket of low-growing emergent species such as hydrocotyle, water parsley, and sedge (*Scirpus pungens*). During the spring, species such as the purple-flowered clover (*Trifolium variegatum*) add some color to this seemingly unique floristic feature, although no special status plant species have been observed in this marsh to date. The persistent inundation discourages oxidation of organic matter within the soils, thereby leading to formation of a dense organic layer below the ground surface that creates a spongy or even bog-like substrate. Unlike many freshwater marshes that form in depressional features or basins, this marsh actually lies on the sloped base of the Inverness Ridge and is therefore actually slightly higher in elevation than the adjacent pasturelands. Hydrologic conditions are maintained by small perennial drainages that flow onto the gradually sloped surface from the south and west (under Sir Francis Drake Boulevard) and emergence of the groundwater table at the base of the Inverness Ridge.

Clumps of tall emergents such as cattails and bulrush occur amidst a blanket of low-growing species such as hydrocotyle and water parsley in the West Pasture's Freshwater Marsh

The sharp juxtaposition in the Project Area between fresh and saline hydrologic sources is nowhere more evident than here: directly east of the Freshwater Marsh boundary lies a broad expanse of Salt Marsh Pasture and Diked Salt Marsh that has formed in response to the muted tidal flows occurring in Fish Hatchery Creek (Sub-Alliances 2, 3, 4, and 16 in Figure 7). It is possible, as well, that, under normal circumstances, certain portions of the "Freshwater" Marsh turn more saline during the summer, because of decreased freshwater flows and increased tidal influence from Fish Hatchery Creek. This phenomenon certainly appears to occur at least in the northern portion of the marsh where a dieback of the perennial hydrocotyle during the summer appears to correlate with an increase in tidal intrusion and associated water and soil salinities (Sub-Alliance 2 in Figure 7 at the northern end of Freshwater Marsh).

Seasonal Wetlands: Vernal pools represent a unique type of wetland ecosystem within Mediterranean climates such as California. These depressional- or swale-type features occur in areas where unique geologic or soil characteristics encourage prolonged seasonal ponding or soil saturation during spring months. The term "seasonal wetlands" is often used to characterize seasonally saturated or inundated depressional or basin features that have neither the soils, geology, nor suite of characteristic flora and fauna associated with vernal pools. Few vernal pools exist in the Tomales Bay watershed, although there are a few and probably even a greater number of seasonal wetlands. Within the Study Area itself, there were few seasonal wetlands

(0.2 hectares/0.51 acres or <0.08 percent), with most being associated with slight depressional features present in upland communities such as Dry Pasture or Ruderal exclusively in the West Pasture (Sub-Alliance 18 in Figures 5, 8, 9, and 10). Establishment of hydrophytic species appears to result primarily from seasonal ponding or saturation of surface run-off and precipitation within the depressions. Most of these features supported annual or short-lived perennial, non-native glycophytic species such as ryegrass, Mediterranean barley, annual bluegrass (*Poa annua*), annual beard grass (*Polypogon monspeliensis*), and common knotweed (*Polygonum arenastrum*; Appendix A).

Wet Meadow: Wet Meadows support at least 30 percent cover of sedge, rush, or other non-clover herbs, as well as grasses. Typically, dominant sedge and rush species are the short- to medium-sized species, as opposed to cattails, tules, and bulrush. Species include glycophytic and/or brackish ones such as spikerush (*Eleocharis macrostachya*), hydrocotyle, rush (*Juncus balticus*, *effusus*, and *lesueurii*), pennyroyal (*Mentha pulegium*), white clover (*Trifolium repens*), water foxtail, western mannagrass, creeping bent grass (*Agrostis stolonifera*), and perennial ryegrass, as well as occasionally sedge (*Scirpus microcarpus*), monkeyflower (*Mimulus guttatus*), and water cress (*Rorippa nasturtium-aquaticum*; Appendix A). The hydroperiod for this community is shorter than for the Freshwater Marsh, but inundation or saturation often extends throughout the spring into at least the early summer. Wet Meadows occurred principally in the West Pasture along the sloped perimeter of the Inverness Ridge where groundwater appears to flow across the surface or just below the surface of the soil (Sub-Alliance 26 in Figures 5, 7, 8, 9, and 11). There was also one highly manipulated (e.g., leveled, spread with manure) field in the East Pasture that has been allowed to go fallow that was mapped as Wet Meadow (Figures 5 and 11). In terms of area, Wet Meadows represented a moderately large proportion of the Study Area (4.8 percent), with area totaling 11.2 hectares (27.75 acres).

***Scrub-Shrub and Forested Riparian*:** Scrub-shrub and Forested Riparian communities primarily occur along the western boundary of the West Pasture, the southern portion of Lagunitas Creek; Wildlife Conservation Board lands near White House Pool and the Green Bridge; and along limited portions of Tomasini and Fish Hatchery Creeks and other small drainages. Grazing has eliminated riparian habitat along most of the drainages within the pastures themselves, although some sapling-sized arroyo willows (*Salix lasiolepis*) and red alders (*Alnus rubra*) are trying to establish at the southern end of Fish Hatchery Creek.

Scrub-Shrub Riparian habitat consisting of immature red alder and arroyo willow on the southern portion of Fish Hatchery Creek.

Unlike riparian communities along some of the larger creeks and rivers, those within the Study Area do not appear to undergo classical riparian successional patterns in which pioneering species such as willows and Fremont cottonwood (*Populus fremontii*) recruit into habitat formed or created through bank erosion or channel avulsion and are later succeeded by some of the other, so-called late-successional species present in northern California such as northern California black walnut (*Juglans californica* var. *hindsii*), box elder (*Acer negundo*), or Oregon ash (*Fraxinus latifolia*).

Some type of vegetation succession may occur in Lagunitas Creek, but, if so, it is considerably upstream of the Study Area (e.g., near Tocaloma). In these areas, some of the late successional species such as box elder, Oregon ash, and big-leaf maple (*Acer macrophyllum*) occur amidst California bay, California buckeye (*Aesculus californicus*), and oaks on the abandoned floodplain terraces. Alder and red willow (*Salix laevigata*) are found both along the active channel and on the abandoned floodplain terraces.

In general, vegetation patterns along at least most of the smaller creeks in Marin County appear to be dictated more by stream and valley slope gradients than successional patterns. Moderate- to high-gradient drainages in Marin County often support what could be viewed more as a facultative riparian overstory community composed of California bay (*Umbellularia californica*), coast live oak (*Quercus agrifolia*), California buckeye (*Aesculus californica*), and, in coastal areas with moist air, Douglas fir (*Pseudotsuga menziesii*) and even redwood (*Sequoia sempervirens*). Where bank slope and substrate conditions permit, red alder often lines the bank of these moderate to high gradient creeks. As drainages and creeks flow down onto valley floors such as that in the Olema Valley and merge into larger, slow-gradient tributaries, the vegetation community shifts dramatically. Species such as California bay and coast live oak drop out of the riparian "zone," although they may remain in forested areas directly adjacent to riparian areas. Instead, the riparian habitat is dominated by fast-growing, pioneering species such as arroyo willow and red alder that often grow in almost impenetrable thickets. While Scrub-Shrub Riparian habitats can represent simply immature or developing tree communities, many times, particularly in those dominated by arroyo willow, the trees never reach heights greater than 20m. This "stunting" could result either from the fact that arroyo willow rarely grows as tall as species such as red willow or from persistent disturbance factors such as heavy flooding or grazing (including "pruning" by cattle).

Forested Riparian habitat consisting of mature red alder and arroyo willow stands along northern portion of Fish Hatchery Creek adjacent to Sir Francis Drake Boulevard.

Within the Study Area, the riparian vegetation communities generally reflected the low stream and valley slope gradient present. A thin strip of predominantly arroyo willows occurred along Tomasini Creek and Lagunitas Creek, with a larger patch occurring along Levee Road in the eastern portion of the White House Pool and Green Bridge county park areas (Sub-Alliances 9 and 17 in Figures 5, 9, 10, and 11). Conversely, along Sir Francis Drake Boulevard and Fish Hatchery Creek, there was a thin strip of riparian habitat that was largely dominated by red alder, although arroyo willow was common (Sub-Alliance 9 in Figures 5, 6, 7, 8, and 9; Sub-Associations 9, 11, and 14 in Figures 12 and 13). Other species present in the Overstory or Subcanopy strata were box elder, California buckeye, eucalyptus (*Eucalyptus globulus*), California bay, coast live oak, and shining willow

(*Salix lucida* ssp. *lasiandra*). Dominant understory species included Himalayan blackberry (*Rubus discolor*), California blackberry (*Rubus ursinus*), thimbleberry (*Rubus parviflorus*), stinging nettle (*Urtica dioica*), horsetail (*Equisetum* spp.), California figwort (*Scrophularia californica*), and California rose (*Rosa californica*). In addition to eucalyptus, a few potential invasive species were also observed such as greater periwinkle (*Vinca major*) and Cape ivy (*Delairea odorata*), although the total percent cover of these species was very low, and they were relegated for the most part to the riparian strip along Sir Francis Drake that adjoins the Inverness Park residential area. By far, the dominant Sub-Association within the Study Area was *Salix lasiolepis-Rubus ursinus,* which totaled 4.7 hectares or 11.6 acres (Appendix B; Sub-Association 66 in Figure 12).

Most of these riparian communities are hydrologically influenced by headwater flooding and, in some areas such as Olema Creek, potentially backwater flooding. Within Lagunitas, Tomasini, and Fish Hatchery Creeks, hydrologic sources include both fluvial freshwater flow and unmanaged or muted tidal flow, with mixing of these influences creating more brackish conditions in some of the riparian areas. The riparian strip along Sir Francis Drake appears to be sustained by both headwaters flooding of small drainages and seep flow from Inverness Ridge. Seep flow may also contribute to the persistence of arroyo willow and Himalayan blackberry along the steep slope of the dairy facility. Despite the probable elimination of vast amounts of potential riparian habitat through development, grazing, or agricultural practices such as ditch maintenance, acreage of Scrub-Shrub Riparian habitat (tree canopy <20 m in height) still totaled 9.7 hectares (23.9 acres), while that of Forested Riparian habitat (tree canopy > 20 m in height) totaled 5.1 hectares (12.5 acres). These acreages represent approximately 4.1 and 2.2 percent of the Study Area, respectively.

Moist Meadow: Moist Meadow represents somewhat of an intermediate between some of the wetter and drier vegetation communities. This habitat supports at least 30 percent cover of some of the "drier" or more facultative sedge and rush species such as rush (*Juncus patens, lesueurii*, and *balticus*) or sedge (*Carex barbarae* or *barbarae*X*obnupta* hybrid; Howell 1970). The hydroperiod is shorter than for Wet Meadow and may involve non-persistent inundation or saturation of soils following seasonal flooding from small drainages and surface run-off. Area of this community remained relatively small, totaling 1.3 hectares (3.3 acres) or 0.6 percent of the Study Area. Moist Meadow was principally observed in the White House Pool and Green Bridge county park areas and in isolated locations in the Project Area (Sub-Alliance 13 in Figures 5, 6, 8, 10, and 11). Dominant species included spearscale (*Atriplex triangularis*), sedge (*Carex barbarae* or *barbarae*X*opnupta* hybrid), tall fescue (*Festuca arundinacea*), rush (*Juncus balticus, lesueurii,* and *patens*), and creeping bent grass (*Agrostis stolonifera*; Appendix A).

***Dry Pasture*:** Despite its sometimes xeric appearance during the summer, very little (1.0 percent) of the pastureland within the Study Area was classified as Dry Pasture. Dry Pasture is dominated (> 50 percent) by non-hydrophytic grasses, clovers, and other herbs and/or lacks wetland hydrology. The 2.4 hectares (6.0 acres) of Dry Pasture mapped occurred principally in the southern portion of the West Pasture and in a thin strip along the West Pasture's Lagunitas Creek levee (Figures 5, 7, 8, and 9). Hydrologic differences between Wet and Dry Pasture probably result from the absence of freshwater drainage and seep influences through surface run-off/higher groundwater tables, with hydrologic inputs restricted to surface run-off from adjacent uplands and precipitation. The dominant species in Dry Pasture included Mediterranean barley (*Hordeum murinum*), brome (*Bromus hordaceus*), ryegrass, and clover (Appendix A).

Brackish Regimes

While the extent of brackish marsh within the San Francisco Bay Estuary is considerable due to significant natural and anthropogenic freshwater sources such as the Sacramento River and wastewater treatment discharges (Baye et al. 2000), brackish marsh is not as common within central California coast's maritime systems. The central coastal marshes tend to be isolated and few because of the steep modern shoreline with few valleys or wave-sheltered environments (Baye et al. 2000). Those that do exist typically have extensive sandy substrates; relatively small, local inputs of fine sediment and freshwater discharges, and are inundated with water approaching marine salinity (34 ppt) during most of the growing season (Baye at al. 2000).

Some coastal tidal marshes associated with stream mouths have relatively more freshwater influence and brackish marsh vegetation, but these conditions are often perpetuated by seasonal reductions in tidal inflow because of partial or complete closure of the tidal inlet through berming by sand beach ridges (Baye et al. 2000). Water diversions, diking, and mechanical removal of sand berms have significantly altered salinity dynamics within many of these small coastal lagoons, often creating artificially elevated salinities and/or poor water quality conditions. Historically, Tomales Bay appeared to have a number of "mini" lagoons – small open embayments protected by parallel-oriented sand bars with a dynamic, mobile inlet -- particularly along its eastern shore. The number of lagoons within the Bay has dropped since the 1860s, but some pocket backbarrier systems that maintain fresh-brackish conditions throughout most of the year due to seasonal berming of the inlet mouth still exist (P. Baye, *pers comm*.). Even those "freshwater" marshes along Tomales Point, which are bermed perennially due to extensive sand bar formation, may have some brackish influence, at least seasonally, from tidal waters infiltrating the porous sand bar, as is seen with Limantour Pond.

The historic extent of brackish vegetation communities was probably highest in the southern portions of Tomales Bay, as tidal influence decreased, and freshwater influences from tributaries and groundwater increased. The combination of significant freshwater fluvial input, as well as groundwater flow along the adjacent ridges and mesas, points to southern Tomales Bay being both historically and currently a sizeable mixing zone characterized by consistently brackish to slightly saline conditions. In most marshes, brackish conditions occur along primary drainages in geographically mobile subtidal and intertidal "zones" that are sandwiched between freshwater-dominated upstream reaches and tidally dominated downstream reaches. Brackish marsh typically establishes along the banks of these primary drainages, with the adjacent floodplains largely consisting of salt marsh, although brackish marsh may develop in depressional features or basins within the marsh plain. The marsh plain then transitions into an upland ecotone dominated by non-hydrophytic plant species. In the southern portion of Tomales Bay, the brackish "zone" may actually be portrayed better as a "ring" along the base of Inverness Ridge and Point Reyes Mesa than a rectangular section along Lagunitas Creek and some of the other smaller drainages. This ring of brackish influence directly results from the interface between tidal flow and freshwater from extensive seep and small drainages. Patches of brackish marsh species such as bulrush (*Scirpus californicus*), cattails (*Typha* sp.), and alkali bulrush

(*Scirpus maritimus*) were visible in 1942 photographs, scattered throughout the East Pasture, Tomasini Creek, and near Railroad Point or at the base of the Tomales Bay Trail (PWA et al. 1993). To some degree, this interface "zone" of brackish water conditions probably shifted geographically on an annual basis due to interannual variability in precipitation, large-scale climatic trends (El Nino versus La Nina), water diversions, etc. However, in general, the plant community would have responded slowly, if at all, to this annual variability in average water salinities, requiring long-term changes in hydrologic regimes to convert to a different type of community.

In general, brackish marsh habitat within Tomales Bay has been negatively affected by construction of roads, berms, and levees that have eliminated this interface zone and created sharp demarcations between glycophytic and halophytic hydrologic regimes (Evens 1993). To some degree, this brackish hydrologic regime has endured in the Study Area despite diking, minimization of tidal flows, and augmentation of freshwater influences by irrigation, septic, etc., because of failure of the tidal control structures and a strong groundwater interaction between Lagunitas Creek and the slightly subsided Project Area. However, a number of factors -- including possibly concentration of salts within brackish waters through evapotranspiration and agricultural-related manipulation of the land and grasses -- has managed to minimize the number and extent of "true" brackish vegetation communities relative to glycophytic and halophytic ones.

Diked Brackish Marsh: Diked Brackish Marsh is dominated (>70 percent) by hydrophytic non-clover herbs that are able to tolerate water salinities that average in the brackish or mesohaline range (5-18 ppt). Diked communities are inside of levees or berms and experience typically only muted tidal action, if any. Principal tidal hydrologic sources include muted tidal flow from creeks such as Fish Hatchery and Tomasini that are managed with tidal control structures and potential groundwater interaction between diked areas and Lagunitas Creek. In addition, these areas are probably also heavily influenced by perennial and seasonal headwaters flooding and seep flow from Inverness Ridge and Point Reyes Mesa, etc. Diked Brackish Marsh represented approximately 1.6 percent of the Study Area, totaling 3.8 hectares (9.4 acres). Most of the Diked Brackish Marsh mapped occurred along drainages such as Fish Hatchery Creek, Tomasini Creek, drainage ditches, Old Sloughs, and low-lying areas or depressional features such as the perimeter of the New Duck Pond and the northeastern portion of the East Pasture (Sub-Alliance 2 in Figures 5, 7, 9, 10, and 11). Plant species within this vegetation community ranged from those considered glycophytic to those considered halophytic and included both short and tall emergent species. Dominant plant species included spearscale (*Atriplex triangularis*), pickleweed (*Salicornia virginica*), annual beard grass (*Polypogon monspeliensis*), saltgrass (*Distichlis spicata*), perennial ryegrass (*Lolium perenne*), hydrocotyle (*Hydrocotyle ranunculoides*), bulrush, rush (*Juncus effusus*), bur-reed (*Sparganium erectum var. stoloniferum*), and cattails

Diked Brackish Marsh along Fish Hatchery Creek in West Pasture.

(Appendix A). Throughout the Study Area, spearscale-dominated polygons accounted for almost 4.1 hectares (10.0 acres), while acreage of bulrush-dominated polygons totaled 1.0 hectare (2.5 acres; Appendix B; Sub-Associations 16, 17, and 18 in Figures 13 and 14). Because of the indistinct or cosmopolitan suite of species present, this community was largely mapped using information on -- or estimations of -- average water salinity conditions.

Tidal Brackish Marsh: Tidal Brackish Marsh occurred exclusively along sections of Lagunitas Creek where water salinities typically average in the mesohaline range (5-18 ppt). Tidal Brackish Marsh communities are outside of levees and berms and experience a full range of tidal and freshwater inputs. The extent of this vegetation community remains minimal within the Study Area (0.9 percent or 2. 1 hectares/5.2 acres) due to the fact that the Giacomini Ranch levees have infringed upon the intertidal zone where brackish marsh (and Tidal Salt Marsh-Low) would typically develop (Sub-Alliance 19 in Figures 5, 6, 8, 9, 10, and 11). The habitat that does exist consists of a thin fringe of either pure or mixed communities of bulrush or alkali bulrush (Appendix A). Occasionally, other species such as Pacific cordgrass (*Spartina foliosa*), pickleweed, or cattails are present, but only in very low numbers (Appendix A).

Tidal Brackish Marsh on Lagunitas Creek

Halophytic Regimes

Unlike its large neighbor to the south, the Tomales Bay estuary did not appear to have historically the extensive network of fringing salt marshes that were once present in San Francisco Bay. U.S. Coast Survey maps from the 1860s and 1870s depict small amounts of marsh habitat along the edges of Tomales Bay, with the largest extent in the southern portion of Tomales Bay in what is currently the East Pasture, Olema Marsh, and the Bear Valley and Olema Creek floodplains. Small salt marsh estuaries are shown at the mouth of some of the other creeks, including Grand Canyon, Millerton Gulch, and the drainage to Audubon Canyon Ranch’s Livermore Marsh. Lagoonal estuaries or lagoonal systems with some fringing marsh on the perimeter occurred behind backbarrier features such as Tomasini Point, Tom’s Point, Preston’s Point, and sand barrier formations near Inverness. Fringing marsh appears to have developed only along a small section of the Bay’s shoreline south of Willow Point. The high sinuosity or degree of curvature mapped for some of the tidal creeks may reflect the prevalence during this period of tidally dominated sediment accretion processes that build marsh surface through successive episodes of fine sediment deposition and peat accretion through recruitment and subsequent decay of organic matter. In fact, during the late 1860s, tidal influence in this portion of the Bay was strong enough that salt marsh extended as far south as Bear Valley along Bear Valley Creek (Evens 1993). The existing undiked marsh currently north of Giacomini Ranch appeared to be largely unvegetated or sparsely vegetated subtidal and intertidal mudflats.

