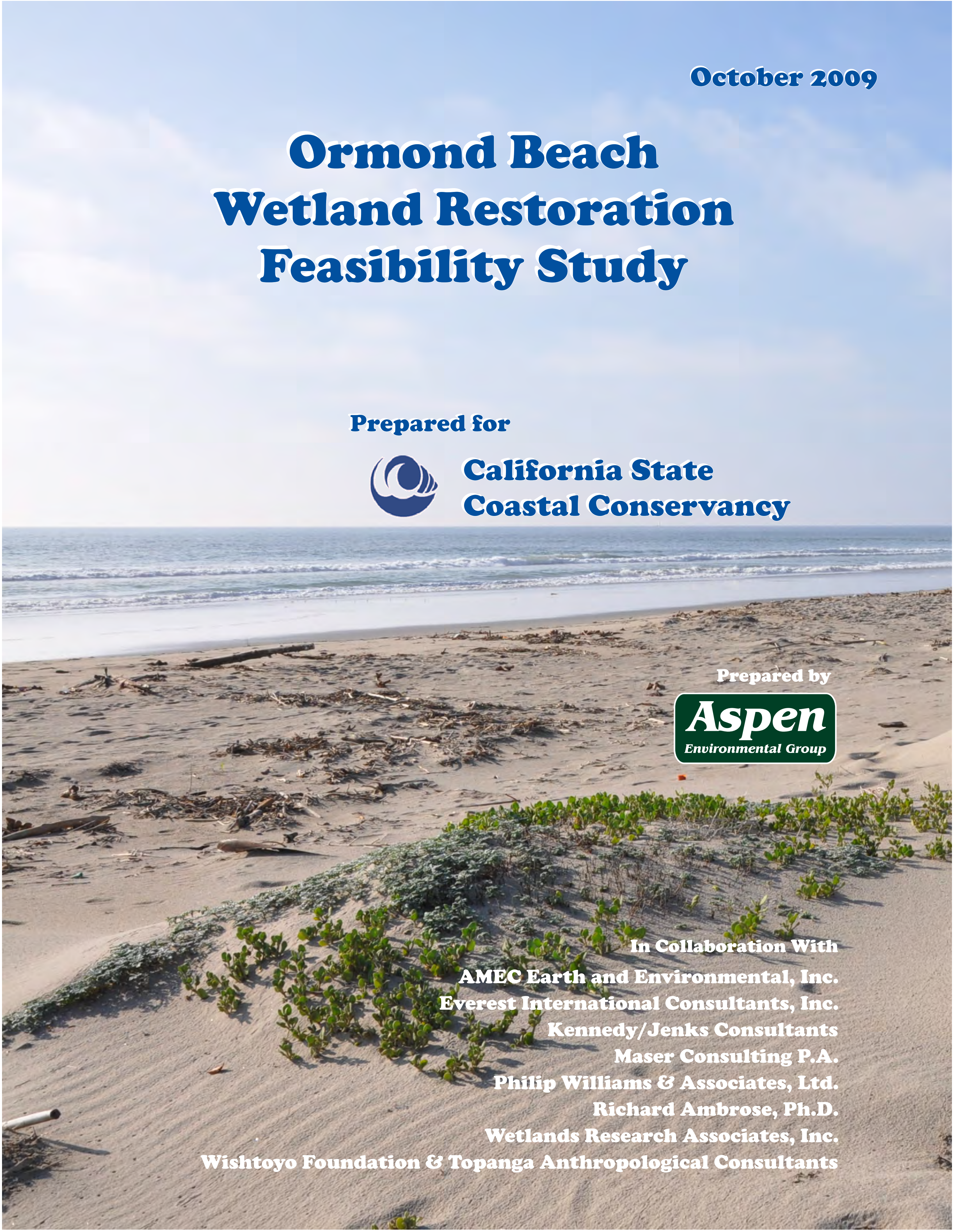
October 2009

Ormond Beach Wetland Restoration Feasibility Study



Prepared for

California State Coastal Conservancy

Prepared by

Aspen Environmental Group

In Collaboration With

AMEC Earth and Environmental, Inc.
Everest International Consultants, Inc.
Kennedy/Jenks Consultants
Maser Consulting P.A.
Philip Williams & Associates, Ltd.
Richard Ambrose, Ph.D.
Wetlands Research Associates, Inc.
Wishtoyo Foundation & Topanga Anthropological Consultants

ORMOND BEACH WETLAND RESTORATION FEASIBILITY STUDY

Prepared for:

California State Coastal Conservancy

1330 Broadway, Suite 1100
Oakland, California 94612-2530

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EXECUTIVE SUMMARY

Ormond Beach is located along the southern coast of Ventura County, California. It falls within the jurisdictional boundaries of both the City of Oxnard and Ventura County, and is between the City of Port Hueneme and Naval Base Ventura County Point Mugu. Historically, the Ormond Beach area contained a diverse set of habitats including sandy beaches, coastal lagoons and estuaries, fore- and backdune areas, brackish and seasonal freshwater marshes, freshwater drainages, grasslands and transitional uplands. Today, local and regional development, as well as other anthropogenic factors, have substantially compromised the historic ecological conditions of the Ormond Beach area. None-the-less, the existing habitat supports many special status plant and wildlife species, urban discharges support an existing beach lagoon, and a limited foredune community extends along the beach area itself. Due to these attributes federal, State, and local agencies, as well as public and private organizations and interest groups, recognize Ormond Beach as an area of immense biological significance and high habitat restoration potential. To this end, the California State Coastal Conservancy (SCC) is pursuing, at a scale unprecedented within the State, to restore as much lost habitat as possible within the Ormond Beach area.

The SCC targeted the Ormond Beach area for habitat restoration and enhancement in the early 1980s. Its initial goal for habitat restoration was "at least 750 acres" in the Ormond Beach area west of Arnold Road. That goal has since risen to at least 1,000 acres within the Ormond Beach area as a result of new sea level rise findings and the need to remove in-holdings and existing industrial development that would obstruct restoration.

The SCC's first coordination efforts resulted in a grant to the City of Oxnard to assist it in extinguishing a paper subdivision and acquiring approximately 90 acres of private, undeveloped land along the beach for coastal wetland protection and restoration. In 1988, while the SCC continued to develop its land acquisition strategy for the area, the Ormond Beach Task Force (OBTF) was formed as a forum for the discussion of issues related to Ormond Beach. During the 1990s, the OBTF focused its attention on preventing proposed development projects in the Ormond Beach area, and pursued community consensus to further promote its protection and restoration. Since the OBTF's inception, the SCC has chaired its bi-monthly meetings.

In 2002, the SCC acquired 260 acres of land in the Ormond Beach area, and subsequently began the process of evaluating the long-term feasibility of, and needs for, establishing a coastal ecosystem that could be sustained (referred to herein as the "project"). In 2005, the SCC provided a grant to The Nature Conservancy (TNC) to purchase an additional 280 acres of land adjacent to the SCC's property with the intention of collaborating with the SCC and OBTF, as well as other local stakeholders, to achieve the SCC's goal of restoring over 1,000 acres of coastal wetland habitat.

The purpose of the Ormond Beach Wetland Feasibility Study (Feasibility Study) is to provide the SCC, its partners, interested parties and stakeholders, and regulatory agencies with reliable information and analysis regarding the viability of restoring, enhancing and creating coastal wetland habitats in the project area. It represents the culmination of several subject-specific and interdisciplinary efforts that, together, have resulted in the identification of six possible alternatives for habitat restoration, enhancement, and creation. For the purposes of the evaluation of these alternatives a seventh alternative, the "No Project Alternative," has also been identified. The specific efforts associated with the Feasibility Study have included the:

- Establishment of function- and value-based restoration goals;
- Collection of data related to the existing (e.g., "baseline") physical conditions of the project site and its surroundings;
- Characterization of biological resources, including the identification of special status species and habitats;
- Characterization of hydrologic, hydraulic and geomorphic conditions;
- Characterization of cultural resources;
- Identification of potential contaminant types and sources and completion of a site-wide soil and surface water investigation;
- Characterization of infrastructure;
- Evaluation of wetland implementation and management opportunities and constraints;
- Development of wetland restoration and enhancement alternatives, including preliminary conceptual design and implementation costs;
- Development of a suite of 26 systematic evaluation criteria and associated metrics for comparison of the alternatives, and subsequently completing that evaluation;
- Development of short- and long-term restoration recommendations for the project's future steps; and,
- Completion of the Feasibility Study.

Overall, the alternatives identified for the project include three concepts, including: (1) creation of a new tidal lagoon with a permanent open connection to the ocean (Alternative 1); (2) restoration of the project area's historic wetland habitat mosaic with intermittingly open inlets and seasonal ponds (Alternative 2); and, (3) enhancement of existing habitats with minimal hydrologic and ground surface modifications (Alternative 3).

To date, 540 acres of land have been acquired for the project; however, because the SCC's land acquisition process has been, and will continue to be, dependent upon numerous and sometimes inter-related factors, acquisition of all the potential properties for the project cannot be predicted with certainty at this time. Therefore, for the three alternatives outlined above, two variants have been developed for each. The "unconstrained" alternatives assume that the SCC and its partners will be able to secure all the candidate properties identified for the project; these alternatives maximize the total amount of acreage available for habitat restoration, enhancement and creation. The remaining three alternatives, referenced as the "constrained" alternatives, assume that some candidate properties will not, in the reasonably foreseeable future, be available for the project. As such, the "project area" addressed in the Feasibility Study is a maximum of approximately 1,730 acres for the unconstrained alternatives, and approximately 770 to 790 acres for the constrained alternatives. The 570-acre Ventura County Game Preserve is included within the "footprint" of the unconstrained alternatives in the hope that its current landowners and members will be interested in restoring this property as well. The No Project Alternative (Alternative 4) assumes that project-related efforts would be limited to the SCC and TNC properties (540 acres).

Following the above strategy, the alternatives described and assessed in the Feasibility Study include:

- Alternative 1 Unconstrained (Alternative 1U): Create New Tidal Lagoon;
- Alternative 1 Constrained (Alternative 1C): Create New Tidal Lagoon;

- Alternative 2 Unconstrained (Alternative 2U): Restore Seasonally Open Wetland Habitats/Ponds;
- Alternative 2 Constrained (Alternative 2C): Restore Seasonally Open Wetland Habitats/Ponds;
- Alternative 3 Unconstrained (Alternative 3U): Enhance Existing Non-Tidal Wetland Habitats;
- Alternative 3 Constrained (Alternative 3C): Enhance Existing Non-Tidal Wetland Habitats; and,
- Alternative 4: No Project Alternative.

These alternatives are considered preliminary in nature and will require further refinement and optimization. It is also possible that the final alternative chosen for implementation could be some type of hybrid of one or more of the above-referenced preliminary alternatives. Table ES-1 provides the total habitat acreage of each alternative, as well as the acreage of total high quality habitat, total high quality habitat preserved and created, and net restored aquatic wetland habitat value.

While the unconstrained alternatives would maximize the total acreage of restored aquatic habitat and newly created high quality habitat, thereby maximizing benefits to listed species and fish species, it is still important to systematically assess and compare each of the alternatives. In an effort to calibrate the advantages and disadvantages of each alternative, a series of 26 evaluation criteria were developed, along with a comparative metric. The evaluation criteria fall into five categories, including: habitat restoration; environmental quality; hydrology and geomorphology; sustainability; and, costs and construction. Due to the nature of the evaluation criteria, under some instances two or more of the alternatives have identical or nearly identical attributes (e.g., their overall ranking is the same for a given criterion). Additionally, in a few instances the alternatives could not be evaluated or compared against each other due to the nature of the criterion; for example, one criterion addresses inlet resistance to closure, which is not applicable to Alternatives 3U, 3C and 4.

Based upon the results of the alternatives evaluation, the unconstrained alternatives were consistently found to be more favorable than their constrained counterparts. The unconstrained alternatives would minimize barriers between habitats, thereby benefitting wildlife migration and maximizing plant dispersal corridors. The constrained alternatives would also present many more issues that affect project implementation, long term maintenance, and stability, such as: buffering of inflows; room to transgress in response to sea level rise; barriers to plant and animal migration; the need for a constructed causeway; levees to control inlet migration; and, flooding of buildings and infrastructure.

In addition to the costs associated with acquiring or otherwise securing the properties needed for Alternatives 1 through 3, the costs associated with their implementation could be a limitation as well. Consequently, preliminary implementation costs have been estimated. In addition to the total cost of construction (including earthwork and soil management/disposal options), the other variables used to estimate implementation costs for the six unconstrained and constrained alternatives included preliminary engineering, completion of the project's environmental review process, final engineering design, construction management, and environmental monitoring. Property costs were not considered, and, for the unconstrained alternatives, remediation of a former metal smelter facility and onsite waste disposal area (referenced in the Feasibility Study as the "Halaco Site") and decommissioning and removal of the existing Reliant Power Plant were not considered. It was assumed that these efforts would be undertaken by parties other than the SCC and its partners.

Table ES-1. Habitat Acreages Overview

Habitat	Alternatives						
	Create New Tidal Lagoon[1] (Alternative 1)		Restore Seasonally Open Wetland Habitats/Ponds[1] (Alternative 2)		Enhance Existing Non-Tidal Wetland Habitats[1] (Alternative 3)		No Project Alternative[1] (Alternative 4)
	Alternative 1U	Alternative 1C	Alternative 2U	Alternative 2C	Alternative 3U	Alternative 3C	
Beach and Southern Foredune	127	79	152	90	153	92	86
Backdune	70	50	55	44	85	65	0
Southern Coastal Salt Marsh (Tidal)	437	180	246	78	44	0	0
Southern Coastal Salt Marsh (Non-Tidal)	0	0	190	142	180	153	96
Treatment Wetlands	21	7	25	7	24	8	0
Coastal Grassland	171	50	221	70	223	69	0
Coastal Grassland (Transitional)	162	36	308	127	650	295	0
Seasonal Wetland Depression (Vegetated)	26	0	77	16	151	58	0
Open Water	474	357	119	64	27	5	3
Unvegetated Inter-Tidal	62	35	13	15	0	0	0
Managed Duck Ponds	168	0	168	0	0	0	0
Willow Scrub	38	0	43	5	8	4	0
Brackish Marsh (Non-Tidal)	0	0	46	24	61	25	28
Seasonal Pond / Panne	0	0	93	90	0	0	45
Salt Grass	0	0	0	0	150	0	0
Creation of High Quality Habitat [2]	1,412	706	1,209	569	716	403	0
Total High Quality Habitat Preserved and Created[3]	1,394	697	1,190	567	677	399	258
Net Restored Aquatic Wetland Habitat Value[4]	973	572	707	415	312	183	0

1 All habitat types are provided as total acreage.
2 Acreage of new high quality habitat acreage created (see Feasibility Study Section 5 and Section 6 Figures).
3 Total acreage of high quality habitat created and preserved minus high quality habitat converted to lower quality habitat.
4 Total new aquatic habitat created (in acres) within the project site (includes subtidal, intertidal, and non-tidal wetland).

