LOS CERRITOS WETLANDS HABITAT RESTORATION PLAN

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Environmental Science and Policy 400
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Executive Summary

The Los Cerritos Wetlands Habitat Restoration Plan is an ecologically based plan to restore the natural habitats of these highly degraded coastal wetlands. In the past, the wetland has been used as a dump and burn site and is currently home to numerous oil operations. Unfortunately, this has given many local residents the impression that the wetlands are of no benefit to the community and would have a better use as stores, parking lots, or roads. Thus, the goals of this restoration plan are to increase the benefits to the nearby beaches, the local economy, the community, and the ecology of the wetland itself and the surrounding areas. The restored wetland will include many educational aspects so the nearby communities have the opportunity to learn about the benefits provided by these and other wetlands.

The restoration plan outlines the different habitats that currently exist in the wetland and the habitats that will exist once the wetland is restored. It covers the species the various habitats will support, including many endangered species such as Belding's Savannah Sparrow and the Western Snowy Plover. In addition to the many species who will call the wetlands home year-round it will be an annual stop over for countless others.

Acknowledgements

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Introduction

Coastal wetlands are among the most ecologically important, productive, and vulnerable habitats in existence. Rivers the world over have been dammed, diked, and diverted to accommodate the needs of human development. Altering the natural courses of these rivers deprives coastal wetlands of an essential regular water influx and, as a result, wetlands are vanishing at an alarming rate. Combined with the fact that wetlands are often filled to create areas for development or dredged to create marinas, this secures a bleak fate for the world's coastal wetlands. Unlike many other ecosystems, destruction of coastal wetlands is often irreversible, making their restoration difficult, but imperative nonetheless.

The Los Cerritos Wetlands complex, as it currently exists, is a heavily degraded former salt marsh habitat that is utilized primarily by local oil operations. Soil elevation has been raised in order to protect oil infrastructure from the effects of natural tidal flooding. Much of the soil used to raise elevation was dredged from local marine environments and therefore possesses high salt content (Moffatt and Nichol, 2007), which is inherently poor for the establishment of native vegetation (Zedler, 2001). As a result of excessive dredging and filling within the complex, tidal influence is non-existent among most elevated areas. Areas of minor degradation, such as Zedler Marsh and Steam Shovel Slough, are subject to tidal influence, support an array of flora and fauna, and may serve as a restoration model for the remaining portions of heavily degraded parcels.

Throughout the spring semester of 2009, the Environmental Science and Policy students of California State University, Long Beach have become intimately familiar with the Los Cerritos Wetlands. We have studied the behind-the-scenes workings of the wetlands; the property owners, the laws and policies, and historical site use. After many hours spent studying these wetlands, a group of dedicated students have decided to put our years of schooling to the test and develop a comprehensive ecologically based restoration plan for the Los Cerritos Wetlands complex.

This restoration plan will provide information on the history of the Los Cerritos Wetlands and its evolution to the current state of degraded wetlands. The many stakeholders involved with this wetlands complex will be addressed as they have greatly impacted the condition of the area.

The varied ecology of Southern California coastal salt marshes will be discussed insofar to address the importance such diverse topography will have to the productivity of these areas. Habitat delineations based on prior ecological condition will be noted as well as the basis for the creation of new habitat types in areas currently void of such habitats.

Interest groups comprised of concerned citizens as well as political actors and operators of oil infrastructure will all play an integral part in this restoration and the needs of each must be served in such a way that none are severely jeopardized. This restoration plan aims to demonstrate that the stream of benefits from a healthy, productive salt marsh ecosystem will extend beyond the scope of the natural world into the realms of economic prosperity and societal enhancement.

To minimize the destruction and construction involved with the implementation of this restoration plan, we have studied the current ecological conditions and developed a plan that utilizes much of the current variation within the landscape to its benefit. Instead of creating a wholly new landscape, this plan aims to enhance the current state without destroying the pockets of productive habitats.

Goals

The beneficiaries of this restoration plan include not only the native flora and fauna but the local citizens, businesses and future generations as well.

Benefits to the Beaches and Coastal Waters

In Heal the Bay's 18th annual report on California beach quality for the year 2007-2008, Long Beach ranked seventh on its list of "Top Ten Beach Bummers." This list is a compilation of the worst beaches in Southern California based on pollution levels during dry and wet periods. The information gathered by Heal the Bay reveals that 64% of monitoring locations within Long Beach received fair to poor grades during episodes of dry weather. The figure becomes even more dismal during instances of wet weather. During these periods, every monitoring location within Long Beach received a grade of "F."

Wetlands act as natural filtration systems, removing many of the harmful pollutants that urban areas tend to generate. Just 14 acres of estuary has the same pollution reducing capacity as a $1 million waste treatment plant (Owen and Chiras, 1995). Currently, pollutants accumulate in the urban runoff on its journey to the San Gabriel River, which flows directly into the Pacific Ocean. We will reduce the amount of untreated runoff entering the ocean by incorporating freshwater bioswales into the wetlands in areas that border nearby communities. Increasing the acreage of wetlands through which this runoff will pass allows the specialized wetlands organisms to absorb and utilize many of these pollutants that would otherwise enter the ocean directly. This will assist in providing cleaner coastal waters and make the beaches more attractive to beach goers, which is imperative given the current state of local beaches.

Benefits to the Local Economy

The current state of the Los Cerritos Wetlands provides few areas that are aesthetically pleasing to the non-naturalist. However, with the implementation of this restoration plan, the complex is transformed into a diverse community equipped with varied topographic elements that will be pleasing to the eye. Adjacent property values will be greatly enhanced by this more pleasant view. The back patios of homes in the Heron Pointe community currently expose the homeowner to oil mules and fields of non-native black mustard (*Brassica nigra*). However, with the implementation of this restoration plan, homeowners will be able to enjoy, from the comfort of their own home, the serene view of meandering tidal creeks and broad marsh plains. On a daily basis, people will be able to experience the sweet serenade of a Western Meadowlark (*Zonotrichia leucophyrs*) while viewing the stoic integrity of a Great Blue Heron (*Ardea herodias*) as it majestically stands guard over its homeland.

Local businesses, too, stand to benefit from this restoration project. As local residents gain appreciation for these natural areas and become more interested and educated about the importance of their incorporation into urban settings, they will give revenue to local sporting goods stores through purchases of binoculars, field guides, cameras and other equipment necessary for the full enjoyment of these natural areas. Local residents, as well as the tourists who will be attracted to this area, will patron local restaurants and other businesses, increasing the economic productivity of surrounding areas, namely Second Street in Long Beach and Main Street in Seal Beach. A study in *Nature* found that on average, the value of goods and services produced by just a single hectare (2.47 acres) of wetlands can approach $20,000 annually. This same study found that the annual value of ecosystem services is 1.8 times the world's gross domestic product and that, out of the coastal ecosystems, estuaries are the most valuable type.

At the time of writing, the unemployment rate in California is 11.2 percent (Bureau of Labor Statistics, May 2009). Increased economic activity and creation of employment is imperative in the current stagnant state of economic affairs. Restoration of the Los Cerritos Wetlands will create a demand for wetlands ecologists, tour guides, maintenance workers, management officials, as well as staff for the visitor center and in-house educational center. This diverse array of jobs will provide opportunities to the many demographics of people living near this wetlands complex.

Benefits to the Community

This comprehensive restoration plan for the Los Cerritos Wetlands includes an educational center to be staffed with wetlands ecologists who will provide classes and seminars to inform the public about wetlands species and functionality. These classes will give people a better understanding of and appreciation for these coastal wetlands. The educational center plans to become a field trip destination for local schools so that children may gain a sense of pride in their community and foster environmental stewardship from an early age.

The involvement of the community in all aspects of this restoration process is imperative. Once the process is complete, there will be a visitor center, educational center, walking trails and lookout platforms to encourage the community to become involved, but also the key is that the community is involved in the process of restoring the site from the beginning. In involving the community in the project, people will gain a sense of ownership for the wetlands; they will want to see their integrity maintained and enhanced. In this way, more local residents stand to become environmentalists, living their lives in a way to minimize their destruction of nature. From seeing the possibilities that can come from healthy natural areas, people will want to preserve this for the future and will take the basic measures such as conserving water and reducing waste that can make such a huge difference in contributing to the sustainability of a community.

The proposed weir in the Orange County Retention Basin serves to increase the flood retention capacity of this basin in the case of an intense flood event, which is likely to occur more frequently in the future as global climate change ensues.

Ecological Benefits

The proposed healthy wetlands complex will provide refuge and safe haven for countless species of birds, fish, invertebrates, mammals and reptiles. Although severely degraded and fragmented, the Los Cerritos Wetlands currently functions as a habitat for many such organisms. With the implementation of this restoration plan, the complex is restored to a fully functioning wetlands community which will experience varied extents of tidal flushing and inundation on a daily basis, thereby greatly increasing the amount of viable habitat for the vast array of species yearning for such diverse locales.

Spatial heterogeneity refers to the variations within a landscape that serve to create a multitude of habitat types intertwined in an area (Zedler, 2001). Heterogeneity is key in creating a functioning wetlands habitat as many species utilize numerous habitat types for their survival on a daily basis. For example, the federally endangered Western Snowy Plover nests in coastal dune habitats or salt pannes, yet forages for invertebrates in the intertidal zone (US Fish and Wildlife Service, 2001). This restoration plan calls for effective variability within the landscape, thereby increasing both species richness and diversity within the complex. Currently, the Los Cerritos Wetlands support approximately 20 species of native salt marsh plants (Zahn, Lecture). With the implementation of this plan a myriad of species will be re-introduced to increase the biodiversity and habitat capability of the wetlands.

Wetlands and estuaries are important nurseries for many species of fish, including both commercially important fish and those who serve integral roles in a food chain. Fish take advantage of the higher productivity, warmer water temperatures, and protection from large open ocean predators offered by coastal wetlands (McHugh, 1967; Boesch and Turner, 1984). This restoration plan aims to increase the ecological capacity of the Los Cerritos Wetlands by incorporating these protected, productive shallow waters for fish. Bay pipefish (*Syngnathus griseolineatus*), California Halibut (*Paralichthys californicus*) and Diamond Turbot (*Hyposopsetta guttulata*) are some of the fish species that will utilize the shallow near-shore waters for nurseries (MLPA Master Plan Science Advisory Team, 2008; Kucas and Hassler, 1986; Batiquitos Lagoon Foundation, 2009).

The Los Cerritos Wetlands falls along the Pacific Flyway, a migratory bird route traveled time and time again by scores of avian species. Many of these birds currently utilize the Los Cerritos Wetlands as a stopover for either a brief rest or to enjoy the warm winters offered by Southern California. This restoration plan will enhance the capability of these wetlands to accommodate the needs of these birds as they travel. The numerous species of plants, as well as the productive habitat for tasty invertebrates incorporated within this restoration plan, will increase its attractiveness to these species and enhance its productivity and ecological importance on a global scale.

Due to habitat fragmentation, pollution and intense competition for resources, species the world over are becoming endangered. This is painstakingly obvious within Southern California, as native habitats are a rare sight indeed. Over 33 percent of the United States' threatened and endangered species live only in wetlands, and nearly half use wetlands at some point in their lives (EPA, 2003). This restoration plan aims to provide ample accommodations for numerous such endangered organisms wishing to reclaim their homeland in these coastal quarters.

Western Snowy Plover (*Charadrius alexandrines nivosus*)
Image courtesy of DuneGuide.com

California Least Tern (*Sterna antillarum browni*)
Image courtesy of San Lorenzo Shoreline Wildlife

The Western Snowy Plover (*Charadrius alexandrines nivosus)* and California Least Tern (*Sterna antillarum browni*) are both federally endangered birds whose preferred nesting site is on the sandy plains of a coastal dune (US Fish and Wildlife Service, 2001; Hunter 1975, Blodget 1978, Carreker 1985, Thompson et al. 1997). This restoration plan incorporates numerous dune habitats, one of which will be physically buffered, to grant these birds safe nesting grounds where they will not risk being trampled or having their eggs consumed by predators.

Belding's Savannah Sparrow (*Passerculus sandwichensis beldingi)* is another federally endangered bird that stands to benefit from this restoration. These sparrows nest within dense pickleweed (*Salicornia virginica*) in mid-marsh habitats (Zedler, 2001), of which this plan provides plenty. The design of this plan incorporates extensive variability within the landscape, providing accessible feeding areas adjacent to attractive nesting sites.

Belding's Savannah Sparrow
(*Passerculus sandwichensis beldingi*)
Image courtesy of Marie Read.2008.

Southern tarplant (*Centromadia parryi ssp. australis*) is an annual herbaceous plant species listed as rare by the California Native Plant Society that grows in alkali locales and peripheral salt marsh locations (Reiser, 1994). This dicot has been observed within the Los Cerritos Wetlands and with the removal of non-native invasive species and enhancement of overall productivity, will find the new habitat one in which it can flourish.

Southern Tarplant (*Centromadia parryi ssp. australis*)
Image courtesy of BonTerra Consulting (CalPhotos) 2005

The endangered Salt Marsh Bird's Beak (*Cordylanthus maritimus ssp. maritimus)* will find the high marsh community suitable to its preferences (Zedler, 2001).

Salt Marsh Bird's Beak (*Cordylanthus maritimus ssp. maritimus*)
Image courtesy of CalFlora.org

The Wandering Skipper (*Panoquina errans*), a species of special concern, utilizes Salt Grass (*Distichlis spicata*) for its larval foodplant (Zedler, 1988). This elegant butterfly has been known to flutter about in the Los Cerritos Wetlands and will become a commonplace entity in the restored complex.

Wandering Skipper (*Panoquina errans*)
Image courtesy of Peter J. Bryant of UC Irvine

A once presumed extinct species of butterfly, the Palos Verdes Blue Butterfly (*Glaucopsyche lygdamus palosverdesensis*), stands to gain habitat in the Coastal Sage Scrub regions of this restoration plan. Incorporation of California locoweed (*Astragalus trichopodus var. lonchus*) and common deerweed (*Lotus scoparius*) will be to the liking of this fragile species.

Palos Verdes Blue Butterfly (*Glaucopsyche lygdamus palosverdesensis*)
Image courtesy of the Urban Wildlands Group

Study Area

The study area for this Restoration Plan is the entire Los Cerritos Wetlands site. Los Cerritos Wetlands lie on the border between Long Beach and Seal Beach, approximately 30 miles south of Los Angeles. Surrounding the entire site are urban and industrial areas with multiple residential neighborhoods, shops, restaurants, and oil facilities. These areas lead to a wide variety of pollutants entering the site, which create a need for site specific management explicitly designed to deal with those issues. The wetlands are bordered by the Los Cerritos Channel to the north, Studebaker Blvd and Westminster Blvd to the west, residential developments off of Seal Beach Blvd to the south, and the Pacific Coast Highway to the east. The San Gabriel River and the Haynes Power Plant Cooling Channel run through the wetlands. The San Gabriel River creates another problem as it is lined by concrete. This generates the need to develop alternative ways to deliver water to the wetlands other than natural filtration methods. The mixture of salt water from the rivers and channels and fresh water from runoff leads to an important mixture of salt water and fresh water in the wetlands, creating a unique ecosystem. Reconnaissance visits to the study area showed four functional or semi-functional wetland ecosystems around which we decided to base our restoration plan. These areas are Steamshovel Slough, one of Zahn's Ponds, Zedler marsh, and Cardoza Channel.