Walker Creek Marsh, one of Tomales Bay's other large undiked marshes, does not even exist in the Coast Survey maps, with the marsh area shown as subtidal area and intertidal flats.

A dramatic increase in sedimentation associated with logging and poor land use practices had the inadvertent effect of also dramatically increasing deltaic aggradation at the mouths of creeks such as Lagunitas and Walker. As noted earlier, between 1860 and 1950, a total of 650 acres of new marsh established from this increase in sedimentation (PWA et al. 1993), and most of this new habitat was probably salt marsh and intertidal mudflats. Some of this sedimentation resulted in conversion of what appeared to be open estuarine systems with a large embayment and little to no marsh habitat into salt marsh estuaries with a significant marsh plain and tidal channels. These salt marsh estuaries have developed at the mouth of White Gulch, Indian Beach, Marshall Creek, Shallow Beach Creek, Millerton Gulch, and others. Deltaic marsh formed at the mouth of not only Lagunitas Creek, but Walker Creek, which are the watershed's two largest subwatersheds and potentially the drainages with the highest sedimentation rates.

While sedimentation actually increased coastal salt marsh acreage, other changes negated this trend, specifically construction of levees for roads and railroad bridges and "reclamation" of land for agricultural purposes. For example, construction of the levee along the southern portion of Sir Francis Drake Boulevard (Levee Road) to a large degree eliminated tidal influence upstream of White House Pool. Many of the marshes on the Bay's eastern shore were impacted to some degree by construction of levees, Highway 1, and the railroad, although some have at least partially breached. To some extent, this same phenomenon occurred in San Francisco Bay, with large-scale losses of salt marsh to agricultural, commercial, and residential development balanced ineffectively with progradational development of fringing marsh from sediments destabilized by Sierra Nevada gold mining activities.

High sedimentation in creeks such as Lagunitas, Walker, Millerton Gulch, and Marshall shifted sediment deposition in these areas from a tidally dominated process to a fluvial-dominated one. In undiked marsh areas, this shift has seemingly resulted in a decrease in the number of marsh channels, a "straightening" of the channels that do develop, and changes in the type and pattern of sediment deposition. High bedloads in Tomales Bay tributaries generally increased the grain size or coarseness of sediment deposited, creating a gradient of coarse gravel and sand in creek beds, fine sands overwashing onto adjacent marsh floodplains, and fine-grained materials such as clays and silts settling out in more sheltered areas. Visible evidence of coarse sediment influences on marsh topography are the accretion of marsh berms or natural alluvial levees along both large and small tidal marsh channels in the Lagunitas and Walker Creek deltas. Within these deltaic floodplains, flooding during tides high enough to overtop alluvial levees leads to creation of small dendritic marsh channels through drainage or surface run-off of floodwaters to the larger drainage channels during low tides (Rachel Kamman, *pers comm*.). However, these channels do not display the torturously meandering planform characteristic of sheltered slough system tidal marshes that have tidally dominated sediment deposition processes. Within tidally dominated marshes, marsh formation occurs through accretion of suspended fine sediments around a bidirectional-current drainage network and differential deposition of marsh peats once the system is vegetated (P. Baye, *pers comm*.). Some of the salt marsh estuaries on the Bay's western shores retain the sinuous planform suggestive of tidally dominated sediment deposition processes.

Another significant factor influencing the formation and character of Tomales Bay's marshes is its geologic history, specifically the fact that San Andreas Fault runs directly down the center of the Bay. Following the 1906 earthquake, USGS geologist G.K. Gilbert surveyed conditions in the Olema and Bolinas areas, documenting sags, trenches, landslides, and other features along the fault trace. Within the Lagunitas Creek delta, sag portions of the trace often appeared as "water lanes:" indeed, the "water lane" depicted as occurring directly north of the Giacomini Ranch in the undiked marsh corresponds almost exactly to the location of an existing, extremely straight tidal marsh channel. During the earthquake, a large portion of the Lagunitas Creek delta "was thrown … into gentle undulations, the difference in height between the swells and hollows being usually less than a foot" (Gilbert 1908). Wave action gradually smoothed out the ridges and troughs, but some of the larger troughs remained, ranging in height from 1 to 3 feet or more (Gilbert 1908). This undulation may explain some of the localized losses of salt marsh habitat that were reported within Tomales Bay (Gilbert 1908). The remnant ridges and troughs may have some relation to the numerous marsh ponds observed in the Lagunitas Creek delta. Small circular ponds with vertical banks are scattered throughout the undiked marsh north of the Giacomini Ranch. Marsh pond features occur in other central California coastal marshes, including San Francisco Bay, but perhaps in not as high a number. Conversely, other features of tidal marshes such as salt pannes, which were depicted in early 1850s U.S. Coast Survey maps as being common in San Francisco Bay, are relatively infrequent in other central coast tidal marshes, including those in Tomales Bay (Baye et al. 2000).

Historically, salinity and tidal elevation, which affects flooding, have been viewed as the primary drivers of plant distribution (Hinde 1954, Atwater and Hedel 1976, Mahall and Park 1976, Nixon 1982, Vince and Snow 1984, Bertness 1991a, 1991b, 1992; Pennings and Callaway 1992; Peinado et al. 1994). The classic paradigm of salt marsh structure portrays a subtle elevational gradient from "low marsh" adjacent to creeks, building gradually to a mid-marsh plain that transitions into a "high marsh" zone at the marshes' highest elevations near the upland ecotone. While some marshes do display this textbook, gradually sloping topography, there are many others that do not (Zedler 2000), including those in Tomales Bay and adjacent coastal watersheds. For example, deltaic wetlands such as those at the mouth of Lagunitas and Walker creeks often support only a thin fringe of "low marsh" along the narrow intertidal creek banks. These banks often rise steeply to the natural alluvial levees, which often consist of "high marsh" or even "high marsh/upland ecotone" vegetation communities. These alluvial levees then slope down to expansive marsh plains that include both mid-marsh and even high marsh communities depending on microtopographic complexity such as depressions and mounds. The transition between the Bay and marsh is more gradual on the bay-ward side of these deltas, with marsh plains very gradually sloping into vegetated or unvegetated mudflat. In the last decade, the extent of Pacific cordgrass (*Spartina foliosa*), which was once noted as being conspicuously absent from Tomales Bay (MacDonald and Barbour 1974), has surged dramatically, primarily through colonization of the Lagunitas Creek delta mudflats. These subtle elevational transitions between marsh plain and Bay are also present in most of the fringing marshes along the western shore of Tomales Bay.

Salt Marsh Pasture: Muted tidal inflow, as well as the strong, apparent groundwater connectivity between Lagunitas Creek and the Project Area, has led to establishment of several halophytic plant communities within lower elevation portions of the pastures such as Diked Salt Marsh and Salt Marsh Pasture. Salt Marsh Pasture is characterized by a significant presence (at least 20 to 25 percent) of halophytic herbs and forbs in polygons with glycophytic grasses, herbs, and pastoral species such as creeping bent grass (*Agrostis stolonifera*) or rough bluegrass (*Poa trivialis*). Halophytes or salt tolerant species include saltgrass (*Distichlis spicata*), alkali heath (*Frankenia salina*), pickleweed (*Salicornia virginica*), spearscale (*Atriplex triangularis*), birdfoot trefoil (*Lotus corniculatus*), etc. (Appendix A). Salt Marsh Pasture polygons dominated most of the northern portion of the West Pasture and some of the very northern portions of the East Pasture (Sub-Alliance 16 in Figures 5, 6, 7, 8, 9, 10, and 11). In total, it represented a substantial proportion (14 percent) of the Study Area, with 33.6 hectares (82.9 acres). Of the Sub-Associations, those with the highest total acreages included *Distichlis-Agrostis* (13.7 hectares/33.8 acres), *Distichlis* (4.6 hectares/11.5 acres), and *Distichlis-Agrostis-Atriplex* (4.3 hectares/10.7 acres; Appendix B; Sub-Associations 23 and 24 in Figures 12, 13, and 14).

Diked Salt Marsh-Mid, High, and Mudflat/Panne: As with Salt Marsh Pasture, topographic subsidence, combined with muted tidal inflow and a saline groundwater table, has encouraged establishment of Diked Salt Marsh vegetation communities, comprised of both typical mid- and high marsh species. Diked Salt Marsh covers a significant expanse of the very northern portion of the West Pasture, as well as some of the depressional slough traces still evident in this pasture (Sub-Alliances 3, 4, and 5 in Figures 5, 6, 7, 8, 10, and 11). In the East Pasture, Diked Salt Marsh is confined to the very northern edges of the East Pasture and around the New Duck Pond, where neither spray or flood irrigation is actively performed (Figures 10 and 11). These habitats represented approximately 6 percent of the Study Area, totaling 2.8 percent (Diked Salt Marsh-Mid; 6.5 hectares or 16.0 acres), 1.6 percent (Diked Salt Marsh-High; 3.7 hectares or 9.1 acres), and 2.0 percent (Diked Salt Marsh-Mudflat/Panne; 4.6 hectares or 11.4 acres).

Diked Salt Marsh in East Pasture.

So-called “mid-marsh” areas were typically dominated by saltgrass, spearscale, and pickleweed, with jaumea (*Jaumea carnosa*) also present (Appendix A). These “mid-marsh” areas occurred largely in topographic depressions such as former slough traces or areas where inundation or saturation of soils persists throughout most of the growing season. High-marsh areas typically supported the same suite of species, but drier halophytes were also present, such as alkali heath. The lowest elevation portion of the East Pasture often floods for a significant period during the winter and spring, which results in sparsely vegetated mudflats that provide habitat for a surprising number of shorebirds and waterfowl during the rainy season. When waters evaporate, a very low-growing, sparse cover of halophytes typically develops, consisting of species such as sand-spurrey (*Spergularia rubra*), spearscale, and, to a much lesser extent, saltgrass.

Tidal Salt Marsh – Low, Mid, High, and High Marsh/Upland Ecotone: Tidal Salt Marsh occurs in the large expanse of undiked deltaic marsh north of the Giacomini Ranch, as well as on central bars/"islands" in Lagunitas Creek, and the fringe marsh along the outboard portion of the Lagunitas Creek levee (Sub-Alliances 20, 21, 22, and 23 in Figures 5-10). These salt marshes are subject to both direct tidal and freshwater influences, including headwaters flooding and high tide events. However, even though the Tidal Salt Marsh communities are not leveed, the levees have undoubtedly affected these communities by minimizing the area available for salt marsh establishment, increasing the scouring force/velocity of fluvial flood flows and associated bed load, and perhaps changing tidal flow dynamics. Tidal Salt Marsh accounted for approximately 5.3 percent of the Study Area, including 0.02 percent of Tidal Salt Marsh-Low (0.04 hectares/0.01 acres), 1.1 percent of Tidal Salt Marsh-Mid (2.6 hectares or 6.3 acres), 3.3 percent of Tidal Salt Marsh-High (7.7 hectares or 19.1 acres), 0.9 percent of Tidal Salt Marsh-High Marsh/Upland Ecotone (2.0 hectares or 5.0 acres).

Tidal Salt Marsh-High Marsh/Upland Ecotone on alluvial levee in undiked marsh.

Despite the proximity of Tomales Bay to San Francisco, some differences exist between the structure of vegetation found in the salt marshes of the central coast and those of the San Francisco Estuary (Baye et al. 2000). Within the southern portion of Tomales Bay, deltaic and fringe marshes typically support a thin fringe of low marsh along the banks of tidal marsh channels and creeks characterized by species such as Pacific cordgrass, alkali bulrush (*Scirpus maritimus*), and even pickleweed. The natural marsh channel and creek banks are often moderately to steeply sloped or even undercut, cresting to broad berms or alluvial levees. The alluvial levees running along larger creeks such as Lagunitas are often quite high, with the top supporting a "high marsh/upland ecotone" vegetation community that transitions into "high marsh" as the levee slopes down to the marsh plain. The high marsh/upland ecotone community typically supports high marsh species such as saltgrass and alkali heath, as well as upland species such as red fescue (*Festuca rubra*). The "high" high marsh areas are characterized by large stands of gumplant (*Grindelia* sp.) interspersed among tall forms of pickleweed. This community typically also grows densely along the lower-elevation levees that border smaller marsh channels and drainages. Within San Francisco Bay marshes, these gumplant-lined channels are also common, although many of natural alluvial levees characteristic of Tomales Bay's deltaic marshes that once occurred on the upstream portions of tidal sloughs no longer exist (Baye et al. 2000).

Tidal Salt Marsh-Mid and Tidal Salt Marsh-High in undiked marsh north of Giacomini Ranch.

Inland of these alluvial levees lie broad, expansive marsh plains supporting interspersed pockets of very low-growing mid-marsh and "low" high marsh species assemblages, as well as small, typically unvegetated marsh ponds. Topographic variation between mid-marsh and "low" high marsh zones remains almost undetectable, but dominant species within these zones differ significantly. Mid-marsh zones are dominated by jaumea, saltgrass, and seaside arrow-grass (*Trigochlin maritima*), are densely vegetated, and are often saturated to the surface. Baye et al. (2000) described the mid marsh plains of marshes of the central coast as supporting very thin, low (<10 cm) turf-like vegetation mosaics with extremely short, sparse, or prostrate pickleweed as a relatively minor component, or, at most, co-dominant with species such as arrow-grass. These salt marsh plant turfs often support high species diversity compared with San Francisco Bay salt marsh plains, which tend to be dominated by pickleweed growing in dense stands (usually over 20 cm thick; up to 50-60 cm in some fringing salt marshes of San Pablo Bay; Baye et al. 2000).

The "low" high marsh typically has a lower percent vegetation cover and supports a mixture of species, including pickleweed, jaumea, seaside arrow-grass (*Triglochin maritima*), arrow-grass (*Triglochin concinna*), western marsh rosemary (*Limonium californicum*), and saltgrass. During the summer, the presence of purple-flowered western marsh rosemary easily distinguishes the "low" high marsh in deltaic marshes. Topographic complexity within marshes is increased by the presence of alluvial fans at the upland ecotone. Alluvial fans create gradually sloping ecotones with uplands, with variably textured sediments and freshwater runoff and seeps (Baye et al. 2000). While these fans have largely been eliminated from San Francisco Bay, alluvial fan-tidal marsh ecotones occur in maritime salt marshes of Point Reyes and Tomales Bay, where they support distinctive local plant assemblages, including uncommon to rare species (Baye et al. 2000). Some of the rare plant species observed in Tidal Salt Marsh in the undiked marsh north of the Project Area, the Tomales Bay trailhead marshes, and in the fringing salt marsh on the outboard portion of the levees include Humboldt Bay owl's-clover (*Castilleja ambigua* ssp. *humboldtiensis*; FSC), Point Reyes bird's beak (*Cordylanthus maritimus* ssp. *palustris*; FSC), and, to a much lesser extent, Marin knotweed (*Polygonum marinense*; FSC; Parsons 2003).

Turf of "low" Tidal Salt Marsh-High with significant cover of western marsh rosemary.

Other

The Study Area also includes a number of other habitats not directly classifiable by specific hydrologic regimes. Many of these vegetation communities are upland ones and/or represent a minor component within the Study Area.

Mesic Coastal Scrub: Even some of the limited coastal scrub habitat present in the Study Area incorporates a mesic or moist component, with perennial or seasonal seep flow on the Point Reyes Mesa creating a unique vegetation community characterized by both arroyo willow (*Salix lasiolepis*) and coyote brush (*Baccharis pilularis*; Sub-Alliance 11 in Figures 5 and 10). In general, this community is dominated by a dense canopy of low shrubs or trees, but with scattered grassy or ruderal openings. Although these areas are not considered "riparian," they nonetheless support riparian species such as arroyo willow. Willow grows in combination with coyote brush, poison hemlock (*Conium maculatum*), poison oak (*Toxicodendron diversilobum*), and even coast live oak (*Quercus agrifolia*). The juxtaposition between wetland (willow) and generally upland (coyote brush) species may relate to the average depth of the groundwater table in this area. While willow seedlings and saplings require hydrophytic conditions to survive, adult trees are phreatophytic and can tap into deeper water tables. Natural seep influences may be augmented to some degree by septic systems from residential areas on Point Reyes Mesa. Groundwater influences extend beyond the slope to Tomasini Creek, which has been bermed to contain flow along the base of Point Reyes Mesa. Water salinities remain in the brackish range even during the late summer and fall when upstream creek flow has dried up, but tidal influence continues due to failure of the tidal control structure. Acreage of Mesic Coastal Scrub was high because it spans the face of the Point Reyes Mesa, totaling 12.7 hectares or 31.5 acres or 5.4 percent of the Study Area.

Arroyo willow and coyote brush dominate the Mesic Coastal Scrub vegetation community along the Point Reyes Mesa.

Coyote Brush Coastal Scrub: This vegetation community is drier than that of Mesic Coastal Scrub and is dominated by a dense canopy of low shrubs (0.5-2m tall), with scattered grassy openings. It occurs very sporadically on very elevated floodplain terraces adjacent to Lagunitas Creek in the White House Pool and Green Bridge areas (Sub-Alliance 1 in Figures 5 and 11). Acreage totals 0.1 hectares (0.3 acres), representing less than 0.05 percent of the Study Area. The dominant species is coyote brush, with species such as poison oak or California blackberry (*Rubus ursinus*) or Himalayan blackberry (*Rubus discolor*) often present (Appendix A).

Moist Grassland: Historically, grasslands often occurred along the upland ecotone of estuaries such as San Francisco, but in heavily developed watersheds such as that one, these communities have largely been lost to commercial and residential development. The historical extent of this type of habitat within Tomales Bay is unknown, but it probably would have been relatively small due to the sharp topographic break between the subtidal/intertidal "lowlands" within the Bay itself and the surrounding hills of the Inverness Ridge, Point Reyes Mesa, etc. Moist Grassland is defined as areas ecotonal to saline or brackish marsh that are dominated by species such as blue wildrye (*Leymus triticoides*; Appendix A). There are occasional inclusions (< 30 percent cover) of some of the "drier" sedge and rush species such as rush (*Juncus patens*) and sedge (*Carex barbarae* and possibly *Carex barbarae*X*obnupta*; Appendix A). Dominant species included both native and non-native annual and perennial grasses such as Mediterranean barley (*Hordeum marinum*), perennial ryegrass (*Lolium perenne*), blue wildrye, Harding grass (*Phalaris aquatica*), and reed canary grass (*Phalaris arundinacea*; Appendix A). Total percent cover of the two *Phalaris* species, often viewed as invasive due to their propensity to spread rapidly, remained comparatively minimal in relation to the other species: reed canary grass was observed exclusively in a low-lying depressional area of the Tomasini Creek floodplain terrace adjacent to Mesa Road.

Moist Grassland areas are typically not actively managed as pasture. Areas that are actively managed as pasture or that were dominated or "sub-dominated" by "escapee" pastoral or forage species such as creeping bent grass (*Agrostis stolonifera*) or rough bluegrass (*Poa trivialis*) were mapped as Salt Marsh Pasture or Wet Pasture. Within the Study Area, Moist Grassland areas are probably heavily influenced by ponding or prolonged saturation by waters from creek bank overflow events during larger storms or storms exceeding bankfull flow (Ordinary High Water event with average return interval of ~1.5 years). Moist Grassland was mapped in several of the "swales" or former secondary channels that have developed behind the alluvial levees that now lie outside the manmade ones along Lagunitas Creek (Sub-Alliance 12 in Figures 5, 8, and 9) and along the tidally influenced portion of the Tomasini Creek berm (Figures 5, 10, and 11). The small area available for establishment of this type of vegetation community has definitely restricted its extent, with acreage totaling 2.0 hectares (5.0 acres) or 0.9 percent of the Study Area.

Ruderal community on alluvial floodplain adjacent to Fish Hatchery Creek

Ruderal: Ruderal communities represented a significant portion of the Study Area. Ruderal included areas supporting a mixture of herbs and forbs with often no clear or consistent dominance pattern. Most of the levees and berms within the Study Area, as well as the alluvial floodplain of Fish Hatchery Creek in the West Pasture, were mapped as Ruderal (Sub-Alliance 15 in Figures 5-11). A large proportion of the species within these polygons was non-native, but a significant amount of blue wildrye was also observed growing on the levees. Hydrologic input to these communities consists of very infrequent overbank flooding and precipitation. Acreage totaled 13.8 hectares (34.2 acres) or approximately 5.9 percent of the Study Area.