For the constrained and unconstrained variants of Alternatives 1 though 3, the estimated total cost for implementation ranges between, in 2009 U.S. dollars, $757,130,000 (Alternative 1U) and $23,430,000 (Alternative 3C). Of these totals, the total project construction cost per acre by alternative ranges between, $654,000 (Alternative 1C) and $23,000 (Alternative 3U) (in 2009 U.S. dollars). It is noted that the project's costs per acre are similar to the restoration costs per acre of other Southern California coastal wetland restoration projects once inflation is factored into the costs of the previously completed projects, such as the Batiquitos Lagoon Enhancement Project (Carlsbad), Bolsa Chica Wetlands Restoration Project (Huntington Beach), and San Dieguito Lagoon Restoration Project (Del Mar).

Preparation of the Feasibility Study is only the first step of the project's implementation. To facilitate future planning, design, and regulatory review and permitting for the project, a series of short- and long-term recommendations have been prepared for the SCC's consideration. The majority of these recommendations are future steps that will need to be taken prior to the project's construction; they have been grouped according to their subject matter, including biological resources, environmental resources and physical processes, regulatory reviews and approvals, and economics (e.g., project costs and funding sources). Each recommendation has also been categorized according to the phase of the project within which the results of the recommendation would be needed, or otherwise should be initiated. However, implementation of all of the recommendations that have been identified may not be realistic, for example, limitations associated with their funding may be a limiting factor. Additionally, not all of the recommendations are necessary for the project's implementation. As such, each recommendation has been prioritized. For the purposes of this Feasibility Study, prioritization of the recommendations includes:

- Critical - Completion of the recommendation is considered an absolute necessity for project implementation and success;
- Very High - Completion of the recommendation is considered extremely important to project implementation and success;
- High - Completion of the recommendation is considered important, but if it is not undertaken it would not pose a "fatal flaw" to the project's implementation and success; and,
- Advantageous – Completion of the recommendation would benefit some aspect (or aspects) of the project, but it is not necessary for the project's implementation and success.

Table ES-2 provides a summary of the recommendations that have been prepared for the project. It is noted, though, that the SCC may have to further prioritize these recommendations as the project progresses.

A preferred, or proposed, alternative is not identified in the Feasibility Study. The SCC, in consultation with its partners, will ultimately have to make this decision as part of the optimization and refinement process of the preliminary alternatives contained in the Feasibility Study and prior to the project's environmental review process. However, all of the preliminary alternatives presented in the Feasibility Study are feasible given the project area's existing and predicted future physical conditions, and have been designed to meet the SCC's goals and objectives for the Ormond Beach area. Although implementation of Alternatives 1 through 3 (unconstrained or constrained) would all result in some adverse environmental impacts during construction, in the long-term they would all result in exceptional ecological and societal benefits at both local and regional scales.

The content of the Feasibility Study has been organized into 11 sections, as follows:

- Section 1 provides an overview of the Feasibility Study's purpose and scope, other technical reports and studies that have been prepared , as well as the Feasibility Study's organization;
- Section 2 provides a summary of existing attributes associated with the project area, including: habitat distributions and biological resources; hydrologic, hydraulic and geomorphic conditions; potential contaminant types and sources; land use and infrastructure; and, cultural resources;
- Section 3 provides a summary of the identified opportunities and constraints related to the project, including land availability, potential supplemental water sources, public recreation and education, potential funding sources, and potential land management partners;
- Section 4 provides a summary of the project's anticipated regulatory requirements and environmental review process;
- Section 5 provides a description of the project's alternatives, as identified and analyzed for the Feasibility Study;
- Section 6 provides an analysis of the project's alternatives, including issues related to: habitat and biological resources; hydrologic, hydraulic and geomorphic conditions; land use and infrastructure; cultural resources; and, soil management and construction quantities and cost estimates;
- Section 7 provides a comparative evaluation of the project's alternatives;
- Section 8 provides the short- and long-term recommendations for the project's future steps;
- Section 9 provides a listing of the acronyms used within the Feasibility Study;
- Section 10 provides a listing of the preparers and reviewers of the Feasibility Study; and,
- Section 11 provides identification of the references cited in the Feasibility Study.

Table ES-2. Summary of Short- and Long-Term Recommendations

Recommendation	Project Phase	Priority
Short-Term Recommendations		
Biological Resources		
Prepare Species-Specific Pre-Restoration Studies	Prior to refinement and optimization of the preliminary alternatives	Critical to Advantageous[1]
Prepare Analysis of Environmentally Sensitive Habitat Areas	Prior to refinement and optimization of the preliminary alternatives	High
Prepare Essential Fish Habitat Analysis	Prior to refinement and optimization of the preliminary alternatives	Critical
Environmental Resources and Physical Processes		
Prepare Ecological Gaps Analysis	Prior to refinement and optimization of the preliminary alternatives	High
Complete Cross-Sections	Prior to refinement and optimization of the preliminary alternatives	Critical
Complete a Regional Littoral Sediment Budget Analysis	Prior to refinement and optimization of the preliminary alternatives	Critical to High[2]
Complete Nearshore Wave Monitoring	Prior to refinement and optimization of the preliminary alternatives	Critical to High[2]
Complete Morphological Modeling of Inlet	Prior to refinement and optimization of the preliminary alternatives	Critical
Prepare Agricultural Drainage Study	Prior to refinement and optimization of the preliminary alternatives	Critical
Prepare Sea Level Rise and Coastal Flood Inundation Study	Prior to or during refinement and optimization of the project's preliminary alternatives	Critical
Prepare a Groundwater Study	Prior to preparation of the project's environmental review document	Critical
Prepare a Subsidence Feasibility Analysis	Prior to or during refinement and optimization of the project's preliminary alternatives	Critical
Complete Water Quality Monitoring and Sampling Program	Initiated prior to or during refinement and optimization of the project's preliminary alternatives	Critical
Prepare an Ecological Risk Analysis	Prior to or during refinement and optimization of the project's preliminary alternatives	Critical
Integrate Public Access and Recreation Plans into Project Design Plans	During refinement and optimization of the project's preliminary alternatives	Critical
Regulatory Processes		
Identify Proposed Project	Prior to preparation of the project's environmental review document	Critical
Identify and Coordinate with the Federal Lead Agency	Prior to preparation of the project's environmental review document	Critical
Initiate Public and Involvement and Participation Program	Prior to preparation of the project's environmental review document	Very High
Initiate Informal Agency Consultations	Prior to preparation of the project's environmental review document	Very High
Complete Formal Wetland Delineation	Prior to preparation of the project's environmental review document	Critical
Complete Cultural Resources Phase I or Phase II Investigation	Prior to preparation of the project's environmental review document	Very High
Complete Environmental Review and Permit Acquisition Processes	Initiate during the preparation of the project's environmental review document	Critical
Prepare Wetland Restoration Management and Monitoring Plan	Complete Draft Plan prior to preparation of the project's environmental review document	Critical

Recommendation	Project Phase	Priority
Economics		
Complete Cost Feasibility Analysis	Prior to preparation of the project's environmental review document	Critical
Assess Funding Potential Under the Corps' In-Lieu Fee Program	Prior to or during preparation of the project's environmental review document	Very High
Complete Carbon Sequestering Analysis	During (as part of) preparation of the project's environmental review document	High
Long-Term Recommendations		
Biological Resources		
Develop and Implement Seed Collection Program	Initiate soon after the approved project has been identified and all properties for project implementation have been secured.	Very High
Environmental Resources and Physical Processes		
Implement Wetland Restoration Management and Monitoring Plan	Implement as first task of any pre-construction activities. Evaluate and revise every five years or as warranted by project site conditions	Critical
Regulatory Processes		
Develop and Implement Permit Compliance Plan	Development of the Plan's organization and structure should begin during the project's regulatory permit acquisition process and completed immediately upon receipt of all of the project's regulatory permits and approvals	Very High
Economics		
Develop Long-Term Funding Program	The program should be developed and implemented as soon as the approved project is established and the properties necessary for its implementation are secured	Critical

[1] Prioritization is study-specific. Please refer to Feasibility Study Section 8.1.1 (Short-Term Recommendations, Biological Resources) for the priority of each study.

[2] Critical if Alternative 1 is chosen as the proposed project; High for the remaining alternatives.

1. INTRODUCTION

Ormond Beach is located along the southern coast of Ventura County, California. It is situated northwest of the Naval Base Ventura County (NBVC) Point Mugu and southeast of the City of Port Hueneme. It falls within the jurisdictional boundaries of both Ventura County and the City of Oxnard. Figure 1-1 provides a regional map of the Ormond Beach area. At a local scale, Ormond Beach is principally accessed via Arnold and Hueneme Roads. It is surrounded by a mix of agricultural, industrial, military, open space, and public and private duck club properties. The beach itself is broad, sandy and flanked by sand dunes and some wetland areas. It provides several recreational opportunities, such as surfing, swimming, sunbathing, fishing and nature observation. Figure 1-2 provides a map of that portion of the Ormond Beach area which is the focus of this Feasibility Study (e.g., the "project area" or "project site"). Figures 1-3 though 1-7 contain photographs of the project area from various viewing locations.

Historically, the greater Ormond Beach area was a diverse ecosystem. The area contained sandy beaches, coastal lagoons and estuaries, fore- and backdune areas, brackish and seasonal freshwater marshes, freshwater drainages, grasslands and transitional uplands. Water sources included surface flows from the Oxnard Plain, freshwater drainages, groundwater, flows from Calleguas Creek, and flood flows from the southward migration of the mouth of the Santa Clara River. Features shown on historical maps from the 1850s and later indicate that the area's wetland habitats played an important role in the Pacific flyway, providing foraging and rest stops for birds migrating between Alaska and Central America. Coastal lagoons and estuaries provided spawning and nursery grounds for local and coastal fish. A wide assemblage of terrestrial and aquatic invertebrates, as well as reptiles, amphibians and mammals were probably present, and marine mammals likely used the lagoons and beach for haul-out sites and pupping.

Today, the project area is a mosaic of several habitat types and development within and surrounding it has dramatically changed its historic conditions. The area's topography has been raised by fill placement to accommodate agricultural, industrial and military uses which, in many cases, has cut off or restricted tidal flows. Watershed urbanization and coastal modifications have altered the entrainment, transport, and delivery of sediment to and along the project area's coastal system. Stream channelization has diverted water away from some former tidal inlets, and concentrated it in others (e.g., Mugu Lagoon). The Reliant Ormond Beach Generating Station (herein referenced as the "Reliant Power Plant"), which flanks the beach approximately 0.8 mile northwest of Arnold Road (Figure 1-8), was constructed and placed into service in the early 1970s. A secondary metal smelter (including onsite waste disposal areas), which is referred to in this Feasibility Study as the "Halaco Site," was constructed approximately 0.8 mile northwest of the Reliant Power Plant in the early 1960s (Figure 1-8) and was operated until 2004.

Because of local and regional development, as well as other anthropogenic factors, the remaining habitats of the project area have been compromised. None-the-less, the area still supports several special status plant and wildlife species, including, but not limited to, the California least tern (*Sterna antillarum browni*), western snowy plover (*Charadrius alexandrinus nivosus*), Belding's savannah sparrow (*Passerculus sandwichensis beldingi*), tidewater goby (*Eucyclogobius newberryi*), globose dune beetle (*Coelus globosus*), wandering (salt marsh) skipper (*Panoquina errans*), and salt marsh bird's beak (*Cordylanthus maritimus ssp. maritimus*). Additionally, urban discharges support a beach lagoon (as well as its associated brackish wetland vegetation), and a limited foredune community extends along the beach area itself. Aquatic plant species such as bulrush (*Scirpus sp.*) and ditch-grass (*Ruppia cirrhosa*) grow along many of the area's drainage ditches, remnants of salt marsh vegetation are present in several locations, and a high groundwater table continues to support native vegetation. As such, federal, State, and local agencies, organizations and interest groups recognize Ormond Beach as an area that has enormous biological significance and high habitat restoration potential. To this end, the California State Coastal Conservancy (SCC) proposes, at a scale unprecedented within California, to restore as much lost habitat as possible within the project area. This Feasibility Study and its associated technical reports and studies have been prepared as an initial step in support of the SCC's proposed restoration effort, which is herein referenced as the Ormond Beach Wetland Restoration Project ("project").

1.1 PROJECT BACKGROUND

The SCC was established in 1976 by State legislature to purchase, protect, restore and enhance coastal resources, and provide public access to the coast. The SCC works in partnership with local governments, other public agencies, nonprofit organizations, and local stakeholders to:

- Protect and improve coastal wetlands, streams, and watersheds;
- Facilitate public access to, and use of, the coast and bay shores;
- Revitalize urban waterfronts;
- Solve complex coastal land use issues;
- Purchase and hold environmentally valuable coastal and bay lands;
- Protect agricultural lands and support coastal agriculture; and,
- Facilitate donations and dedications of land and easements for public coastal access, wildlife habitat, agriculture, and open space.

Recognizing the ecological value of the Ormond Beach area, the SCC targeted it for habitat restoration and enhancement in the early 1980s. Its initial goal for land acquisition and habitat restoration was "at least 750 acres" in the area west/northwest of Arnold Road (see Figures 1-2 and 1-8 for the location of Arnold Road). That goal has since risen to at least 1,000 acres as result of new sea level rise findings and the need to remove in-holdings and existing industrial development that would obstruct restoration.

The SCC's first efforts resulted in a grant to the City of Oxnard to assist it in extinguishing a paper subdivision and acquiring approximately 90 acres of private, undeveloped land along the beach for coastal wetland protection and restoration. In 1988, while the SCC continued to develop its land acquisition strategy, the Ormond Beach Task Force (OBTF) was formed as a forum for the discussion of issues related to the beach. During the 1990s, the OBTF focused its attention on preventing proposed development projects in the Ormond Beach area, and pursued community consensus to further promote its protection and restoration. Since the OBTF's inception, the SCC has chaired its bi-monthly meetings.