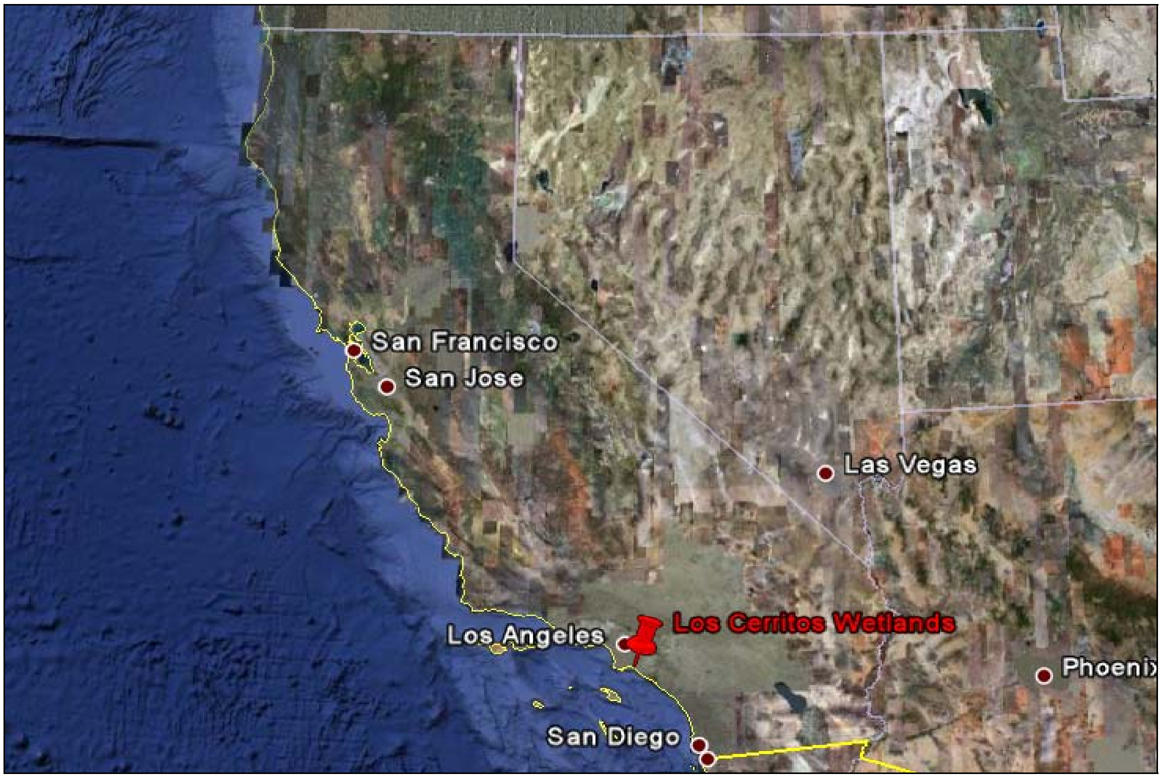


Figure 1 - Los Cerritos Wetlands, Placement in California; Imagery provided by Google Earth

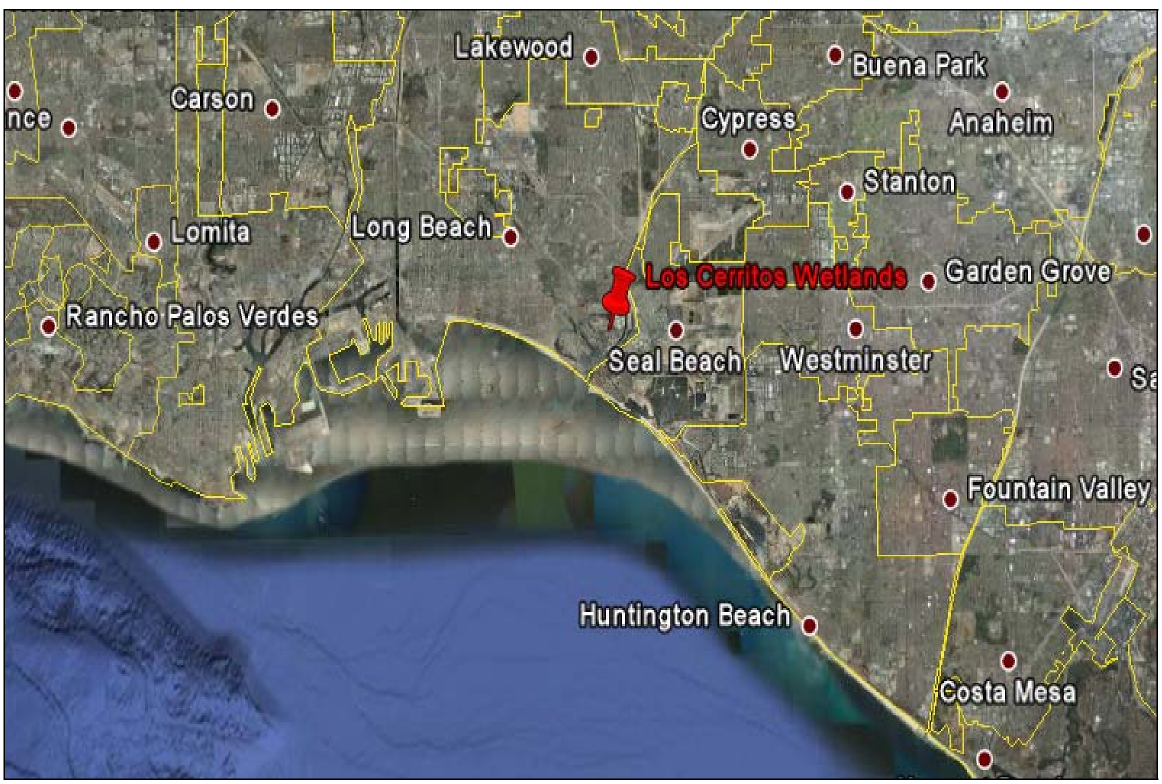


Figure 2 - Los Cerritos Wetland, Placement in Southern California; Image provided by Google Earth

Figure 3. Los Cerritos Wetlands, Placement in Long Beach and Seal Beach; Image Provided by Google Earth

Historical Background

Los Angeles and Orange Counties once contained over 12,000 acres of coastal wetlands; today less than 4000 acres remain (Figure 4) and much of that land is degraded. Los Cerritos Wetlands was once comprised of 2400 acres along most of the East Long Beach coast (Figure 5 and 6). It now consists of only 776 acres (Los Cerritos Trust). Unfortunately, very little is known of the wetlands prior to development, making restoration an even greater challenge (Los Cerritos Stewards). The severe loss of coastal wetland along the California coastline means saving the pieces that still exist is of utmost importance.

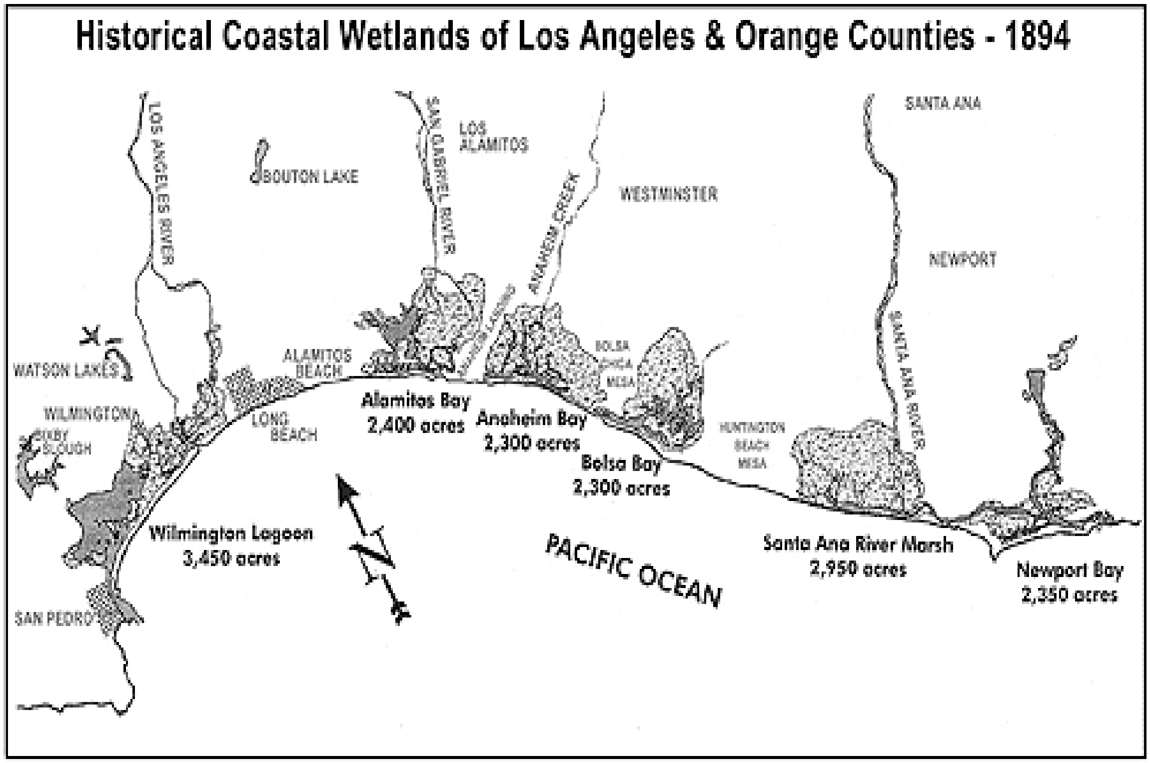


Figure 4 – Wetlands of Southern California, Historical Amounts; Image provided by Eric Zahn

Figure 5 - Los Cerritos Wetlands prior to intense development; southward view; Image provided by Eric Zahn

Figure 6 - Los Cerritos Wetlands in 1927, prior to intense development; northward view; Image courtesy of Leonard Arkinstall, Los Cerritos Wetlands Stewards, Inc.

Current Conditions

The tide of obstacles to be overcome at the Los Cerritos Wetlands before restoration can take place presents unique challenges. The primary obstacle is the extreme degradation that has taken place as a result of the intense urbanization of the area. The complex has historically been used as an unregulated dump and burn site for trash and dredge material (Landsman, 2006). It also has many oil mules currently in operation dotted throughout the complex. As a result of these oil operations, roads have been built throughout the wetlands and the heavy machinery used in the oil processes have compacted the soil (Small, 2005). These factors all combine to create poor soil conditions that inhibit productive vegetative growth (Zedler, 2001). Water quality in the wetland is also poor (Moffat and Nichol, 2007; Western Solutions, 2005). This is due partly to polluted runoff from the surrounding streets and partly to the lack of tidal influence from the few culverts entering the property (Zedler, 2001). One other obstacle facing the wetlands are the many non-native species found throughout the complex. These non-native species often out-compete native species for both space and resources, thereby reducing the number of native species supported by the landscape. These non-native species include Crystal iceplant

(*Mesymbryanthemum crystallimum*), Russian thistle (*Salsola tragus*) and Ripgut grass (*Bromus diandrus*). See Appendix for a complete list of the non-native species in the complex.

Despite the obstacles the complex faces, there are numerous viable habitats for the restoration plan to build upon. Steam Shovel Slough will serve as a model of a pristine salt marsh habitat experiencing full tidal flushing. Callaway Marsh, Zedler Marsh, and Shopkeeper Marsh will all be utilized as models for functioning marshes experiencing muted tidal influence. Other existing habitats include freshwater marshes, coastal sage scrub, salt pannes, and mudflats. We will be working off of these existing functional habitats to restore the remainder of the complex.

The complex is currently divided among several title-holders: 2H Construction, Bryant, Hellman Ranch Co., Dean-Berger LLC, The Los Angeles County Department of Water and Power, the Los Cerritos Wetlands Authority, and the State of California. The Los Cerritos Wetlands Authority (LCWA) is the only title-holder actively working to preserve the wetlands. For this restoration plan to become a reality, the LCWA must own title to the entire complex.

In addition to the title-holders, there are a number of stakeholders also involved with the complex. These stakeholders include the City of Long Beach, the City of Seal Beach, the Los Cerritos Land Trust, the Los Cerritos Wetlands Stewards, the San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy and the Los Cerritos Wetlands Authority.

Prior to initiating the restoration project permits must be obtained from many different government agencies. The four major laws that protect the wetlands are the Clean Water Act, the Endangered Species Act, the California Coastal Act, and the Migratory Bird Treaty Act (Hall, 2009).

Several sections of the Clean Water Act are relevant to the Los Cerritos Wetlands Complex; these are sections 402, 404, 303, 319, 316, and 311. The Clean Water Act protects U.S. navigable waterways; this is defined as any water bodies that are connected to navigable water and land that is adjacent to the water. This definition indicates to us that portions of the Los Cerritos Wetlands are protected under the Clean Water Act.

- Section 402 protects the waterways of the wetlands from point source pollution. Any discharge from factories or other facilities will be regulated under this section. Specific limits dealing with the amount of discharge is regulated through the NPDES permits. Monitoring and reporting requirements are also listed in the NPDES permit as well (EPA, 2009)
- Section 404 specifically protects any dredging and discharge onto wetlands connected to or flowing into U.S. waterways; permits are required before any dredging occurs. In order to flood the areas in which the restoration has purposed, dredging must occur in those areas to decrease the elevation of the land in order for water to enter. This permit will be issued by the U.S. Army Corps of Engineers, with an oversight by the EPA. (Klee, 1999).
- Section 303 focuses on water quality. A beneficial use of the water body needs to be identified first, and then water quality standards of that body of water will be set depending on what the beneficial use is. In the case of the Los Cerritos Wetlands, water quality must be good enough to sustain the marine and bird habitat (Hall, 2009). If the

water is not at the regulated level of quality, a developed total maximum daily load (TMDL) must be created and these waters must be monitored (EPA, 2009). Pollutants that are listed under the Clean Water Act must be regulated as the restoration proceeds. Section 303 will set limits utilizing TMDLs to control the specific level that certain chemicals will be allowed to reach within the wetlands. If necessary, permits may be required for large amounts of harmful materials to be released (Hall, 2009).

- Section 311 deals with oil facilities, a very common sight in the Los Cerritos Wetlands. This section does not allow any discharge of oil or hazardous materials into navigable waters (EPA, 2009).
- Section 316 regulates thermal discharge into the water. This relates directly to the cooling channel and the temperature of the water that is released from the AES power plant. It is common for cooling water intake structures to destroy large numbers of aquatic species by sucking them into the plant's cooling system. Per section 316, best technology available must be utilized to minimize the harmful environment impacts caused by these intake structures that are used for cooling purposes. (EPA, 2009).
- Section 319 deals with non-point source pollution that could possibly be released into the water. Urban runoff is an example of nonpoint source pollution that is harmful to the Los Cerritos Wetlands (Hall, 2009). State level permits are issued by the Regional Water Quality Control Board and State Water Quality Control Broad. Under the Clean Water Act permits are issued by the Army Corps of Engineers with an oversight by the Environmental Protection Agency.

The Los Cerritos Wetlands Complex is home to several endangered species; therefore permits are required when a possible "taking" could occur during the restoration. The levee of Steam Shovel Slough is a nesting site to many Belding Savannah Sparrows thus the restoration plan has been designed to prevent destruction of this area. However, since the levee break in the plan is adjacent to the nesting site, a permit will be required in the event a taking of the endangered species occurs. Permits will be issued by California Fish and Game at the state level, while the Endangered Species Act is enforced by U.S. Fish and Wildlife Services at the federal level (Klee, 1999).