Special Habitats

Of the Sub-Alliances mapped within the Study Area, at least four potentially qualify as a NDDB special habitat or natural community: Tidal Salt Marsh-Low, Tidal Salt Marsh-Mid, Tidal Salt Marsh-High, and High Marsh/Upland Ecotone. These communities appear to match the

Northern Coastal Salt Marsh habitat described by Holland (1979) and subsequently identified as a special habitat. As noted earlier, Northern Coastal Salt Marsh has already been documented at the head of Tomales Bay. While information on the exact location of this occurrence was not available, it is likely that the NDDB record refers to the undiked marsh north of the Giacomini Ranch and possibly at the base of the Tomales Bay trailhead. However, this occurrence should be expanded to include the fringe on the outboard portion of the Lagunitas Creek/Giacomini Ranch levees, as well, particularly the northern portions of the levee where the "shelf" is widest.

Most of the freshwater marshes mapped within the Study Area do not appear to qualify as a NDDB special habitat, even the somewhat floristically unique Freshwater Marsh in the West Pasture. According to Holland (1986), Coastal and Valley Freshwater Marshes are characterized by being permanently flooded by freshwater rather than brackish or alkaline waters or waters having variable salinity regimes. Probably because of the historical tidal incursion through the malfunctioning one-way tidegate on Fish Hatchery Creek, this marsh appears to have a highly variable salinity regime, with salinities increasing during the summer and dropping during the winter and spring when seep flows are probably highest. The high spatial (and temporal) variation in salinity within this portion of the West Pasture is reflected in the fact that the "Freshwater Marsh" lies directly adjacent to an area dominated by halophytic species such as pickleweed and saltgrass. For this reason, this marsh would probably not qualify as a NDDB special habitat.

Invasive Species

The presence of exotic or invasive non-native plant species was documented through vegetation mapping, although the specific location and areal extent of occurrences of specific "problem" species were not necessarily mapped unless the occurrence was relatively large (e.g., stands of eucalyptus, Sub-Association 31 in Figure 14). Exotic or invasive species were defined as those ranked by the California Invasive Plant Council (CalIPC) or by the Seashore as a significant threat to native ecosystems of California and/or the parks. CalIPC relies on a categorical system of ranking the seriousness posed by invasive species, with List A comprising the most invasive ones and the list, "Considered But Not Listed," the least invasive. The most recent version of this system dates to October 1999, although CalIPC is updating the list. Table 3 presents a list of the CalIPC species observed in the Study Area.

Approximately 27 CalIPC exotic or invasive species occurred in the Study Area. Although the number of species is relatively high, the number of occurrences and/or areal extent of most of these plants remained comparatively low. Of the 27 species, nine (9) were on List A-1, which includes the most invasive and widespread invasive species. The most common List A-1 species in the Study Area were eucalyptus (*Eucalyptus globulus*), fennel (*Foeniculum vulgare*), and Himalayan blackberry (*Rubus discolor*; Table 3). As noted earlier, eucalyptus was primarily found growing in large stands along Point Reyes Mesa (Sub-Association 31 in Figure 14). Himalayan blackberry represented a common riparian understory or shrub species, although California blackberry (*Rubus ursinus*) appeared to have a higher percent cover (Appendix B). Fennel primarily establishes in Ruderal and Disturbed habitats along levees, berms, and other areas. Only one (1) individual or clump of pampas grass (*Cortaderia selloana*) has been observed in the Project Area. Some efforts at eradicating this clump have already been undertaken. Cape ivy (*Delairea odorata*) occurred in a comparatively small number of polygons (13), but, due to the species' invasiveness, its presence represents a threat because of the Project's objective of increasing riparian habitat. Giant reed (*Arundo donax*) does not currently grow in the Study Area, but there are two (2) currently non-spreading occurrences upstream of the Study Area on Olema Creek and tributaries to Lagunitas Creek (Brannon Ketcham, *pers comm*.). One List A-2 species has been documented in the Study Area, pennyroyal (*Mentha pulegium*), which is a obligate hydrophyte that is relatively common (88 polygons) in many of the glycophytic vegetation communities such as Wet Pasture and Freshwater Marsh.

Species on List B, which contains those that CalIPC has characterized as of "lesser" invasiveness, appeared to represent both the highest number of occurrences and/or areal extent of invasive plants within the Study Area (Table 3). Italian thistle (*Carduus pynocephalus*), bull thistle (*Cirsium vulgare*), poison hemlock (*Conium maculatum*), and tall fescue (*Festuca arundinacea*) were all quite common within the Study Area, specifically the Project Area. Densities of Italian thistle and bull thistle typically remained low in polygons in which they occurred, but poison hemlock and tall fescue were often found in dense clumps on levees and within pastures, respectively. Other species such as greater periwinkle (*Vinca major*) were restricted to riparian areas, but it, as with Cape ivy, represents a threat to riparian restoration efforts. Interestingly, common velvet grass (*Holcus lanatus*), which is threatening the integrity of the parks' coastal grasslands through rapid colonization of coastal prairies and dairy cattle ranches, was not as common as other grasses within the Project Area.

TABLE 3: List of CalIPC Invasive Species documented in the Giacomini Wetland Restoration Project Study Area during 2001-2003.

COMMON NAME	SCIENTIFIC NAME	COMMENTS
List A-1: Most Invasive Wildland Pest Plants; Widespread		
cheat grass	*Bromus tectorum*	Very uncommon
yellow star thistle	*Centaurea solstitialis*	Very uncommon
pampas grass	*Cortaderia selloana*	Only one (1) occurrence; one (1) individual in East Pasture near Tomasini Creek berm.
Scotch broom	*Cytisus scoparius*	Only one (1) occurrence
Cape ivy	*Delairea odorata*	Present in 13 polygons mapped in Forested and Scrub-Shrub Riparian habitat along Sir Francis Drake road.
eucalyptus	*Eucalyptus globulus*	Present in 32 polygons. Most occur in monotypic stands along "face" of Point Reyes Mesa.
fennel	*Foeniculum vulgare*	Very common. Present in 105 polygons, sometimes in very high densities on levees and berms along channels.
French broom	*Genista monspessulana*	Very uncommon.
Himalayan blackberry	*Rubus discolor*	Very common. Present in 200 riparian-associated polygons, often in fairly high densities.
List A-2: Most Invasive Wildland Pest Plants; Regional		
pennyroyal	*Mentha pulegium*	Very common (88 polygons) in wetland areas and dense in those areas in which it occurs.
List B: Wildland Pest Plants of Lesser Invasiveness		
wild mustard	*Brassica nigra*	Very common. Present in 60 polygons.
Italian thistle	*Carduus pynocephalus*	Moderately common. Present in 44 polygons, but typically not in high densities. Found within pastures and levees/berms.
bull thistle	*Cirsium vulgare*	Very common. Present in 152 polygons, but typically not in large densities. Found within pastures and levees/berms.
poison hemlock	*Conium maculatum*	Very common. Present in 195 polygons. Often dense along levees and berms of channels.
tall fescue	*Festuca arundinacea*	Very common. Present in 228 polygons. Typically dense patches within larger Wet Pasture or Salt Marsh Pasture areas.

TABLE 3 (CONT.): List of CalIPC Invasive Species documented in the Giacomini Wetland Restoration Project Study Area.

COMMON NAME	SCIENTIFIC NAME	COMMENTS
List B: Wildland Pest Plants of Lesser Invasiveness		
common velvet grass	*Holcus lanatus*	Very common. Present in 158 polygons, but typically not in high densities.
Harding grass	*Phalaris aquatica*	Uncommon. Present in only 14 polygons. Typically not in high densities, with one exception near Tomasini Creek.
greater periwinkle	*Vinca major*	Uncommon. Present in 26 polygons in Forested and Scrub-Shrub Riparian habitat along Sir Francis Drake Boulevard.
Need More Information		
caper spurge	*Euphorbia lathyris*	Very uncommon. Present in only six (6) polygons in very low densities.
rough cat's-ear	*Hypochaeris radicata*	Common. Present in 26 polygons. Often found in drier pastures and levees and berms.
	Phyla nodiflora	Very uncommon. Present in only two (2) polygons.
Considered, but not Listed		
field bindweed	*Convolvulus arvensis*	Very uncommon. Present in only eight (8) polygons and typically in low densities.
foxglove	*Digitalis purpurea*	Very uncommon. Present in only one (1) polygon.
California bur clover	*Medicago polymorpha*	Very uncommon. Present in only two (2) polygons.
bristly ox-tongue	*Picris echioides*	Common. Present in 66 polygons, but typically in fairly low densities.
milk thistle	*Silybum marianum*	Common. Present in 27 polygons and typically in low densities within pastures and levees.
spiny cocklebur	*Xanthium spinosum*	Common. Present in 19 polygons. Sometimes dense in areas where it does occur. Occurs along ranch roads, dairy facilities, drainage ditches, and low spots in pastures.

Golden Gate National Recreation Area
Giacomini Wetland Restoration Project

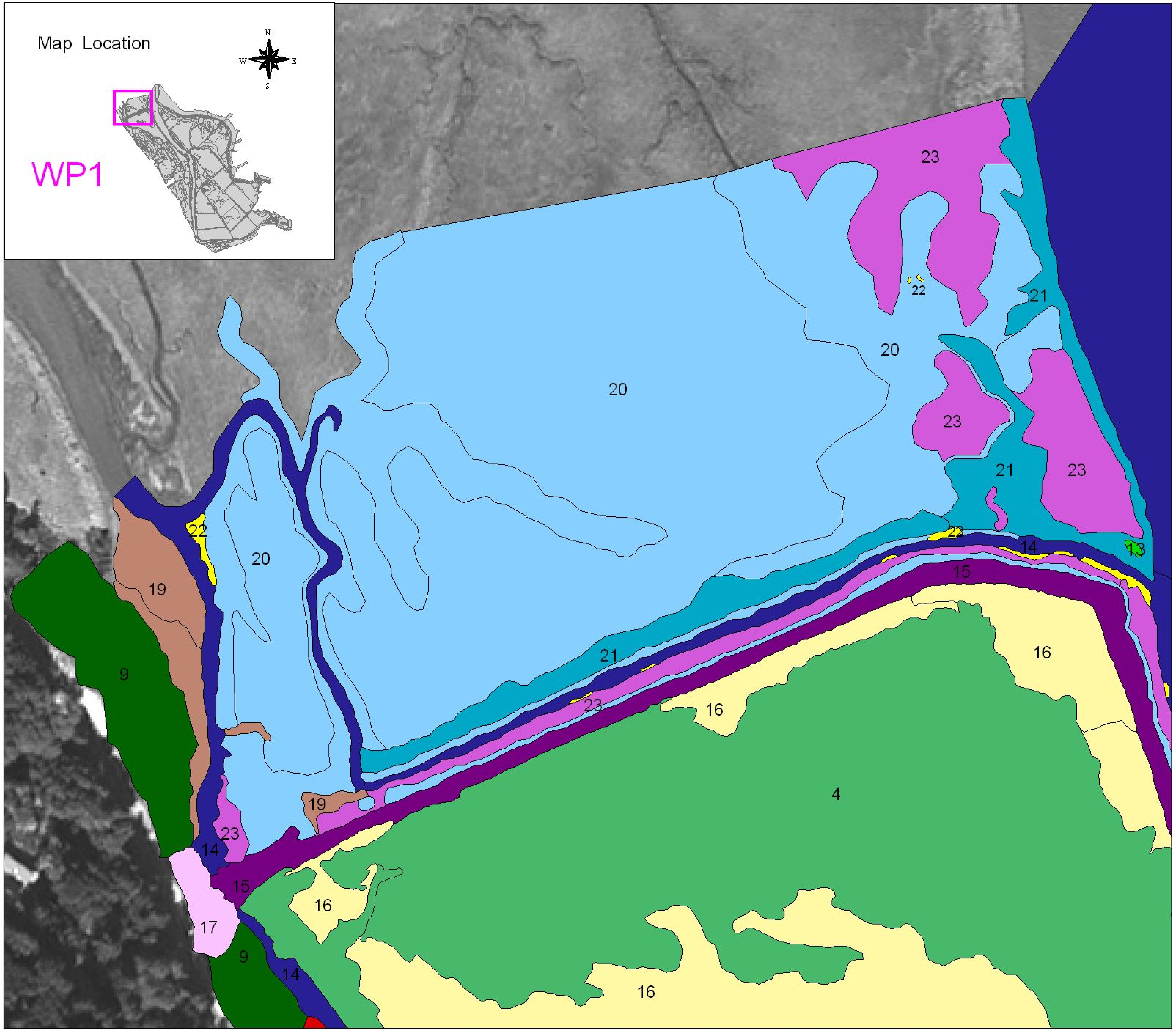


Figure 6. Detail WP1 (West Pasture) of vegetation communities mapped at Sub-Alliance level.

1	Coyote Brush Coastal Scrub
2	Diked Brackish Marsh
3	Diked Salt Marsh-High
4	Diked Salt Marsh-Mid
5	Diked Salt Marsh-Mudflat/Panne
6	Disturbed
7	Dry Grassland
8	Dry Pasture
9	Forested Riparian
10	Freshwater Marsh
11	Mesic Coastal Scrub
12	Moist Grassland
13	Moist Meadow
14	Open Water
15	Ruderal
16	Salt Marsh Pasture
17	Scrub-Shrub Riparian
18	Seasonal Wetland
19	Tidal Brackish Marsh
20	Tidal Salt Marsh-High
21	Tidal Salt Marsh-High/Upland Ecotone
22	Tidal Salt Marsh-Low
23	Tidal Salt Marsh-Mid
24	Unvegetated
25	Vernal Marsh
26	Wet Meadow
27	Wet Pasture

National Park Service
Point Reyes National Seashore
Natural Resources

0.03 0 0.03 Miles

Plot date: October 31, 2003 s:\gis\projects1\giacomini\giac_alliance_details.apr

Golden Gate National Recreation Area

Giacomini Wetland Restoration Project

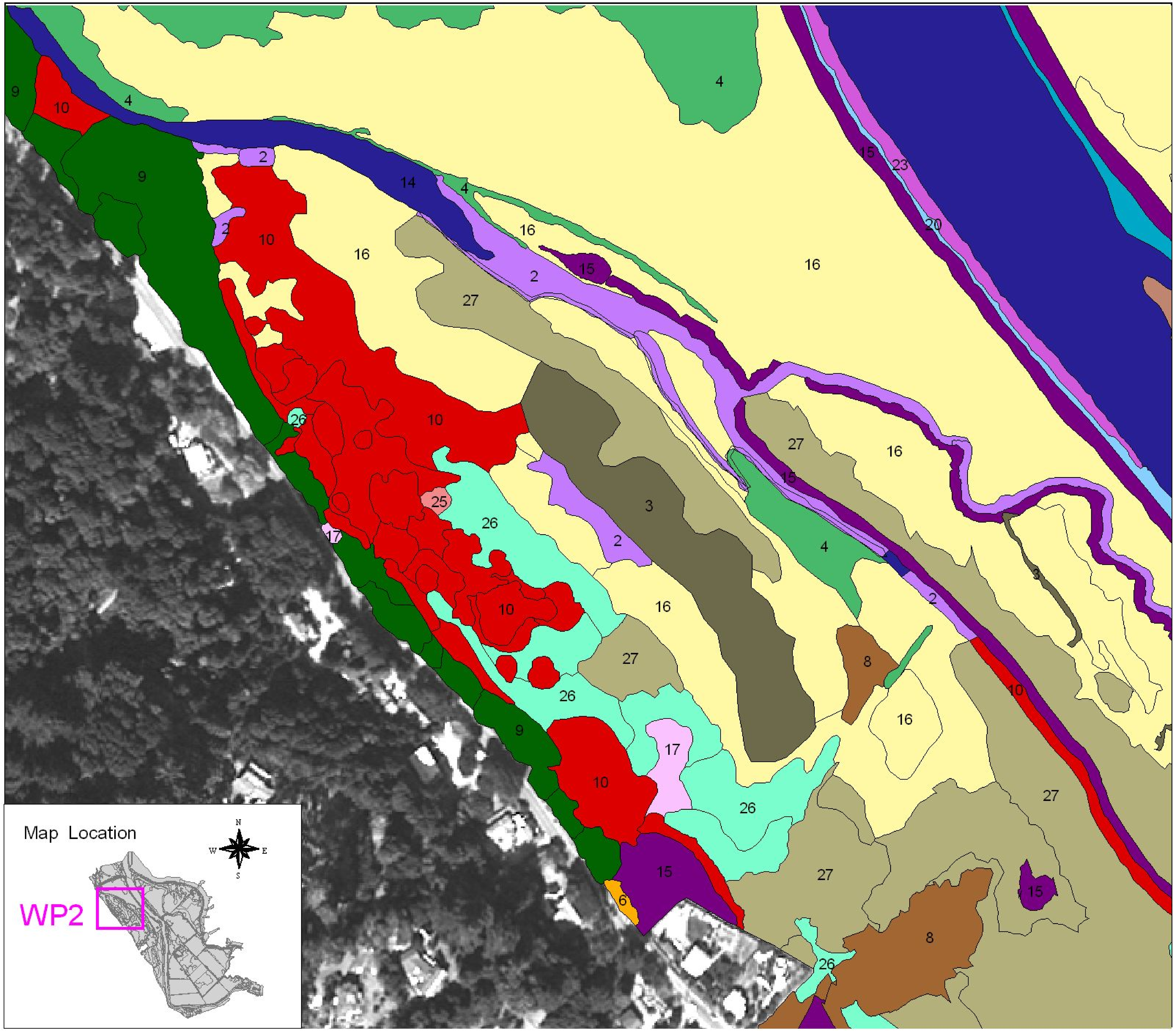


Figure 7. Detail WP2 (West Pasture) of vegetation communities mapped at Sub-Alliance level

1	Coyote Brush Coastal Scrub
2	Diked Brackish Marsh
3	Diked Salt Marsh-High
4	Diked Salt Marsh-Mid
5	Diked Salt Marsh-Mudflat/Panne
6	Disturbed
7	Dry Grassland
8	Dry Pasture
9	Forested Riparian
10	Freshwater Marsh
11	Mesic Coastal Scrub
12	Moist Grassland
13	Moist Meadow
14	Open Water
15	Ruderal
16	Salt Marsh Pasture
17	Scrub-Shrub Riparian
18	Seasonal Wetland
19	Tidal Brackish Marsh
20	Tidal Salt Marsh-High
21	Tidal Salt Marsh-High/Upland Ecotone
22	Tidal Salt Marsh-Low
23	Tidal Salt Marsh-Mid
24	Unvegetated
25	Vernal Marsh
26	Wet Meadow
27	Wet Pasture

National Park Service
Point Reyes National Seashore
Natural Resources

0.03 0 0.03 0.06 Miles

Plot date: November 3, 2003 s:\gis\projects1\giacomini\giac_alliance_details.apr

Golden Gate National Recreation Area

Giacomini Wetland Restoration Project

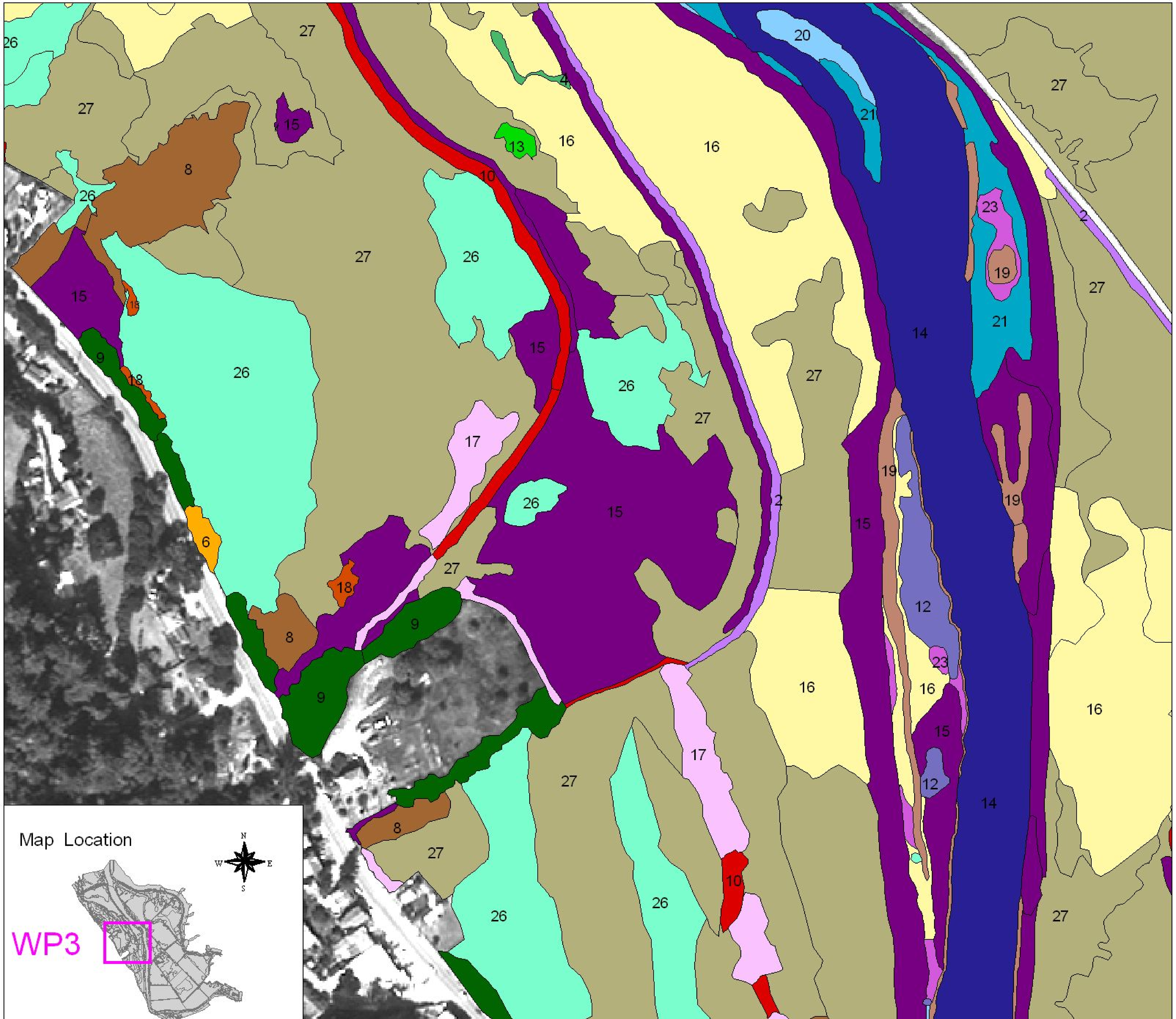


Figure 8. Detail WP3 (West Pasture) of vegetation communities mapped at Sub-Alliance level.