In 2002, the SCC acquired 260 acres of land surrounding the Reliant Power Plant from Southern California Edison (SCE), the original owner of the facility, with the intent of purchasing at least 1,000 acres for habitat restoration and enhancement. With completion of this purchase, the SCC began the process of evaluating the long-term feasibility and needs for establishing a coastal ecosystem that functions within, and provides value to, the greater Ormond Beach area.

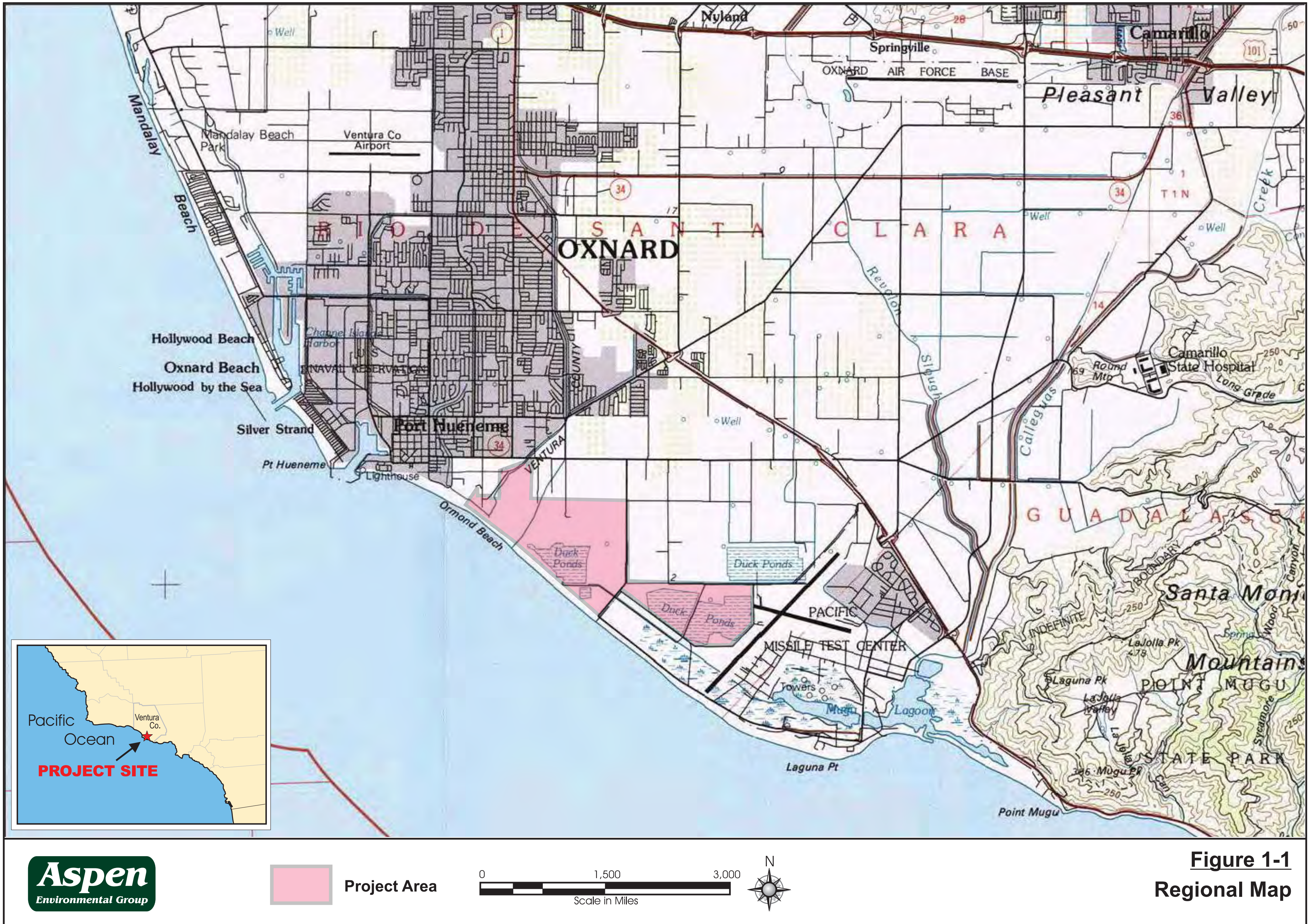

Figure 1-1
Regional Map

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Figure 1-2

Local Map of Ormond Beach Project Area

A. Beach and Foredune Area Looking Southeast

B. Beach and Foredune Area Looking Northwest

Aspen Environmental Group

Figure 1-3

Project Area Photographs of Beach and Foredune Areas From Southwest of Reliant Power Plant

A. Looking Northeast From Boundary Between SCC and NBVC Point Mugu Properties

B. Looking North/Northeast From Boundary Between SCC and NBVC Point Mugu Properties

C. Looking West/Northwest From Boundary Between SCC and NBVC Point Mugu Properties

D. Looking West From Backdune Area

Aspen Environmental Group

Figure 1-4

Project Area Photographs
Southeast of Reliant Power Plant (Set 1)


A. Looking Northwest


B. Looking North


C. Looking Northeast


D. Looking East/Northeast

Aspen Environmental Group

Figure 1-5

**Project Area Photographs
Southeast of Reliant Power Plant (Set 2)**

A. Looking East/Northeast

B. Looking North/Northeast

C. Looking Northwest
(Halaco Waste Disposal Site is located to the left of the photograph)

D. Looking West/Northwest

Aspen Environmental Group

Figure 1-6

**Project Area Photographs
Northwest of Reliant Power Plant**

A. Looking East/Southeast Into Ventura County Game Preserve

B. Looking West Into Southland Sod Farm

Aspen Environmental Group

Figure 1-7

Project Area Photographs From Arnold Road

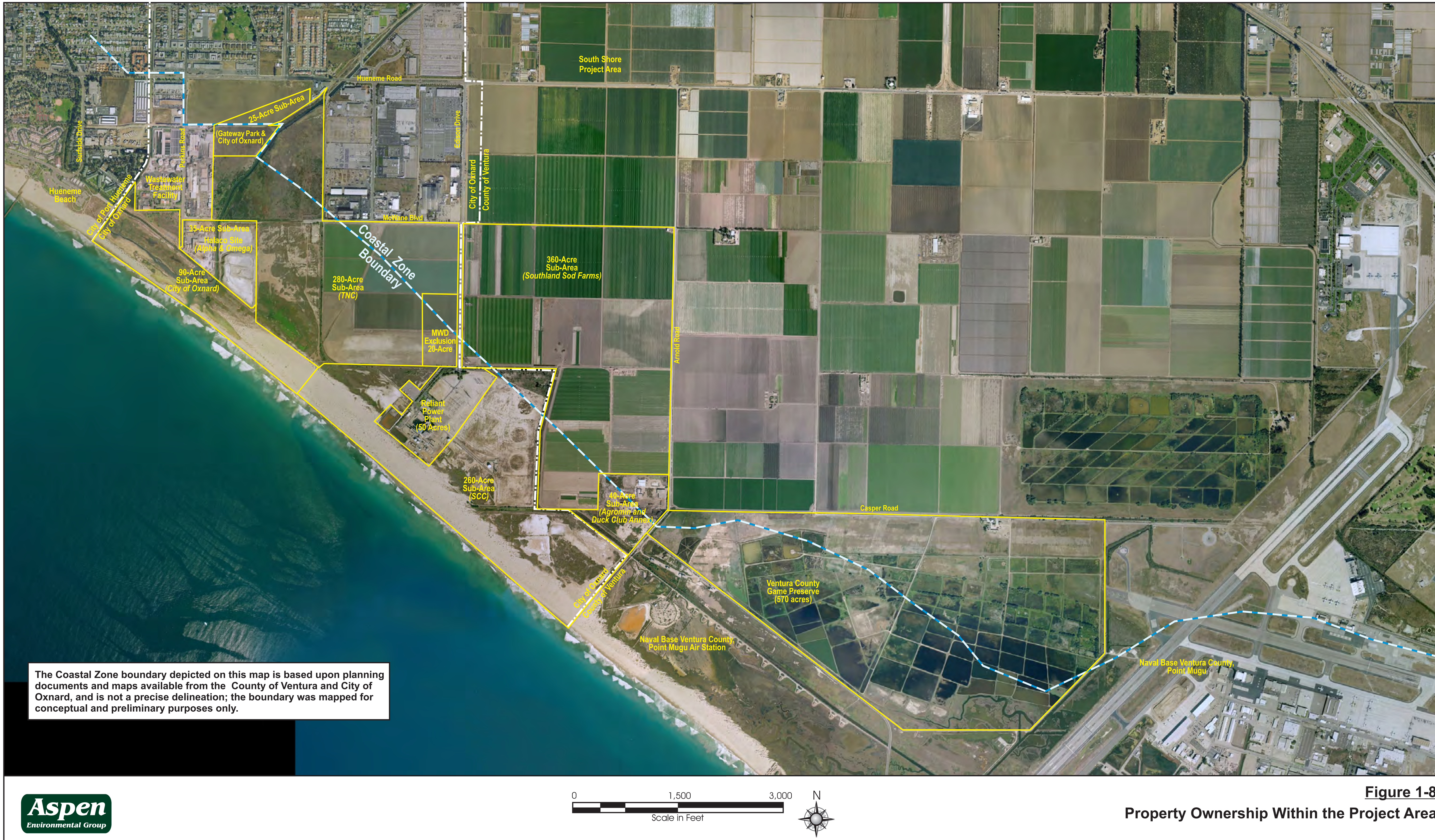


Figure 1-8

Property Ownership Within the Project Area

With SCC funding, in 2005 The Nature Conservancy (TNC) purchased an additional 280 acres of land adjacent to (north/northwest of) the SCC's property from the Metropolitan Water District (MWD) of Southern California and the City of Oxnard. TNC intends to collaborate with the SCC and OBTF, as well as other local stakeholders, to achieve the SCC's goal of restoring over 1,000 acres of the Ormond Beach area. Figure 1-8 provides a map of property ownership within the project area.

Three concepts for habitat restoration, enhancement and creation have been identified, including the: creation of a new tidal lagoon with a permanent open connection to the ocean (Alternative 1); restoration of the project area's historic wetland habitat mosaic with intermittingly open inlets and seasonal ponds (Alternative 2); and, enhancement of existing habitats with minimal hydrologic and ground surface modifications (Alternative 3). However, because the SCC's land acquisition process has been, and will continue to be, dependent upon numerous and sometimes inter-related factors, acquiring or otherwise securing of all the candidate properties for the project cannot be predicted with certainty at this time. Therefore, two variations of the three alternatives referenced above have been developed. The "unconstrained" alternatives assume that the SCC and its partners will be able to secure all of the candidate properties for the project; these alternatives maximize the total amount of acreage available for habitat restoration and enhancement. The remaining three alternatives, referenced as the "constrained" alternatives, assume that some properties will not, in the reasonably foreseeable future, be available for the project. To this end, the total project area addressed in this Feasibility Study is a maximum of approximately 1,730 acres for the unconstrained alternatives and approximately 770 to 790 acres for the constrained alternatives. The 570-acre Ventura County Game Preserve (VCGP) is included within the "footprint" of the unconstrained alternatives in the hope that its current landowners and members will be interested in restoring this property as well. A fourth alternative, the "No Project Alternative" (Alternative 4) assumes that project-related efforts would be limited to the SCC and TNC properties (540 acres). Section 5 of this Feasibility Study provides in-depth descriptions of the unconstrained and constrained alternatives.

1.2 STUDY PURPOSE AND SCOPE

The purpose of this Feasibility Study is to provide the SCC, its partners, interested parties and stakeholders, and regulatory agencies with reliable information and analysis regarding the viability of restoring, enhancing and creating coastal wetland habitats in the project area. Due to the complexity of such an ambitious undertaking, an interdisciplinary team of resource/issue-specific experts was formed to complete a series of tasks that, collectively, provided the basis for the information, analysis and recommendations presented in this Feasibility Study. The tasks completed for this Feasibility Study have included:

- Establishment of function- and value-based restoration goals;
- Collection of data related to the existing (e.g., "baseline") physical conditions of the project site and its surroundings;
- Characterization of biological resources, including the identification of special status species and habitats;
- Characterization of hydrologic, hydraulic and geomorphic conditions;
- Characterization of cultural resources;
- Identification of potential contaminant types and sources, and completion of a site-wide soil and surface water investigation;

- Characterization of infrastructure;
- Evaluation of wetland implementation and management opportunities and constraints;
- Development of wetland restoration and enhancement alternatives, including preliminary conceptual design and implementation costs;
- Development of a suite of 26 systematic evaluation criteria and associated metrics for comparison of the alternatives, and subsequently completing that evaluation;
- Development of short- and long-term restoration recommendations for the project's future steps; and,
- Completion of this Feasibility Study.

It is noted that the alternatives presented in this Feasibility Study are considered preliminary in nature and will require further refinement and optimization as future short- and long-term recommendations are undertaken, discussions between the SCC, its partners, regulatory agencies and the public continue, and the project's environmental review and approval process are carried forward. It is additionally possible that the final alternative chosen for implementation could be some type of hybrid of one or more of the alternatives evaluated in this Feasibility Study.

1.3 PRIOR PROJECT STUDIES AND REPORTS

As outlined in Section 1.2 (Study Purpose and Scope), several resource/issue-specific tasks were undertaken in support of this Feasibility Study. Several of these tasks culminated in the completion of technical reports and studies, as follows:

- *Ormond Beach Restoration Feasibility Study: Infrastructure Investigation Report*. Prepared by Everest International Consultants, Inc. December 2004.
- *Ormond Beach Wetland Restoration Project: Soil Contaminant Review*. Prepared by Everest International Consultants, Inc. and AMEC Earth & Environmental, Inc. January 2005.
- *Cultural Resources in the Ormond Beach Wetlands Restoration Area*. Wishtoyo Foundation and Topanga Anthropological Consultants. May 2005.
- *Project Restoration Goals Report for the Ormond Beach Wetland Restoration Feasibility Study*. Prepared by Aspen Environmental Group. May 2005.
- *Ormond Beach Wetlands Restoration Project: Preliminary Evaluation of Potential Water Sources*. Prepared by Everest International Consultants, Inc. June 2005.
- *Recreation and Education Opportunities Report for the Ormond Beach Wetlands Restoration Feasibility Study*. Prepared by Aspen Environmental Group. July 2005.
- *Potential Water Sources for the Ormond Beach Restoration Feasibility Plan*. Prepared by Kennedy/Jenks Consultants, Inc. July 2005.
- *Ormond Beach Wetland Restoration Feasibility Study: Potential Land Management Partners Report*. Prepared by Aspen Environmental Group. November 2005.
- *Ormond Beach Wetland Restoration Feasibility Study: Anticipated Regulatory Requirements Report*. Prepared by Aspen Environmental Group. July 2006.
- *Ormond Beach Wetland Restoration Site-Wide Soil/Surface Water Investigation*. Prepared by AMEC Earth & Environmental, Inc. November 2006.