The purpose of the California Coastal Act is to provide recreational use, as well as to protect, enhance, and restore coastal lands. This act protects land that is within three miles seaward, which includes the entire Los Cerritos Wetland complex. Under this act, permits are required for any building to occur and these permits are only issued if the building is coast-dependent and provides public access to the coast (CCA, 2009). The proposed restoration plan includes a learning center, trails, and a bird blind. These structures will be open to the public and are created for educational purposes. The construction of these projects will require a permit from the California Coastal Commission under the Coastal Act.

The Migratory Bird Treaty Act is an international treaty that takes precedence over federal law. This act is intended to protect areas of land used by migratory birds for feeding and stopover during their routes. (USFWS, 2009). Some birds are protected by both Migratory Bird Treaty Act as well as the Endangered Species Act, which allows them twice the protection. If a specific bird is not covered within the Endangered Species Act, it may still be protected within the Migratory Bird Treaty Act.

Habitat Types

Subtidal zone

Figure 7 - Submerged eelgrass
Image courtesy of Joe Costa

Subtidal habitats are identified as those being completely submerged at all stages of the tidal cycle, such as bays and harbors (Figure 7). As their water source is the ocean, most of subtidal zones are located near or on the coastline. The salinity and temperature of these regions often reflect a balance between the conditions of the open ocean and that of shallow intertidal regions (Zedler, 2001).

The extent and variability of vegetation is contingent upon light penetration and, therefore, water clarity; vegetation is generally denser in shallower water due to higher light availability. Seagrass beds are frequently found in these shallower regions and serve many species of fish; eelgrass (*Zostera marina*) is a dominant species in southern California waters (Zedler 2001).

The fauna supported by subtidal regions in southern California is largely dependent upon depth and vegetation. One can expect to find various species of crustaceans, gastropods, bivalves, fish, reptiles, and mammals (Zedler, 2001).

Saltwater Marsh

Figure 8 - Bolsa Chica Wetlands
Image courtesy of Richard Wong

Saltwater marsh is a highly vegetated area above the subtidal zone that experiences varying extents of tidal inundation (Figure 8). Salinity levels can vary between 40 and 100 ppt based upon tidal inundation frequency, rainfall, elevation, and soil type (Zedler, 2001). Three main plant assemblages dominate the area: cordgrass marsh, marsh plain, and high marsh (Zedler, 2001).

Cordgrass marsh occurs at the lowest elevation of the three assemblages; it is subject to frequent flooding. The dominant plant species is cordgrass (*Spartina foliosa*), which serves as a year-round habitat for the endangered Light Footed Clapper Rail (*Rallus longirastris levipes*) (Zedler, 2001).

Marsh plain is located above the cordgrass assemblage, and the frequency of tidal inundation is somewhat diminished. Many species can be found in abundance in the marsh plain; some of the more dominant plant species include pickleweed (*Salicornia virginica*), salt wort (*Batis maritima*), annual pickleweed (*Salicornia bigelovii*), sea-blite (*Suaeda esteroa*), fleshy jaumea (*Jaumea carnosa*), arrow-grass (*Triglochin concinna*), and sea lavender (*Limonium californicum*). Marsh plain's pickleweed plants serve as habitat for the endangered Belding's Savannah Sparrow (Zedler, 2001).

The high marsh is subject to the lowest levels of tidal inundation. Its dominant perennial plant species include glasswort (*Salicornia subterminalis*), shoregrass (*Monanthochloe littoralis*), alkali heath (Frankenia salina), salt grass (*Distichlis spicata*), sea lavender (*Limonium californicum*), Watson's saltbush (*Atriplex watsonii*), and spreading alkaliweed (*Cressa truxensis*). During the winter months, when southern California experiences most of its rainfall, increased precipitation causes soil salinity levels to fall; several annual plant species take advantage of this change and temporarily colonize the region (Zedler, 2001).

Salt Panne

Figure 9 - Close up of a salt panne
Image courtesy of travel.webshots.com

Salt pannes are areas of salty substrate that develop in the upper intertidal zone and experience varied periods of inundation (Figure 9). Soil salinity levels in a salt panne may reach up to 200 ppt during the summer (Zedler, 2001); pannes are therefore generally devoid of conspicuous vegetation as the vast majority of plants are unable to withstand such sustained levels of high salinity.

Despite this lack of vegetation, salt pannes are productive regions, providing nesting habitat for two species of special concern - the Western Snowy Plover (*Charadrius alexandrines nivosus*) and California Least Tern (*Sterna antillarum browni*) (Zedler, 2001). In addition, various endangered species of tiger beetles (*Cicindela spp.*) and rove beetles (*Bledius spp.*) burrow in the sediments of a salt panne.

During instances of intense rainfall, salt pannes become inundated aquatic systems and may support algae and ditch grass (*Ruppia maritima)* (Zedler, 2001). In these intervals of submersion, salt pannes serve as feeding and resting sites for Western Snowy Plovers (Zedler et al. 1992). In restoration projects, salt pannes are difficult to plan for, as their development is contingent upon the concurrence of many factors.

Brackish Marsh

Figure 10 - Pescadero Marsh, Pescadero State Park
Image courtesy of San Mateo Coast Natural History Association

Brackish marshes occur where saltwater converges with freshwater bodies and seepages; salinities generally lie between 0.5 to 30 ppt (Zedler, 2001; Figure 10). Urban runoff may also contribute to the formation of brackish regions. This intermediate step between salt- and freshwater bodies generates plant assemblages of similar composition – both fresh and salt marsh plants may be found. The frontier for brackish plant assemblages and salt marsh vegetation also tends to vary, as seasonal deviations in freshwater discharges may occur throughout the year. The typically dominant plant species in a brackish marsh habitat are cattails (*Typha domingensis*), bulrushes (*Scirpus californicus*), ditchgrass (*Ruppia maritima*), and spiny rush (*Juncus acutus*) (Zedler, 2001).

Freshwater Marsh

Figure 11 - Freshwater marsh, Humboldt Bay
Image Courtesy of Andrea Pickart

A freshwater marsh is defined as a body of non-saline water yielding hydrophilic, non-woody vegetation, though trace amounts of salt water may inundate the region periodically (Zedler 2001; Figure 11). These habitats experience little to no tidal influence and are typically recharged by rainfall or vernal pool influence. Urban runoff may also serve as a source of water recharge, giving these habitats a dual purpose as filtering bioswales. Typical dominant species are bulrushes (*Schoenoplectus americanus, S. californicus, Bolboschoenus maritimus*) and cattails (*Typha angustifolia, T. domingensis, T. latifolia*) (Bowler and Elvin, 2003).

Tidal Creeks and Channels

Figure 12 - A tidal channel in the Los Cerritos Wetlands
Image courtesy of Shannon Hood

Tidal creeks and channels are water bodies subject to tidal influence that carry water from deeper, larger subtidal habitats to emergent marsh vegetation (Zedler, 2001; Figure 12). They are extremely varied habitats, exhibiting different depths, widths, salinities, sedimentation types, water flows, and tidal inundation; as a result, they can support varied species of flora and fauna (Zedler, 2001).

Tidal creeks are differentiated into orders by width; the largest classification has a designated four-meter average width. A typical tidal creek will empty completely at low tide. Tidal channels exhibit an average ten meter width, carry larger flow volumes, and retain some depth of water at all tidal stages. This gives channels the ability to support subtidal vegetation as well as its associated array of faunal species (Zedler, 2001).

Intertidal Flats

Figure 13 - Intertidal flats
Image courtesy of www.batiguitos.org

Intertidal flats are stretches of land that are submerged at high tide and at least partially revealed at low tide (Zedler, 2001; Figure 13). Also known as mud- or sandflats, these regions have no vascular vegetation, but often have substantial algal biomass and exhibit the highest level of invertebrate biodiversity found in coastal wetlands. These assemblages can include gastropods, bivalves, polychaetes, amphipods, and crustaceans (Zedler, 2001).

By housing such an array of invertebrate species, intertidal flats also serve as an invaluable feeding site for many avian species. With differing species types inhabiting various depths of substrate, these habitats can provide for a vast array of bird species to feed from their own niche (Zedler, 2001).

Transition Zone

Figure 14 - Alkali heath (*Frankenia salina*), a dominant transition zone species
Image courtesy of longbeachnaturalareas.blogspot.com

Transition zones are an integral part of any ecosystem as they facilitate the convergence of habitats and act as a corridor for species utilizing both regions (Zedler, 2001; Figure 14). In coastal wetlands, the concept of transition zones is applicable to the overlap of upland and marshland vegetation (Zedler, 2001). This habitat type experiences varied extents of salinity and inundation, both depending on rainfall and local flood events (Zedler, 2001).

During seasonal bouts of moist, low salinity soils, nonnative species such as little iceplant (*Mesymbryanthemum nodiflorum*) and rabbitfoot beardgrass (*Polypogon monspeliensis*) may flourish, but this habitat type is largely inhospitable to most exotic species (Zedler, 2001). Since this region associates two distinct habitats, species from both salt marsh and upland habitats can be found in a transition zone. Common salt marsh species found in a transition zone include Alkali heath (*Frankenia salina*), saltgrass (*Distichlis spicata*) and alkali weed (*Cressa truxillensis*) (Zedler, 2001; Santa Monica Bay, 2006). Species typical of upland habitats generally found within transition zones include boxthorn (*Lycium californicum*), bush seepweed (*Suaeda maquinii*) and California saltbush (*Atriplex californica*) (Zedler, 2001; Santa Monica Bay, 2006). Typical brackish marsh species such as spiny-rush (*Juncus acutus*) and alkali ryegrass (*Leymus triticoides*) may also be found within a typical transition ecotone (Santa Monica Bay, 2006).

Terrestrial species supported by transition zones include the California Kingsnake (*Lampropeltis getulus californiae*), western harvest mouse (*Reithrodontomys megalotis*), and California ground squirrel (*Spermophilus beechyi*) (Santa Monica Bay, 2006).

Coastal Sage Scrub

Figure 15 - Coastal Sage Scrub near Oceanside, CA.
Image courtesy of David Olson

The California Coastal Sage ecoregion is located exclusively along the coasts of southern California and northwestern Mexico and covers approximately 14,000 square miles. Despite this seemingly large number, it is classified as an endangered habitat type and houses multiple species of endangered and threatened plants. Given the coastal location of this territory, the land itself is highly sought after for residential and commercial uses, yet also provides habitat for the endangered California gnatcatcher (*Polioptila californica*). This species therefore serves as an umbrella species to protect the region, calling upon the Endangered Species Act to protect this habitat type from urban invasion (World Wildlife, 2001).

Coastal sage scrub habitat thrives in Mediterranean climates and generally sees precipitation levels between 150 and 500 mm annually (Zedler, 2001; Figure 15). Ideally, soil content will be comprised of volcanic rock or soils of sedimentary origin and elevation will be below 1,000 m (World Wildlife, 2001).

This habitat type is very diverse, but is characterized by a predominance of several low profile, drought resistant shrubs: black sage (*Salvia mellifera*), white sage (*Salvia apiana*), Munz's sage (*Salvia munzii*), California sage (*Artemisia californica*), California buckwheat (*Eriogonum fasculatum*), bush sunflower (*Encelia california*), toyon (*Heteromeles arbutifolia*), and lemonadeberry (*Rhus integrifolia*) (NPS, 2009).

Coastal Dunes

Figure 16 - Dunes in Pismo Beach, CA
Image courtesy of Dr. Ron Blakely

Coastal dunes are typified by bare sand; vegetation generally occurs over less than 10% of its surface (Zedler, 2001: Figure 16). Due to both lack of rain – which would dilute soil salinity – and the onshore wind that carries salt spray inland, southern California dunes are generally the most saline found in the state (California National Grasslands Association, 2008).

Plant species inhabiting coastal dunes cope not only with high salinity levels, but also with the instability inherent in sandy substrate. Many species cope with shifting conditions by forming hillocks, accumulations of wind blown sand that allow vegetation to grow above the burial level. Though these conditions seem to lend themselves to opportunistic annual species, most species that thrive are, in fact, perennials. This is largely accredited to the difficulty for seedling establishment in sand. Most active plant communities living within coastal dune habitat are classified as rare or vulnerable (California National Grasslands Association, 2008).

As a general rule, five plant species can account for the entire vegetation of a given dune region. These species may be dominated by sea rocket (*Cakile maritima*), beach bur (*Ambrosia chamissonis*), sea fig (*Carpobrotus chilensis*), yellow sand verbena (A*mbronia latifolia*), beach salt bush (*Atriplex leucophylla*), and European dune grass (*Ammophilia arenaria*) (Guadalupe Restoration Project, 2008).

Foredune grasslands exist in association with the typical conception of a coastal dune; this globally endangered habitat type exists only on North America's Pacific Coast dunes. The Native American dunegrass (*Leymus mollis)* characterizes foredunes, though beach bluegrass (*Poa macrantha)* can also be observed as the dominant species. Foredune grasslands are typically found on high-energy, ocean-facing sand stretches, but calmer bay-facing and brackish shorelines may also support *L. mollis* (Guadalupe Restoration Project, 2008).

Dune Scrub

Figure 17 - Dune scrub habitat along coastal California
Image courtesy of The Urban Wildlife Group

Dune scrub communities are typically found on stabilized, inland dune regions. Densely packed shrubs comingling with grasses, wildflowers, and expanses of bare sand characterize the region (Zedler, 2001; Figure 17). This habitat can also be very dynamic, as high winds can destabilize dune sand and uproot vegetation. Common plant species include bush lupine (*Lupinus arboreus*), sticky monkeyflower (*Mimulus aurantiacus*), California coffeeberry (*Rhamnus californica*), Chamisso's lupine (*Lupinus chamissonis*), coyote bush (*Baccharis pilularis*), lizard tail (*Eriophyllum staechadifolium*), mock heather (*Ericameria ericoides*), and poison oak (*Toxicodendron diversilobum*) (NPS, 2008).