1	Coyote Brush Coastal Scrub
2	Diked Brackish Marsh
3	Diked Salt Marsh-High
4	Diked Salt Marsh-Mid
5	Diked Salt Marsh-Mudflat/Panne
6	Disturbed
7	Dry Grassland
8	Dry Pasture
9	Forested Riparian
10	Freshwater Marsh
11	Mesic Coastal Scrub
12	Moist Grassland
13	Moist Meadow
14	Open Water
15	Ruderal
16	Salt Marsh Pasture
17	Scrub-Shrub Riparian
18	Seasonal Wetland
19	Tidal Brackish Marsh
20	Tidal Salt Marsh-High
21	Tidal Salt Marsh-High/Upland Ecotone
22	Tidal Salt Marsh-Low
23	Tidal Salt Marsh-Mid
24	Unvegetated
25	Vernal Marsh
26	Wet Meadow
27	Wet Pasture

National Park Service
Point Reyes National Seashore
Natural Resources

0.03 0 0.03 0.06 Miles

1 : 2,391 1 inch = 0.04 miles

Plot date: November 3, 2003 s:\gis\projects1\giacomini\giac_alliance_details.apr

Golden Gate National Recreation Area

Giacomini Wetland Restoration Project

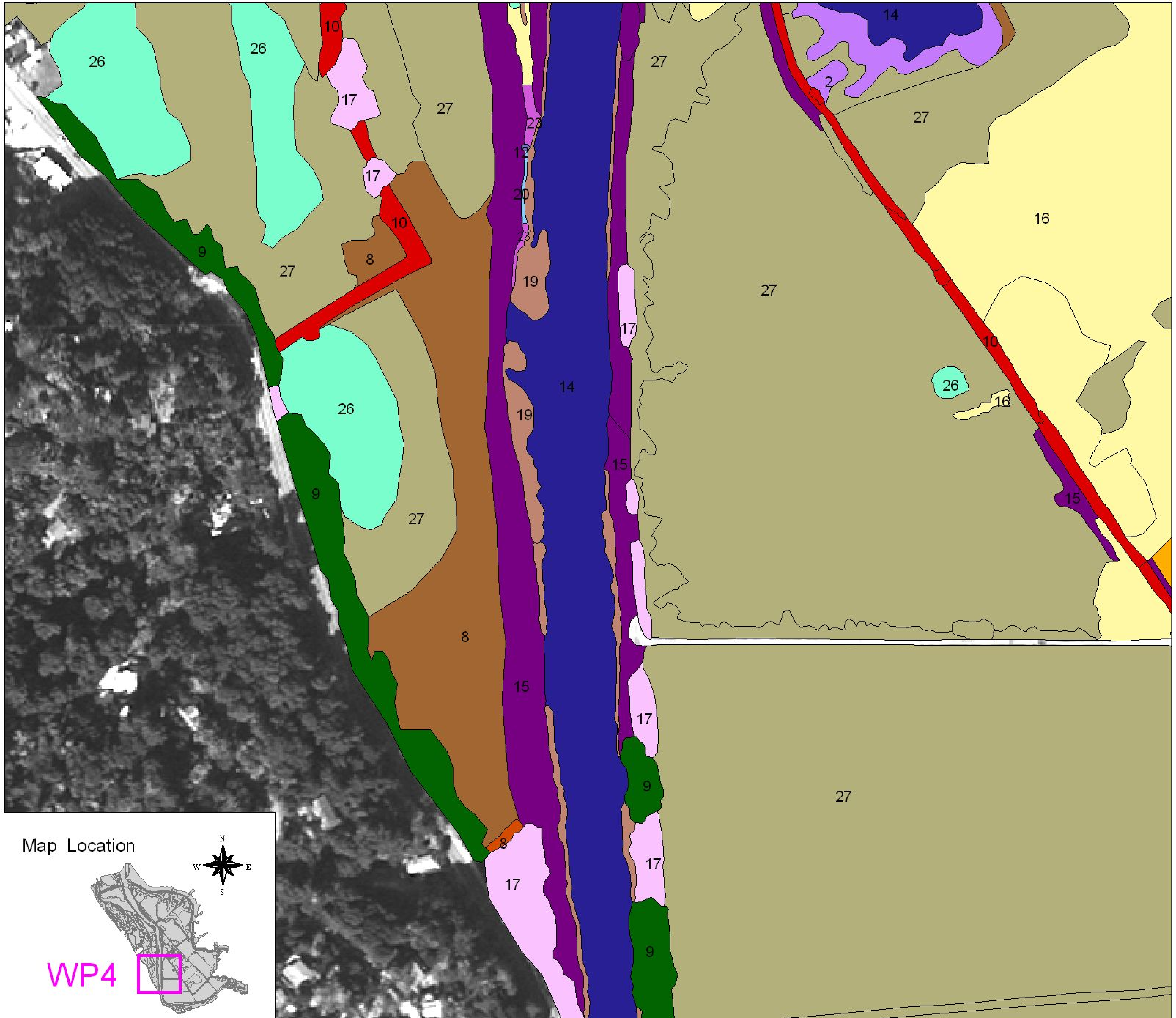


Figure 9. Detail WP4 (West Pasture) of vegetation communities mapped at Sub-Alliance level.

1	Coyote Brush Coastal Scrub
2	Diked Brackish Marsh
3	Diked Salt Marsh-High
4	Diked Salt Marsh-Mid
5	Diked Salt Marsh-Mudflat/Panne
6	Disturbed
7	Dry Grassland
8	Dry Pasture
9	Forested Riparian
10	Freshwater Marsh
11	Mesic Coastal Scrub
12	Moist Grassland
13	Moist Meadow
14	Open Water
15	Ruderal
16	Salt Marsh Pasture
17	Scrub-Shrub Riparian
18	Seasonal Wetland
19	Tidal Brackish Marsh
20	Tidal Salt Marsh-High
21	Tidal Salt Marsh-High/Upland Ecotone
22	Tidal Salt Marsh-Low
23	Tidal Salt Marsh-Mid
24	Unvegetated
25	Vernal Marsh
26	Wet Meadow
27	Wet Pasture

National Park Service
Point Reyes National Seashore
Natural Resources

0.02 0 0.02 0.04 Miles

Plot date: November 3, 2003 s:\gis\projects1\giacomini\giac_alliance_details.apr

Golden Gate National Recreation Area

Giacomini Wetland Restoration Project

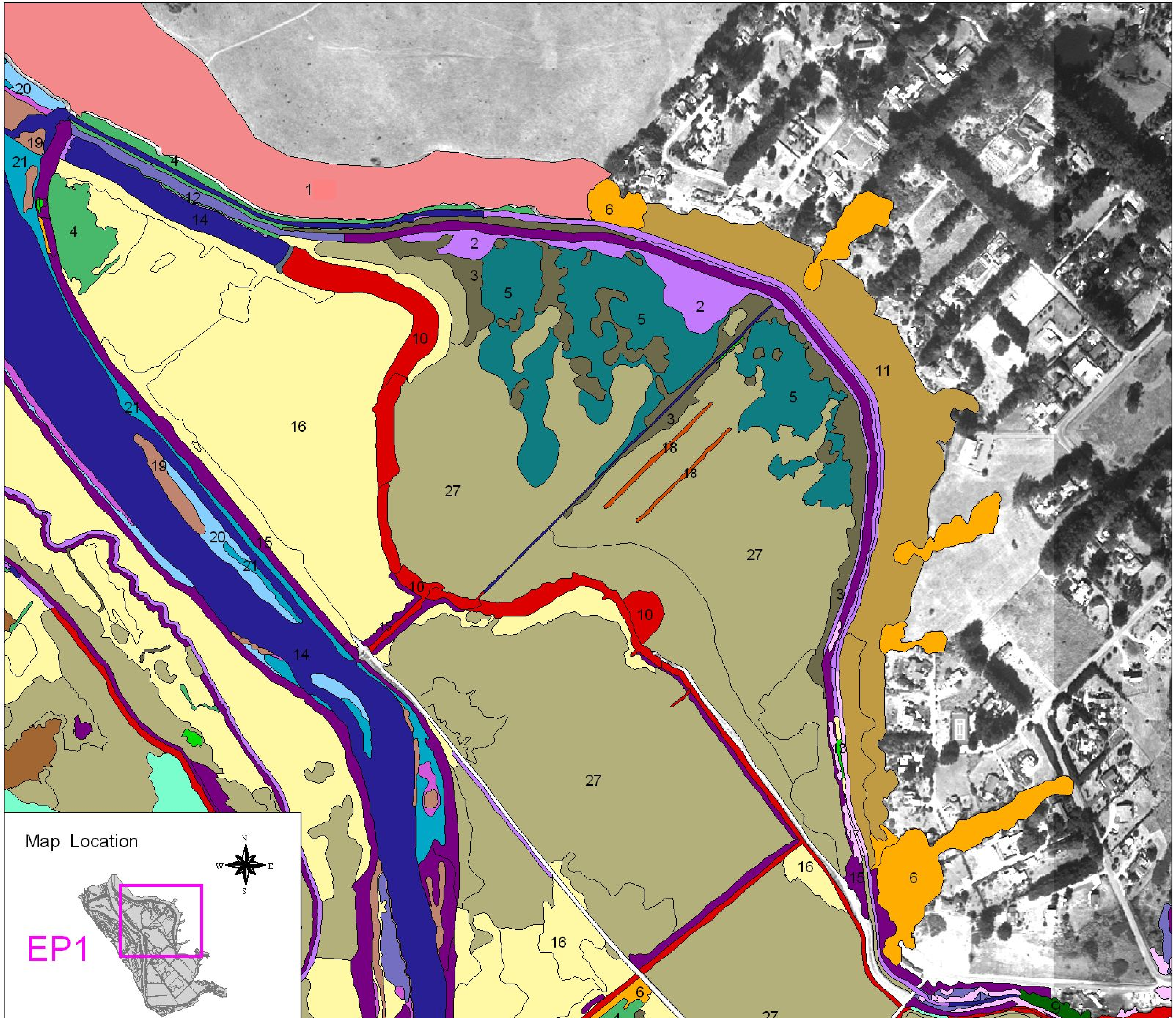


Figure 10. Detail EP1 (EastPasture) of vegetation communities mapped at SUB-ALLIANCE level.

1	Coyote Brush Coastal Scrub
2	Diked Brackish Marsh
3	Diked Salt Marsh-High
4	Diked Salt Marsh-Mid
5	Diked Salt Marsh-Mudflat/Panne
6	Disturbed
7	Dry Grassland
8	Dry Pasture
9	Forested Riparian
10	Freshwater Marsh
11	Mesic Coastal Scrub
12	Moist Grassland
13	Moist Meadow
14	Open Water
15	Ruderal
16	Salt Marsh Pasture
17	Scrub-Shrub Riparian
18	Seasonal Wetland
19	Tidal Brackish Marsh
20	Tidal Salt Marsh-High
21	Tidal Salt Marsh-High/Upland Ecotone
22	Tidal Salt Marsh-Low
23	Tidal Salt Marsh-Mid
24	Unvegetated
25	Vernal Marsh
26	Wet Meadow
27	Wet Pasture

National Park Service
Point Reyes National Seashore
Natural Resources

0.05 0 0.05 0.1 0.15 Miles

1 : 4,868 1 inch = 0.08 miles

Plot date: November 3, 2003 s:\gis\projects1\giacomini\ep_giac_alliance_details.apr

Golden Gate National Recreation Area

Giacomini Wetland Restoration Project

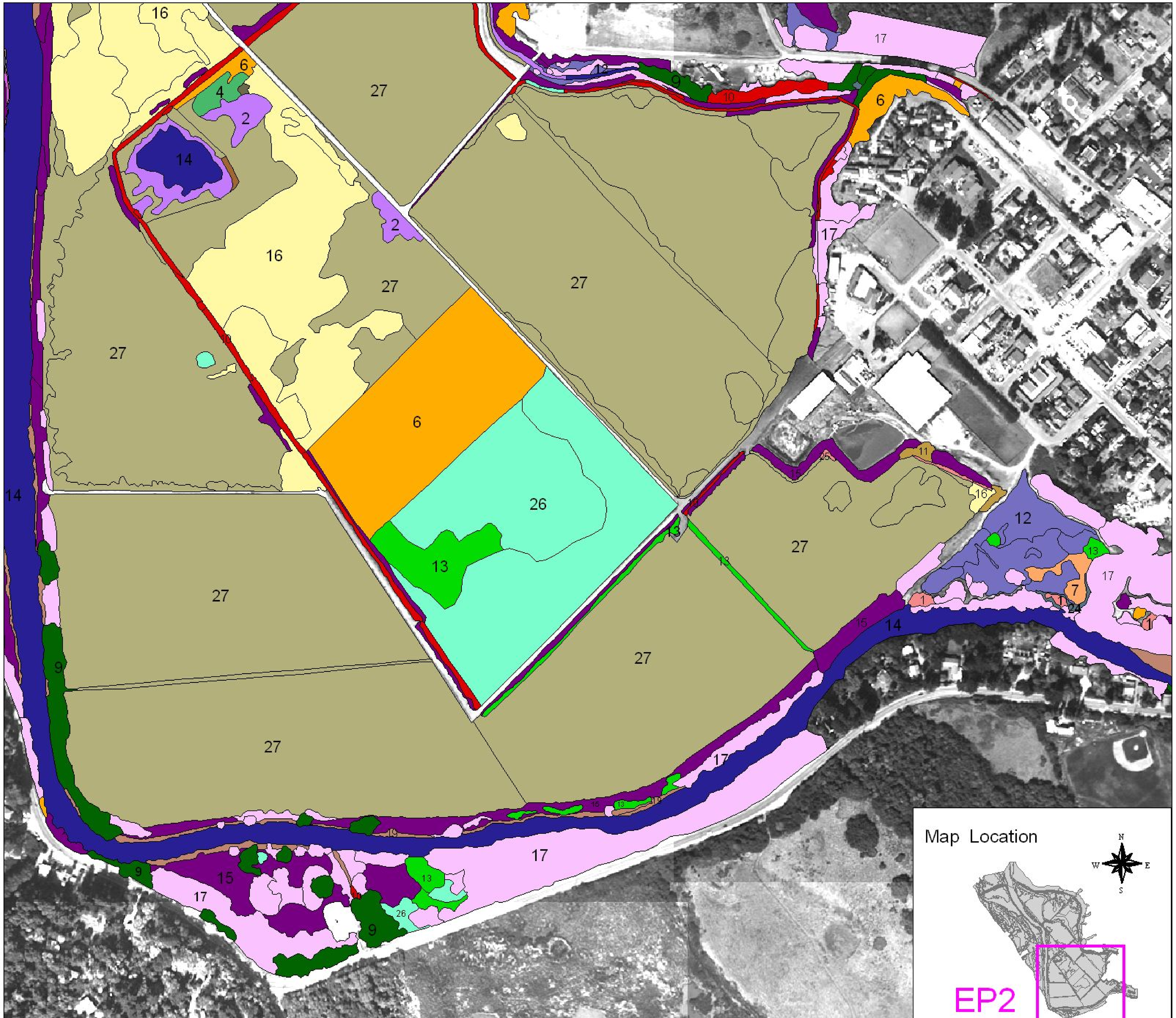


Figure 11. Detail EP2 (EastPasture) of vegetation communities mapped at SUB-ALLIANCE level.

1	Coyote Brush Coastal Scrub
2	Diked Brackish Marsh
3	Diked Salt Marsh-High
4	Diked Salt Marsh-Mid
5	Diked Salt Marsh-Mudflat/Panne
6	Disturbed
7	Dry Grassland
8	Dry Pasture
9	Forested Riparian
10	Freshwater Marsh
11	Mesic Coastal Scrub
12	Moist Grassland
13	Moist Meadow
14	Open Water
15	Ruderal
16	Salt Marsh Pasture
17	Scrub-Shrub Riparian
18	Seasonal Wetland
19	Tidal Brackish Marsh
20	Tidal Salt Marsh-High
21	Tidal Salt Marsh-High/Upland Ecotone
22	Tidal Salt Marsh-Low
23	Tidal Salt Marsh-Mid
24	Unvegetated
25	Vernal Marsh
26	Wet Meadow
27	Wet Pasture

National Park Service
Point Reyes National Seashore
Natural Resources

0.05 0 0.05 0.1 0.15 Miles

1 : 4,689 1 inch = 0.07 miles

Plotdate: November 3, 2003 s:\gis\projects1\giacomini\ep_giac_alliance_details.apr

Golden Gate National Recreation Area

Giacomini Wetland Restoration Project

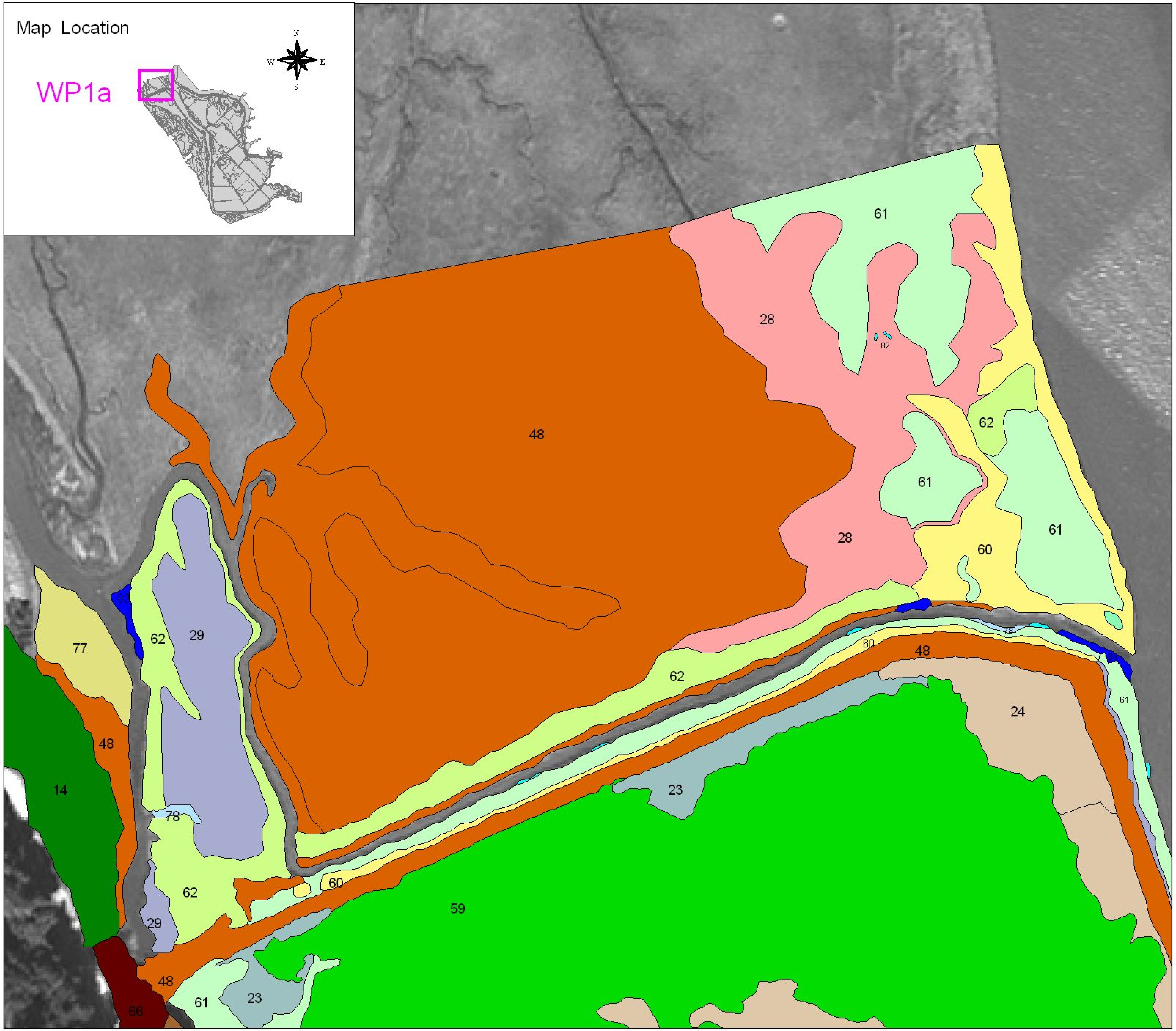


Figure 12. Detail WP1a (West Pasture) of vegetation communities mapped at Sub-Association level.