- *Biological Assessment for Ormond Beach*. Prepared by Wetlands Research & Associates (WRA), Inc. July 2007.
- *Ormond Beach Wetland Restoration Feasibility Study: Potential Project Funding Sources Report*. Prepared by Aspen Environmental Group. February 2007.
- *Ormond Beach Wetland Restoration Feasibility Plan: Hydrologic and Geomorphic Conditions Report*. Prepared by Phillip Williams & Associates, Ltd. (PWA). September, 2007.

With the exception of the *Cultural Resources in the Ormond Beach Wetlands Restoration Area Report*, which, due to its nature, is considered proprietary, the above-referenced reports and studies can be accessed at the SCC's website, or are otherwise on file with the SCC. All of the above-referenced documents are incorporated into this Feasibility Study by reference.

In addition to the technical efforts associated with this Feasibility Study, the Graduate Design 606 Studio, Department of Landscape Architecture, California State Polytechnic University of Pomona, is currently working with the SCC to develop a Public Access and Trail Plan for the project (referred to as the "Access Vision Plan"). The Graduate Design 606 Studio met with the OBTF on January 22, 2009 to introduce and discuss possible features of the Access Vision Plan. The Graduate Design 606 Studio subsequently coordinated a tour of the project area on March 22, 2009 to identify what the public did and did not know about Ormond Beach and the project, and solicit information from the attendees as to what their primary interests and goals are in terms of public access, education, and possible visitor amenities. When complete, the Graduate Design 606 Studio's Access Vision Plan will be factored into the project's future refinement and optimization of the conceptual alternatives presented in this Feasibility Study, and then will be integrated into the project's final engineering and design plans.

1.4 STUDY ORGANIZATION

This Feasibility Study has been organized into 11 sections and is supported by three technical appendices. The main sections of this Feasibility Study are as follows:

- **Section 1** provides an overview of this Feasibility Study's purpose and scope, other technical reports and studies that have been prepared in support of this Feasibility Study, and the Feasibility Study's organization.
- **Section 2** provides a summary of existing attributes associated with the project site, including: habitat distributions and biological resources; hydrologic, hydraulic and geomorphic conditions; potential contaminant types and sources; land use and infrastructure; and, cultural resources.
- **Section 3** provides a summary of the identified opportunities and constraints related to the project, including land availability, potential supplemental water sources, public recreation and education, potential funding sources, and potential land management partners.
- **Section 4** provides a summary of the project's anticipated regulatory requirements and environmental review process.
- **Section 5** provides a description of the project's alternatives, as identified and analyzed for this Feasibility Study.
- **Section 6** provides an analysis of the project's alternatives, including issues related to: habitat and biological resources; hydrologic, hydraulic and geomorphic conditions; land use and infrastructure; cultural resources; and, soil management and construction quantities and cost estimates.
- **Section 7** provides a comparative evaluation of the project's alternatives.

- **Section 8** provides the short- and long-term recommendations for the project's future steps as identified by this Feasibility Study's technical and advisory team (known as the Design Integration Group, or "DIG").
- **Section 9** provides a listing of the acronyms used within this Feasibility Study.
- **Section 10** provides a listing of the preparers and reviewers of this Feasibility Study, including the technical reports and studies listed in Section 1.3 (Prior Project Studies and Reports).
- **Section 11** provides identification of the references cited in this Feasibility Study.

2. SUMMARY OF EXISTING CONDITIONS

The following section provides a summary of the existing conditions of the project site as related to biological resources, hydrology, hydraulics and geomorphics, potential contaminant types and sources, land use and infrastructure, and cultural resources. These summaries are based upon the more detailed technical reports prepared for the project, as outlined in Section 1.3 (Prior Project Studies and Reports).

2.1 HABITAT DISTRIBUTIONS AND BIOLOGICAL RESOURCES

The project area includes a variety of upland plant communities, wetland plant communities, and open water/ocean habitat. The types of upland plant communities found within the project site include non-native annual grassland, coyote brush, saline/haline herbs, willow scrub, southern foredunes, and mixed transitional vegetation. The three general wetland plant communities found within the project area are characterized as southern coastal salt marsh, coastal freshwater/brackish marsh, and managed duck ponds. Agricultural and industrial uses of the project area have left their imprint in the form of agricultural fields, cultivated sod fields, and privately-owned parcels positioned within the project area that serve as barriers to habitat connectivity. Please refer to the *Biological Assessment for Ormond Beach* (Wetlands Research Associates, Inc. [WRA], 2007) for a detailed discussion of the project area's biological resources.

Upland Plant Communities. Figure 2-1 provides a mapping of the project area's plant communities and habitats. Upland plant communities located primarily within the northern portion of the western half of the project area are non-native annual grassland and coyote brush. There are two different non-native annual grassland associations within the project area: Ruderal Vegetation Association, and Coyote Brush/Western Ragweed (*Ambrosia psilostachya*) Association. This non-native annual grassland habitat has been significantly impacted through previous agricultural operations, historical development, and other human-induced impacts, and consists of a number of species of non-native grasses and forbs including soft chess (*Bromus hordeaceus*), rip-gut brome (*Bromus diandrus*), Italian rye-grass (*Lolium multiflorum*), bristly ox-tongue (*Picris echioides*), black mustard (*Brassica nigra*), and wild radish (*Raphanus sativus*). This habitat incorporates patches of coyote brush habitat, both the Eucalyptus (*Eucalyptus sp.*) Association and Myoporum (*Myoporum laetum*) Association, which occur along the banks of many of the drainage ditches within the project area. In addition to the native coyote brush, other native species observed in this community, although infrequently, include mulefat (*Baccharis salicifolia*), brass buttons (*Cotula coronopifolia*), and heliotrope (*Heliotropium curassavicum*).

Upland plant communities located primarily within the northern portion of the eastern half of the project area (within the VCGP) are the saline/haline herb community and willow scrub. The saline/haline herb community is dominated by herbaceous species typically found on saline soils, including alkali mallow (*Malvella leprosa*), alkali weed (*Cressa truxillensis*), alkali-heath (*Frankenia salina*), saltbush (*Atriplex sp.*), and woolly seablite (*Suaeda taxifolia*). The willow scrub habitat consists of willow patches dominated by several species of Salix, including arroyo willow (*Salix lasiolepis*). The majority of these patches are located on the levees surrounding the managed duck ponds. The willow scrub communities within the project site are not associated or dependent upon a stream or any other type of watercourse and therefore do not meet the California Department of Fish and Game (CDFG) or California Coastal Commission (CCC) definition of riparian habitats (CDFG ESD, 1994; CCC, 1981). However, these willows do provide habitat for avian fauna and may qualify as sensitive habitat.

The southern foredune habitat found along the southern and western boundaries of the project site is characteristic of the sand verbena (*Abronia sp.*) beach bursage series defined by Sawyer and Keeler-Wolf (1994). Native plant species that are dominant in this habitat type include beach evening primrose (*Camissonia cheiranthifolia*), beach bur (*Ambrosia chamissonis*), and beach morning-glory (*Caystegia soldanella*). This is considered sensitive habitat by the CDFG, as is the intertidal shore between the foredunes and the subtidal marine deepwater habitat; this area is called a Marine Intertidal Irregularly-flooded Unconsolidated-Sand Wetland.

The mixed transitional plant community is present throughout the project area and represents a shift between the upland and wetland plant communities. The upland plant species are dominated by invasive exotics, such as black mustard (*Brassica nigra*), non-native annual grasses, iceplant (*Carpobrotus sp.*), saltbush (*Atriplex sp.*), fat-hen spearscale (*Atriplex triangularis*), and curly dock (*Rumex crispus*). The wetland plants are comprised of varying densities and combinations of salt grass (*Distichlis spicata*), perennial pickleweed (*Sarcocornia pacifica*), and California tule (*Schoenoplectus californicus*).

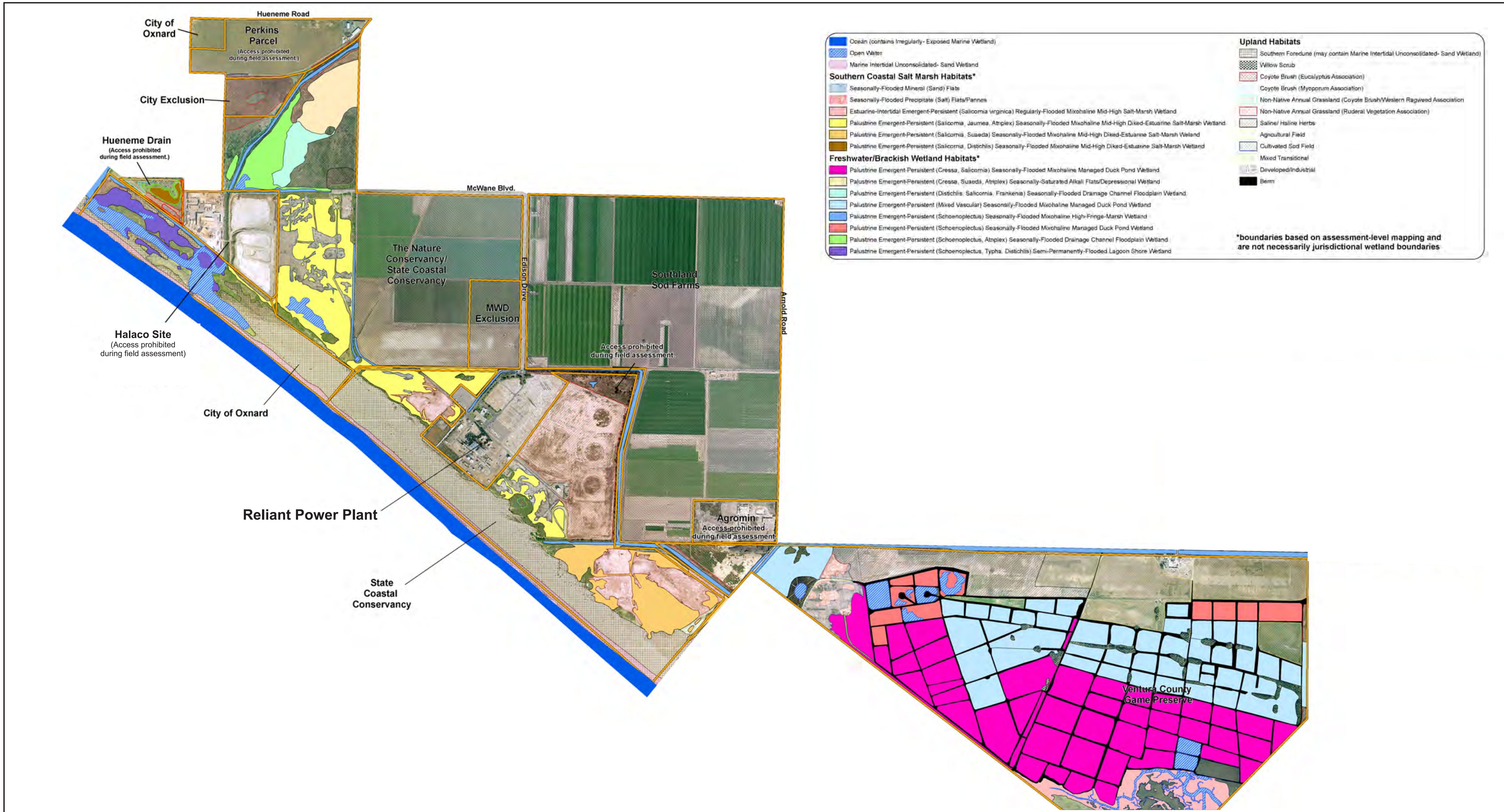
Wetland Plant Communities. The southern coastal salt marsh and coastal freshwater/brackish marsh wetlands are found throughout the project site, whereas the managed duck ponds are only located in the southeast corner of the project area. All of these types of wetlands are linked to the presence of a water table that occurs close to or at the surface for at least part of the growing season. They are considered sensitive habitat by the CDFG, CCC, and U.S. Army Corps of Engineers (USACE) and are described in more detail below. Figure 2-2 provides a mapping of the project area's sensitive habitats.

Southern Coastal Salt Marsh

There are three types of southern coastal salt marshes within the project site; they are typically a perennial pickleweed association of low tidelands and estuaries. The vegetation in these southern coastal salt marshes is primarily composed of succulent halophytic and hydrophytic plants such as perennial pickleweed or annual pickleweed (*Salicornia subterminalis*), salt grass, woolly seablite, and California sealavender (*Limonium californicum*). Pickleweed typically occupies the middle to high marsh, whereas salt grass occurs in low areas but can also be dominant in the higher terrain (McClelland Engineers, 1985). The only intertidal salt marsh on-site, located in the southern corner of the VCGP, receives muted tidal input through a system of channels that connect to Mugu Lagoon. This wetland type is characterized as Estuarine-Intertidal Emergent-Persistent (*Sarcocornia pacifica*) Regularly-Flooded Mixohaline Mid-High Salt-Marsh Wetland. The other salt marshes are non-tidal or are seasonally flooded ponds/pannes. These communities are dominated by perennial pickleweed with salt pannes and sand flats separating the elevated stands of vegetation. They are characterized as Palustrine Emergent-Persistent Seasonally-Flooded Mixohaline Mid-High Diked-Estuarine Salt-Marsh Wetland. In addition to being dominated by perennial pickleweed, one type is co-dominated by jaumea (*Jaumea carnosa*) and fat-hen spearscale, while the other is co-dominated by woolly seablite. The endangered salt marsh bird's-beak (*Cordylanthus maritimus*) was observed during the project's July 2004 site visit (WRA, 2007) in one of these non-tidal wetlands located west of the NBVC Point Mugu in the SCC parcel (please refer to Figure 1-8).