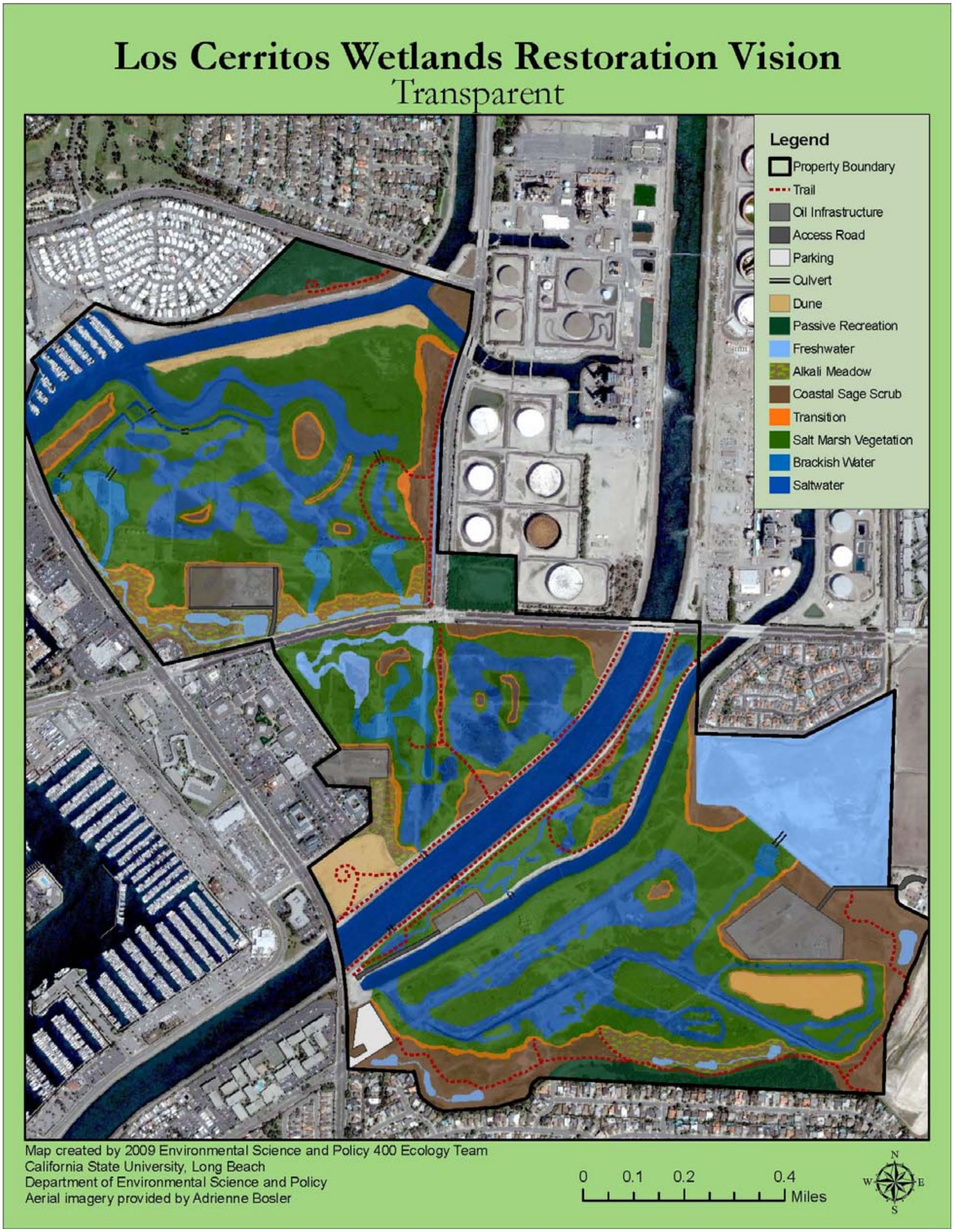
Alkali Meadows


Figure 18 – Alkali Meadow region
Image courtesy of Todd Keeler

Historically, alkali meadows in the San Gabriel River floodplain were characterized by wetland plants, native plants, and several species of rare plants generally found in association with vernal pools and alkali flats (Zedler, 2001; Figure 18). Salt marsh grass (*Distichlis spicata*), one of the more alkali tolerant grass species, was a typically dominant plant and has previously been found to grow abundantly well beyond the reach of regular tidal inundation (Casanova et al.).

Transitional boundaries between alkali meadows and other upland regions can be difficult to determine; historic soil maps reveal the presence of willow growth, salt, grasses, and hydrophilic alkali tolerant plants as indicators. The same maps have led to the identification of what once were twenty-six distinct meadows covering 23,137 acres (Casanova et al.).

Restoration Plan

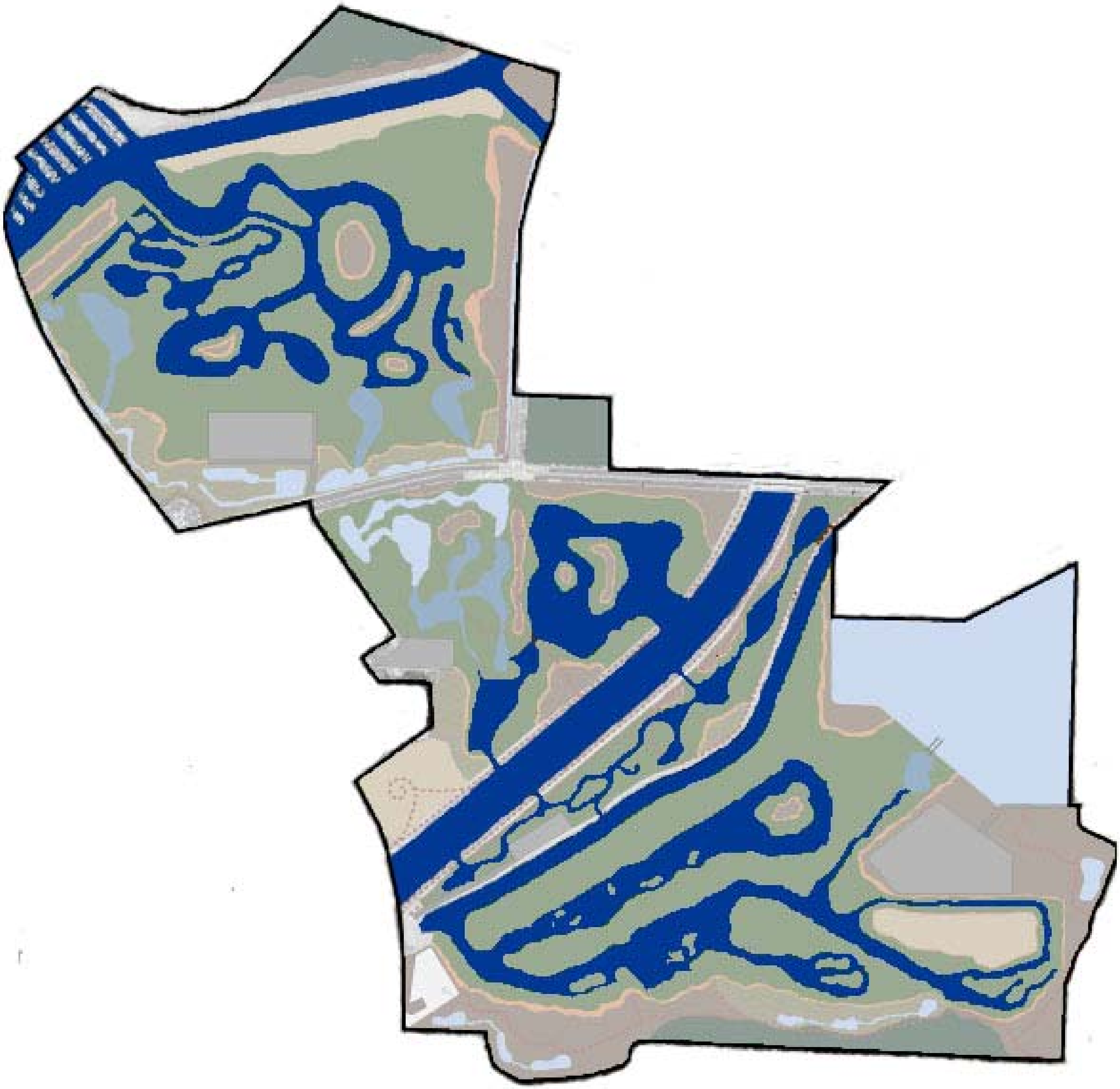

Los Cerritos Wetlands Restoration Vision
Transparent
Legend
Property Boundary
Trail
Oil Infrastructure
Access Road
Parking
Culvert
Dune
Passive Recreation
Freshwater
Alkali Meadow
Coastal Sage Scrub
Transition
Salt Marsh Vegetation
Brackish Water
Saltwater
Map created by 2009 Environmental Science and Policy 400 Ecology Team
California State University, Long Beach
Department of Environmental Science and Policy
Aerial imagery provided by Adrienne Bosler
0 0.1 0.2 0.4 Miles
N
S
W
E

Names:

A. Least Tern Recreation Area
B. Clapper Rail Trail
C. Least Tern Nesting Site
D. Eva Island
E. Wally Island
F. Los Cerritos Ponds
G. Feeding Island
H. In and Out Channel
I. Belding's Island
J. Belding's Trail
K. Egret Island
L. Studebaker Island
M. Oil Park 1
N. Zahn's Ponds
O. Anne Island
P. Studebaker Peninsula and Trail
Q. Darwin Marsh
R. Hervey Island
S. Giatti Island
T. 404 Bay
U. Oil Park 2
V. Muir Ponds
W. Kruger Dune
X. Zedler Marsh
Y. Zedler Trail
Z. Oil Park 3
AA. Belding's Peninsula
BB. Gabrieleno Island
CC. Cardoza Channel
DD. Area 18
EE. Bay of Banshee
FF. Celestial Creek
GG. Tongva Trail
HH. Timmy's Trail
II. OC Retention Basin
JJ. Oil Park 4
KK. Forager's Field

Habitat Delineations

Saltwater Bodies



Numerous tidal channels and creeks will be created to increase tidal flushing throughout the restoration site. The northern portion of the restoration site contains Steam Shovel Slough, which is the most pristine portion of the Los Cerritos Wetlands and serves as a model for the rest of the complex. The main method of introducing saltwater to the rest of the northern section of the wetland is to modify two spots along the southern levee of Steam Shovel Slough, thus creating Wally Island. To make up for habitat lost by levee modifications, excess fill material will be utilized to create Belding's Island, a hotspot for Belding's Savannah Sparrow nesting and feeding. A second method of introducing saltwater to the northern portion of the restoration site is to enhance Lenny's Lagoons, located southwest of the opening to Steam Shovel Slough from the Los Cerritos Channel. In and Out Channel will connect Lenny's Lagoons to Steam Shovel Slough to allow for greater tidal flushing.

The portion of the restoration site below Second Street and above the San Gabriel River will use the San Gabriel River as its main saltwater source. Darwin's Marsh and 404 Bay were placed according to the location's preexisting lower elevations and their proximity to the San Gabriel River. The main saltwater source for Muir Ponds will be a culvert connected to the San Gabriel River. Additionally, a small tidal creek will connect Muir Ponds and 404 Bay to increase tidal flushing.

The expansion of Zedler Marsh into a system of tidal creeks and ponds was assigned because of the existing healthy habitat of Zedler Marsh and the proximity of the large water bodies – the San Gabriel River and Haynes Cooling Channel – that will serve as a steady flushing source. The Zedler Marsh system will have four culvert-based saltwater sources.

The main method of introducing saltwater to the southern portion of the restoration site is through the Haynes Cooling Channel. The Haynes Cooling Channel provides a reliable saltwater supply with tidal influence. The most extensive tidal channel and creek system in this portion of the restoration site is Cardoza Channel. A small creek currently exists within the restoration site and acts as a guide for the more robust Cardoza Channel. Immediately north of Cardoza Channel is the Gabrieleno Island Slough, which was designed to be a model of the pristine Steam Shovel Slough. Celestial Creek and the Bay of Banshee are both saltwater creek systems that branch off of Cardoza Channel.

Brackish Water

Brackish ponds will be formed between the salt- and freshwater ponds as a result of the abundance of freshwater urban runoff. Brackish ponds currently exist within the restoration site, though they are highly dependent on precipitation and freshwater runoff. This plan aims to expand the brackish pond system and use the freshwater urban runoff to the advantage of the restoration site. Water bodies like Muir Pond were placed to serve as a transition between fresh- and saltwater bodies. Brackish ponds also benefit the restoration site by diversifying habitat types and increasing overall biodiversity.

Freshwater Bodies

All freshwater bodies within the restoration site are formed as a direct result of freshwater urban runoff. The freshwater ponds bordering Studebaker Road, Second Street, Pacific Coast Highway, and Gum Grove Park are located in probable locations of urban runoff and serve as bioswales. Zahn's Ponds are an expansion of current sites of freshwater ponds. The Orange County Retention Basin has the capability to fill with freshwater, though this circumstance is unlikely. The plan includes the Orange County Retention Basin as a freshwater body because it has the potential to affect the restoration site. Tongva Pond is part of an existing restoration project and will not be modified, though this plan will utilize its function as a freshwater pond. Freshwater ponds have been planned along the southern border of the restoration site to collect runoff from surrounding homes and businesses. They have been designed to effectively capture runoff as it flows down the steep slope from Gum Grove Park and the housing tract above.

Salt Marsh

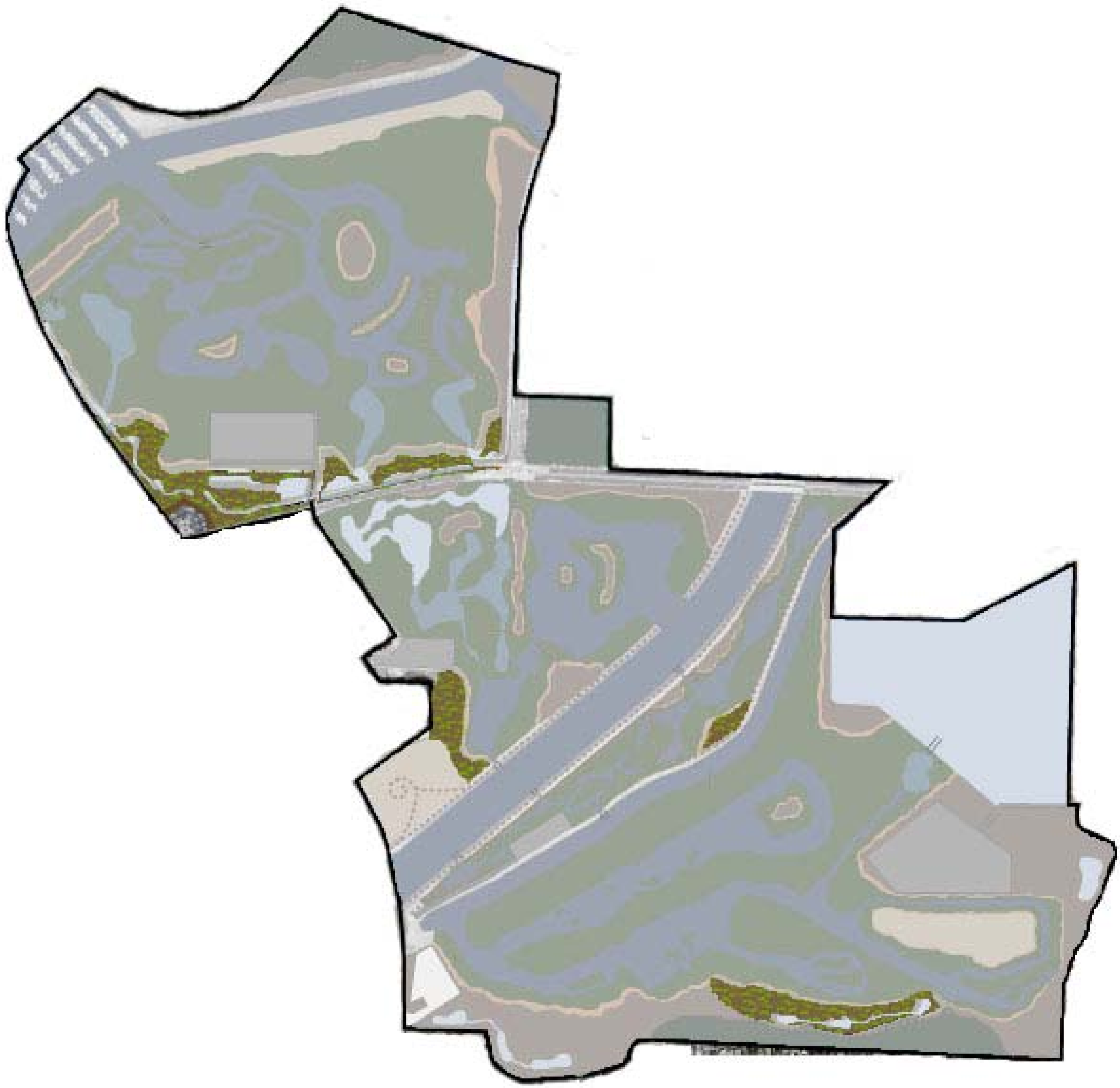
The most abundant habitat type within the restoration site is salt marsh vegetation. Areas bordering saltwater bodies will contain salt marsh vegetation. Salt marsh vegetation will most likely form naturally as a result of the introduction of saltwater to previously unvegetated regions. The creation of Lenny's Lagoons by Leonard Arkinstall of the Los Cerritos Wetlands Stewards, Inc. proves that salt marsh habitat can successfully reestablish itself if given access to saltwater bodies. Feeding Island is designed as an island that has the ability to be exposed at low tide and inundated at high tide. Mid- and upper marsh has been placed predominately in regions that are presently low-lying and either not adjacent to a suitable water source or degraded to a lesser extent than surrounding regions and are, therefore, better suited for re-vegetation.