14	Alnus/Salix lasiolepis-Rubus ursinus
23	Distichlis
24	Distichlis-Agrostis
28	Distichlis-Other
29	Distichlis-Salicornia
48	Mixed
59	Salicornia
60	Salicornia-Distichlis-Festuca rubra
61	Salicornia-Jaumea-Distichlis
62	Salicornia-Other
66	Salix lasiolepis-Rubus ursinus
70	Salix lasiolepis/Rubus ursinus
77	Scirpus maritimus
78	Scirpus maritimus-Salicornia
82	Spartina foliosa
83	Spartina foliosa-Other

National Park Service
Point Reyes National Seashore
Natural Resources

0.02 0 0.02 0.04 Miles

Plot date: November 3, 2003 s:\gis\projects1\giacomini\giac_assoc.apr

Golden Gate National Recreation Area
Giacomini Wetland Restoration Project

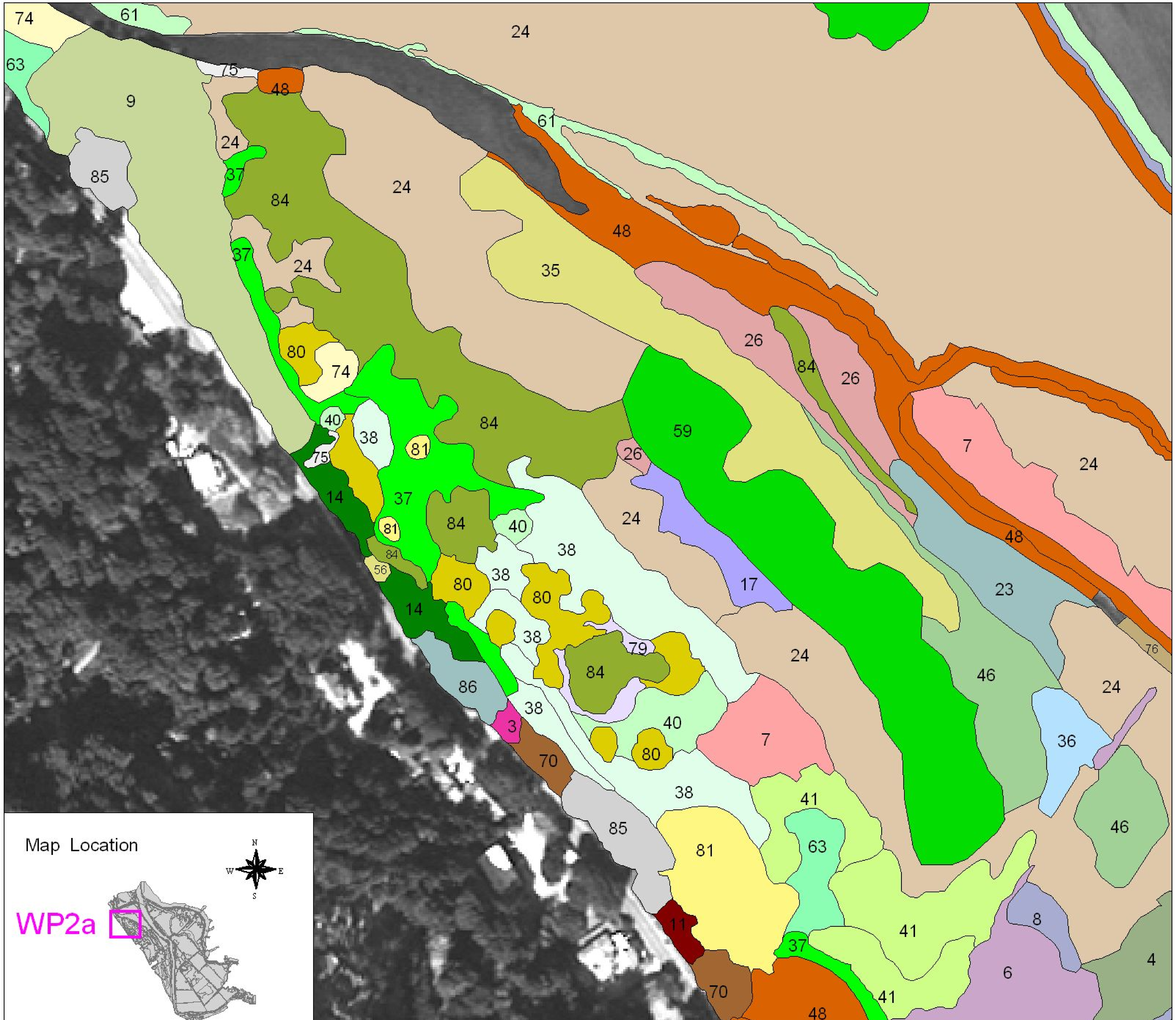


Figure 13. Detail WP2a (West Pasture) of vegetation communities mapped at the SUB-ASSOCIATION level.

- 3 Aesculus californica
- 4 Agrostis
- 6 Agrostis-Other
- 7 Agrostis-Trifolium
- 8 Agrostis-Trifolium-Lolium
- 9 Alnus-Salix lasiolepis
- 11 Alnus/Rubus discolor
- 14 Alnus/Salix lasiolepis-Rubus ursinus
- 17 Atriplex-Other
- 24 Distichlis-Agrostis
- 26 Distichlis-Agrostis-Other
- 35 Hordeum marinum-Other
- 36 Hordeum murinum-Other
- 37 Hydrocotyle
- 38 Hydrocotyle-Other
- 40 Juncus balticus
- 41 Juncus effusus-Other
- 46 Lolium-Other
- 48 Mixed
- 56 Rubus ursinus-Equisetum
- 59 Salicornia
- 61 Salicornia-Jaumea-Distichlis
- 63 Salix lasiolepis
- 70 Salix lasiolepis/Rubus ursinus
- 74 Scirpus americanus
- 75 Scirpus californicus
- 76 Scirpus californicus-Other
- 79 Scirpus microcarpus
- 80 Sparganium
- 81 Sparganium-Other
- 85 Umbellularia californica
- 86 Umbellularia californica-Quercus agrifolia

National Park Service
Point Reyes National Seashore
Natural Resources

0.02 0 0.02 0.04 Miles

Plot date: November 3, 2003 s:\gis\projects1\giacomini\giac_assoc.apr

Golden Gate National Recreation Area

Giacomini Wetland Restoration Project

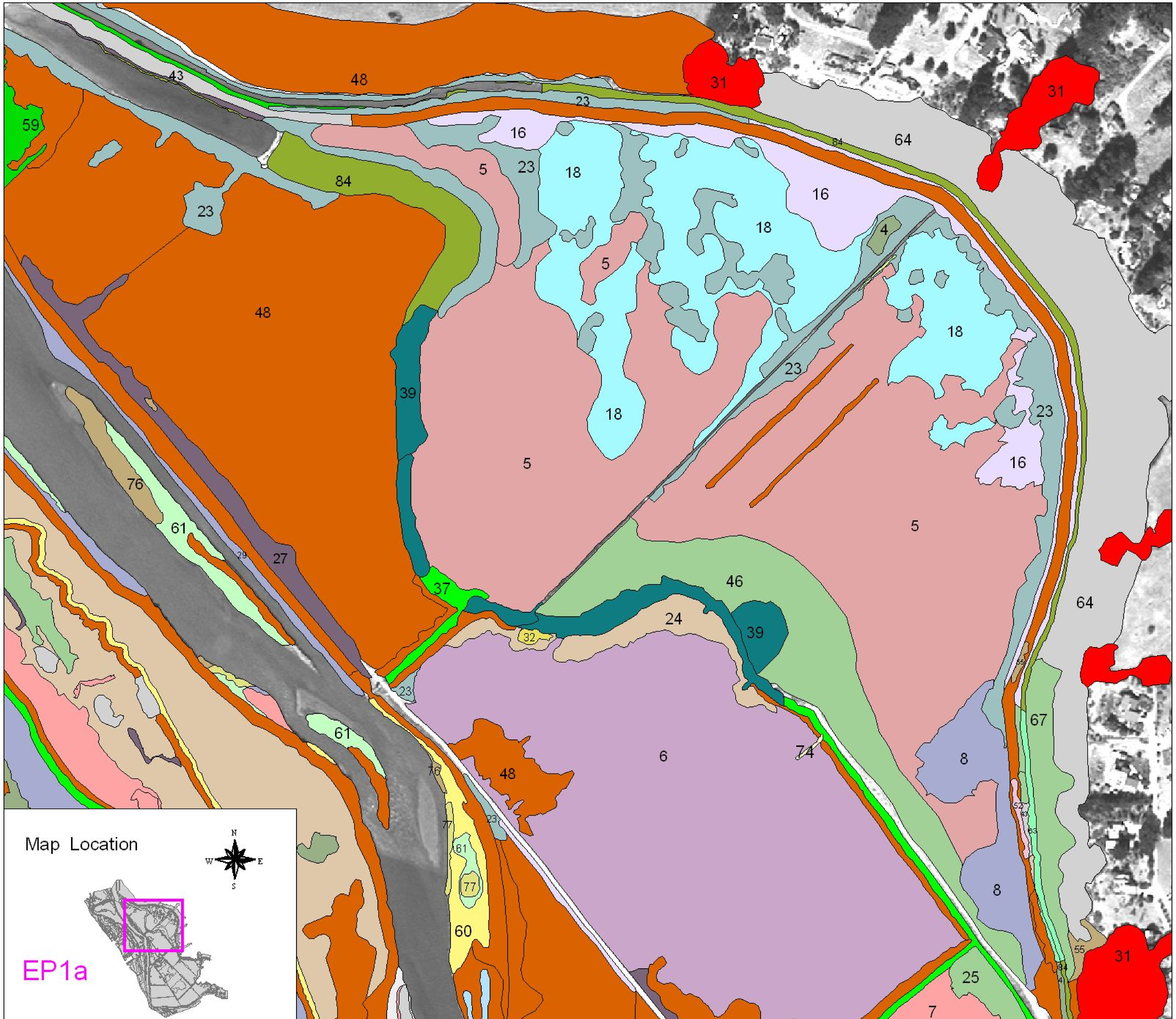


Figure 14. Detail EP1a (East Pasture) of vegetation communities mapped at Sub-Association level.

Code	Community
4	Agrostis
5	Agrostis-Atriplex-Other
6	Agrostis-Other
8	Agrostis-Trifolium-Lolium
16	Atriplex
18	Atriplex-Spergularia
23	Distichlis
24	Distichlis-Agrostis
27	Distichlis-Atriplex-Other
29	Distichlis-Salicornia
31	Eucalyptus
32	Festuca arundinacea-Other
37	Hydrocotyle
39	Hydrocotyle-Typha
41	Juncus effusus-Other
43	Leymus
46	Lolium-Other
48	Mixed
52	Rubus discolor
55	Rubus ursinus
59	Salicornia
60	Salicornia-Distichlis-Festuca rubra
61	Salicornia-Jaumea-Distichlis
63	Salix lasiolepis
64	Salix lasiolepis-Baccharis
67	Salix lasiolepis-Rubus ursinus-Toxicodendron
74	Scirpus americanus
76	Scirpus californicus-Other
77	Scirpus maritimus
84	Typha

National Park Service
Point Reyes National Seashore
Natural Resources

0.03 0 0.03 0.06 Miles

Plot date: November 3, 2003 s:\gis\projects1\giacomini\giac_assoc.apr

CONCLUSIONS

Summary

The mapping of more than 80 percent of the Project Area as Active Pasture or Agriculture during initial vegetation mapping efforts conducted by the Seashore/GGNRA suggests that the Project Area is primarily a monotypic, pastoral forb-and herb-dominated vegetation community largely shaped by agricultural activities. However, our ground-based vegetation mapping efforts uncovered an incredible amount of habitat diversity in this highly managed landscape. There were approximately 27 Sub-Alliances and 86 Sub-Associations mapped within the Study Area (Table 2; Appendices A and B).

The Study Area's hydrologic complexity undoubtedly accounts for the wide variety of habitats present, most of which were either wetland or riparian in nature and included glycophytic (freshwater), brackish, and halophytic (saline) hydrologic regimes. Even the pasturelands retain enough wetland characteristics for a significant percentage to be classified as either Wet Pasture (40 percent of the Study Area) or Salt Marsh Pasture (14 percent of the Study Area). Wet Pasture and Salt Marsh Pasture are largely dominated by hydrophytic pastoral grasses and herbs such as creeping bentgrass (*Agrostis stolonifera*), rough bluegrass (*Poa trivialis*), white clover (*Trifolium repens*), although the latter supports a number of halophytic species, as well, including saltgrass (*Distichlis spicata*), alkali heath (*Frankenia salina*), and pickleweed (*Salicornia virginica*). The legacy of agriculture is perhaps best reflected by the fact that Ruderal represented the third largest vegetation community in the Study Area: most of the levees and berms were mapped as Ruderal, which is a mixture of native and non-native species with no clear dominance pattern.

The presence of halophytic vegetation communities such as Salt Marsh Pasture and Diked Salt Marsh underscores the strong connection between the diked areas and Lagunitas Creek despite levees and tidegates. This connection probably persists due to a combination of factors, including minor topographic subsidence, muted tidal inflow through failed tidegates, and a potential groundwater connection resulting from the alluvial nature of the Project Area's soils. Despite this connection, diking, along with flood and spray irrigation, appears to have elevated the areal extent of glycophytic communities within the Study Area relative to historic conditions, as it has in many other areas in the Tomales Bay watershed and Point Reyes Peninsula (Evens 1993). Glycophytic communities such as Wet Pasture, Wet Meadow and Freshwater Marsh accounted for almost 50 percent of the Study Area. Based on historic information, freshwater marshes such as Olema Marsh and the one in the West Pasture, which support special status amphibian and avian species, actually represent artifacts of diking and berming activities along Lagunitas Creek. These activities have increased glycophytic regimes at the expense of transitional ones such as brackish marsh, which may have once dominated the southern end of Tomales Bay during the 1800s. The strong freshwater influences from creeks and drainages, as well as groundwater seep flow from Inverness Ridge and Point Reyes Mesa, suggest that this portion of the Bay was once a sizeable mixing or interface zone between freshwater and saline influences.

Diking has impacted halophytic vegetation communities, as well, relegating Tidal Salt Marsh to the undiked deltaic marsh north of the Giacomini Ranch and to small islands and fringing areas on the outboard portions of levees. The levees have not only usurped areas available for establishment of Tidal Salt Marsh, but have also affected the potential for its establishment by changing hydrologic dynamics such as flood flow velocity, sediment transport, etc. U.S. Coast Survey maps from 1863 depict marsh as occurring through most of the East Pasture and in the Olema Creek and Bear Valley Creek (Olema Marsh) floodplains. Excessive sedimentation associated with logging and poor land use practices substantially increased aggradation within Tomales Bay, particularly in the southern end. Between 1860s and 1980s, approximately 650 acres of new salt marsh were formed within the Bay (PWA et al. 1993). A large percentage of this new marsh was diked in the 1940s by the Waldo Giacomini family for operation of a dairy cattle ranch. The remaining undiked marsh is comprised of a variety of salt marsh communities, including "low," "mid," "high," and "high marsh/upland ecotone." It supports an incredible number of sensitive biotic resources, including Pacific cordgrass (*Spartina foliosa*), Point Reyes bird's-beak (*Cordylanthus maritimus* ssp. *palustris*), Humboldt Bay owl's-clover (*Castilleja ambigua* ssp. *humboldtiensis*), California clapper rail (*Rallus longirostris obsoletus*), and California black rail (*Laterallus jamaicensis coturniculus*). In fact, the California Natural Diversity Database (NDDB) identified "the head of Tomales Bay" as the location of one of its special habitats, Northern Coastal Salt Marsh.

Potential Impacts

The proposed Project may have direct and indirect (e.g., changes in hydrologic patterns) impacts on existing vegetation communities within the Study Area. These include:

- **Habitat "Conversion:"** The proposed Project will likely increase tidal influence, thereby causing a shift in vegetation communities from glycophytic to brackish or halophytic. Some glycophytic communities may remain or even establish at the perimeter of the Project Area, where perennial freshwater flow from drainages or seeps occurs and tidal influence is at its least. However, it is likely that the Freshwater Marsh in the West Pasture would become more brackish in nature, given its proximity to the "mouth" of Fish Hatchery Creek into Tomales Bay. This marsh, while floristically unique and home to the California red-legged frog (*Rana aurora draytonii*), does not appear to qualify as Coastal and Valley Freshwater Marsh NDDB special habitat, because of the variable salinity regimes present. According to Holland (1986), Coastal and Valley Freshwater Marshes are characterized by being permanently flooded by freshwater rather than brackish or alkaline waters or waters having variable salinity regimes. Long-term tidal incursion through the malfunctioning one-way tidegate on Fish Hatchery Creek has probably historically led to slightly brackish conditions during the summer.

- **Habitat Loss Due to Construction**: Removal or breaching of the levees will directly impact undiked Tidal Salt Marsh on the outboard portions of Lagunitas Creek levees. This vegetation community has been identified by the NDDB as a special habitat, although it is not necessarily afforded any direct regulatory protection. A small fringe of Tidal Salt Marsh and some other vegetation communities has established as a "shelf" along the levees. Some of these areas support the special status plant species Humboldt

Bay owl's-clover and species of regional significance such as Pacific cordgrass. Construction will also impact Ruderal communities that have established on the levees themselves. While these communities are not floristically significant, Ruderal areas with taller vegetation can provide some degree of high tide refugia for species such as rails. In general, the levees support a diverse mixture of non-native species, but certain portions have large expanses of blue wildrye (*Leymus triticoides*).

- **Habitat Loss Due to Changes in Hydrologic Patterns**: The proposed Project may also indirectly affect adjacent vegetation communities, particularly Tidal Salt Marsh and Tidal Brackish Marsh, by changing hydrologic patterns such as creek locations, flow velocities, sedimentation rates, etc.

Any direct or indirect impacts to Tidal Salt Marsh or Tidal Brackish Marsh is expected to be offset in the long term by increases in establishment of salt marsh communities if the levees or portions of the levees are removed. Not only will removal of levees encourage the conversion of existing glycophytic habitats such as Wet Pasture to Tidal Brackish or Tidal Salt Marsh, but also some degree of formation of new salt marsh should continue through sediment deposition. While sedimentation rates in Lagunitas Creek have dropped substantially due to construction of dams in the Lagunitas Creek and Nicasio Creek watersheds (PWA et al. 1997), some degree of fluvial-driven bedload and suspended sediment transport still appears to occur. In addition, wind-wave resuspension of fine sediments within Tomales Bay may play some role in formation of new marshes through mudflat accretion as it does to a large degree in the San Francisco Bay Estuary. The recent establishment of Pacific cordgrass on the intertidal mudflats in southern Tomales Bay may alter the availability, however, of non-flood suspended sediment, as it is likely to stabilize fine-grained, nutrient-rich sediment (P. Baye, *pers comm*.). Currently, hydrologists are working to assess what sources of sediment may be available for any wetlands restored.

In terms of vegetative establishment, the high plant diversity present in both the diked and undiked marsh areas should provide a rich source of seeds and vegetative fragments to boost recruitment of native species in both "converted" and "new" marsh areas. At this point, the number of hydrophytic invasive plant species present in the Study Area is low. Pennyroyal (*Mentha pulegium*), a mint species considered a regional invasive species, is the one wetland obligate that occurs commonly in some of the glycophytic habitats such as Wet Meadow and Freshwater Marsh. Some of the more facultative wetland species such as common velvet grass (*Holcus lanatus*) and poison hemlock (*Conium maculatum*) could establish in some of the "drier" wetland habitats that develop. An increase in salinity within water and soils following restoration should act to either preclude or minimize the presence of these glycophytic wetland species.