Coastal Freshwater/Brackish Marshes

The coastal freshwater/brackish marshes (Holland, 1986) are located in the northwestern corner of the project site, where freshwater flows into the lagoon area from three drains and infiltrates into the ocean through the beach sands or flows through occasional breaches in the sand barrier. The five specific types of brackish marshes found within the project area include:



Aspen Environmental Group

Source: Wetlands Research Associates, 2007.

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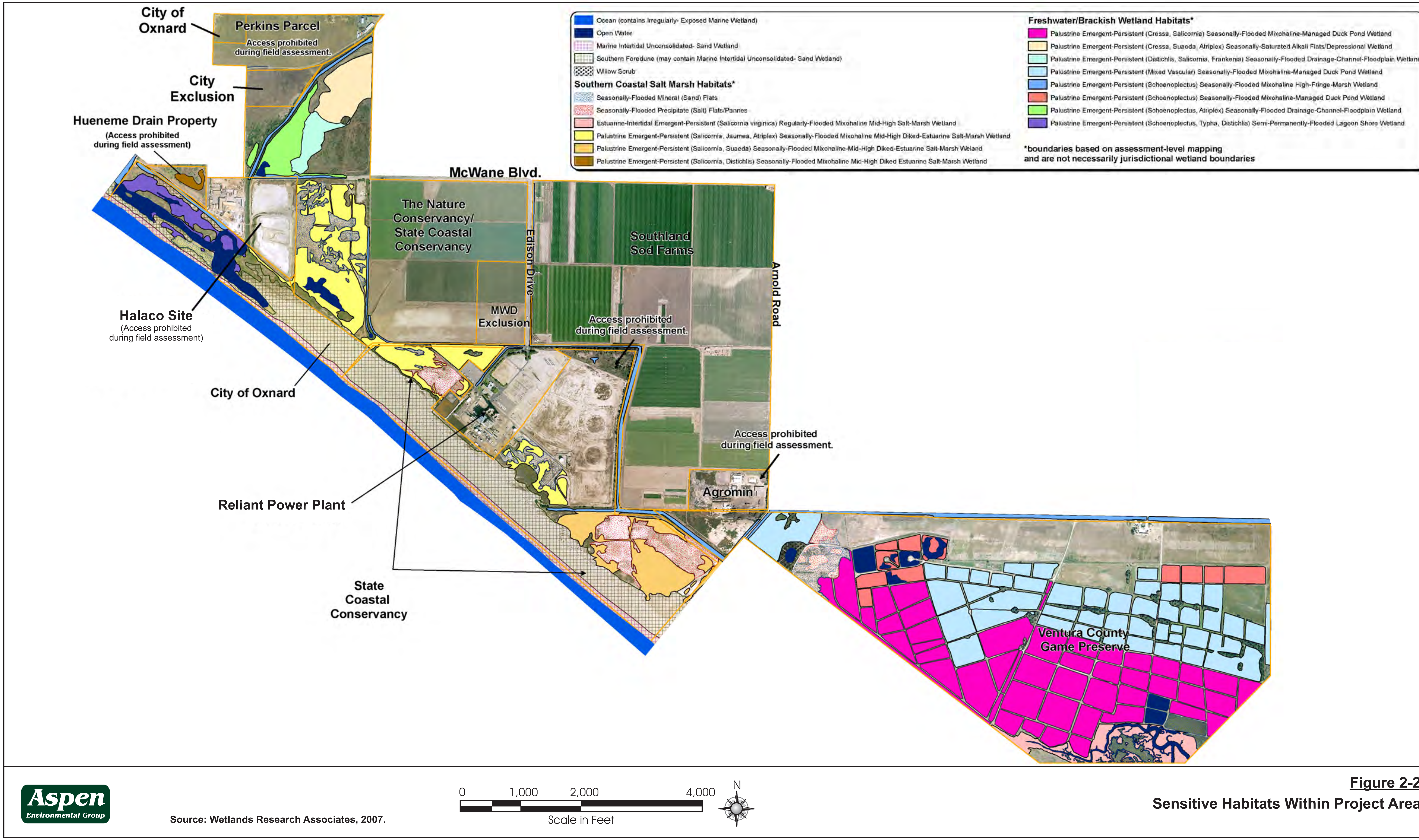
Figure 2-1
Plant Communities and Habitats Within Project Area



Aspen Environmental Group

Source: Wetlands Research Associates, 2007.

Figure 2-2
Sensitive Habitats Within Project Area

- Palustrine Emergent-Persistent (*Schoenoplectus, Typha, Distichlis*) Semi-Permanently-Flooded Lagoon Shore Wetland;
- Palustrine Emergent-Persistent (*Schoenoplectus*) Seasonally-Flooded Mixohaline High-Fringe Marsh Wetland;
- Palustrine Emergent-Persistent (*Schoenoplectus, Atriplex*) Seasonally-Flooded Drainage Channel Floodplain Wetland;
- Palustrine Emergent-Persistent (*Distichlis, Sarcocornia, Frankenia*) Seasonally-Flooded Drainage Channel Floodplain Wetland; and,
- Palustrine Emergent-Persistent (*Cressa, Suaeda, Atriplex*) Seasonally-Saturated Alkali Flats/Depressional Wetland.

Managed Duck Ponds

These habitats are located solely within the VCGP and consist of artificial wetlands that were created by a system of levees and berms. Many of the plant communities within the managed duck ponds resemble salt marsh or brackish marsh communities. All three types of managed duck ponds within the project area are characterized as Palustrine Emergent-Persistent Seasonally-Flooded Mixohaline Managed Duck Pond Wetlands, but the species they are dominated by varies between: (1) perennial pickleweed and alkali-weed; (2) California tule and bulrush (*Bolboschoenus maritimus*); and, (3) mixed vascular plants, including California tule, bulrush, curly dock, salt grass, perennial pickleweed, alkali weed, and others.

Open Waters/Ocean Habitat. A series of channels throughout the project site, an open water lagoon in the northwest corner of the project area, and open water areas within the VCGP provide fish habitat. Some of these waters are considered to be Essential Fish Habitat (EFH) and are protected by National Oceanic and Atmospheric Administration (NOAA) Fisheries Service. In addition, brackish open water in the northwestern corner of the project area provides habitat for the federally endangered tidewater goby (*Eucyclogovius newberryi*).

Table 2-1provides a summary of the acreages of the sensitive habitat types located within the project area, as shown on Figure 2-2.

Table 2-1. Summary of Sensitive Habitats

Sensitive Habitat Type	Northwest of Arnold Road (Acres)	Southeast of Arnold Road (Acres)	Total Habitat (Acres)
Open Waters/Ocean (Essential Fish Habitat)	75	15	90
Southern Foredune (includes Marine Intertidal Unconsolidated-Sand Wetland)	135	0	135
Willow Scrub	0	11	11
Seasonal Pond/Panne (includes Sand Flats and Salt Pannes)	48	21	69
Southern Coastal Salt Marsh (Tidal) (i.e. Estuarine-Intertidal Wetland)	0	21	21
Southern Coastal Salt Marsh (Non-Tidal) (i.e. the three Palustrine Southern Coastal Salt Marshes on Figure 2-2)	87	0	87
Duck Pond Palustrine Wetlands	0	313	313
Coastal Freshwater/Brackish Marsh	53	12	65
Open Waters/Ocean (Essential Fish Habitat)	75	15	90
Seasonal Pond/Panne	48	21	69
Total Acreage	521	429	950

Special Status Wildlife Species. According to a review of special status wildlife species observations in the vicinity of the project site and Ventura County, 77 species could potentially occur within the project area. Of these, 27 were documented onsite during the biological surveys conducted for the *Biological Assessment for Ormond Beach* (WRA, 2007). Of the remaining 50 species that were not documented during the surveys, seven have high potential to occur onsite, 13 have moderate potential, 16 have low potential, and 14 are assumed to not be present because the required habitat conditions do not exist onsite. Table 2-2 lists all wildlife species documented in the project area during the above-referenced biological surveys that are federal and State-listed species, and Table 2-3 lists all wildlife species documented in the project site during the biological surveys that are federal and State species of concern or fully protected species.

Table 2-2. Federal and State Listed Wildlife Species Documented in the Project Area

Species Name	Status	Habitat within the Project Area
Tidewater goby (*Eucyclogovius newberryi*)	Federal Endangered, CDFG Species of Special Concern	The brackish open waters in the northwest corner of the Study Area provide suitable habitat for this species. This species was documented in Ormond Lagoon by USFWS, Ventura Office in 2006 (personal communication with Chris Dellith, June 30, 2009).
California Brown Pelican (*Pelecanus occidentalis californicus*)	Federal Endangered, State Endangered, CDFG Fully Protected	Forage and roost in the coastal freshwater/brackish marsh dominated by *Schoenoplectus*, *Typha*, and *Distichlis*
American Peregrine Falcon (*Falco peregrinus anatum*)	State Endangered, CDFG Fully Protected	Suitable foraging and roosting habitat is available throughout the project area and a small population is currently present at NBVC Point Mugu.
Western Snowy Plover (*Charadrius alexandrius nivosus*)	Federal Threatened, United State Fish and Wildlife Service (USFWS) Bird of Conservation Concern, CDFG Species of Special Concern	Present year-round at Ormond Beach. Several nest and roost in the southern foredune habitat and forage along shoreline and open waters.
California Least Tern (*Sterna antillarium browni*)	Federal Endangered, State Endangered, CDFG Fully Protected	A small colony nest and roost in the southern foredune habitat at south Ormond Beach, using open water habitat for foraging.
Belding's Savannah Sparrow (*Passerculus sandwichensis belding*)	State Endangered	Present in fragmented patches of saltmarsh habitat throughout the project area, but concentrated primarily (1) between the Halaco Site and Reliant Power Plant, and (2) the saltmarsh in the southern portion of the VCGP.

Table 2-3. Federal and State Species of Concern/Fully Protected Species Documented in Project Area

Species Name	Status	Habitat within the Project Area
Southern California saltmarsh shrew (*Sorex ornatus salicornicus*)	CDFG Species of Special Concern	Potential habitat is available in many of the southern coastal salt marsh and coastal freshwater/brackish marsh habitats throughout the project area. This species was observed in the brackish marsh northeast of the Halaco Site.
San Diego black-tailed jackrabbit (*Lepus californicus bennettii*)	CDFG Species of Special Concern	Observed in the southern foredune area southeast of the Halaco Site. Other potential habitats includes the non-native grassland and mixed transitional habitats.
Double-crested Cormorant (*Phalacrocorax auritus*)	CDFG Species of Special Concern	Large colonies roost in the uplands immediately adjacent to the coastal freshwater/brackish marsh dominated by *Schoenoplectus*, *Typha*, and *Distichlis*.
White-faced Ibis (*Plegadis chihi*)	CDFG Species of Special Concern	The coastal freshwater/brackish marsh dominated by *Schoenoplectus* provides suitable habitat for this species.
Cooper's Hawk (*Accipiter cooperii*)	CDFG Species of Special Concern	Roost and forage in upland habitats within the project area.

Species Name	Status	Habitat within the Project Area
Sharp-shinned Hawk (*Accipiter striatus*)	CDFG Species of Special Concern	Roost and forage in upland habitats within the project area.
Northern Harrier (*Circus cyaneus*)	CDFG Species of Special Concern	Suitable nesting/roosting habitat available throughout the project area. Observed foraging over upland, salt and freshwater marshes, and ruderal areas.
White-tailed Kite (*Elanus caeruleus*)	CDFG Fully Protected	Observed in non-native grassland, mixed transitional, and coastal freshwater/brackish marsh dominated by *Schoenoplectus*.
Merlin (*Falco columbarius*)	CDFG Species of Special Concern	Observed foraging in sod farm habitat. May also forage in open upland habitats. Not believed to breed in project area.
Long-billed Curlew (*Numenius americanus*)	USFWS Bird of Conservation Concern, CDFG Species of Special Concern	Observed foraging along the shoreline at Ormond Beach and in the open, dry ponds of the VCGP.
Western Burrowing Owl (*Athene cuniculara*)	USFWS Bird of Conservation Concern, CDFG Species of Special Concern	The non-native annual grassland and roadside berms provide habitat.
Loggerhead Shrike (*Lanius ludovicianus*)	USFWS Bird of Conservation Concern, CDFG Species of Special Concern	Observed in the vicinity of non-native annual grassland habitats.
California Horned Lark (*Eremophila alpestris actia*)	CDFG Species of Special Concern	Is regularly observed foraging in the sod farms. Non-native grassland and mixed transitional areas also provide habitat.
Tri-colored Blackbird (*Agelaius tricolor*)	USFWS Bird of Conservation Concern, CDFG Species of Special Concern	Suitable emergent wetland habitat is available along Oxnard Industrial Drain, adjacent coastal freshwater/brackish marsh habitat, and dense emergent wetland vegetation at the managed duck ponds.
South Coast garter snake (*Thamnophis sirtalis ssp.*)	CDFG Species of Special Concern	One observed crossing Arnold Road adjacent to the cultivated sod fields. Suitable habitat includes upland, salt marsh and brackish marsh.
Wandering (saltmarsh) skipper (*Panoquina errans*)	Extremely rare in California, considered globally imperiled by the World Conservation Union	Observed in the southern coastal salt marsh, coastal freshwater/brackish marsh, and non-native annual grassland (coyote brush/western ragweed association).

Three species that have a high potential for occurrence but have not been documented in the project area. They include:

Federal and State Listed Species

- Light-footed Clapper Rail (*Rallus longirostris levipes*): Federally Endangered, State Endangered, CDFG Fully Protected; and,
- Least Bell's Vireo (*Vireo bellii pusillus*): Federal Endangered, State Endangered, USFWS Bird of Conservation Concern.

Federal and State Species of Concern/Fully Protected Species

- Yellow Warbler (*Dendroica petechia brewsteri*) – CDFG Species of Special Concern.

Special Status Plant Species. The project site contains suitable habitat for 28 of the 40 special status plant species that occur within the vicinity of the project area. Please refer to Figure 2-3 for a mapping of the project area's special status plant species. Of these 28 species, five are present onsite, nine have a high potential to occur onsite, 12 have a moderate potential to occur onsite, and two have a low potential. Of the five species that are present onsite, three were documented during the project's July 2004 biological survey (WRA, 2007), and two were documented previously by others (Jones and Stokes, 1998; CDFG, 2004; Impact Sciences, 1996). The three special status species observed during the 2004 survey included:

- Salt marsh bird's-beak (*Cordylanthus maritimus ssp. maritimus*): Federal Endangered, State Endangered, California Native Plant Society (CNPS) List 1B. This species was documented within several of the coastal salt marsh habitats within the project area, and in the managed duck ponds.
- Spiny rush (*Juncus acutus ssp. leopoldii*): CNPS List 4. This species was observed within several of the wetland habitats within the project area.
- Woolly seablite (*Suaeda taxifolia*): CNPS List 4. This species was observed in several of the wetland habitats within the project area.