Specific areas previously covered in salt marsh vegetation within Cardoza Channel have been preserved and modified into islands. All islands within saltwater bodies containing only salt marsh vegetation have the ability to be exposed at low tide and inundated at high tide.

Transition Zone

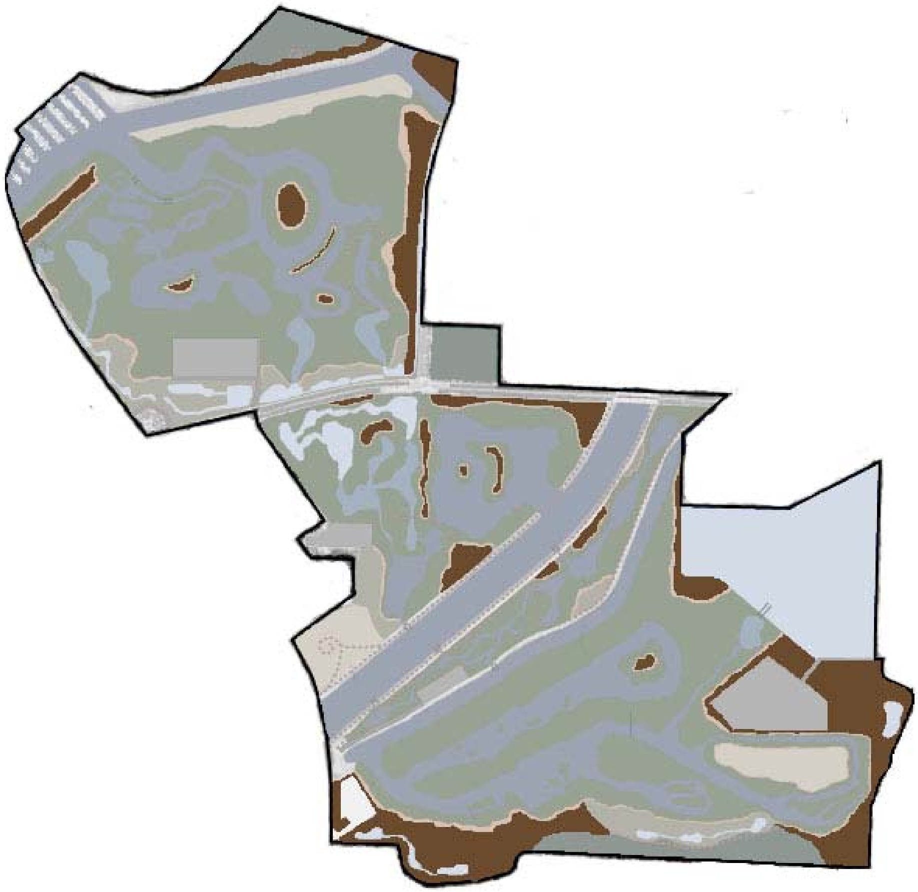
Transition zones exist at the interface of salt marsh and upland habitats, such as coastal sage scrub or alkali meadow. The transition zone that follows Belding's Trail along Studebaker Road is exaggerated in width to include the existing population of southern tarplant (*Centromadia parryi ssp. australis*), which is listed as "rare, threatened, or endangered in California and elsewhere" by the California Native Plant Society.

Alkali Meadow



Alkali meadow regions were chosen for their proximity to saltwater and preference for alkaline soils. Alkali meadows have been placed along the border of Gum Grove Park to allow for foraging by raptors nesting in the Eucalyptus trees of the park.

Coastal Sage Scrub



The majority of coastal sage scrub habitat occurs at the highest upland elevations within the restoration site or as buffers between the wetlands and the urban environment. Additionally, many coastal sage scrub uplands within the restoration site will host a majority of the extensive trail system.

The Least Tern Recreation Area will contain a coastal sage scrub buffer that follows the Los Cerritos Channel from Loynes Drive to the residences that occupy the western border of the recreation area. The upland area that currently exists along the western edge of Studebaker Road will be transformed into a proper coastal sage scrub habitat. Coastal sage scrub has been planned to act as a vegetated buffer that would surround Oil Parks 1 through 4, decreasing their visibility to visitors. In some locations, such as along the southern portion of Second Street, regions were chosen to take advantage of preexisting higher elevations. On Studebaker Peninsula and along the northern edge of the San Gabriel River, coastal sage scrub habitats have been placed largely to serve as urban buffers and to deter the public from leaving the trail system. Coastal sage scrub has been placed along the southwest portion of the restoration site to act as a vegetated upland buffer between the wetlands and the large residential area to the south, as well as provide additional space for Timmy’s Trail. The area around Tongva Pond and Tongva Trail is part of a previous restoration project and will not be modified, though the general habitat type is coastal sage scrub with riparian influence from Tongva Pond. Coastal sage scrub has been placed along the western edge of the Orange County Retention Basin to act as a buffer from the residential area directly to the north.

Dune

The sandy, unvegetated, degraded portion to the north of Steam Shovel Slough and south of the Los Cerritos Channel will be converted into dune habitat. Least Tern Nesting Site will be a long, narrow band of dune habitat utilized as a fenced-off nesting area for the least tern (*Sternula antillarum*).

Kruger Dune is located on a parcel of land that is currently completely scraped bare of vegetation and habitat functionality. Kruger Dune is a cost-effective option for this portion of the restoration site as it will be used as a location to store excess fill material during the restoration process. By using excess fill material to create Kruger Dune we are creating habitat where no other habitat can exist without extensive remediation. Kruger Dune will be different from other dune habitats within the restoration site, as it will also serve as a raised viewing platform for visitors.

The Area 18 Nesting Site is a raised dune island composed primarily of excess fill material. Area 18, as it currently exists, is an extremely degraded upland habitat with poor soils and a high percent cover of black mustard (*Brassica nigra*). By using excess fill material to create a raised dune site at Area 18 we are covering the contaminated soils of the site, increasing habitat diversity and significantly increasing healthy biodiversity. Area 18 is designed to be a raised least tern nesting site and is surrounded by a tidal creek for additional protection from predators.

Bird Islands

Bird islands are larger islands within the restoration site that contain salt marsh, transition zone, and upland coastal sage scrub habitat. The main idea is to provide protection for birds from predators during nesting and feeding by creating a safe-haven upland zone within the island. There are a total of eight bird islands to be included in the restoration site.

1. Wally Island is the largest of the bird islands and will be formed after the southern levee of Steam Shovel Slough is modified. The area is currently a former dumpsite and the most cost-effective means of restoration is to use excess fill material to create Wally Island.

2. Belding's Island is a long, narrow strip of habitat to be designed specifically for the State endangered Belding's Savannah Sparrow. This island was created to make up for the habitat lost by the Steam Shovel Slough southern levee modification.

3. South of Belding's Island is Studebaker Island, which is a smaller version of Wally Island.

4. Egret Island will serve as a bird sanctuary for the area surrounding Lenny's Lagoons.

5. Hervey Island and Giatti Island were designed to be the ecological center of 404 Bay.

6. Anne Island is a large bird island within Zahn's Ponds. The unique aspect of Anne Island is that it borders both brackish and freshwater, allowing for increased habitat diversity.

7. Gabrieleno Island will be placed at the end of the northeast end of Gabrieleno Island Slough.

Infrastructure Improvements

A number of infrastructure improvements are necessary before moving forward with the restoration portion of this project.

Oil Infrastructure Consolidation

Oil operations within the Los Cerritos Wetlands complex will prove to be a significant obstacle in terms of ecological restoration. It is unrealistic to assume that oil infrastructure will be removed entirely from the restoration site. While oil operations will eventually cease to exist, it is important to work with oil companies to allow for a number of Oil Parks within the complex in order to expedite the restoration process. Oil Parks will contain consolidated oil infrastructure from within the complex, including oil mules, trucks, buildings, and associated materials. Additionally, a number of access roads will be constructed to allow for truck access to the Oil Parks. There are four Oil Parks included in this plan, Oil Parks 1 through 4, with Oil Park 1 being the northernmost region and Oil Park 4 being the southernmost region. The reason for the location of each Oil Park is primarily based on the amount of existing oil infrastructure in each location. As a result of oil infrastructure consolidation, slant drilling will be utilized to allow oil companies to continue their operations without compromising the health of the wetlands.

In order to protect adjacent habitats from Oil Parks, it will be necessary to create a vegetated buffer around the perimeter of the Oil Park. The vegetated buffer will consist of coastal sage scrub plants, primarily toyon (*Heteromeles arbutifolia*) and lemonadeberry (*Rhus integrifolia*). Toyon is a native coastal shrub that can grow up to 8m in height (Rundel et al. 2005), while lemonadeberry is a native coastal shrub that can grow up to 7m tall (Rundel et al. 2005). Mechanically excavated fill material can be used to raise the elevation around each Oil Park, created a raised buffer in addition to the coastal sage scrub habitat that will be planted.

1. Oil Park 1 - The location for Oil Park 1 was chosen based on areas with existing oil operations and the poor ecological quality of the land at the site. Access to oil operations was also a deciding factor for determining the location of the consolidation site. An access road will be maintained from Oil Park 1 to the north side of Second Street to allow for company access to the facility. In keeping the consolidated oil operations away from the main water source, Steam Shovel Slough, the pollution and noise will affect the least amount of organisms possible.

2. Oil Park 2 - The location for Oil Park 2 was chosen based upon preexisting oil structures and ease of access. No roads will be built to access this area, as the existing Shopkeeper Road can serve this purpose.

3. Oil Park 3 - Oil Park 3 was placed on the strip of land between the San Gabriel River and the Haynes Cooling Channel to allow oil operations to continue in that area while avoiding oil structures from crossing adjacent water bodies. The precise location was chosen due to its proximity to Pacific Coast Highway and the high degree of degradation that presently exists there.

4. Oil Park 4 is in an area currently home to extensive oil mules and infrastructure. Access to Oil Park 4 will be possible through the access road that enters the property off of Regency Drive.

Construction Staging

Construction staging areas are necessary in order to manage the mechanical aspects of the restoration project. The Kruger Dunes, the Los Cerritos Wetlands Nature Center and the parking area off of Pacific Coast Highway will be used as construction staging areas while the remainder of the wetland complex begins the restoration process. As a result, these three areas will be among the last areas of completion. The regions were chosen due to their central location and the extent of their post-restoration ecological function.

Levees

The natural levee on the southern border of Steam Shovel Slough will be modified to create Wally Island. In doing this, water from Steam Shovel Slough will be dispersed into channels and creeks that span throughout the parcel.

Portions of the San Gabriel River and Haynes Cooling Channel levees must be modified to provide a main water source for restored areas. A break in the northern wall of the San Gabriel River levee is necessary to feed 404 Bay, Darwin and Zedler Marshes and act as a saltwater source for the rest of the channels and creeks associated with the central area of the wetlands.

A small break in the southernmost portion of the Haynes Cooling Channel is necessary to feed Cardoza Channel and act as a saltwater source for the southern portion of the property. Levees off of the Haynes Cooling Channel were modified in only one location so interaction with the Haynes Steam Plant upstream could be kept at a minimum.

Culverts

Culverts will be constructed wherever possible to reduce the amount of levee modifications. Additionally, culverts are an efficient method of introducing a water source to a new area. At present, a small underground culvert in the Haynes Cooling Channel serves to supply a separate channel with water that flows through the southern portion of the property. This culvert will be removed in place of the Haynes Cooling Channel levee modification.

1. Two culverts currently exist and connect Steam Shovel Slough to Lenny's Lagoons.

2. Three additional culverts will be constructed to bring saltwater into the ponds with the intention of creating a brackish water habitat.

3. Four culverts are to be constructed along the San Gabriel River to provide a water source for portions of Zedler Marsh and Muir Ponds.

4. One culvert is to be constructed along the southwest edge of the Orange County Retention Basin to act as a spillway during large flood events.

Urban Impacts

Enhanced trash booms will be placed along the openings of Steam Shovel Slough, 404 Bay, and Cardoza Channel to prevent trash from entering the main water source. The California State University, Long Beach 2009 Political Science Team is currently executing trash surveys at nearby wetlands to help set trash TMDLs (Total Maximum Daily Load). Installing trash booms will significantly improve water quality conditions of the wetlands.

Small amounts of light pollution in an urban restoration project are inevitable, though there are many sources of light pollution that currently exist surrounding the restoration site. Just west of Steam Shovel Slough, across Pacific Coast Highway in the Marina Pacifica Shopping Center is the Best Buy Store sign. The Best Buy sign is an extremely bright light source that stays on throughout the evening, conspicuously intruding the late night serenity of Steam Shovel Slough. Tall willow trees (*Salix sp.*) will be planted to create a light pollution barrier along the eastern edge of Pacific Coast Highway north of Second Street. In addition, light shields will be installed on all streetlights that surround the restoration site to further minimize effects of light pollution.

The City of Long Beach has constructed curbs along Pacific Coast Highway, Second Street, Studebaker Road, and Westminster Avenue in an attempt to control urban runoff. The curbs will be removed during restoration to allow runoff to spread out evenly into the freshwater ponds and bioswales surrounding the complex.

Education Plan

An important goal of this restoration project is to increase public awareness of the Los Cerritos Wetlands through education. An extensive trail system, the Los Cerritos Wetlands Nature Center, viewing platforms, and bird blinds will all serve as tools to educate the public.

Trails

An extensive trail system will be constructed that will connect the restoration site from Least Tern Recreation Area to Gum Grove Park and Tongva Pond. The primary goal of the trail system is to allow for close public interaction with nature without adversely affecting the ecological health of the restoration site. Prickly pear cactus (*Opuntia littoralis*) can be placed along trail edges in designated areas to deter visitors from leaving trails and entering the sensitive marsh habitat.

1. Belding's Trail is designed to be starting point from the Los Cerritos Wetlands Nature Center. The trail is centrally located and transects primarily through upland coastal sage scrub habitat. Belding's Trail gives visitors a beautiful view of the restoration site from Steam Shovel Slough to Shopkeepers Ponds. Included in the viewshed of this trail is Belding's Island, where many pairs of the endangered Belding's Savannah Sparrow will nest and feed. A raised boardwalk will guide visitors through both transition zones and salt marsh areas to get a closer look at both Belding's and Studebaker Islands. Raised boardwalks allow visitors to experience nature intimately without disturbing sensitive habitat.

2. Clapper Rail Trail begins at the south side of Loynes Drive, within Least Tern Recreation Area. This trail was designed to lead to an elevated viewing platform, which will provide a beautiful view of the Los Cerritos Channel, Least Tern Nesting Site, and Steam Shovel Slough. Kiosks will be installed along Clapper Rail Trail to provide additional information to visitors regarding the importance of wetlands to the community.

3. Studebaker Trail is an extension of Studebaker Road and will include a raised boardwalk that follows Studebaker Peninsula. Along the middle of Studebaker Trail is a path that veers west and leads to a bird blind for bird viewing. Bird activity will be monitored and available on the Los Cerritos Wetlands Nature Center via webcam from the bird blind station. See more about the bird blind below.