A greater threat to coastal wetland restoration efforts comes from species such as Atlantic cordgrass (i.e., *Spartina alterniflora* or hybrids) or dense-flowered cord grass (*Spartina densiflora*), which have been sighted recently in Drakes Bay and Tomales Bay, respectively. The occurrence of dense-flowered cord grass in northern Tomales Bay is believed to have been successfully extirpated, and efforts to eradicate Atlantic cordgrass from Drakes Bay appear to be successful. Active planting or sowing of native stock or seed may need to be conducted in areas where the seed or vegetative fragment source is absent or sporadic or the number of non-native, invasive plant species with potential to establish is high such as riparian or native grassland vegetation communities. Without active seeding or plug transplantation, any efforts to establish native grassland vegetation communities would probably fail due to the high number of non-native grass species present in the Study Area and comparatively low densities of native grass species. Due to extensive riparian vegetation along Lagunitas and the upstream portions of Fish Hatchery and Tomasini Creeks, riparian restoration efforts will benefit from a high native seed source. However, there are a number of invasive species that could threaten these efforts, including Cape ivy (*Delairea odorata*) and greater periwinkle (*Vinca major*), which have been documented in the Study Area. Where established, these species decrease native plant species diversity and, at least for greater periwinkle, vegetation "layering" of riparian habitats that is important for its use by wildlife species. Cape ivy and greater periwinkle are both present in fairly low numbers in Forested and Scrub-Shrub riparian habitat along Sir Francis Drake, but should be removed prior to project initiation to reduce threats to restoration efforts.

Potential Mitigation Measures

Some measures that might be taken to ensure that the impacts of the Project to existing vegetation communities such as Tidal Salt Marsh are minimized include:

1) timing levee and berm removal toward summer and fall when at least some of the special status plants have already gone to seed;
2) flagging areas that can be avoided to minimize the potential for impacts from construction equipment access and equipment stockpiling;
3) stockpiling topsoils from areas in which impacts cannot be avoided for use in construction area rehabilitation once the levees or berms are removed; and/or
4) collecting seed from key native plant species (such as blue wildrye) in impacted areas prior to dehiscence for sowing after construction is completed.

REFERENCES

Atwater, B.F. and C.H. Hedel. 1976. *Distribution of seed plants with respect to tide levels and water salinity in the natural tidal marshes of the northern San Francisco Bay Estuary, California*. U.S. Geological Survey, Menlo Park, California. Open File Report 76-389. 41 pp.

Avocet Research Associates. 2003. *Giacomini Marsh Restoration Site Special Status Animal Species: Reconnaissance & Compliance*. Report to the National Park Service. Point Reyes Station, California.

Baye, P.R., P.M. Faber, and B. Grewell. 2000. *Tidal Marsh Plants of the San Francisco Estuary*. In Olofson, P.R., ed. Goals Project. Baylands Ecosystem Species and Community Profiles: Life histories and environmental requirements of key plants, fish, and wildlife. Prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board, Oakland, California.

Baye, Peter. Coastal Ecologist. Annapolis, California. Personal communications dated May 6 and October 28, 2003.

Beidleman, L.H. and E.N. Kozloff. 2003. *Plants of the San Francisco Bay Region. Mendocino to Monterey*. Revised Edition. University of California Press. Berkeley, California.

Bertness, M.D. 1992. *The ecology of New England salt marsh plant communities*. American Scientist. 80:260-268.

Bertness, M.D. 1991a. *Zonation of Spartina spp. in a New England salt marsh*. Ecology. 72:138-148.

Bertness, M.D. 1991b. *Interspecific interactions among high marsh perennials in a New England salt marsh*. Ecology. 72:125-137.

CDFG (California Department of Fish and Game). 2003. *The vegetation classification and mapping program. List of California Terrestrial Natural Communities recognized by the California Natural Diversity Database.* September 2003 Edition. Wildlife and Habitat Data Analysis Branch. Sacramento, California.

Cheatham, N.H. and J.R. Haller. 1975. *An annotated list of California habitat types*. University of California Natural Land and Water Reserves System. Berkeley, California.

Evens, J.G. 1993. *The Natural History of the Point Reyes Peninsula*. Point Reyes National Seashore Association. Point Reyes, California. 224 pp.

Gilbert, G.K. 1908. *The earth movement on the fault of April, 18, 1906, Tomales Bay to Bolinas Lagoon in The California earthquake of April 18, 1906: Report of the State Earthquake*

Investigation Commission. Volume I(I). The Carnegie Institution of Washington, Washington, D.C.

Hickman, J.C., ed. 1993. *The Jepson Manual: higher plants of California*. University of California Press, Berkeley and Los Angeles, California.

Hinde, H. 1954. *The vertical distribution of salt marsh phanerogams in relation to tide levels*. Ecol. Mono. 24:209-225.

Holland, R.F. 1986. *Preliminary Descriptions of the Terrestrial Natural Communities of California*. Prepared for The Resources Agency, Department of Fish and Game. Sacramento, California. October 1986.

Howell, J.T. 1970. *Marin Flora*. University of California Press. Berkeley, California.

Kamman, Rachel. 2003. Hydrologist. Kamman Hydrology & Engineering. San Rafael, California. Personal communications dated August 2003.

Keeler-Wolf, T. February 1999. *Field and photo-interpretation key to the vegetation alliances and defined associations from the Point Reyes National Seashore, Golden Gate National Recreation Area, San Francisco Municipal Water District Lands, and Mt. Tamalpais, Tomales Bay, and Samuel P. Taylor State Park.*

Ketcham, Brannon. 2003. Hydrologist. Point Reyes National Seashore. Point Reyes Station, California. Personal communications dated November 2003.

Macdonald, K.B. and M.G. Barbour. 1974. *Beach and salt marsh vegetation of the North American Pacific Coast.* In R.J. Reinhold and W.H. Queen, Eds. Ecology of halophytes. Academic Press, New York, New York.

Mahall, B.E. and R.B. Park. 1976. *The ecotone between Spartina foliosa Trin and Salicornia virginica L. in salt marshes of northern San Francisco Bay*. Journal of Ecology. II. Soil Water and Salinity. 64:793-809.

Mason, H. 1969. *A Flora of the Marshes of California*. University of California Press, Berkeley and Los Angeles, California.

National Park Service. 2000. *Management Policies 2001*. U.S. Department of the Interior. NPS D1416. Washington, D.C.

Niemi, T.M. and N.T. Hall. 1996. *Historical changes in the tidal marsh of Tomales Bay and Olema Creek, Marin County, California*. Journal of Coastal Research. 12(1):90-102.

Nixon, S. 1992. *The ecology of New England high salt marshes: a community profile*. Biological Services Program, U.S. Department of the Interior, Fish and Wildlife Service; FWS/OBS-81/55. Washington, D.C.

Parsons, L. 2003. *Draft Botanical Survey Report. Giacomini Wetland Restoration Project*. Golden Gate National Recreation Area/Point Reyes National Seashore. Point Reyes Station, California.

Peinado, M., F. Alcaraz, J. Delgadillo, M. De La Cruz, J. Alvarez, and J.L. Aguirre. 1994. *The coastal salt marshes of California and Baja California.* Vegetatio. 110:55-66.

Pennings, S.C. and R.M. Callaway. 1992. *Salt marsh plant zonation: the relative importance of competition and physical factors*. Ecology. 73:681-690.

Philip Williams & Associates, Wetlands Research Associates, Strong Associates, and L.J. Butler. 1993. *An evaluation of the feasibility of wetland restoration on the Giacomini Ranch, Marin County.* Prepared for the National Park Service.

PORE (Point Reyes National Seashore). 2003. Vegetation Mapping for Point Reyes National Seashore and Golden Gate National Recreation Area.

Sawyer, Jr., J.O . and T. Keeler-Wolf. 1996. *A Manual of California Vegetation*. California Native Plant Association. Sacramento, California.

Schirokauer, David. 2003. GIS Biologist. Point Reyes National Seashore. Point Reyes Station, California. Personal communications dated October 2003.

Schirokauer, D. and A. Parravano. 2003. *Enhanced wetlands mapping final report*. Point Reyes National Seashore. Point Reyes Station, California.

Shuford, W.D. and I.C. Timossi. 1989. *Plant communities of Marin County*. California Native Plant Society. Sacramento, California.

Soil Conservation Service (SCS). 1985. *Soil survey of Marin County, California*. U.S. Department of Agriculture in cooperation with the U.S. Department of the Interior, National Park Service, and University of California Agricultural Experiment Station.

Soil Conservation Service (SCS). March 1992. *Hydric soils lists*. U.S. Department of Agriculture. Davis, California.

U.S. Fish and Wildlife Service. 1991. *Atlas of National Wetlands Inventory maps for Marin County, California*. Portland, Oregon.

Vince, S.W. and A.A. Snow. 1984. *Plant zonation in an Alaskan salt marsh. I. Distribution, abundance, and environmental factors*. Journal of Ecology. 85:71-82.

Zedler, J.B., Ed. 2001. *Handbook for restoring tidal wetlands*. CRC Press LLC, Boca Raton, Florida. 439 pp.

APPENDICES

Appendix A. Description of Giacomini Sub-Alliances and Sub-Associations

Vegetation Mapping

Giacomini Wetland Restoration Project Area

Mapping Rules

1. Smallest individual mapping unit: 10X10 m
2. Areas with distinct vegetation associations that were smaller than 10X10 m were noted as "inclusions" within larger polygons and described either on separate datasheet or on same datasheet.
3. Note under Scrub-Shrub and Forested Classes, we have added another class, "10," which refers to mixed evergreen/broad-leaved deciduous.

Clusters

Disturbed
Grassland
Marsh
Open Water
Pasture
Riparian
Ruderal
Shrubland
Unvegetated

Sub-Alliances

Glycophytic Regimes:

Dry Pasture: Dominated (>50 percent) non-hydrophytic grasses, clovers, and other herbs and/or lacks wetland hydrology. These areas are typically actively managed as pasture OR are dominated or "sub-dominated" by "escapee" pastoral or forage species.

Wet Pasture: Dominated (>50 percent) hydrophytic grasses, clovers, and other herbs. Area is either actively managed as pasture or contains some of the predominant pastoral or forage species such as *Agrostis stolonifera* or *Poa palustris*.

Wet Meadow: At least 30 percent cover of sedge, rush, or other non-clover herbs, as well as grasses. Typically, dominant sedge and rush species are the short- to medium-sized species (as opposed to cattails, tules, and bulrush), and the hydroperiod is shorter than for Freshwater Marsh, but often extends throughout the spring and into the summer.

Moist Meadow: At least 30 percent cover of some of the "drier" or more facultative sedge and rush species such as *Juncus patens*, *Juncus lesueurii*, *Juncus balticus*, or *Carex* *barbarae.* Hydroperiod is shorter than for Wet Meadow and may involve non-persistent inundation/saturation following seasonal flooding

Dry Grassland: Dominated (>50 percent) by non-hydrophytic grasses, clovers, and other herbs and/or lacks wetland hydrology. These areas are typically not actively managed as pasture OR are not dominated or “sub-dominated” by “escapee” pastoral or forage species.

Moist Grassland: Areas ecotonal to saline or brackish water areas that are dominated by species such as *Leymus triticoides*, with the occasional inclusion (<30 percent cover) of some of the “drier” sedge and rush species such as *Juncus patens*, *Juncus balticus*, and *Carex barbarae*. These areas are typically not actively managed as pasture. Areas that are actively managed as pasture OR are dominated or “sub-dominated” by “escapee” pastoral or forage species such as *Agrostis stolonifera* or *Poa palustris* are mapped as Salt Marsh Pasture or Wet Pasture.

Seasonal Wetland: Dominated typically by non-persistent herbs and forbs adapted to short hydroperiod following seasonal ponding/saturation. Typically in closed depressions that encourage perching of surface water.

Vernal Marsh: Dominated (>70 percent) typically by persistent sedges, rushes, and other non-clover herbs. Hydroperiod is longer than Seasonal Wetland but shorter than Freshwater Marsh.

Freshwater Marsh: Dominated (>70 percent) typically by persistent sedges, rushes, and other non-clover herbs. Typically inundated or saturated nearly year-round.

Scrub-Shrub Riparian: Dominated by riparian tree or shrub species that are less than 16 feet in height. In many instances, these areas represent earlier seral stages of Forested Riparian communities.

Forested Riparian: Dominated by riparian tree species that are greater than 16 feet in height. In many instances, these areas represent later seral stages of riparian community succession.

Brackish Regimes:

Diked Brackish Marsh: Dominated (>70 percent) by hydrophytic non-clover herbs able to tolerate water salinities that average in the brackish or mesohaline range (5-18 ppt). Diked communities are inside of levees or berms and experience typically only muted tidal action, if that. May include a range of glycophytic or halophytic species. Defined to a large extent by water salinity conditions.

Tidal Brackish Marsh: Dominated (>70 percent) by hydrophytic non-clover herbs able to tolerate water salinities that average in the brackish or mesohaline range (5-18 ppt). Tidal communities are outside of levees or berms and experience a full range of tidal and freshwater action. May include a range of glycophytic or halophytic species. Defined to a large extent by water salinity conditions. In low-elevational areas, characteristic species are *Scirpus californicus* and *Scirpus maritimus*.

Halophytic Regimes:

Salt Marsh Pasture: Significant presence (at least 20 to 25 percent) of halophytic herbs and forbs in grass-dominated polygon. Halophytes or salt tolerant species include saltgrass, alkali heath, pickleweed, spearscale, birdfoot trefoil, etc.

Diked Salt Marsh: Dominated (>70 percent) by halophytic herb and forbs in herb/shrub-dominated polygon that is behind levees or berms and therefore hydrologically altered.

- **Mid:** Typically comprised of a mix of *Salicornia virginica*, *Jaumea carnosa*, and *Distichlis spicata*.
- **High:** Typically comprised of a mix of *Salicornia virginica*, *Distichlis spicata*, or *Frankenia salina*.
- **Mudflat/Panne:** Typically sparsely vegetated because of extensive flooding. Dominant species often include *Spergularia* sp., *Distichlis*, and *Salicornia*.

Tidal Salt Marsh: Dominated (>70 percent) by halophytic herb and forbs in herb/shrub-dominated polygon that is outside of levees or berms and therefore not hydrologically altered.

- **Low:** Typically comprised of *Spartina foliosa*.
- **Mid:** Typically comprised of a mix of *Salicornia virginica*, *Jaumea carnosa*, and *Distichlis spicata*.
- **High:** Typically comprised of a mix of *Salicornia virginica*, *Distichlis spicata*, *Frankenia salina*, and *Festuca rubra*. *Jaumea carnosa* may also be present, as well, but cover is typically decreased, while cover of *Grindelia* has increased.
- **High/Upland Ecotone:** Often dominated by *Festuca rubra*, although other species such as *Salicornia virginica*, *Distichlis spicata*, *Jaumea carnosa*, *Frankenia salina* are often present, as well. At least partially defined by the increased presence of true upland and/or weedy species such as *Lactuca serriola*, *Sonchus* sp., *Raphanus sativus*, etc.

Other:

Ruderal: Mixture of herbs and forbs with no clear or consistent dominance pattern.

Disturbed: Vegetation dominated primarily by ornamental species.

Open Water: Primarily open water with very low, sporadically distributed percent cover of plants (<20 percent total cover).

Coyote Brush Coastal Scrub: Shrub stands dominated (>50 percent) by coyote brush.

Mesic Coastal Scrub: Areas dominated (>50 percent) by species such as *Salix lasiolepis*, *Baccharis pilularis*, and *Conium maculatum*.

Oak Savannah: Grasslands dominated by annual and perennial grasses with occasional pockets of oak, primarily *Quercus agrifolia*.

Sub-Associations:

Grouping Rules:

- Species with cover two cover classes higher than any of the other species are typically listed as a singular species "association:" for example, if *Scirpus californicus* was cover class 6, and the next highest percent occurrence was *Scirpus maritimus* at cover class 4, then the association would be *Scirpus californicus.*
- Species within one cover class of each other are grouped together, although the order does not necessarily reflect highest to lowest cover. For example, if *Distichlis* is cover class 5, and *Salicornia* and *Jaumea* are cover class 4, respectively, the association would still be *Salicornia-Jaumea-Distichlis*, even though *Distichlis*, in this instance, has the highest cover.
- Grouping is not performed for Ruderal polygons at this point.
- Some liberal interpretation will be required at this point, but if there are no clear dominants, then the polygon association is simply listed as "Mixed."
- Species associations that do not occur frequently are listed as "Other."

Dry Pasture: Dominated (>50 percent) by non-hydrophytic grasses, clovers, and other herbs and/or lacks wetland hydrology.

- **Hordeum murinum-Other**
- **Lolium-Other**
- **Mixed**

Wet Pasture: Dominated (>50 percent) by hydrophytic grasses, clovers, and other herbs. Area is either actively managed as pasture or contains some of the predominant pastoral or forage species such as *Agrostis stolonifera* or *Poa palustris*.

- **Agrostis**
- **Agrostis-Atriplex-Other**
- **Agrostis-Other**
- **Agrostis-Trifolium**
- **Agrostis-Trifolium-Lolium**
- **Alopecurus-Other**
- **Hordeum brachyantherum**
- **Hordeum marinum-Other**
- **Festuca arundinacea**
- **Glyceria**
- **Leymus**
- **Lolium-Other**
- **Mixed**

Wet Meadow: At least 30 percent cover of sedge, rush, or other non-clover herbs, as well as grasses. Typically, dominant sedge and rush species are the short- to medium-sized species (as opposed to cattails, tules, and bulrush), and the hydroperiod is shorter than for Freshwater Marsh, but often extends throughout the spring and into the summer.

- **Eleocharis-Other**
- **Hydrocotyle-Other**
- **Juncus balticus**
- **Juncus effusus-Other**
- **Juncus lesueurii**
- **Mentha-Agrostis-Other**
- **Mixed**

Moist Meadow: At least 30 percent cover of some of the "drier" or more facultative sedge and rush species such as *Juncus patens*, *Juncus lesuerii*, *Juncus balticus*, or *Carex barbarae*. Hydroperiod is shorter than for Wet Meadow and may involve non-persistent inundation/saturation following seasonal flooding

- **Atriplex**
- **Carex barbarae**
- **Festuca arundinacea**
- **Juncus balticus**
- **Juncus lesueurii**
- **Other**
- **Mixed**

Seasonal Wetland: Dominated typically by non-persistent herbs and forbs adapted to short hydroperiod following seasonal ponding/saturation. Typically in closed depressions that encourage perching of surface water.

- **Hordeum marinum-Other**
- **Other**
- **Mixed**

Vernal Marsh: Dominated (>70 percent) typically by persistent sedges, rushes, and other non-clover herbs. Hydroperiod is longer than Seasonal Wetland but shorter than Freshwater Marsh.

- **Atriplex-Other**
- **Mixed**

Freshwater Marsh: Dominated (>70 percent) typically by persistent sedges, rushes, and other non-clover herbs. Typically inundated or saturated nearly year-round.

- **Hydrocotyle**
- **Hydrocotyle-Other**
- **Hydrocotyle-Typha**
- **Juncus balticus**
- **Juncus effusus-Other**
- **Other**
- **Scirpus americanus**

- **Scirpus californicus**
- **Scirpus californicus-Other**
- **Scirpus microcarpus**
- **Sparganium**
- **Sparganium-Other**
- **Typha**
- **Mixed**

Scrub-Shrub Riparian: Dominated by riparian tree or shrub species that are less than 16 feet in height. In many instances, these areas represent earlier seral stages of Forested Riparian communities.

- **Alnus-Salix lasiolepis**
- **Alnus-Salix lasiolepis-Rubus ursinus**
- **Baccharis-Rubus discolor**
- **Baccharis-Rubus ursinus**
- **Rubus discolor**
- **Rubus ursinus**
- **Rubus ursinus-Equisetum**
- **Rubus ursinus-Rosa**
- **Rubus discolor-Scrophularia**
- **Salix lasiolepis**
- **Salix lasiolepis-Acer-Rubus discolor**
- **Salix lasiolepis-Acer-Rubus ursinus**
- **Salix lasiolepis-Rubus discolor**
- **Salix lasiolepis-Rubus ursinus**
- **Salix lasiolepis-Salix lucida**
- **Salix lucida**
- **Mixed**

Forested Riparian: Dominated by riparian tree species that are greater than 16 feet in height. In many instances, these areas represent later seral stages of riparian community succession.