The two special status species previously documented on-site were:

- Red sand-verbena (*Abronia maritima*): CNPS List 4. This species has been documented within the southern foredune and transitional habitat within the project area.
- Coulter's goldfields (*Lasthenia glabrata ssp. coulteri*): CNPS List 1B. This species has been documented within the southern coastal salt marsh dominated by *Sarcocornia*, *Jaumea*, and *Atriplex*.

The nine special status plant species that were not observed on-site but that have a high potential to occur there, are:

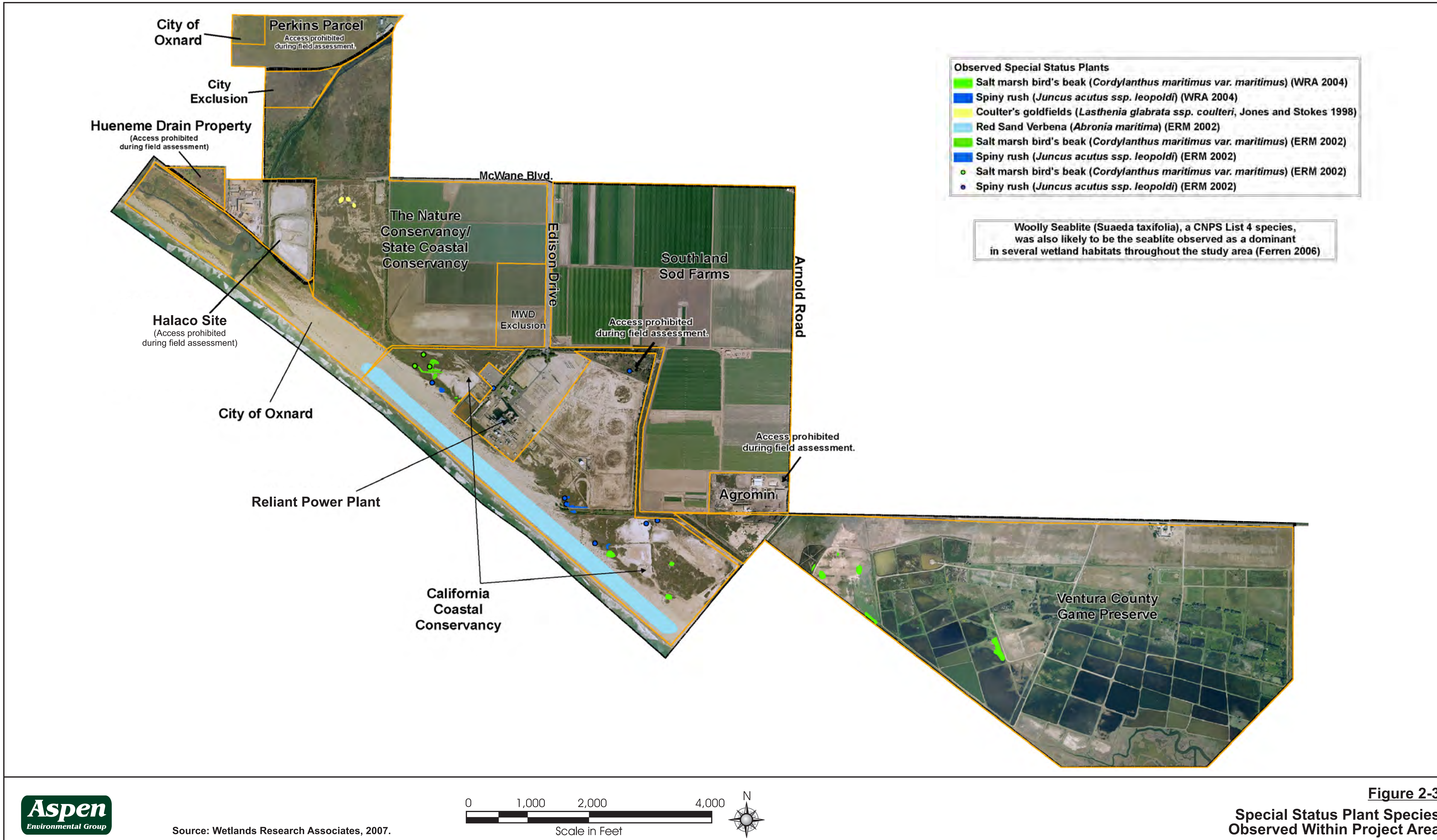
- Southern tarplant (*Centromadia parryi ssp. australis*): CNPS List 1B;
- Orcutt's pincushion (*Chaenactis glabriuscula var. orcuttiana*): CNPS List 1B;
- Dune larkspur (*Delphinium parryi spp. blochmaniae*): CNPS List 1B;
- Beach spectaclepod (*Dithyrea maritima*): State Threatened, CNPS List 1B;
- Small spikerush (*Eleocharis parvula*): CNPS List 4;
- Suffrutescent wallflower (*Erysimum insulare spp. suffrutescens*): CNPS List 4;
- Vernal barley (*Hordeum intercedens*): CNPS List 3;
- California spineflower (*Mucronea californica*): CNPS List 4; and,
- Estuary seablite (*Suaeda esteroa*): CNPS List 1B.

Of the 12 special status plant species with a moderate potential to occur within the project site, two species are federally and/or State-listed. They are Braunton's milk-vetch (*Astragalus brauntonii*), which is federal endangered, and Ventura Marsh milk-vetch (*Astragalus pycnostachyus var. lanosissimus*), which is federal and State endangered.

In addition, silverscale saltbush (*Atriplex argentea*) was observed within the Perkins parcel (see Figure 2-3) by Dr. Wayne Ferren, Jr. on January 20 and September 2, 1999 (Ferren, 2002). Silverscale saltbush is not a special status species; however, Dr. Ferren believes this species is locally rare (Ferren, 2002 and 2005).

2.2 HYDROLOGIC, HYDRAULIC AND GEOMORPHIC CONDITIONS

As referenced in Section 1 (Introduction), the project area and its surroundings have undergone a series of land use and hydrologic changes over the last 150 years. These changes have altered the project site's landforms and processes, resulting in a shift from natural wetlands to mostly managed agricultural and industrial uses. This section summarizes these changes, particularly with regard to land use, hydrology and geomorphology. An overview of likely changes due to anticipated future sea level rise concludes this section. Please refer to the *Ormond Beach Wetland Restoration Feasibility Plan: Hydrologic and Geomorphic Conditions Report* (Philip Williams and Associates, 2007) for a more detailed account of these conditions.



Source: Wetlands Research Associates, 2007.

Figure 2-3
Special Status Plant Species Observed Within Project Area

Land Use. Historically, the project area was part of a wetland complex that extended from Point Hueneme through Mugu Lagoon. These wetlands were supplied with water from precipitation, freshwater discharges from the Oxnard Plain, high groundwater elevations, dune overtopping by ocean swell, and, for portions adjacent to Mugu Lagoon, tidal exchange. Coastal salt marsh interspersed with salt pans comprised the majority of the wetlands. A portion of this wetland complex also included seasonal lagoons that were probably connected to the ocean for brief periods of time when the dunes breached.

The natural coastal habitats of the project area have been altered by several 20th century land use changes and modifications of the hydrologic and geomorphic processes. As a result, the project area's historic coastal wetlands and lagoons have diminished in size and become fragmented. Development has altered the topography and directly impacted coastal habitats within the project area. Substantial changes in land use of the project area include: agricultural development; construction of the Reliant Power Plant; expansion of industrial uses along Perkins Road, particularly, the Halaco Site; and, habitat modification and management to attract ducks for the area's managed duck clubs.

Hydrology. Because the project area's annual precipitation of 17 inches is greatly exceeded by its annual evaporation potential of more than 60 inches (United Water Conservation District, 2001), freshwater discharge and groundwater, as well as the ocean, are essential water sources for sustaining the project site's past and present wetlands.

Channelization of the Oxnard Plain, as well as urbanization and agricultural production, has modified the hydrologic characteristics of the local watersheds which provide freshwater discharge to the project area. The result has been modified frequency and duration of runoff events as well as a diminished supply of freshwater to the historic wetlands. Presently, freshwater discharge enters the project site from the northwest primarily through three constructed channels, including the: Oxnard Industrial Drain; J Street Drain; and, Hueneme Drain (see Figure 1-2). Typical combined annual average flow from these sources is approximately 10 cubic feet per second (ft^3/s); the peak 10-year and 50-year combined flow are 4,100 ft^3/s and 6,000 ft^3/s, respectively. Management for local agriculture involves a system of irrigation, subsurface tiling, and drainage collection. Overall, this system routes water through the project area more regularly and more rapidly than historic seasonal precipitation and percolation rates. Much of this agricultural water is collected in drainage channels and subsurface drains and then conveyed to Mugu Lagoon via the Oxnard Drainage Ditch #3 (ODD#3) (see Figure 1-2).

The project site's groundwater consists primarily of a semi-perched zone which is separated from deeper aquifers by a clay lens approximately 30 feet below the ground surface (United Water Conservation District, 2001). This clay lens is nearly impermeable, thereby limiting connection between the surface aquifer and the deeper aquifers which are actively recharged and pumped for water supply. Although salt water intrusion is a concern for the deeper aquifers, the limited connection between the perched surface aquifer and the deeper aquifers minimizes the potential for project restoration impacting the deeper, water-supply aquifers. Groundwater in the semi-perched zone originates from precipitation, irrigation, and ocean water intrusion. The water table exceeds the ground surface during winter months at lower ground levels near the ocean; during late summer and fall, the water table falls up to ten feet below the ground surface at higher, inland locations. Water within this semi-perched zone is typically saline near the coast and ranges from brackish to fresh inland. Agricultural uses reduce the potential for negative impacts from salinity on crops by applying fresh irrigation water. In contrast, the proposed restoration of coastal salt marsh would be compatible with the existing salinity.

The site's ocean boundary serves as the hydrologic control to the southwest. The average diurnal tide range is 5.4 feet, with peak annual astronomic tides up to 1.5 feet higher. During winter storms, surging water levels have been observed up to three feet above Mean Higher High Water (MHHW). Storms also bring larger wind waves, which, when combined with storm surge, may overtop the dunes. Because the volume of water that overtops the dunes during a flood event may be limited, water levels behind the dunes may not reach the same elevation as ocean water levels. A coastal flood study would be required to predict the elevation and extent of flooding. The existing Federal Emergency Management Agency (FEMA) flood delineation for this area is indeterminate, only indicating the potential for flooding but not predicting its extent (FEMA, 1985). A more recent assessment of coastal flooding at a State-wide scale predicts that the 100-year coastal flood event will inundate nearly the entire project area (Heberger et al., 2009). However, this assessment may over-predict the inundation extent because it assumes unimpeded flooding and does not account for varying topography. Given the lack of analysis specific to the project area, a coastal flood study is recommended in Section 8.1.2.

Storm-generated overtopping alone, or in combination with fresh water discharge, can lead to dune breaching and an intermittent inlet which connects the ocean to an inland lagoon. Tidal exchange with historic lagoons or the present J Street Lagoon has not been sufficient to maintain a permanent inlet; sand transport along the beach fills the inlet, cutting off the lagoon from the ocean. This intermittent inundation from the ocean, as well salt transport through groundwater, has created saline soils on land adjacent to the ocean.

Geomorphology. Geomorphic processes, created by the interaction between the land surface and hydrology, play a significant role in the project area's evolution. Currently, most of the project site's ground elevation is above tidal water levels, and therefore is shaped by watershed geomorphic processes. Less than 200 acres of the project area are at elevations below high water levels.

Most of the land currently above high water levels has its morphology controlled by human uses. Therefore, watershed impacts on geomorphology are limited. Sediment delivery via the three primary drainages (the Hueneme, J Street and Oxnard Industrial Drains) is unknown due to a lack of data; however, because of urbanization and channelization, the fluvial delivery of watershed sediments is assumed to be small.

Portions of the project site influenced by the coastal morphologic processes include the beach and dune system as well as the J Street Lagoon. Locally, the beach and dune morphology are shaped by the natural sand transport energized by ocean waves and wind. However, at a regional scale, the natural flux of sand along the shore has been disrupted by harbor construction to the northwest of the project site. Mechanical bypassing of the Channel Islands and Port Hueneme Harbors maintains the flux of sand. The stable beach front depends on the continued operation of mechanical bypassing, which delivers about an average of 850,000 cubic yards per year.

Alongshore sand transport also plays a key role in the present day J Street Lagoon morphology. This lagoon is typically cut off from the ocean by the beach berm created by alongshore sand transport. Freshwater discharge to the lagoon, ocean wave overtopping, or mechanical intervention occasionally breach this berm, connecting the lagoon to the ocean via an inlet. However, the tidal exchange through the inlet is minimal because the bed elevation of the J Street Lagoon is higher than most high tides. This limited tidal exchange is not sufficient to sustain an open inlet in the face of the ongoing alongshore sand transport and the inlet closes relatively soon after opening.

Sea Level Rise. In the future, sea level rise will very likely become the driving factor for hydrologic and geomorphic change within the project area, and should be strongly considered when designing and evaluating the project's alternatives. An increase in sea level rise would enable tides to penetrate further and higher on a regular basis, thereby pushing the shoreline landward and altering habitat distributions which are sensitive to inundation frequency and duration. For example, in the likely situation that sea level rises by three feet before the end of this century, a substantial portion of the project area's existing ground elevation would fall below present day MHHW plus three feet, as shown in Figure 2-4. Increased sea levels would also amplify the impact of extreme wind-wave and storm surge events since these events will be superimposed on higher base conditions. The actual rate of sea level rise is difficult to predict, particularly since future greenhouse gas emissions are not known. Recent interpretations of sea level rise predictions for planning purposes (Isenberg, 2008) recommend that project planning anticipates 1.3 feet of sea level rise by 2050 and 4.6 feet of sea level rise by the end of this century.