4. A walking path along the northern levee of the San Gabriel River will extend from Westminster Avenue to Kruger Dunes and Pacific Coast Highway. The Kruger Dunes will be raised and act as an elevated viewing platform using excess fill material from the restoration site. A bike path along the southern levee of the San Gabriel River currently exists and extends from Westminster Avenue to Pacific Coast Highway.

5. Zedler Trail is designed to follow alongside the existing bike trail and will extend from Westminster Avenue to Pacific Coast Highway. This walking path will include areas of raised boardwalk that allow visitors to experience the Zedler Marsh system at a close proximity without disturbing sensitive habitat. The southernmost half of Zedler Trail follows the northern levee of the Haynes Cooling Channel with portions of raised boardwalk to explore the Zedler Marsh system at a safe distance.

6. Timmy’s Trail begins at the parking lot along the southwestern edge of the property, off of Pacific Coast Highway. This trail was designed to follow the unique upland coastal sage scrub and alkali meadow habitats of the southernmost portion of the restoration site, giving visitors a view of the entire southern portion of the restoration site. Two smaller trails lead north near the western edge of Gum Grove Park and Forager’s Field. These smaller trails are designed to take visitors to the edge of the salt marsh habitat, where they will be provided with benches and informational kiosks regarding general wetlands information.

7. Tongva Trail runs from the eastern entrance of Gum Grove Park to the end of Tongva Pond. This trail currently exists as part of a separate restoration project and no modifications are necessary.

Los Cerritos Wetlands Nature Center

The Los Cerritos Wetlands Nature Center will be located on the northwest corner of the Studebaker Road and Second Street intersection. The exterior of the nature center will include small freshwater ponds with native freshwater vegetation and a public parking area. The Los Cerritos Nature Center itself will be a two-story education center designed to educate the public about wetlands ecology and restoration. The lower level of the nature center will be built as an interactive wetlands ecology learning center. The public will have the opportunity to learn about the habitats that exist within the Los Cerritos Wetlands complex, actions that are being taken to maintain a healthy wetlands habitat, and opportunities for individuals to become involved in wetlands restoration. The upper level will be reserved for the use of schools; it will be built as a classroom that incorporates basic lab instrumentation to cultivate the environmental conceptions of local students of all ages.

Bird Blind

A three-sided bird blind will be built on the peninsula extending into Muir Pond. The structure will be built into the ground, creating a viewing window that is closer to ground level; this construction style will afford a better view of the low-lying feeding and nesting habits of the birds that will likely be found in the area. In addition, we hope to install a webcam into the bird blind that will serve for both public enrichment and education opportunities for any schools that wish to engage their students in regular observations.

Fill Material

The nature of this project requires large areas of earth to be mechanically excavated in order to create mudflats, tidal channels, and intertidal creeks. The result of this excavation will be an abundance of fill material, which is expensive to dispose of off-site. There are four options to dispose of excess fill material:

1. Consolidate the clean fill material into specified areas to create elevated viewing platforms. An example of this can be seen at the Bolsa Chica Ecological Reserve. This is the preferred method of fill material disposal, as it is the most efficient and cost-effective method of disposal. There are two elevated viewing platforms composed of fill material included in this plan.
2. Consolidate the clean fill material into specified areas to create elevated nesting sites. Raised nesting sites are designed to protect juvenile birds during nesting season by decreasing accessibility to predators.
3. Manipulate the clean fill material to create topographical features that will increase vegetation diversity in terms of zonation. Topographic complexity enhances species richness and provides additional nesting habitat (Desmond, 1996). Fill material could also be used as a cap to cover the former landfill on the southwest corner of the wetlands complex.
4. Transport fill material to an off-site location to be disposed of conventionally. Off-site disposal is not the preferred method of fill material disposal due to the fact that this method is significantly more expensive and provides less benefit to the public. The soil must be treated through bio-remediation or transported to an off-site location for remediation if soil assessments within the site show that the soil is unsuitable for restoration. Costs to transport contaminated material off-site can be as high as $100 per cubic yard (Moffatt and Nichol, 2007).

Plant Propagation

Plant palettes should be developed after grading plans and soil assessments have been finalized. All plant species to be planted within the restoration site will be native California plants using seedlings acquired from local native nurseries. Possible local native plant nurseries include the Theodore Payne Foundation, El Nativo Growers, Las Pilitas Nursery, RECON Native Plants, and Tree Of Life Nursery. Plant palettes can be established by emulating vegetation patterns of similar local wetland habitats. The Bolsa Chica Wetlands, Anaheim Bay, Ballona Wetland, San Dieguito Lagoon, Los Peñasquitos Lagoon, Crown Point, Sweetwater Marsh, Connector Marsh, Tijuana Estuary, and San Quintín Bay are local wetland habitats facing similar constraints and can serve as models in terms of planting schemes and case studies in a larger ecological context (Zedler, 2001). See Appendix for a full species list of possible plants for the restoration site.

Numerous precautions must be taken before a planting scheme is implemented. Many wetland restoration sites can have hypersaline soils due to a lack of tidal flushing, though this can be alleviated by the introduction of tidal flushing (Zedler, 2001). Furthermore, elevation, timing, fertilization, irrigation, plant size, plant density, species density and distribution, and sun hardening are all important aspects to consider when developing a planting scheme (Zedler, 2001).

The installation of California locoweed (*Astragalus trichopodus var. lonchus*) and common deerweed (*Lotus scoparius*) in upland coastal sage scrub regions may allow for the introduction of the federally endangered Palos Verdes blue butterfly (*Glaucopsyche lygdamus palosverdesensis*). This once extinct species of butterfly can flourish once more if given the proper channels. Given the fragile history of the rare Palos Verdes blue butterfly it is important to implement appropriate methods of management to care for the sensitive habitat. California locoweed and common deerweed are early successional plants, meaning that, over time, they will be replaced by more competitive k-selected species if left to natural succession (Smith and Smith, 2006). It is imperative that these early successional plants are maintained as a host species to aid in the success of the Palos Verdes blue butterfly.

Management and Maintenance

An adaptive management approach should be used to monitor the health of the restoration site. Adaptive management reduces the risk of failure by allowing for midcourse corrections and adjustments to the plan (Zedler, 2001). A management team can monitor and conduct research within the restoration site to identify possible shortcomings and alter the plan on a case-by-case basis. Adaptive management strategies, combined with continued research and proper site maintenance, will aid in the success of this restoration project.

Fencing to discourage species disturbance during initial restoration years will allow for greater establishment and increased success. The Area 18 Nesting Site is raised and surrounded by a tidal creek, though a fence should be constructed for additional protection. In addition to fencing, Prickly pear cactus (*Opuntia littoralis*) is to be planted in near trails to discourage off-trail recreation and decrease human disturbance.

Non-native vegetation provides a challenge for any urban restoration project. The average percent cover of non-native species within the salt marsh-upland transition zone of the Los Cerritos Wetlands is 51.11% (Zahn, 2008). A proper planting scheme will address non-native vegetation removal and maintenance. See Appendix for a full list of non-native species observed within areas of the transition zones of the restoration site.

Conclusion

The primary goal of this habitat restoration plan is to provide a proper ecological framework for enhancing the Los Cerritos Wetlands, while at the same time identifying opportunities and constraints of the restoration site. This plan will change as additional data are collected, which will result in a better understanding of what is capable at the Los Cerritos Wetlands in terms of restoration opportunities. The habitat delineations presented in this report reflect qualitative restoration theory and are subject to change as more research is completed.

There are further considerations not addressed in this restoration plan that must be taken into account when developing a master plan for the Los Cerritos Wetlands. Grading plans must be created before mechanically excavating any portion of the complex to establish tidal creeks and channels. Rough grading plans have been created for the southern portion of the property, though the plans are simplified version of what is required in a master plan (Moffatt and Nichol, 2007). Additionally, hydrologic conditions need to be analyzed to determine which modifications can be made to the restoration site (Coats et al., 1995). Substrate conditions directly affect plant growth, invertebrate colonization, and many other factors (Zedler, 2001). In addition to hydrologic conditions and grading plans, current conditions of soil texture, organic content, nutrients, soil salinity and pH must be analyzed before developing a master plan.

This plan assumes that the Los Cerritos Wetlands Authority has acquired all land within the restoration site. Restoration is inherently dependent on sharing resources within the property and requires connectivity among each parcel. A restoration plan executed in phases is to be developed if land acquisition is delayed or halted. Phasing will expedite the restoration process and allow for work to begin sooner.

This plan assumes that oil infrastructure has been consolidated to designated areas within the Los Cerritos Wetlands Complex. Though oil operations will eventually cease to exist on the restoration site, working with oil companies will allow for an expedited restoration process. This plan also assumes that most non-native vegetation has been removed prior to planting.

References

Batiquitos Lagoon Foundation. “Fish: Fishes of the Lagoon.” 2 May 2009. <www.batiquitosfoundation.org/newsite/downloads/Factsheet_Fish.pdf>

Blakely, Ron. “Coastal Dunes, Pismo Beach, CA.” No date. Online image. Oceanography. 6 May 2009. <jan.ucc.nau.edu/~rcb7/Oceanography.html>.

Blodget, B.G. “The effect of off-road vehicles on least terns and other shorebirds.” M.S. Thesis, University of Massachusetts, Amherst, MA. (1978): 79.

Boesch, D.F. and Turner, R.E. “Dependence of fishery species on salt marsh: the role of food and refuge.” *Estuaries* 7 (1984): 460-468. Print.

Bowler, P.; Elvin, M. “Vascular Plant Checklist for the University of California Natural Reserve System’s San Joaquin Freshwater Marsh Reserve.” Crossosoma, 2003 <nrs.ucop.edu/Reserves/sjfm/moreinfo.html>.

California Environmental Resources Evaluation System (CERES). "CWIS -- California Coastal Act." Last updated 13 Aug. 1998. Obtained 06 May 2009. <http://ceres.ca.gov/wetlands/permitting/cca_summary.html>.

California Native Grasslands Association. “Restoring the Grasslands of Northern California’s Coastal Dunes.” Grasslands. Vol. XVII, No. 1. Winter 2008. <www.fws.gov/humboldtbay/pdfs/grasslandsarticle.pdf>.

Casanova, J; Dark, S; Grossinger, R; Hall, N; Stein, E. “Historical Ecology and Landscape Change of the San Gabriel River and Floodplain.” SCCWRP Technical Report #499.

Carreker, R.G. Habitat suitability index models: least tern. 1985. FWS/OBS- Biological Report 82(10.103): 29.

Coats, R. N., P. B. Williams, C. K. Cuffe, J. B. Zedler, D. Reed, S. M. Waltry, and J. S. Noller. 1995. Design guidelines for tidal channels in coastal wetlands. Philip Williams & Associates, Ltd., San Francisco, California, USA.

Costa, Joe. “Eelgrass in shallow waters at Uncatena Island.” No date. Online image. Eelgrass in Buzzards Bay. 6 May 2009. <www.buzzardsbay.org/eelgrass.htm>.

Costanza, Robert. "The value of the world's ecosystem services and natural capital." *Nature* 387(1997): Print.

Guadalupe Restoration Project. “Guadalupe Oil Field.” Last updated 2008. <http://www.guaddunes.com/plants.html>.

Hall, Darwin. "Application of Law and Doctrine to the Los Cerritos Wetlands Complex." ES_P 400. California State University, Long Beach, Long Beach. 02 Feb. 2009.

Hunter, M.L., Jr. “Least tern breeding range extension in Maine.” (1975). Auk 92(1):143-144.

Keeler, Todd. “Sacramento National Wildlife Refuge, USA.” No date. Online image. California Central Valley Grasslands. 6 May 2009. <www.worldwildlife.org/wildworld/ profiles/terrestrial/na/na1201_full.html>.

Klee, Gary A. The Coastal Environment Toward Integrated Coastal and Marine Sanctuary Management. Upper Saddle River, NJ: Prentice Hall, 1999.

Kucas, Stephen T. and Hassler, Thomas J. “Species Profiles: Life histories and environmental requirements of coastal fishes and invertebrates; Pacific Southwest.”(April 1986): 11-44.

Landsman, Nicholas. Priority organic pollutant analysis of sediment cores and water samples from Los Cerritos Wetlands. September 30, 2006. IIRMES Annual Report: Undergrad ES&P CSULB. pp 49-50.

Longcore, T., R. Mattoni, and A. Mattoni. 2005. Salvage of individual pupae as a mitigation for loss of Palos Verdes blue butterfly habitat. *Journal of the Lepidopterists’ Society* 59(1):10–11.

McHugh, J.L.. "Estuarine Nekton." *Estuaries* 83(1967): 581-619. Print

MLPA Master Plan Science Advisory Team. December 6, 2008. “Draft Criteria for List of Species Likely to Benefit from MPAs in the MLPA South Coast Study Region”. Document M-1.

Moffatt and Nichol. “Alamitos Bay Circulation Study: Final Report.” August 30, 2007. Prepared for City of Long Beach Department of Public Works.

National Park Service. “Coastal Dune Scrub Community.” Last updated 2008. <http://www.nps.gov/prsf/naturescience/coastal-dune-scrub-community.htm>.

National Park Service. “Meeting the Natives.” Last updated 2009. <http://www.nps.gov/archive/cabr/florplnt.html>.

Olson, David. “Coastal sage scrub near Oceanside, CA.” No date. California Coastal Sage and Chaparral. 6 May 2009. <www.worldwildlife.org/wildworld/ profiles/terrestrial/na/na1201_full.html>.

Owen, Oliver S., and Daniel D. Chiras. 1995. *Natural Resource Conservation: Management for a Sustainable Future.* 6th ed. Englewood Cliffs: Prentice Hall.

Pickart, Andrea. “Freshwater marsh.” 7 Feb 2009. Online image. Humboldt Bay National Wildlife Complex, Pacific Southwest Region. 6 May 2009. <www.fws.gov/humboldtbay/habitats.html>.

Reiser, C. “Rare Plants of San Diego County.” May 1994. Sierra Club: San Diego Chapter.

San Mateo Coast Natural History Association. “Pescadero Marsh.” No date. Online image. Pescadero Marsh Natural Preserve. 6 May 2009. <sanmateocoastnha.org/pages/marsh.html>.

Santa Monica Bay Foundation. Nov. 18, 2006. “Descriptions of Typical Southern California Estuarine Ecosystems.” Ballona Wetlands Design Charrette. http://www.santamonicabay.org/smbay/Portals/0/ballona/Habitat_Description_v5.pdf

Small, Mary. 2005. Los Cerritos Wetlands Joint Powers Authority; File No. 98-015. Coastal Conservancy.

Smith, T. M. and R. L. Smith. Elements of Ecology: Sixth Edition. San Francisco: Pearson Education, 2006.

South Slough National Estuarine. Research Reserve. “Meandering tidal creek in the Winchester Tidelands Restoration Project. No date. Online image. NOAA Coastal Services Center. 6 May 2009. <www.csc.noaa.gov/coastal/implementation/implementation.htm>.

Thompson, B.C., J.A. Jackson, J. Burger, L.A. Hill, E.M. Kirsch, and J.L. Atwood. “Least tern.” *The Birds of North America*. (1997): 290.

U.S. Environmental Protection Agency. "Basic Information | Cooling Water Intake Structures - CWA Section 316(b) | US EPA." 02 June 2008. 06 May 2009 <http://www.epa.gov/waterscience/316b/basic.htm>.

U.S. Environmental Protection Agency. "Clean Water Act." Last updated 06 April 2009. Obtained 06 May 2009. <http://yosemite.epa.gov/R10/WATER.NSF/TMDLs/CWA+303d+List#Regulations>.

U.S. Environmental Protection Agency. "Clean Water Act Overview | Emergency Management | US EPA." Last updated 17 March 2009. Obtained 06 May 2009 <http://www.epa.gov/oem/content/lawsregs/cwaover.htm>.