- **Acer negundo**
- **Acer negundo-Aesculus californicus**
- **Aesculus californicus**
- **Alnus/Rubus discolor**
- **Alnus/Salix lasiolepis-Rubus discolor**
- **Alnus/Salix lasiolepis-Rubus parviflorus**
- **Alnus/Salix lasiolepis-Rubus spectabilis**
- **Alnus/Salix lasiolepis-Rubus ursinus**
- **Eucalyptus**
- **Salix lasiolepis**
- **Salix lasiolepis/Rubus discolor**
- **Salix lasiolepis/Rubus ursinus**
- **Umbellularia californica**

- **Umbellularia californica-Quercus agrifolia**
- **Mixed**

Brackish Regimes:

Diked Brackish Marsh: Dominated (>70 percent) by hydrophytic non-clover herbs able to tolerate water salinities that average in the brackish or mesohaline range (5-18 ppt). Diked communities are inside of levees or berms and experience typically only muted tidal action, if any. May include a range of glycophytic or halophytic species. Defined to a large extent by water salinity conditions.

- **Atriplex**
- **Atriplex-Other**
- **Distichlis-Other**
- **Hydrocotyle**
- **Scirpus californicus-Other**
- **Sparganium-Other**
- **Typha**
- **Mixed**

Tidal Brackish Marsh: Dominated (>70 percent) by hydrophytic non-clover herbs able to tolerate water salinities that average in the brackish or mesohaline range (5-18 ppt). Tidal communities are outside of levees or berms and experience a full range of tidal and freshwater action. May include a range of glycophytic or halophytic species. Defined to a large extent by water salinity conditions. In low-elevational areas, characteristic species are *Scirpus californicus* and *Scirpus maritimus*.

- **Scirpus californicus**
- **Scirpus californicus-Other**
- **Scirpus maritimus**
- **Scirpus maritimus-Salicornia**
- **Mixed**

Halophytic Regimes:

Salt Marsh Pasture: Significant presence (at least 20 to 25 percent) of halophytic herbs and forbs in grass-dominated polygon. Halophytes or salt tolerant species include saltgrass, alkali heath, pickleweed, spearscale, birdfoot trefoil, etc.

- **Distichlis**
- **Distichlis-Agrostis**
- **Distichlis-Agrostis-Atriplex**
- **Distichlis-Agrostis-Other**
- **Distichlis-Other**
- **Distichlis-Atriplex-Other**
- **Lolium-Hordeum brachyantherum**

- **Lolium-Other**
- **Mixed**

Diked Salt Marsh: Dominated (>70 percent) by halophytic herbs and forbs in herb/shrub-dominated polygon that is behind levees or berms and therefore hydrologically altered.

- **Mid:** Typically comprised of a mix of *Salicornia virginica*, *Jaumea carnosa*, and *Distichlis spicata*.
    - **Distichlis-Atriplex-Other**
    - **Salicornia**
    - **Salicornia-Distichlis**
    - **Salicornia-Other**

- **High:** Typically comprised of a mix of *Salicornia virginica*, *Distichlis spicata*, or *Frankenia salina*.
    - **Distichlis**
    - **Distichlis-Other**
    - **Distichlis-Atriplex-Other**
    - **Salicornia**

- **Mudflat/Panne:** Sparsely vegetated areas that are flooded for an extended duration and support a low-growing canopy of herbs.
    - **Atriplex-Spergularia**

Tidal Salt Marsh: Dominated (>70 percent) by halophytic herb and forbs in herb/shrub-dominated polygon that is outside of levees or berms and therefore not hydrologically altered.

- **Low:** Typically comprised of ***Spartina foliosa*.**
    - **Scirpus maritimus**
    - **Scirpus maritimus-Salicornia**
    - **Spartina foliosa**
    - **Spartina foliosa-Other**
    - **Mixed**

- **Mid:** Typically comprised of a mix of *Salicornia virginica*, *Jaumea carnosa*, and *Distichlis spicata*.
    - **Distichlis**
    - **Distichlis-Atriplex-Other**
    - **Salicornia**
    - **Salicornia-Jaumea-Distichlis**
    - **Mixed**

- **High:** Typically comprised of a mix of *Salicornia virginica*, *Distichlis spicata*, *Frankenia salina*, and *Festuca rubra*. *Jaumea carnosa* may also be present, as well, but cover is typically decreased, while cover of *Grindelia* has increased.
    - **Distichlis**
    - **Distichlis-Other**
    - **Distichlis-Atriplex-Other**
    - **Salicornia**
    - **Salicornia-Distichlis-Other**
    - **Salicornia-Other**
    - **Salicornia-Jaumea-Distichlis**
    - **Mixed**

- **High/Upland Ecotone:** Often dominated by *Festuca rubra*, although other species such as *Salicornia virginica*, *Distichlis spicata*, *Jaumea carnosa*, *Frankenia salina* are often present, as well. At least partially defined by the increased presence of true upland and/or weedy species such as *Lactuca serriola*, *Sonchus* sp., *Raphanus sativus*, etc.
    - **Distichlis-Other**
    - **Salicornia-Distichlis-Other**
    - **Salicornia-Other**
    - **Mixed**

Other:

Ruderal: Mixture of herbs and forbs with no clear or consistent dominance pattern.

Disturbed: Vegetation dominated primarily by ornamental species.

- **Eucalyptus**

Open Water: Primarily open water with very low, sporadically distributed percent cover of plants (<20 percent total cover).

Moist Grassland: Areas ecotonal to saline or brackish water areas that are dominated by species such as *Leymus triticoides*, with the occasional inclusion (<30 percent cover) of some of the "drier" sedge and rush species such as *Juncus patens*, *Juncus balticus*, and *Carex barbarae*. These areas are typically not actively managed as pasture. Areas that are actively managed as pasture OR are dominated or "sub-dominated" by "escapee" pastoral or forage species such as *Agrostis stolonifera* or *Poa palustris* are mapped as Salt Marsh Pasture or Wet Pasture.

- **Hordeum marinum-Other**
- **Leymus**
- **Lolium**
- **Phalaris aquatica**
- **Phalaris arundinacea**

Dry Grassland

- **Bromus diandrus**

Coyote Brush Coastal Scrub: Areas dominated by low shrubs (0.5-2 m tall), usually dense but with scattered grassy openings. Dominant species is *Baccharis pilularis*, with species such as *Toxicodendron diversilobum* or *Rubus* also often present.

- **Baccharis**
- **Baccharis-Rubus discolor**
- **Baccharis-Rubus ursinus**

Mesic Coastal Scrub: Areas dominated by low shrubs or trees, often dense but with scattered grassy or ruderal openings. Although these areas are not considered "riparian," they nonetheless can support some riparian species such as *Salix lasiolepis*. Within the Project Area, this community was found growing along the hillsides of Point Reyes Mesa, where willow grew in combination with *Baccharis pilularis*, *Conium maculatum*, *Toxicodendron diversilobum*, and even some oaks such as *Quercus agrifolia*. Presence of seeps in hillside may promote development of a groundwater table that enables survival of more hydrophytic species in an an area that would otherwise be considered upland.

- **Salix lasiolepis-Baccharis**
- **Salix lasiolepis-Rubus ursinus-Toxicodendron**
- **Mixed**

Appendix B. List of Giacomini Sub-Associations

No.	GIACOMINI SUB-ASSOCIATION	NO. OF POLYGONS	HECTARES	ACRES
1	*Acer negundo*	2	0.08	0.19
2	*Acer negundo-Aesculus californica*	1	0.06	0.14
3	*Aesculus californica*	1	0.02	0.04
4	*Agrostis*	7	1.89	4.67
5	*Agrostis-Atriplex*-Other	4	12.50	30.88
6	*Agrostis*-Other	7	11.69	28.90
7	*Agrostis-Trifolium*	5	6.54	16.15
8	*Agrostis-Trifolium-Lolium*	8	13.38	33.07
9	*Alnus-Salix lasiolepis*	3	0.97	2.41
10	*Alnus-Salix lasiolepis-Rubus ursinus*	1	0.18	0.44
11	*Alnus/Rubus discolor*	1	0.03	0.07
12	*Alnus/Salix lasiolepis-Rubus discolor*	1	0.13	0.33
13	*Alnus/Salix lasiolepis-Rubus spectabilis*	2	0.28	0.70
14	*Alnus/Salix lasiolepis-Rubus ursinus*	3	0.63	1.56
15	*Alopecurus*-Other	2	0.68	1.69
16	*Atriplex*	5	4.07	10.05
17	*Atriplex*-Other	3	0.15	0.36
18	*Atriplex-Spergularia*	4	4.31	10.66
19	*Baccharis*	2	0.05	0.13
20	*Baccharis-Rubus discolor*	2	0.06	0.16
21	*Baccharis-Rubus ursinus*	3	0.31	0.77
22	*Carex barbarae*	4	0.18	0.44
23	*Distichlis*	28	4.63	11.45
24	*Distichlis-Agrostis*	16	13.69	33.83
25	*Distichlis-Agrostis-Atriplex*	6	4.31	10.65
26	*Distichlis-Agrostis*-Other	4	0.35	0.87
27	*Distichlis-Atriplex*-Other	6	0.85	2.10
28	*Distichlis*-Other	8	1.67	4.12
29	*Distichlis-Salicornia*	6	1.47	3.64
30	*Eleocharis*-Other	3	1.54	3.80
31	*Eucalyptus*	7	2.78	6.87
32	*Festuca arundinacea*-Other	20	13.60	33.61
33	*Glyceria*	3	0.26	0.65
34	*Hordeum brachyantherum*	3	0.08	0.20
35	*Hordeum marinum*-Other	6	1.43	3.53
36	*Hordeum murinum*-Other	4	0.72	1.79
37	*Hydrocotyle*	10	1.39	3.43
38	*Hydrocotyle*-Other	6	0.66	1.64
39	*Hydrocotyle-Typha*	5	1.06	2.61
40	*Juncus balticus*	9	0.32	0.80
41	*Juncus effusus*-Other	6	1.07	2.63
42	*Juncus lesueurii*	2	0.01	0.02
43	*Leymus*	15	1.04	2.58

No.	GIACOMINI SUB-ASSOCIATION	NO. OF POLYGONS	HECTARES	ACRES
44	*Lolium*	6	0.96	2.38
45	*Lolium-Hordeum brachyantherum-Atriplex*	3	1.91	4.73
46	*Lolium*-Other	9	4.30	10.63
47	*Mentha-Agrostis*-Other	3	2.04	5.04
48	Mixed	87	66.08	163.27
49	Other	8	0.49	1.21
50	*Phalaris aquatica*	1	0.03	0.07
51	*Phalaris arundinacea*	1	0.12	0.30
52	*Rubus discolor*	28	1.23	3.05
53	*Rubus discolor-Rosa*	1	0.01	0.03
54	*Rubus discolor-Scrophularia*	1	0.02	0.04
55	*Rubus ursinus*	6	0.18	0.45
56	*Rubus ursinus-Equisetum*	1	0.01	0.02
57	*Rubus ursinus-Rosa*	1	0.01	0.03
58	*Rubus ursinus-Rubus discolor*	1	0.08	0.20
59	*Salicornia*	4	6.23	15.38
60	*Salicornia-Distichlis-Festuca rubra*	6	1.05	2.59
61	*Salicornia-Jaumea-Distichlis*	16	3.30	8.16
62	*Salicornia*-Other	4	0.89	2.20
63	*Salix lasiolepis*	24	1.44	3.56
64	*Salix lasiolepis-Baccharis*	1	4.42	10.92
65	*Salix lasiolepis-Rubus discolor*	8	1.50	3.72
66	*Salix lasiolepis-Rubus ursinus*	8	4.69	11.59
67	*Salix lasiolepis-Rubus ursinus-Toxicodendron*	1	0.54	1.32
68	*Salix lasiolepis-Salix lucida*	4	1.08	2.67
69	*Salix lasiolepis/Rubus discolor*	4	0.84	2.07
70	*Salix lasiolepis/Rubus ursinus*	5	0.41	1.01
71	*Salix lucida*	1	0.02	0.05
72	*Salix-Acer-Rubus discolor*	1	0.03	0.08
73	*Salix-Acer-Rubus ursinus*	1	0.06	0.15
74	*Scirpus americanus*	3	0.14	0.34
75	*Scirpus californicus*	28	1.01	2.50
76	*Scirpus californicus*-Other	5	0.28	0.69
77	*Scirpus maritimus*	6	0.43	1.07
78	*Scirpus maritimus-Salicornia*	5	0.21	0.52
79	*Scirpus microcarpus*	2	0.04	0.11
80	*Sparganium*	9	0.34	0.83
81	*Sparganium*-Other	4	0.63	1.57
82	*Spartina foliosa*	7	0.01	0.02
83	*Spartina foliosa*-Other	3	0.03	0.08
84	*Typha*	17	2.66	6.58
85	*Umbellularia californica*	3	0.24	0.60
86	*Umbellularia californica-Quercus agrifolia*	1	0.07	0.17

Appendix C. List of plant species observed in the Giacomini Wetland Restoration Project Study Area

Appendix Table B-1. List of Plant Species Observed Within the Giacomini Wetland Restoration Study Area. Initials in table columns refer to areas observed within Study Area: key is provided at back of table.

Scientific Name	Common Name	Status	Giacomini		SLC Land	TBT	Mesa	SM	DSM	R	FW	B	DP	WP	SMP	NG
			East	West												
Aceraceae																
Acer negundo var. *californicum*	box elder			X						X						
Alismataceae																
Alisma lanceolatum	water plantain		X	X							X					
Alisma plantago-aquatica	water plantain					X					X					
Anacardiaceae																
Toxicodendron diversilobum	poison oak		X	X		X				X						
Apiaceae																
Conium maculatum	poison hemlock		X	X			X					X				
Eryngium armatum						X										X
Foeniculum vulgare	fennel		X	X			X					X				
Heracleum lanatum	cow parsnip			X												
Hydrocotyle ranunculoides			X	X		X					X			X		
Lomatium dasycarpum				X												
Oenanthe sarmentosa			X	X			X				X					
Scandix pecten-veneris	Venus' needle					X										X
Torilis arvensis				X								X				
Apocynaceae																
Vinca major	greater periwinkle			X						X						
Aquifoliaceae																
Ilex aquifolium	English holly			X						X						X
Araliaceae																
Aralia californica	elk clover			X						X						X
Hedera helix	English ivy			X						X						X

Appendix Table B-1. List of Plant Species Observed Within the Giacomini Wetland Restoration Study Area. Initials in table columns refer to areas observed within Study Area: key is provided at back of table.

Scientific Name	Common Name	Status	Giacomini		SLC Land	TBT	Mesa	SM	DSM	R	FW	B	DP	WP	SMP	NG
			East	West												
Asteraceae																
Achillea millefolium	yarrow					**X**										**X**
Anthemis cotula	mayweed		**X**	**X**												
Artemisia californica	California sagebrush					**X**										
Artemisia douglasiana	mugwort		**X**	**X**		**X**	**X**	**X**		**X**		**X**				
Baccharis douglasii	marsh baccharis									**X**						
Baccharis pilularis	coyote brush		**X**	**X**		**X**	**X**	**X**				**X**				
Carduus pycnocephalus	Italian thistle		**X**	**X**		**X**							**X**			
Carthamus baeticus	smooth distaff thistle			**X**												
Centaurea solstitialis	yellow star thistle		**X**				**X**									
Chamomilla suaveolens	pineapple weed		**X**	**X**			X					**X**				
Cirsium vulgare	bull thistle		**X**	**X**			**X**					**X**				
Conyza bonariensis				**X**												**X**
Conyza canadensis	horseweed		**X**													
Cotula coronopifolia	brass-buttons		**X**	**X**		**X**		**X**	**X**		**X**				**X**	
Delaria odorata	Cape ivy									**X**						
Erechtites sp.	fireweed		**X**	**X**			**X**					**X**				
Filago gallica	herba impia			**X**												**X**
Gnaphalium luteo-album	cudweed		**X**	**X**										**X**		
Gnaphalium californicum	cudweed				**X**											
Gnaphalium palustre	cudweed			**X**		**X**					**X**					
Grindelia hirsutula	gumplant					**X**										
Grindelia stricta	gumplant		**X**	**X**	**X**	**X**		**X**								

Appendix Table B-1. List of Plant Species Observed Within the Giacomini Wetland Restoration Study Area. Initials in table columns refer to areas observed within Study Area: key is provided at back of table.

Scientific Name	Common Name	Status	Giacomini		SLC Land	TBT	Mesa	SM	DSM	R	FW	B	DP	WP	SMP	NG
			East	West												
Asteraceae																
Hemizonia congesta ssp. *congesta*	hayfield tarweed					X										X
Hypochaeris glabra	smooth cat's ear		X	X												
Hypochaeris radicata	rough cat's ear		X	X		X	X					X				X
Jaumea carnosa	jaumea		X	X	X	X		X	X							
Lactuca serriola	prickly lettuce		X	X								X				
Lessingia filaginifolia var. *californica*	California-aster					X										X
Madia sativa	coast tarweed		X	X			X					X				
Picris echioides	bristly ox-tongue		X	X		X	X					X				
Senecio vulgaris	ragwort		X	X												
Silybum marianum	milk thistle		X	X		X						X				
Sonchus asper sp. *asper*	prickly sow thistle		X	X			X					X				
Sonchus oleraceus	common sow thistle			X			X			X						
Taraxacum officinale	dandelion		X	X		X						X	X			
Xanthium spinosum	spiny cocklebur			X		X					X					
Xanthium strumarium	cocklebur		X									X				
Azollaceae																
Azolla filiculoides			X	X							X					
Betulaceae																
Alnus rubra	alder			X						X						
Corylus cornuta var. *californica*	California hazelnut			X												

Appendix Table B-1. List of Plant Species Observed Within the Giacomini Wetland Restoration Study Area. Initials in table columns refer to areas observed within Study Area: key is provided at back of table.

Scientific Name	Common Name	Status	Giacomini		SLC Land	TBT	Mesa	SM	DSM	R	FW	B	DP	WP	SMP	NG
			East	West												
Blechnaceae																
Blechnum spicant	deer fern			X								X				
Boraginaceae																
Borago officinalis				X						X						
Plagiobothrys stipitatus var. *micranthus*	popcorn flower					X										X
Brassicaceae																
Barbarea orthoceras	common winter cress			X												
Barbarea vulgaris	common wintercress		X													
Brassica nigra	black mustard		X	X		X	X					X				
Brassica rapa	field mustard															
Capsella bursa-pastoris	shepherd's purse			X												
Cardamine oligosperma	bitter-cress		X								X					
Lepidium campestre	peppergrass		X	X												
Raphanus raphanistrum	jointed charlock		X	X			X					X				
Raphanus sativus	wild radish		X	X			X					X				
Rorippa curvisiliqua	water cress		X	X							X				X	
Rorippa nasturtium-aquaticum	water cress		X	X			X				X			X		
Rorippa palustris var. *occidentalis*	water cress										X					
Sisymbrium officinale	hedge mustard		X			X										
Callitrichaceae																
Callitriche heterophylla var. *bolanderi*	water starwort					X					X					

Appendix Table B-1. List of Plant Species Observed Within the Giacomini Wetland Restoration Study Area. Initials in table columns refer to areas observed within Study Area: key is provided at back of table.

Scientific Name	**Common Name**	**Status**	**Giacomini**		**SLC Land**	**TBT**	**Mesa**	**SM**	**DSM**	**R**	**FW**	**B**	**DP**	**WP**	**SMP**	**NG**
			East	**West**												
Caprifoliaceae																
Lonicera hispidula var. *vacillans*	honeysuckle					**X**				**X**						
Lonicera involucrata var. *ledebourii*	twinberry			**X**		**X**				**X**						
Sambucus mexicana	blue elderberry			**X**								**X**				
Sambucus racemosa var. *racemosa*	red elderberry			**X**						**X**						
Symphoricarpos albus var. *laevigatus*	snowberry			**X**						**X**						
Symphoricarpos mollis	creeping snowberry			**X**						**X**						
Caryophyllaceae																
Cerastium arvense	field chickweed			**X**												
Cerastium fontanum ssp. *vulgare*	mouse-ear chickweed															
Cerastium glomeratum	mouse-ear chickweed		**X**	**X**		**X**										**X**
Silene gallica	campion		**X**	**X**								**X**				
Spergula arvensis ssp. *arvensis*	starwort			**X**								**X**				
Spergularia bocconii	sand-spurrey		**X**													
Spergularia macrotheca var. *macrotheca*	sand-spurrey		**X**	**X**				**X**								
Spergularia rubra	sand-spurrey		**X**	**X**			**X**	**X**			**X**	**X**				
Stellaria media	common chickweed		**X**													

Appendix Table B-1. List of Plant Species Observed Within the Giacomini Wetland Restoration Study Area. Initials in table columns refer to areas observed within Study Area: key is provided at back of table.