2.3 POTENTIAL CONTAMINANT TYPES AND SOURCES

The project area has several onsite and adjacent past and present uses that have been established as sources of chemical contamination. The project area includes a former metal smelter facility and onsite waste disposal areas (the Halaco Site) as well as agricultural fields and an industrial drain; properties surrounding the project site also include agricultural and industrial uses. Public use of the project site and its surroundings has additionally resulted in the accumulation of substantial amounts of trash at some locations, such as the drainages located at the west/northwest end of the project area, which may also be contributing to the degradation of surface water quality. A major component of this Feasibility Study consisted of evaluating the physical and chemical characteristics of the project area to ascertain if sources of contamination pose a "fatal flaw" to wetland restoration, and if and how excavated soils may be beneficially reused (e.g., beach nourishment, nearshore placement for littoral cell replenishment, river berm and levee construction, upland fill for contouring or revegtation, and structural fill).

To date, several contaminant investigations have been conducted within and adjacent to the project site. The majority of these studies have been completed since the mid-1990s. Figure 2-5 provides a map of the location of these previous investigations. These investigations were conducted for specific purposes and did not involve sampling at the same locations; similarly, because the purpose of these investigations varied, the number of samples taken for testing differed from investigation to investigation. Consequently, the findings of these investigations cannot be quantitatively compared against each other. Overall, however, between the previous investigations reviewed, heavy metal concentrations for at least one sample location were found to exceed either their applicable Effects Range-Low (dry weight) (ERL), Effects Range-Median (dry weight) (ERM) or Apparent Effects Threshold (dry weight) (AET) (AMEC Earth & Environmental, Inc., 2006). The ERL and ERM are used to form a general opinion as to whether the chemical concentrations found in sediments are likely to have adverse impacts on sensitive organisms (AMEC Earth & Environmental, Inc., 2006). The ERL is the lower tenth percentile concentration of the available sediment toxicity data examined, while the ERM is the median concentration of the toxic samples taken. Overall, toxic effects are rarely expected to occur at concentrations less than ERLs, while toxic effects are likely to occur at concentrations above ERMs (AMEC Earth & Environmental, Inc., 2006). The AET is the contaminant concentration level of sediment above which adverse effects are always expected to occur for a specified biological indicator (or indicators).

Of the previous investigations reviewed, at least one sample location for at least one investigation detected elevated levels of arsenic, cadmium, copper, lead, nickel, silver and zinc (e.g., the ERMs and AETs for these heavy metals were exceeded), and at least one sample for chromium exceeded its AET

(AMEC Earth & Environmental, Inc., 2006). The primary locations within the project site where elevated heavy metal concentrations occur include areas within, and adjacent to, the Halaco Site, the Reliant Power Plant and the western end of the VCGP. In addition to heavy metal contamination, two of the previous investigations reviewed also detected significantly elevated pesticide concentrations of dichloro-diphenyl-dichloroethane (DDD), dichloro-diphenyl-dichloroethylene (DDE), and dichloro-diphenyl-trichloroethane (DDT) (AMEC Earth & Environmental, Inc., 2006).

Due to the findings of these previous investigations, several locations within the project area continue to be of concern, as depicted in Figure 2-6.[1] In response to these concerns, two separate investigations within the project area have either been completed or are in process. One involved a site-wide soil and surface water investigation that was conducted specifically for the project (AMEC Earth & Environmental, Inc., 2006); the other involves an on-going investigation by the United States Environmental Protection Agency (USEPA) associated with the Halaco Site and its surroundings. The following sections provide a summary of these efforts.

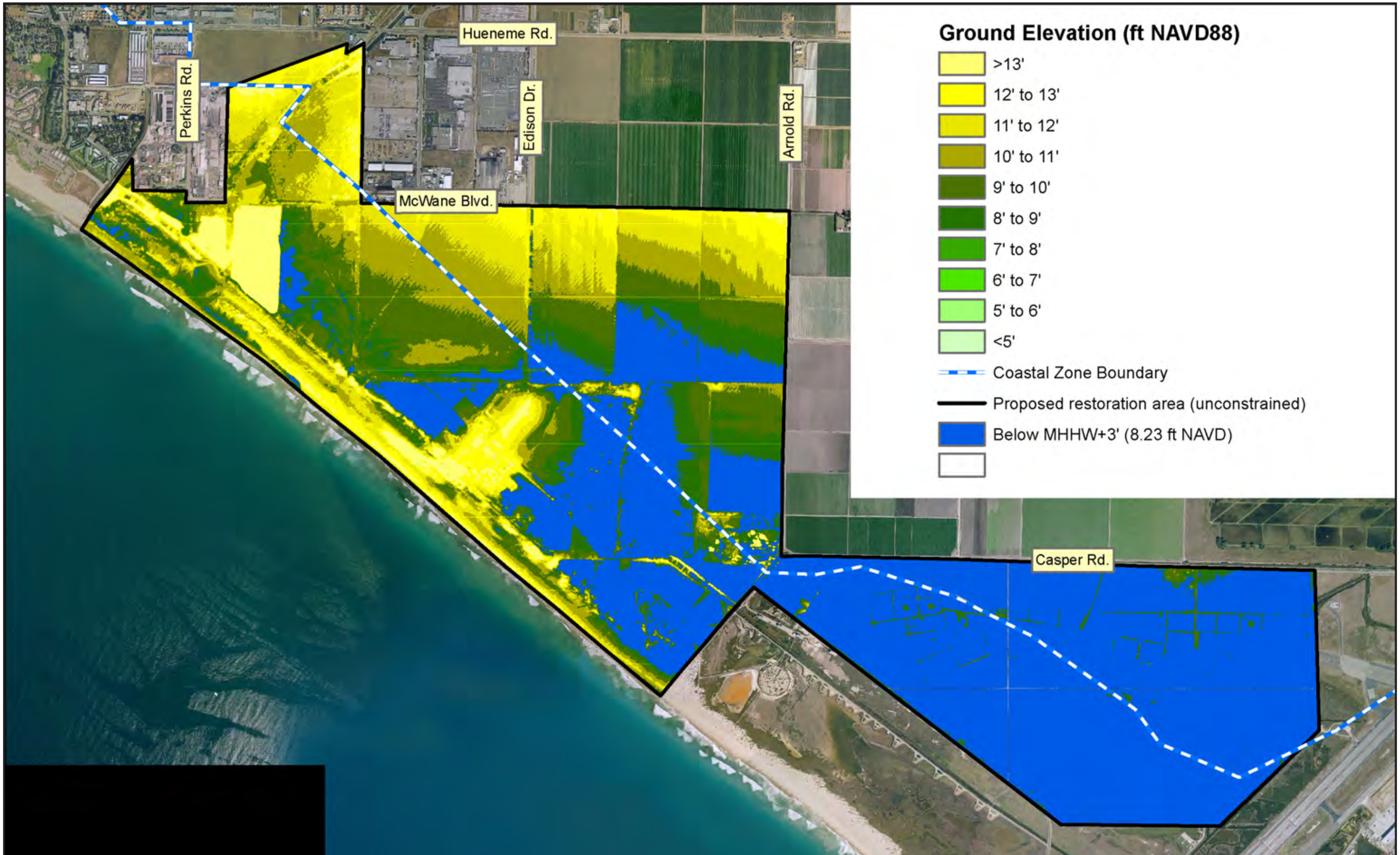
2.3.1 Summary of General Site-Wide Soil and Surface Water Investigation

The project's site-wide soil and surface water investigation was conducted in 2006 and involved: review of previous investigations conducted in and near the project site; preparation of a *Sampling and Analysis Plan*; preparation of a *Site-Specific Health and Safety Plan* for on-site investigators, as required by the Occupational Safety and Health Administration (OSHA); soil (e.g., subsurface soil borings) sampling at 30 locations throughout the project area; surface water collection at 10 locations throughout the project site; and, subsequent chemical analysis and assessment of the soil and surface water samples collected. The procedures, methodology, and results of the investigation are detailed in the effort's final report, titled *Ormond Beach Wetland Restoration Site-Wide Soil/Surface Water Investigation* (AMEC Earth and Environmental, Inc., 2006); Figure 2-7 provides the locations within the project site where soil and surface water samples were collected. The purpose of the investigation was to provide a general overview of the physical and chemical characteristics of the project site's soils and surface water and was not intended to provide an exhaustive analysis of all potential chemical contaminants with the project area or their potential impacts on human health or the environment (AMEC Earth and Environmental, Inc., 2006).

Beneficial Reuse. Grain size results will dictate whether excavated sediment for the project can be used for nearshore or onshore beach nourishment. In general, sediment for on-beach nourishment purposes should be greater than 80 percent sand and greater than 0.075 millimeters in size. In addition, the sediment should be similar to the material already present at the receiver beach. For the purposes of the project's beneficial reuse analysis it was determined that excavated soils should be 60 percent or more sand for nearshore (e.g., greater than 30 feet deep) placement.

Six of the 30 soil samples taken within the project site were greater than 60 percent sand; the total percent sand of these six samples ranged between 61.82 and 94.07. For the remaining 24 soil samples, when sand was observed, it was typically found near the bottom of the core sample (15 to 20 feet below ground surface). These results indicate that disposal alternatives in addition to beach placement will likely need to be pursued for the project's construction.

[1] It is noted that Figure 2-6 was prepared prior to the United States Environmental Protection Agency's current investigation of the Halaco Site and its surroundings.

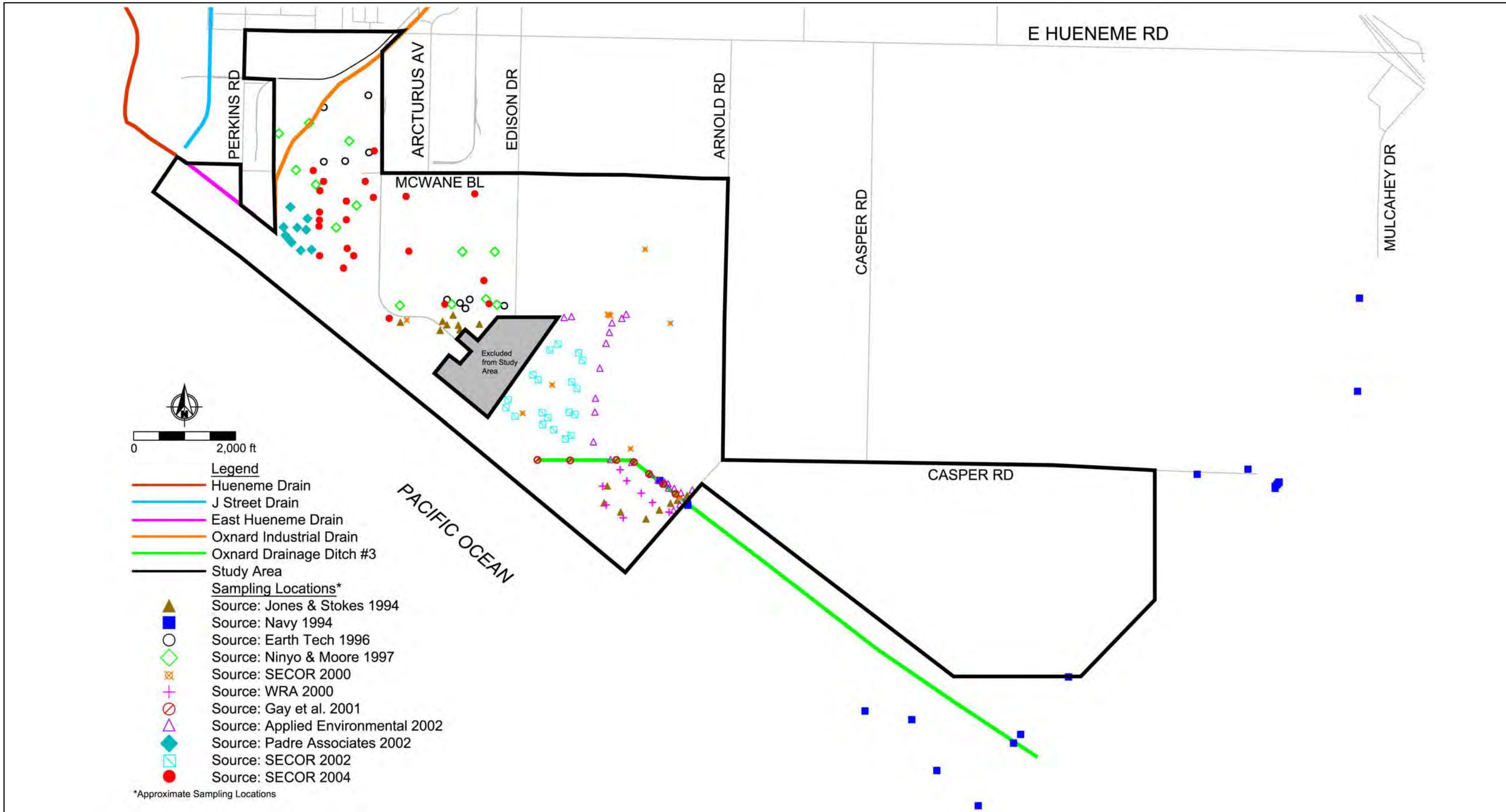


Aspen Environmental Group

0 1,000 2,000 4,000
Scale in Feet
N

Source: Philip Williams & Associates, Ltd., 2009.