U.S. Environmental Protection Agency. “Fish and Wild Habitat.” Last updated 16 January 2003. <http://www.epa.gov/owow/wetlands/fish.html>.

U.S. Environmental Protection Agency. “Oceans, Coasts, and Estuaries.” Last updated 31 Aug. 2007. 6 May 2009 <http://www.epa.gov/owow/invasive_species/invasives_management/cwa402.html>.

U.S. Fish and Wildlife Service, Alaska Region. "Migratory Bird Treaty Act: Summary from Federal Wildlife Laws Handbook." Obtained 06 May 2009 <http://alaska.fws.gov/ambcc/ambcc/treaty_act.htm>.

U.S. Fish and Wildlife Service. "Western Snowy Plover Natural History and Population Trends." May 2001. *Western Snowy Plover Pacific Coast Population Draft Recovery Plan.*

Western Solutions, Inc. August 2005. San Gabriel River Watershed Management Area: Final Report.

Wong, Richard. "Bolsa Chica Ecological Reserve." No date. Online image. California Coast Pictures: Photos of San Diego and Orange County. 6 May 2009. <www.rwongphoto.com/SoCalCoast.html>

World Wildlife. "California Coastal Sage and Chaparral." Full Report. 2001. <http://www.worldwildlife.org/wildworld/profiles/terrestrial/na/na1201_full.html>.

Zahn, E. "Ecology of Southern California's Coastal Salt Marshes." March 16, 2009: Lecture.

Zedler, J. "Assessing the Functions of Mitigation Marshes in Southern California." Preceedings of the National Wetlands Symposium: Urban Wetlands. June 26-29, 1988. Oakland, CA.

Zedler, J. 2001. Handbook for Restoring Tidal Wetlands. CRC Press: Boca Raton, Florida.

Appendix

Table 1 – Expected Bird Species after the Restoration of the Los Cerritos Wetlands Complex

Scientific Name	Common Name	Protection
Accipiter cooperii	Cooper's Hawk	MBTA
Actitis macularia	Spotted sandpiper	MBTA
Aechmophorus clarkii	Clark's Grebe	MBTA
Aechmophorus occidentalis	Western Grebe	MBTA
Agelaius phoeniceus	Red-winged Blackbird	MBTA
Anas acuta	Northern Pintail	MBTA
Anas americana	American Widgeon	MBTA
Anas clypeata	Northern Shoveler	MBTA
Anas crecca	Green-Winged Teal	MBTA
Anas cyanoptera	Cinnamon Teal	MBTA
Anas discors	Blue-Winged Teal	MBTA
Anas platyrhynchos	Mallard	MBTA
Anas strepera	Gadwall	MBTA
Anthus rubescens	American Pipit	MBTA
Ardea alba	Great Egret	MBTA
Ardea herodias	Great Blue Heron	MBTA
Asio flammeus	Short-eared Owl	MBTA
Aythya affinis	Lesser Scaup	MBTA
Aythya marila	Greater Scaup	MBTA
Branta canadensis	Canada Geese	MBTA
Bombycilla cedrorum	Cedar Waxwing	MBTA
Bucephala albeola	Bufflehead	MBTA
Buteo jamaicensis	Red Tailed Hawk	MBTA
Buteo lineatus	Red Shouldered Hawk	MBTA
Butorides virescens	Green Heron	MBTA
Calidris alba	Sanderling	MBTA
Calidris alpina	Dunlin	MBTA
Calidris minutilla	Least Sandpiper	MBTA
Calidris mauri	Western Sandpiper	MBTA
Calidris pusilla	Semipalmated Sandpiper	MBTA
Calypte anna	Anna's Hummingbird	MBTA
Carduelis tristis	American Goldfinch	MBTA
Carduelis psaltria	Lesser Goldfinch	MBTA
Cathartes auras	Turkey Vulture	MBTA
Catoptrophorus semipalmatus	Willet	MBTA
Carpadacus mexicanus	House Finch	MBTA
Ceryle alcyon	Belted Kingfisher	MBTA
Charadrius alexandrinus	Snowy Plover	MBTA, CESA
Charadrius semipalmatus	Semipalmated Plover	MBTA
Charadrius vociferous	Killdeer	MBTA
Circus cyaneus	Northern Harrier	MBTA
Cistothorus palustris	Marsh Wren	MBTA
Columba livia	Rock Pigeon	None
Corvus brachyrhynchos	American Crow	MBTA
Dendroica coronata	Yellow-rumped Warbler	MBTA
Dendroica petechia	Yellow Warbler	MBTA
Egreta thula	Snowy Egret	MBTA
Elanus leucurus	White Tailed Kite	MBTA
Falco sparverius	American Kestrel	MBTA

Fulica americana	American Coot	MBTA
Himantopus mexicanus	Black-necked Stilt	MBTA
Hirundo rustica	Barn Swallow	MBTA
Icterus cucullatus	Hooded Oriole	MBTA
Gallinula chloropus	Common Moorhen	MBTA
Gavia immer	Common Loon	MBTA
Gavia pacifica	Pacific Loon	MBTA
Geothlypis trichas	Common Yellowthroat	MBTA
Lanius ludovicianus	Loggerhead Shrike	MBTA
Larus argentatus	Herring Gull	MBTA
Larus californicus	California Gull	MBTA
Larus delawarensis	Ring-Billed Gull	MBTA
Larus hermanni	Herman's gull	MBTA
Larus occidentalis	Western Gull	MBTA
Limnodromus griseus	Short-billed Dowitcher	MBTA
Limnodromus scolopaceus	Long-Billed Dowitcher	MBTA
Limosa fedosa	Marbled Godwit	MBTA
Lonchura punctulata	Nutmeg Minikin	None
Megaceryle alcyon	Belted King Fisher	MBTA
Melospiza melodia	Song Sparrow	MBTA
Mergus serrator	Red-Brested Merganser	MBTA
Mimus polyglottos	Northern Mockingbird	MBTA
Molothrus ater	Brown-headed Cowbird	MBTA
Myiarchus cinerascens	Ash-throated Flycatcher	MBTA
Numenius americanus	Long Billed Curlew	MBTA
Numenius phaeopus	Whimbrel	MBTA
Nycticorax nycticorax	Black-crowned Night Heron	MBTA
Oxyura jamaicensis	Ruddy Duck	MBTA
Pandion haliaetus	Osprey	MBTA
Passer domesticus	House Sparrow	None
Passerculus sandwichensis	Upland Savannah Sparrow	MBTA
Passerculus sandwichensis beldingi	Belding's Savannah Sparrow	CESA
Pelecanus occidentalis	California Brown Pelican	MBTA, ESA, CESA
Petrochelidon pyrrhonota	Cliff Swallow	MBTA
Phalacrocorax auritus	Double-Crested Cormorants	MBTA
Phalaropus lobatus	Red-necked Phalarope	MBTA
Phalaropus tricolor	Wilson's Phalarope	MBTA
Picoides pubescens	Downy Woodpecker	MBTA
Pipilo crissalis	California Towhee	MBTA
Pluvialis squatarola	Black-Bellied Plover	MBTA
Podiceps auritus	Horned Grebe	MBTA
Podiceps nigricollis	Eared Grebe	MBTA
Podilymbus podiceps	Pied Billed Grebe	MBTA
Quiscalus mexicana	Great-tailed Grackle	MBTA
Quiscalus quiscula	Common Grackle	MBTA
Rallus longirostris levipes	Light-Footed Clapper Rail	MBTA, ESA, CESA
Recurvirostra americana	American Avocet	MBTA
Regulus calendula	Ruby-crowned Kinglet	MBTA
Rynchops niger	Black Skimmer	MBTA
Sayornis nigricans	Black Pheobe	MBTA
Sayornis saya	Say's Pheobe	MBTA
Selasphorus sasin	Allen's Hummingbird	MBTA
Stelgidopteryx serripennis	Northern Rough-winged Swallow	MBTA

Sterna antillarum browni	California Least Tern	MBTA, ESA, CESA
Sterna caspia	Caspian Tern	MBTA
Sterna elegans	Elegant Tern	MBTA
Sterna forsteri	Forster's Tern	MBTA
Sternula antillarum browni	Least Tern	MBTA, ESA, CESA
Sturnella neglecta	Western Meadowlark	MBTA
Sternus vulgaris	European Starling	None
Tachycineta bicolor	Tree Swallow	MBTA
Tringa melanoleuca	Greater Yellowlegs	MBTA
Tringa semipalmatus	Willet	MBTA
Tyrannus verticalis	Western Kingbird -	MBTA
Tyrannus vociferans	Cassin's Kingbird	MBTA
Vermivora celata	Orange-crowned Warbler	MBTA
Vireo cassinii	Cassin's Vireo	None
Vireo gilvus	Warbling Vireo	MBTA
Wilsonia pusilla	Wilson's Warbler	MBTA
Zenaida macroura	Mourning Dove	MBTA
Zonotrichia leucophrys	White Crowned Sparrow	MBTA

Fish and Wildlife Service: Endangered Species Program, 2008; Fish and Wildlife Service: MBTA Alpha List; NatureServe, 2009; Bird Sightings Data: ES&P Biology Team, 2007; Zahn, 2009

*Key
MBTA: Migratory Bird Treaty Act
ESA: U.S. Endangered Species Act
CESA: California Endangered Species Act

Table 2 – Expected Invertebrate Species after the Restoration of the Los Cerritos Wetlands Complex

Scientific Names	**Common Name**	**Protection**
Ammothella biunguiculata var. *californica*	Sea Spider	None
Aplysia californica	Sea Hare	None
Brephidium exilis	Pygmy Blue Butterfly	None
Bulla gouldiana	Cloudy Bubble Snail	None
Callianassa californiensis	Red Ghost Shrimp	None
Cerithidea californica	California Horn Snail	None
Cicindela californica	California Tiger Beetle	ESA
Cicindela trifasciata sigmoidea	Mudflat Tiger Beetle	None
Crytomya californica	California Jackknife Clam	None
Hemigrapsus nudus	Purple Shore Crab	None
Macoma nasuta	Bent Nose Clam	None
Nephtys caecoides	Fire Worm	None
Navanax inermis	Striped Sea Hare	None
Octopus bimaculoides	Two Spotted Octopus	None
Pachygrapsus crassipes	Striped Shore Crab	None
Panoquina errans	Wandering Skipper	None
Polliceps polymerus	Gooseneck Barnacle	None
Polydora sp.	Spinoid Worms	None
Sanquinolaria nuttalli	Purple Clams	None
Solen rosaceus	Razor Clam	None
Tagelus californianus	California Jackknife Clam	None
Uca crenulata	Fiddler Crab	None
Urechis caupo	Inn-Keeper Worm	None

Fish and Wildlife Service: Endangered Species Program, 2008; NatureServe, 2009; Zahn, 2009
*Key
ESA: U.S. Endangered Species Act

Table 3 – Expected Fish Species after the Restoration of the Los Cerritos Wetlands Complex

Scientific Name	Common Name	Protection
Acanthogobius flavimanus	Yellow-Finned Goby	None
Atherinops affinis	Topsmelt	None
Atractoscion nobilis	White Seabass	None
Clevelandia ios	Arrow Gobi	None
Clupea pallasii	Pacific Herring	None
Cymatogaster aggregata	Shiner Surfperch	None
Engraulis mordax	Northern Anchovy	None
Fundulus parvipinnis	California Killifish	None
Gillichthys mirabilis	Longjaw Mudsucker	None
Hypsoblennus gentilis	Bay Blenny	None
Hypsopsetta guttulata	Diamond Turbot	None
Leptocottus armatus	Staghorn Sculpin	None
Leuresthes tenius	California Grunion	None
Mugil cephalus	Striped Mullet	None
Mustelus californicus	Gray Smoothhound Shark	None
Paralichthys californicus	California Halibut	None
Rhinobatos productus	Shovelnose Guitarfish	None
Syngnathus griseolineatus	Bay Pipefish	None
Triakis semifasciata	Leopard Shark	None
Urobatis haleri	Round Sting Ray	None

Fish and Wildlife Service: Endangered Species Program, 2008; NatureServe, 2009; Zahn, 2009

Table 4 – Expected Reptile Species after the Restoration of the Los Cerritos Wetlands Complex

Scientific Name	Common Name	Protection
Chelonia mydas	Green Sea Turtle	ESA, CESA
Gerrhonotus multicarinatus	Southern Alligator Lizard	None
Lampropeltis getula californiae	King Snake	None
Pituophis catenifer	Gopher Snake	None
Sceloporus occidentalis	Western Fence Lizard	None
Uta stansburiana	Side Blotched Lizard	None

Fish and Wildlife Service: Endangered Species Program, 2008; NatureServe, 2009

*Key
ESA: U.S. Endangered Species Act
CESA: California Endangered Species Act

Table 5 – Expected Bird Species after the Restoration of the Los Cerritos Wetlands Complex

Scientific Name	Common Name	Protection
Canis latrans	Coyote	None
Citellus beecheyi beecheyi	California Ground Squirrel	None
Lynx rufus	Bobcat	None
Phoca vitulina	Harbor Seal	MMPA
Reithrodontomys megalotis	Western Harvest Mouse	None
Reithrodontomys raviventris	Saltmarsh Harvest Mouse	ESA, CESA
Zalophus californianus	California Sea Lion	MMPA

Fish and Wildlife Service: Endangered Species Program, 2008; NatureServe, 2009; Zahn, 2009

*Key
ESA: U.S. Endangered Species Act
CESA: California Endangered Species Act
MMPA: Marine Mammal Protection Act

Table 6 – Expected Flora after the Restoration of the Los Cerritos Wetlands Complex

Scientific Name	**Common Name**	**Protection**	**S**	**SM**	**BM**	**FM**	**I**	**T**	**D/S**	**CSS**	**AM**
Abronia latifolia	Yellow Sand Verbena	None							*		
Abronia umbellata	Pink Sand Verbena	None							*		
Abronia umbellata breviflora	Pink Sand Verbena	None							*		
Ambrosia chamissonis	Beach Bur	None							*		
Artemisia californica	California Sagebrush	None								*	
Atriplex californica	California Saltbush	None						*			
Atriplex watsonii	Watson's Saltbush	None		*							
Baccharis salicifolia	Mulefat	None								*	
Baccharis pilularis	Coyote Bush	None							*		
Batis maritima	Salt Wort	None		*							
Bolboschoenus maritimus	Bulrush	None				*					
Camissonia californica	California Suncup	None							*	*	*
Camissonia cherianthifolia	Beach Primrose	None							*		
Cressa truxillensis	Alkaliweed	None		*			*				
Cuscuta salina	Saltmarsh Dodder	None		*							
Distichlis spicata	Salt Grass	None		*				*			*
Encelia californica	California Sunflower	None								*	
Ericameria ericoides	Mock Heather	None							*		
Eriogonum fasciculatum	California Buckwheat	None								*	
Eriophyllum staechadifoliur	Seaside Wooly Sunflower	None							*		
Frankenia palmeri	Palmer's Frankenia	None						*	*		
Frankenia salina	Alkali Heath	None		*							
Heteromeles arbutifolia	Toyon	None								*	
Isocoma menziesii	Goldenbush	None								*	
Jaumea carnosa	Fleshy Jaumea	None		*							
Juncus acutus	Spiny Rush	None			*			*			
Leymus triticoides	Alkali Ryegrass	None						*			
Limonium californicum	California Sealavender	None		*							
Lupinus arboreus	Bush Lupine	None							*		
Lupinus chamissonis	Dune Lupine	None							*		
Lycium californicum	Boxthorn	None						*			
Mimulus aurantiacus	Sticky Monkeyflower	None							*		
Monanthochloe littoralis	Shoregrass	None		*							
Opuntia littoralis	Coastal Prickly Pear	None								*	
Poa macrantha	Beach Bluegrass	None							*		
Rhamnus californica	California Coffeeberry	None							*		
Rhus integrifolia	Lemonade Berry	None								*	
Ruppia maritima	Ditch grass	None		*	*						
Salicornia bigelovii	Pickleweed	None		*							
Salicornia virginica	Annual Pickleweed	None		*							
Salicornia subterminalis	Glasswort	None		*							
Salvia apiana	White Sage	None								*	
Salvia mellifera	Black Sage	None								*	
Salvia munzii	Munz's Sage	None								*	
Schoenoplectus americanus	Bulrush	None				*					
Scirpus spp.	Bulrush/Tule Grass	None						*			
Scirpus californicus	Bulrush	None			*	*		*			
Spartina foliosa	Cordgrass	None		*							
Sueada calceoliformis	Horned Sea-blite	None		*							
Suaeda californica	California Sea-blite	ESA		*							

Suaeda esteroa	Sea-blite	None		*							
Suaeda maquinii	Bush Seepweed	None						*			
Sueada taxifolia	Wholly Sea-blite	None						*			
Toxicodendron diversilobur	Poison Oak	None							*		
Triglochin concina	Arrow Grass	None		*							
Typha angustifolia	Cattail	None				*					
Typha domingensis	Cattail	None			*	*					
Typha latifolia	Cattail	None				*					
Zostera marina	Eelgrass	None	*								

Fish and Wildlife Service: Endangered Species Program, 2008; NatureServe, 2009: Zahn, 2009

*Key
S: Subtidal Zone
SM: Salt Marsh
BM: Brackish Marsh
FM: Freshwater Marsh
I: Intertidal Zone
T: Transition Zone
D/S: Dune/Dune Scrub
CSS: Coastal Sage Scrub
AM: Alkali Meadow

Table 7 - Non-native plants found within Los Cerritos Wetlands as observed by the 2008 ES&P Biology Team.