Scientific Name	**Common Name**	**Status**	**Giacomini**		**SLC Land**	**TBT**	**Mesa**	**SM**	**DSM**	**R**	**FW**	**B**	**DP**	**WP**	**SMP**	**NG**
			East	**West**												
Chenopodiaceae																
Atriplex triangularis	spearscale		**X**	**X**				**X**	**X**		**X**				**X**	
Chenopodium album	lamb's quarters			**X**						**X**	**X**					
Chenopodium ambrosioides	Mexican tea		**X**									**X**				
Salicornia virginica	pickleweed		**X**	**X**	**X**	**X**		**X**	**X**						**X**	
Convolvulaceae																
Calystegia purpurata ssp. *purpurata*	morning glory		**X**	**X**		**X**	X					**X**				
Cucurbitaceae																
Marah fabaceus	California man-root		**X**				**X**			**X**						
Cupressaceae																
Cupressus sp.	cypress					**X**										
Juniperus sp**.**	juniper						**X**					**X**				
Cuscutaceae																
Cuscuta salina var. *major*	dodder			**X**					**X**							
Cyperaceae																
Carex barbarae	sedge		**X**	**X**						**X**		**X**				
Carex densa	sedge			**X**		**X**										
Carex dudleyi	sedge					**X**										
Carex obnupta	sedge			**X**						**X**						
Carex praegracilis	sedge			**X**												
Carex subbracteata	sedge			**X**							**X**			**X**		
Carex tumulicola	sedge					**X**										
Cyperus eragrostis	nutsedge		**X**	**X**		**X**	**X**				**X**			**X**		
Eleocharis macrostachya	spikerush		**X**	**X**		**X**					**X**			**X**	**X**	
Scirpus acutus var. *occidentalis*	tule		**X**	**X**							**X**					
Scirpus americanus				**X**							**X**					

Appendix Table B-1. List of Plant Species Observed Within the Giacomini Wetland Restoration Study Area. Initials in table columns refer to areas observed within Study Area: key is provided at back of table.

Scientific Name	Common Name	Status	Giacomini		SLC Land	TBT	Mesa	SM	DSM	R	FW	B	DP	WP	SMP	NG
			East	West												
Cyperaceae																
Scirpus californicus			X	X		X					X					
Scirpus maritimus			X	X		X		X	X							
Scirpus microcarpus			X	X				X			X					
Scirpus pungens	common threesquare			X		X		X			X			X		
Dipsacaeae																
Dipsacus fullonum	wild teasel		X								X					
Dryopteridaceae																
Athyrium filix-femina var. *cyclosporum*	lady fern			X						X						
Polystichum munitum	western sword fern		X							X						
Pteridium aquilinum var. *pubescens*	bracken fern					X	X			X						
Equisetaceae																
Equisetum hyemale ssp. *affine*	common scouring rush		X								X					
Equisetum telmateia ssp. *braunii*	giant horsetail		X	X			X				X	X		X		
Ericaceae																
Arbutus menziesii	madrone					X										
Euphorbiaceae																
Euphorbia lathyris	caper spurge		X									X				
Fabaceae																
Genista monspessulana	French broom		X	X								X				
Lathyrus latifolius	perennial sweet pea		X									X				
Lathyrus vestitus var. *vestitus*	wild pea					X										

Appendix Table B-1. List of Plant Species Observed Within the Giacomini Wetland Restoration Study Area. Initials in table columns refer to areas observed within Study Area: key is provided at back of table.

Scientific Name	Common Name	Status	Giacomini		SLC Land	TBT	Mesa	SM	DSM	R	FW	B	DP	WP	SMP	NG
			East	West												
Fabaceae																
Lotus corniculatus	birdfoot trefoil		X	X		X	X		X		X	X			X	X
Lotus formosissimus						X										X
Lupinus arboreus	yellow bush lupine		X	X								X				
Lupinus bicolor	miniature lupine		X			X						X				X
Lupinus nanus	lupine		X	X								X				
Lupinus variicolor	lupine					X										
Medicago polymorpha	California burclover		X	X		X	X					X				X
Trifolium depauperatum var. *depauperatum*	clover					X										X
Trifolium dubium	little hop clover		X	X		X	X					X			X	X
Trifolium fragiferum	strawberry clover		X	X		X	X				X	X	X	X		
Trifolium fucatum	clover															
Trifolium oliganthum	clover		X													
Trifolium repens	white clover		X	X		X	X					X	X	X		X
Trifolium subterraneum	subterranean clover		X	X		X						X	X			X
Trifolium variegatum	clover			X							X			X		
Vicia hirsuta	vetch			X												
Vicia sativa ssp. *nigra*	narrow-leaved vetch		X	X		X						X				X
Vicia sativa ssp. *sativa*	spring vetch		X	X								X				
Vicia tetrasperma	vetch									X		X				

Appendix Table B-1. List of Plant Species Observed Within the Giacomini Wetland Restoration Study Area. Initials in table columns refer to areas observed within Study Area: key is provided at back of table.

Scientific Name	Common Name	Status	Giacomini East	Giacomini West	SLC Land	TBT	Mesa	SM	DSM	R	FW	B	DP	WP	SMP	NG
Fagaceae																
Quercus agrifolia var. *agrifolia*	coast live oak		X			X						X				
Frankeniaceae																
Frankenia salina	alkali heath		X	X				X	X						X	
Gentianaceae																
Centaurium muehlenbergii	centaury					X										X
Geraniaceae																
Erodium botrys	storksbill			X		X										
Erodium cicutarium	storksbill		X	X								X				
Erodium moschatum	storksbill		X	X								X				
Geranium carolinianum	geranium		X	X		X						X		X		
Geranium dissectum	geranium		X	X		X	X					X		X		X
Geranium molle	geranium		X			X						X				X
Grossulariaceae																
Ribes sanguineum	red flowering currant			X						X						
Ribes menziesii	canyon gooseberry			X								X				
Hippocastanaceae																
Aesculus californica	California buckeye		X	X						X						
Iridaceae																
Sisyrinchium bellum	blue-eyed-grass		X			X						X				X
Sisyrinchium californicum	golden-eyed-grass			X									X			
Juncaceae																
Juncus balticus	rush		X	X		X	X					X		X		
Juncus bolanderi	rush			X			X			X	X					
Juncus bufonius var. *bufonius*	toad rush			X										X		

Appendix Table B-1. List of Plant Species Observed Within the Giacomini Wetland Restoration Study Area. Initials in table columns refer to areas observed within Study Area: key is provided at back of table.

Scientific Name	Common Name	Status	Giacomini		SLC Land	TBT	Mesa	SM	DSM	R	FW	B	DP	WP	SMP	NG
			East	**West**												
Juncaceae																
Juncus bufonius var. *occidentalis*	toad rush			X		X										
Juncus capitatus	annual rush			X		X		X								
Juncus effusus var. *brunneus*	rush		X	X		X					X					
Juncus effusus var. *pacificus*	rush		X	X			X									
Juncus lesueurii	rush		X	X		X		X								
Juncus occidentalis	rush					X										
Juncus patens	rush		X	X		X								X	X	X
Juncus phaeocephalus	rush			X		X					X			X		
Juncaginaceae																
Triglochin concinna var. *concinna*	arrow-grass					X			X							
Triglochin maritima	seaside arrowgrass		X	X	X	X		X			X					
Lamiaceae																
Lamium purpureum	dead nettle		X	X						X		X				
Marrubium vulgare	horehound		X									X				
Mentha x piperita	peppermint			X							X					
Mentha pulegium	pennyroyal		X	X		X	X				X			X		
Mentha spicata var. *longifolia*	spearmint			X						X	X			X		
Monardella sp.						X										
Prunella vulgaris var. *lanceolata*	self-heal					X										
Satureja douglasii	yerba buena					X										
Stachys ajugoides var. *ajugoides*	hedge nettle			X		X										X
Lamiaceae																
Stachys ajugoides var. *rigida*	hedge nettle			X									X			
Stachys bullata	hedge nettle						X									

Appendix Table B-1. List of Plant Species Observed Within the Giacomini Wetland Restoration Study Area. Initials in table columns refer to areas observed within Study Area: key is provided at back of table.

Scientific Name	**Common Name**	**Status**	**Giacomini**		**SLC Land**	**TBT**	**Mesa**	**SM**	**DSM**	**R**	**FW**	**B**	**DP**	**WP**	**SMP**	**NG**
			East	**West**												
Lamiaceae																
Stachys chamissonis	hedge nettle			**X**						**X**	**X**					
Lauraceae																
Umbellularia californica	California bay		**X**	**X**		**X**				**X**						
Lemnaceae																
Lemna sp.	duckweed		**X**	**X**		**X**	**X**				**X**					
Liliaceae																
Allium unifolium	onion					**X**										**X**
Amaryllis belladona	naked pink lady															
Chlorogalum pomeridianum	soap plant		**X**			**X**										**X**
Smilacina sp.	false solomon's seal			**X**						**X**						**X**
Linaceae																
Linum usitatissimum	common flax					**X**										**X**
Lythraceae																
Lythrum hyssopifolium	loosestrife		**X**			**X**	**X**				**X**					
Malvaceae																
Malva neglecta	common mallow			**X**												
Malva nicaeensis	bull mallow		**X**													
Malva sylvestris	high mallow		**X**													
Modiola caroliniana			**X**	**X**								**X**				
Myricaceae																
Eucalyptus globulus			**X**													
Myricaceae																
Myrica californica	wax myrtle					**X**										
Onagraceae																
Camissonia ovata	sun cup		**X**			**X**						**X**				**X**

Appendix Table B-1. List of Plant Species Observed Within the Giacomini Wetland Restoration Study Area. Initials in table columns refer to areas observed within Study Area: key is provided at back of table.

Scientific Name	Common Name	Status	Giacomini		SLC Land	TBT	Mesa	SM	DSM	R	FW	B	DP	WP	SMP	NG
			East	West												
Onagraceae																
Epilobium angustifolium	fireweed		X	X								X				
Epilobium ciliatum ssp. *ciliatum*	willow herb			X							X					
Epilobium ciliatum ssp. *watsonii*	willow herb			X		X	X				X					
Ludwigia peploides	water primrose		X								X					
Oxalidaceae																
Oxalis rubra				X									X			X
Papaveraceae																
Eschscholzia californica	California poppy		X	X		X	X					X				X
Pinaceae																
Pinus muricata						X										
Pseudotsuga menziesii var. *menziesii*	Douglas fir					X										
Plantaginaceae																
Plantago lanceolata	English plantain		X	X		X	X					X				X
Plantago major	common plantain		X	X							X		X			
Plantago maritima var. juncoides	plantain			X		X		X								
Plumbaginaceae																
Limonium californicum	western marsh rosemary		X	X		X		X	X							
Poaceae																
Agrostis capillaris	bent grass															
Agrostis stolonifera	creeping bent grass		X	X			X			X		X				
Agrostis viridis	bent grass			X												
Aira caryophyllea	European hairgrass		X	X		X						X				X

Appendix Table B-1. List of Plant Species Observed Within the Giacomini Wetland Restoration Study Area. Initials in table columns refer to areas observed within Study Area: key is provided at back of table.

Scientific Name	Common Name	Status	Giacomini		SLC Land	TBT	Mesa	SM	DSM	R	FW	B	DP	WP	SMP	NG
			East	West												
Poaceae																
Alopecurus geniculatus	water foxtail			X							X				X	
Alopecurus pratensis	meadow foxtail		X	X									X		X	
Avena barbata	slender wild oat		X	X		X	X					X				X
Avena fatua	wild oat		X													
Briza maxima	quaking grass		X	X		X	X					X				X
Briza minor	quaking grass		X			X						X				X
Bromus carinatus var. *carinatus*	California brome		X	X		X						X				X
Bromus catharticus	rescue grass		X				X					X				
Bromus diandrus	ripgut brome		X	X		X	X					X				
Bromus hordeaceus	brome		X	X		X	X					X				X
Bromus tectorum	cheat grass			X									X			
Cynodon dactylon	Bermuda grass			X										X		
Cynosurus echinatus	hedgehog dogtail		X			X						X				X
Dactylis glomerata	orchard grass		X	X								X	X			
Danthonia californica						X										X
Distichlis spicata			X	X	X	X		X	X						X	
Echinochloa crus-galli			X								X					
Festuca arundinacea	tall fescue		X	X			X					X	X	X	X	
Festuca rubra	red fescue		X	X	X			X								
Glyceria leptostachya	manna grass			X							X					
Glyceria occidentalis	manna grass		X	X		X					X			X		

Appendix Table B-1. List of Plant Species Observed Within the Giacomini Wetland Restoration Study Area. Initials in table columns refer to areas observed within Study Area: key is provided at back of table.

Scientific Name	Common Name	Status	Giacomini		SLC Land	TBT	Mesa	SM	DSM	R	FW	B	DP	WP	SMP	NG
			East	West												
Poaceae																
Holcus lanatus	common velvet grass			X		X	X									X
Hordeum brachyantherum ssp. *brachyantherum*	barley		X	X		X	X							X		X
Hordeum jubatum	barley			X								X				
Hordeum marinum ssp. *gussoneanum*	Mediterran-ean barley		X	X			X	X							X	
Hordeum murinum ssp. *leporinum*	Mediterran-ean barley		X	X		X	X					X				X
Leymus triticoides			X	X			X	X				X			X	
Lolium multiflorum	Italian ryegrass		X	X		X	X					X		X		X
Nassella pulchra	purple needlegrass					X										X
Paspalum dilatatum	Dallis grass						X									
Phalaris aquatica	Harding grass		X	X		X	X				X	X				
Phalaris arundinacea	canary reed grass						X									
Poa annua	annual blue grass		X	X		X					X	X	X	X		X
Poa trivialis	rough bluegrass		X	X							X					
Polypogon australis	Chilean beard grass			X							X					
Polypogon interruptus	ditch beard grass		X	X		X					X			X		
Polypogon monspeliensis	annual beard grass		X	X		X			X							
Spartina foliosa	cordgrass		X		X							X				
Torreyochloa pallida var. *pauciflora*	weak mannagrass					X					X					
Vulpia bromoides			X	X		X				X		X				X

Appendix Table B-1. List of Plant Species Observed Within the Giacomini Wetland Restoration Study Area. Initials in table columns refer to areas observed within Study Area: key is provided at back of table.

Scientific Name	Common Name	Status	Giacomini		SLC Land	TBT	Mesa	SM	DSM	R	FW	B	DP	WP	SMP	NG
			East	West												
Poaceae																
Vulpia myuros var. *hirsuta*			**X**	**X**												
Polemoniaceae																
Navarretia squarrosa	skunkweed			**X**		**X**										**X**
Polygonaceae																
Polygonum arenastrum	common knotweed		**X**			**X**	**X**					**X**				
Polygonum hydropiper	marshpepper		**X**	**X**		**X**	**X**									
Polygonum hydropiperoides	waterpepper			**X**							X					
Polygonum persicaria	lady's thumb		**X**	**X**		**X**	**X**				**X**					
Polygonum punctatum				**X**						**X**						
Rumex acetosella	sheep sorrel		**X**	**X**		**X**	**X**					**X**	**X**			
Rumex conglomeratus	dock		**X**	**X**			**X**									
Rumex crispus	curly dock		**X**	**X**		**X**	**X**		**X**		**X**	**X**	**X**	**X**		
Rumex obtusifolius	bitter dock			**X**							**X**					
Rumex occidentalis	western dock		**X**	**X**				**X**								
Rumex pulcher	fiddle dock		**X**	**X**			**X**					**X**	**X**			
Rumex salicifolius var. crassus	willow dock			**X**							**X**					
Rumex salicifolius var. *salicifolius*	willow dock			**X**							**X**					
Rumex salicifolius var. *transitorius*	willow dock		**X**	**X**								**X**				
Potamogetonaceae																
Potamogeton nodosus	long-leaved pondweed					**X**					**X**					
Ruppia cirrhosa	ditch grass		**X**								**X**					
Zannichella palustris	horned-pondweed					**X**					**X**					

Appendix Table B-1. List of Plant Species Observed Within the Giacomini Wetland Restoration Study Area. Initials in table columns refer to areas observed within Study Area: key is provided at back of table.

Scientific Name	Common Name	Status	Giacomini		SLC Land	TBT	Mesa	SM	DSM	R	FW	B	DP	WP	SMP	NG
			East	West												
Primulaceae																
Anagallis arvensis	scarlet pimpernel		X	X		X						X				
Ranunculaceae																
Ranunculus aquatilus	buttercup					X					X					
Ranunculus californicus	buttercup					X										X
Ranunculus muricatus	buttercup		X	X		X								X	X	
Ranunculus occidentalis	buttercup		X	X												
Rhamnaceae																
Rhamnus californica ssp. *californica*	California coffeeberry			X		X				X						
Rosaceae																
Cotoneaster franchetti						X										
Heteromeles arbutifolia	toyon					X										
Holodiscus discolor	oceanspray			X						X						
Oemleria cerasiformis	oso berry					X				X						
Potentilla anserina ssp. *pacifica*	cinquefoil		X	X		X		X	X		X		X		X	
Potentilla glandulosa ssp. *glandulosa*	cinquefoil					X										
Prunus sp.	plum		X	X						X		X				
Rosaceae																
Rosa californica	California rose					X	X									X
Rosa eglanteria										X						
Rubus discolor	Himalayan blackberry		X	X		X	X			X		X				

Appendix Table B-1. List of Plant Species Observed Within the Giacomini Wetland Restoration Study Area. Initials in table columns refer to areas observed within Study Area: key is provided at back of table.

Scientific Name	Common Name	Status	Giacomini		SLC Land	TBT	Mesa	SM	DSM	R	FW	B	DP	WP	SMP	NG
			East	West												
Rosaceae																
Rubus parviflorus	thimbleberry			X						X						
Rubus spectabilis	salmonberry			X						X						
Rubus ursinus	California blackberry			X		X	X			X						
Rubiaceae																
Galium aparine	bedstraw		X	X						X		X				
Galium trifidum var. *pacificum*	bedstraw			X							X					
Sherardia arvensis	field madder		X									X				
Salicaceae																
Populus alba	poplar															
Salix laevigata	red willow		X	X			X				X					
Salix lasiolepis	arroyo willow		X	X		X	X			X	X					
Salix lucida ssp. *lasiandra*	shining willow		X				X			X						
Scrophulariaceae																
Castilleja ambigua ssp. *ambigua*	salt marsh owl's clover					X		X								
Castilleja ambigua ssp. *humboldtiensis*	Humboldt Bay owl's clover	FSC; 1B	X	X	X	X		X								
Cordylanthus maritimus ssp. *palustris*	Point Reyes bird's-beak	FSC; 1B				X		X	X							
Digitalis purpurea	foxglove			X						X						
Mimulus aurantiacus	monkey flower					X										
Mimulus guttatus	monkey flower			X							X			X		
Mimulus moschatus	musk monkey flower			X							X					
Scrophularia californica ssp. *californica*	California figwort		X	X			X			X		X				
Verbascum blattaria	moth mullein			X								X				

Appendix Table B-1. List of Plant Species Observed Within the Giacomini Wetland Restoration Study Area. Initials in table columns refer to areas observed within Study Area: key is provided at back of table.

Scientific Name	**Common Name**	**Status**	**Giacomini**		**SLC Land**	**TBT**	**Mesa**	**SM**	**DSM**	**R**	**FW**	**B**	**DP**	**WP**	**SMP**	**NG**
			East	**West**												
Scrophulariaceae																
Veronica americana	American brooklime		**X**	**X**			**X**				**X**			**X**		
Veronica anagallis-aquatica	water speedwell			**X**			**X**				**X**			**X**		
Solanaceae																
Datura sp.	jimson weed		**X**								**X**					
Solanum americanum	nightshade			**X**						**X**						
Taxodiaceae																
Sequoia sempervirens - cultivar	redwood – possible cultivar						**X**					**X**				
Typhaceae																
Sparganium erectum ssp. *stoloniferum*	bur-reed		**X**	**X**							**X**					
Typha angustifolia	narrow-leaved cattail		**X**	**X**			**X**				**X**					
Typha latifolia	broad-leaved cattail			**X**		**X**	**X**									
Urticaceae																
Urtica dioica	stinging nettle		**X**	**X**						**X**						
Urtica urens	dwarf nettle		**X**													
Verbenaceae																
Phyla nodiflora var. *nodiflora*			**X**									**X**				

Key:
Giacomini East – East Pasture
Giacomini West – West Pasture
SLC Land – SLC Lands
TBT – Tomales Bay Trail
Mesa – Mesa Road
SM – Undiked Salt Marsh

Appendix Table B-1. List of Plant Species Observed Within the Giacomini Wetland Restoration Study Area. Initials in table columns refer to areas observed within Study Area: key is provided at back of table.

DSM – Diked Salt Marsh
R – Riparian
FW – Freshwater Marsh
B – Berm/Levee
DP – Dry Pasture
WP – Wet Pasture
SMP – Salt Marsh Pasture
NG – Non-native Grassland