Scientific Name	**Common Name**
Atriplex semibaccata	Australian saltbush
Baccharis pilularis	Coyotebush
Bassia hyssopifolia	Smotherweed
Brassica nigra	Black mustard
Bromus diandrus	Ripgut grass
Bromus madritensis	Red brome
Centaurea melitensis	Tocalote
Erodium cicutarium	Redstem stork's bill
Hordeum vulgare	Farmer's foxtail
Lolium multiflorum	Italian ryegrass
Malva parviflorum	Cheeseweed
Melilotus alba	White sweetclover
Melilotus indica	Yellow sweetclover
Mesymbryanthemum crystallimum	Crystal iceplant
Mesymbryanthemum nodiflorum	Little iceplant
Myoporum laetum	Lollypop tree
Parapholis incurva	European sicklegrass
Plantago sp.	Plantain
Polypogon monspeliensis	Rabbitfoot beardgrass
Raphanus sativa	Wild radish
Salsola tragus	Russian thistle
Silybum marianum	Milk thistle
Sisymbrium sp.	Short pod mustard
Solamum sp.	Nightshade
Sonchus oleraceus	Sow thistle

Table 8 - Bird species sighted in the Los Cerritos Wetlands as observed by the 2007 ES&P Biology Team. Table courtesy of http://www.intoloscerritoswetlands.org

Common Name	**Scientific Name**	**Protection***
Allen's Hummingbird	*Selasphorus sasin*	MBTA
American Avocet	*Recurvirostra americana*	MBTA
American Coot	*Fulica americana*	MBTA
American Crow	*Corvus brachyrhynchos*	MBTA
American Goldfinch	*Carduelis tristis*	MBTA
American Kestrel	*Falco sparverius*	MBTA
American Pipit	*Anthus rubescens*	MBTA
American Wigeon	*Anas americana*	MBTA
Anna's Hummingbird	*Calypte anna*	MBTA
Ash-throated Flycatcher	*Myiarchus cinerascens*	MBTA
Barn Swallow	*Hirundo rustica*	MBTA
Belding's Savannah Sparrow	*Passerculus sandwichensis beldingi*	CESA
Belted Kingfisher	*Ceryle alcyon*	MBTA
Black Phoebe	*Sayornis nigricans*	MBTA
Black-bellied plover	*Pluvialis squatarola*	MBTA
Black-crowned Night Heron	*Nycticorax nycticorax*	MBTA
Black-necked Stilt	*Himantopus mexicanus*	MBTA
Blue-winged Teal	*Anas discors*	MBTA
Brown-headed Cowbird	*Molothrus ater*	MBTA
Bufflehead	*Bucephala albeola*	MBTA
Bushtit	*Psaltriparus minimus*	MBTA
California Brown Pelican	*Pelicanus occidentalis*	MBTA, ESA, CESA
California Gull	*Larus californicus*	MBTA
California Least Tern	*Sterna antillarum browni*	MBTA, ESA, CESA
California Towhee	*Pipilo crissalis*	MBTA
Caspian Tern	*Sterna caspia*	MBTA

Cassin's Kingbird	*Tyrannus vociferans*	MBTA
Cassin's Vireo	*Vireo cassinii*	NONE
Cedar Waxwing	*Bombycilla cedrorum*	MBTA
Cinnamon Teal	*Anas cyanoptera*	MBTA
Clarks Grebe	*Aechmophorus clarkii*	MBTA
Cliff Swallow	*Petrochelidon pyrrhonota*	MBTA
Common Grackle	*Quiscalus quiscula*	MBTA
Common Moorhen	*Gallinula chloropus*	MBTA
Common Yellowthroat	*Geothlypis trichas*	MBTA
Coopers Hawk	*Accipiter cooperii*	MBTA
Double-crested Cormorant	*Phalacrocorax auritus*	MBTA
Downy Woodpecker	*Picoides pubescens*	MBTA
Eared Grebe	*Podiceps nigricollis*	MBTA
Elegant Tern	*Sterna elegans*	MBTA
European Starling	*Sturnus vulgaris*	NONE
Feral Duck	hybrid	NONE
Feral Goose	hybrid	NONE
Forster's Tern	*Sterna forsteri*	MBTA
Gadwall	*Anas strepera*	MBTA
Great Blue Heron	*Ardea herodias*	MBTA
Great Egret	*Ardea alba*	MBTA
Greater Scaup	*Aythya marila*	MBTA
Greater Yellowlegs	*Tringa melanoleuca*	MBTA
Great-tailed Grackle	*Quiscalus mexicana*	MBTA
Green Heron	*Butorides virescens*	MBTA
Green-winged Teal	*Anas crecca*	MBTA
Heermann's Gull	*Larus heermanni*	MBTA
Herring Gull	*Larus argentatus*	MBTA
Hooded Oriole	*Icterus cucullatus*	MBTA

Horned Grebe	*Podiceps auritus*	MBTA
House Finch	*Carpodacus mexicanus*	MBTA
House Sparrow	*Passer domesticus*	NONE
Killdeer	*Charadrius vociferus*	MBTA
Least Sandpiper	*Calidris minutilla*	MBTA
Lesser Goldfinch	*Carduelis psaltria*	MBTA
Lesser Scaup	*Aythya affinis*	MBTA
Loggerhead Shrike	*Lanius ludovicianus*	MBTA
Long-billed Curlew	*Numenius americanus*	MBTA
Long-billed Dowitcher	*Limnodromus scolopaceus*	MBTA
Mallard	*Anas platyrhynchos*	MBTA
Marbled Godwit	*Limosa fedoa*	MBTA
Mourning Dove	*Zenaida macroura*	MBTA
Northern Mockingbird	*Mimus polyglottos*	MBTA
Northern Pintail	*Anas acuta*	MBTA
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	MBTA
Northern Shoveler	*Anas clypeata*	MBTA
Nutmeg Manikin	*Lonchura punctulata*	NONE
Orange-crowned Warbler	*Vermivora celata*	MBTA
Osprey	*Pandion haliaetus*	MBTA
Pacific Loon	*Gavia pacifica*	MBTA
Pied-billed Grebe	*Podilymbus podiceps*	MBTA
Red-breasted Merganser	*Mergus serrator*	MBTA
Red-shouldered Hawk	*Buteo lineatus*	MBTA
Red-tailed Hawk	*Buteo jamaicensis*	MBTA
Red-winged Blackbird	*Agelaius phoeniceus*	MBTA
Ring-billed Gull	*Larus delawarensis*	MBTA
Rock Pigeon	*Columba livia*	NONE
Ruby-crowned Kinglet	*Regulus calendula*	MBTA

Ruddy Duck	*Oxyura jamaicensis*	MBTA
Sanderling	*Calidris alba*	MBTA
Semipalmated Plover	*Charadrus semipalmatus*	MBTA
Short-billed Dowitcher	*Limnodromus griseus*	MBTA
Snowy Egret	*Egretta thula*	MBTA
Song Sparrow	*Melospiza melodia*	MBTA
Spotted Sandpiper	*Actitis macularia*	MBTA
Tree Swallow	*Tachycineta bicolor*	MBTA
Turkey Vulture	*Cathartes aura*	MBTA
Upland Savannah Sparrrow	*Passerculus sandwichensis*	MBTA
Warbling Vireo	*Vireo gilvus*	MBTA
Western Grebe	*Aechmophorus occidentalis*	MBTA
Western Gull	*Larus occidentalis*	MBTA
Western Kingbird	*Tyrannus verticalis*	MBTA
Western Meadowlark	*Sturnella neglecta*	MBTA
Western Sandpiper	*Calidris mauri*	MBTA
Whimbrel	*Numenius phaeopus*	MBTA
White-crowned Sparrow	*Zonotrichia leucophyrs*	MBTA
Willet	*Catoptrophorus semipalmatus*	MBTA
Wilson's Warbler	*Wilsonia pusilla*	MBTA
Yellow Warbler	*Dendroica petechia*	MBTA
Yellow-rumped Warbler	*Dendroica coronata*	MBTA

*Key

- MBTA = Migratory Bird Treaty Act
- ESA = Endangered Species Act
- CESA = California Endangered Species Act

Table 9 – Invertebrates found in California Coastal Wetlands

Common Name	Scientific Name
Polychaete Worms	
Fire Worm	*Nephtys caecoides*
Inn-Keeper Worm	*Urechis caupo*
Scale Worm	*Polynoidea sp.*
Spinoid Worm	*Polydora sp.*
Crustaceans	
Striped Shore Crab	*Pachygrapsus crassipes*
Yellow Shore Crab	*Hemigrapsus oregonensis*
Purple Shore Crab	*Hemigrapsus nudus*
Fiddler Crab	*Uca crenulata*
Red Ghost Shrimp	*Callianassa californiensis*
Acorn Barnacle	*Semibalanus balanoides*
Gooseneck Barnacle	*Polliceps polymerus*
Gastropods	
Striped Sea Hare	*Navanax inermis*
Sea Hare	*Aplysia californica*
Cloudy Bubble Snail	*Bulla gouldiana*
Cone Snail	*Conus californicus*
California Horn Snail	*Cerithidea californica*
Bivalves	
Common Littleneck Clam	*Protothaca staminea*
California Jackknife Clam	*Crytomya californica*
Razor Clam	*Solen rosaceus*
Bent Nose Clam	*Macoma nasuta*
Purple Clam	*Sanquinolaria nuttalli*
Insects	
Sea Spider	*Ammothella biunguiculata*
Wandering Skipper	*Panoquina errans*
Pygmy Blue Butterfly	*Brephidium exilis*
Mudflat Tiger Beetle	*Cicindela trifasciata sigmoidea*
Gabb's Tiger Beetle	*Cicindela gabbi*
Rove Beetles	*Bledius spp.*
Saldid Bug	*Pentacora signoreti*
Ruby Meadowhawk	*Sympetrum rubicundulum*

Table 10 - Average percent cover of non-native and native plant species, and unvegetated cover within the Los Cerritos Wetlands as observed by the ES&P 2008 Biology Team.

	Zedler Marsh	**Percent Cover**	**Campgrounds**	**Percent cover**	**Hellman Property**	**Percent cover**	**Steamshovel Slough**	**Percent Cover**
Native	*Anaphalis sp.*	0.15	*Cressa truxillensis*	8.97	*Isocoma menziesii*	1.41	*Batis maritima*	2.08
	Conyza canadensis	0.02	*Distichlis spicata*	24.77	*Salicornia subterminalis*	5.12	*Distichlis spicata*	0.09
	Cressa truxillensis	0.31	*Frankenia salina*	0.09	*Salicornia virginica*	12.31	*Frankenia salina*	0.06
	Distichlis spicata	0.72	*Salicornia virginica*	11.11	*Spergularia marina*	0.20	*Jaumea carnosa*	0.21
	Frankenia salina	2.08	*Scirpus robustus*	0.42			*Monanthochloe littoralis*	27.69
	Galium angustifolium	0.54	*Xanthium strumarium*	0.06			*Salicornia subterminalis*	1.90
	Isocoma menziesii	14.86					*Limonium californica*	0.40
	Salicornia subterminalis	0.76						
Non-native								
	Bassia hyssopifolia	5.39	*Bassia hyssopifolia*	2.27	*Atriplex semibaccata*	3.66	*Atriplex semibaccata*	0.02
	Brassica nigra	1.73	*Bromus diandrus*	0.81	*Bassia hyssopifolia*	0.77	*Bassia hyssopifolia*	7.58
	Bromus diandrus	0.39	*Bromus madritensis*	0.49	*Brassica nigra*	0.08	*Bromus diandrus*	8.11
	Bromus madritensis	1.63	*Centaurea melitensis*	1.85	*Bromus diandrus*	2.77	*Bromus madritensis*	0.09
	Centaurea melitensis	4.48	*Eriodium cicutarium*	0.17	*Centaurea melitensis*	0.38	*Centaurea melitensis*	0.95
	Hordeum vulgare	0.05	*Lolium multiflorum*	0.91	*Hordeum vulgare*	1.21	*Hordeum vulgare*	0.84
	Melilotus indica	5.10	*Melilotus alba*	0.22	*Lolium multiflorum*	1.56	*Malva parviflorum*	0.24
	Mesymbryanthemum crystallinum	1.54	*Melilotus indica*	8.83	*Malva parviflorum*	0.10	*Melilotus indica*	7.51
	Mesumbryanthemum nodiflorum	17.10	*Mesymbryanthemum crystallinum*	0.27	*Melilotus indica*	1.04	*Mesumbryanthemum nodiflorum*	19.60
	Parapholis incurva	1.01	*Mesumbryanthemum nodiflorum*	2.50	*Mesumbryanthemum nodiflorum*	31.25	*Parapholis incurva*	4.54
	Polypogon monspeliensis	2.48	*Parapholis incurva*	15.07	*Parapholis incurva*	5.70	*Salsola tragus*	0.08
	Silybum marianum	0.03	*Plantago sp.*	0.50	*Polypogon monspeliensis*	1.15	*Silybum marianum*	0.48
	Sisymbrium sp.	1.51	*Polypogon monspeliensis*	2.00	*Raphanus sativa*	0.59	*Solanum sp.*	0.09
	Sonchus oleraceus	0.07	*Sisymbrium sp.*	0.42	*Salsola tragus*	3.12	*Sonchus oleraceus*	0.61
			Solanum sp.	0.21	*Sonchus oleraceus*	2.84		
			Sonchus oleraceus	2.10				
	Unvegetated	38.01	*Unvegetated*	16.38	*Unvegetated*	23.28	*Unvegetated*	17.94