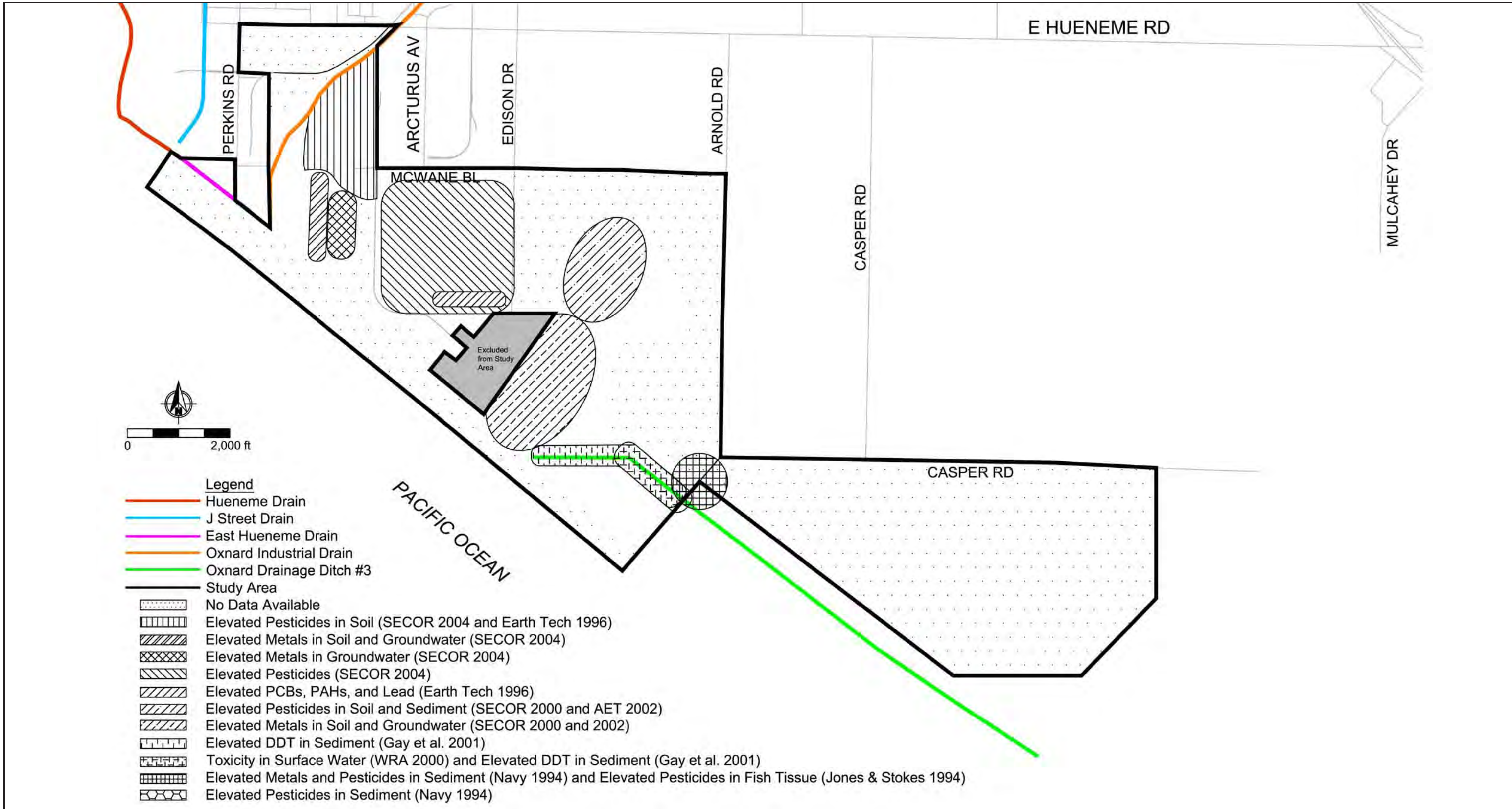
Figure 2-4
Existing Ground Surface Below MHHW +3'



Source: AMEC Earth and Environmental, Inc., 2006.

Note: This figure was prepared for the project's *Ormond Beach Wetland Restoration Site-Wide Soil/Surface Water Investigation*, which was completed prior to the United States Environmental Protection Agency's current investigation of the Halaco Site and its surroundings.

Figure 2-5
Previous Soil Sample Locations Within the Project Area



Aspen Environmental Group

Source: AMEC Earth and Environmental, Inc., 2006.

Note: This figure was prepared for the project's *Ormond Beach Wetland Restoration Site-Wide Soil/Surface Water Investigation*, which was completed prior to the United States Environmental Protection Agency's current investigation of the Halaco Site and its surroundings.

Figure 2-6
Approximate Areas of Concern for Chemical Contaminants in Soil, Sediment, and Groundwater Within or Near the Project Area

Aspen Environmental Group

Source: AMEC Earth and Environmental, Inc., 2006.

Figure 2-7

Soil and Surface Water Sampling Locations for the Site-Wide Soil/Surface Water Investigation

Soil Chemistry. The soil chemistry analysis conducted for the project detected cadmium and arsenic concentrations that exceeded their respective Threshold Effects Levels (TELs) for freshwater sediment; however, toxic effects are rarely expected to occur at concentrations less than established TELs (AMEC Earth & Environmental, Inc., 2006). One sample taken additionally exceeded the ERL for arsenic, but did not exceed the ERM for this heavy metal. Total petroleum hydrocarbons were detected in six of the samples evaluated, with concentrations ranging between 9 to 80 milligrams per kilogram (mg/kg). Although banned in the 1970's, elevated levels of DDT and its associated derivatives were also detected in nine of the soil samples taken; these samples were located throughout the entire project site, with the exception of the VCGP (AMEC Earth & Environmental, Inc., 2006). As with ERMs, toxic effects are likely to occur at concentrations above TELs. The total pesticide levels detected within the project site could affect the sediment reuse options. Soils with the highest concentrations of pesticides may be precluded from disposal in areas that are in contact with the aquatic environment and sensitive aquatic receptors. Additional analysis of the archived soil samples that were collected, as well as further testing, will be necessary when final soil reuse options are evaluated.

Surface Water Chemistry. Surface water chemistry concentrations were low and typical of what is commonly found in surface runoff drainages. Copper (three sample locations) and zinc (one sample location) were found to be slightly above ambient water quality criteria. No sediment samples were collected from the drainages where surface water sampling was performed. Sediments in these drainages may have elevated levels of contaminants, in particular DDT, which was found to be present in several of soil samples taken even though its use was banned in the early 1970s.

2.3.2 Summary of Current Investigation of the Halaco Site

The USEPA began its investigation of contaminated materials at the Halaco Site in 2006. The following summary of this investigation is based upon information available from the USEPA's website for the Halaco Site (USEPA, 2009a).

The Halaco Site was operated as a secondary metal smelter from 1965 to 2004, recovering aluminum, magnesium, and zinc from dross, sludge, castings, sheets, pellets, granules, cans, car parts, and other scrap metal. The Halaco Site includes a former smelter, and an adjacent waste management area where wastes were deposited. From about 1965 to 1970, wastes were placed in an unlined earthen settling pond adjacent to the Oxnard Industrial Drain. From approximately 1970 to 2002, wastes were placed in unlined earthen settling ponds east of the smelter area. An estimated 700,000 cubic yards of waste remain within the Halaco Site.

In 2006 the USEPA completed a multimedia study as part of its initial site assessment and removal effort. The study included laboratory analysis of approximately 129 soil, sediment and waste samples, ten surface water samples, 14 groundwater samples, and 35 air samples. In June 2007 the USEPA completed additional testing of waste materials buried in the southeast corner of the former smelter area to determine existing levels of thorium, radium, and metals. Based upon the findings of these investigations, the Halaco Site was added to the Superfund National Priorities List in September 2007.

In 2008 the USEPA completed a preliminary study of surface water and groundwater movement within and near the Halaco Site to better understand the extent and movement of identified contaminants, as well as a screening-level assessment of human health and environmental risks posed by site-related contamination.

The preliminary surface and groundwater study concludes that the primary contaminants associated with the Halaco Site include chloride salts, metals, thorium, thorium decay products, and ammonia; metals found in the waste also include aluminum, barium, beryllium, cadmium, chromium, copper, lead, magnesium, manganese, nickel, and zinc (USEPA, 2008a). The fuels, oils, and solvents reportedly disposed of at the Halaco Site also included a variety of petroleum hydrocarbons that may have contained volatile organic compounds (VOCs); however, VOCs have been detected only sporadically and at low levels. These contaminants have affected the water quality of the Oxnard Industrial Drain, the J Street Lagoon and its surrounding wetland areas, and surrounding properties (USEPA, 2008a). The quality of these surface waters is additionally affected by surface water runoff from the Oxnard Plain that flows into the Hueneme, J Street and Oxnard Industrial Drains; the water quality of the existing lagoon is also periodically affected by ocean water when the existing beach berm breaches (USEPA, 2008a). The preliminary surface and groundwater study notes that there is strong evidence that wastes have adversely affected shallow groundwater at the Halaco Site, but that the horizontal and vertical extent of groundwater contamination is not known (USEPA, 2008a).

The preliminary ecological and human health risk assessment included a screening level environmental risk assessment for biological resources within and surrounding the Halaco site (USEPA, 2008b). The "constituents of potential environmental concern" (e.g., contaminant sources), that were evaluated included:

- Antimony
- Arsenic
- Barium
- Berylium
- Boron
- Cadmium
- Chromium
- Cobalt
- Copper
- Lead
- Manganese
- Mercury
- Molybdenum
- Nickel
- Silver
- Selenium
- Thallium
- Vanadium
- Zinc
- Cs-137*
- K-40*
- Ra-226*
- Ra-228*
- Th-228*
- Th-230*
- Th-232*

* Key:
Cs-137: An alkali metal
K-40: Potassium
Ra-226: Radium
Ra-228: Radium
Th-228: Thorium
Th-230: Thorium
Th-232: Thorium

The screening level environmental risk assessment concludes that all of the contaminant sources evaluated exceed their respective screening threshold for at least one receptor in at least one area, except for Cs-137, Ra-226, Th-230 and Th-232 (USEPA, 2008b). Table 2-4 provides a summary of the findings of the screening level environmental risk assessment.

In February 2009, the USEPA published a "Preliminary Plan for Additional Sampling and Analysis Activities" (Preliminary Plan). The Preliminary Plan summarizes both information on historic operations and waste disposal practices as well as past testing, compares past test results to human health and ecological screening levels for contaminated soils and sediments, and proposes soil, water and other sampling and testing to complete the majority of the outstanding information needed to complete the remedial investigation, including:

- The extent to which waste materials are in contact with surface or groundwater;
- The extent to which contamination in the existing lagoon's sediments occurs;

Table 2-4. Summary of the USEPA's Screening Level Environmental Risk Assessment

Environmental Attribute/Location	Constituent of Potential Environmental Concern																									
	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium (Total)	Cobalt	Copper	Lead	Manganese	Mercury	Molybdenum	Nickel	Silver	Selenium	Thallium	Vanadium	Zinc	Cs-137	K-40	Ra-226	Ra-228	Th-228	Th-230	Th-232
Surface Water																										
Onsite	X	-	X	X	NA	X	-	X	X	X	X	-	NA	-	X	-	NA	X	X	-	X	NA	NA	-	-	-
Offsite	NA	-	X	NA	NA	-	X	NA	X	-	X	-	NA	-	-	-	NA	NA	-	NA	NA	NA	NA	NA	NA	NA
Potential Background	X	-	X	-	NA	X	-	X	-	X	X	-	NA	-	X	-	NA	-	-	-	-	NA	NA	-	-	-
Fish for Least Tern																										
Oxnard Industrial Drain/Wetland	U	-	-	U	NA	-	-	-	-	-	-	NA	NA	-	U	X	U	-	X	NA	NA	NA	NA	NA	NA	NA
Sediment					NA																					
Oxnard Industrial Drain - Potential Background	X	-	U	U	NA	-	-	U	-	-	-	-	NA	-	-	U	U	U	X	-	-	NA	NA	-	-	-
Oxnard Industrial Drain - Onsite	X	X	U	U	NA	X	X	U	X	X	X	-	NA	X	-	U	U	U	X	-	-	NA	NA	-	-	-
Wetland - Potential Background	X	-	U	U	NA	X	-	U	X	-	-	-	NA	-	-	U	U	U	X	-	-	NA	NA	-	-	-
Wetland - Onsite	X	-	U	U	NA	X	X	U	X	X	X	X	NA	X	-	U	U	U	X	-	-	NA	NA	-	-	-
Beach - Potential Background	X	-	X	U	NA	-	-	-	-	-	-	-	NA	-	X	X	U	-	-	-	-	NA	NA	-	-	-
Beach - Onsite	X	-	X	U	NA	X	-	-	-	-	-	X	NA	-	X	X	U	-	-	-	-	NA	NA	-	-	-
Marine - Potential Background	X	-	X	U	NA	X	-	-	-	-	X	-	NA	X	X	X	U	-	-	-	-	NA	NA	-	-	-
Marine - Onsite	X	-	X	U	NA	X	-	-	-	-	-	X	NA	-	X	X	U	-	-	-	-	NA	NA	-	-	-
Sediment for Snowy Plovers					NA																					
Oxnard Industrial Drain - Potential Background	U	-	X	U	NA	X	-	-	X	X	X	X	NA	-	U	X	U	-	X	NE	NE	NE	NE	NE	NE	NE
Oxnard Industrial Drain - Onsite	U	X	X	U	NA	X	X	-	X	X	X	X	NA	-	U	X	U	X	X	NE	NE	NE	NE	NE	NE	NE
Wetland - Potential Background	U	-	X	U	NA	X	-	-	X	X	-	X	NA	-	U	X	U	-	X	NE	NE	NE	NE	NE	NE	NE
Wetland - Onsite	U	-	X	U	NA	X	X	-	X	X	X	X	NA	-	U	X	U	X	X	NE	NE	NE	NE	NE	NE	NE
Beach - Potential Background	U	-	-	U	NA	X	-	-	-	-	-	X	NA	-	U	-	U	-	-	NE	NE	NE	NE	NE	NE	NE
Beach - Onsite	U	-	X	U	NA	X	-	-	-	X	-	X	NA	-	U	-	U	-	X	NE	NE	NE	NE	NE	NE	NE
Marine - Potential Background	U	-	X	U	NA	X	-	-	-	X	-	X	NA	-	U	X	U	-	X	NE	NE	NE	NE	NE	NE	NE
Marine - Onsite	U	-	X	U	NA	X	-	-	-	X	-	X	NA	-	U	X	U	-	X	NE	NE	NE	NE	NE	NE	NE
Soils and Waste for Terrestrial Plants																										
Smelter Waste	X	-	X	X	X	-	X	-	X	-	X	-	X	-	-	X	X	X	X	-	-	NA	NA	-	-	-
Smelter Soil	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	X	X	-	-
Waste Disposal Waste	X	-	X	X	X	-	X	-	X	X	X	-	X	X	-	X	X	X	X	-	-	NA	NA	-	-	-
Management Waste Unit Waste	X	X	X	X	X	-	X	X	X	X	X	-	X	X	-	X	X	X	X	-	-	NA	NA	-	-	-
The Nature Conservancy (East)	X	-	X	X	NA	-	X	-	X	X	X	-	-	X	-	X	X	X	X	-	-	NA	NA	-	-	-
The Nature Conservancy (North)	-	-	-	NA	NA	-	X	NA	-	-	X	-	NA	-	-	-	NA	NA	-	NA	NA	NA	NA	NA	NA	NA
Agricultural (North)	-	-	-	-	NA	-	X	-	-	-	X	-	-	-	-	X	X	X	X	-	-	NA	NA	-	-	-
Agricultural (East)	-	-	-	NA	NA	-	X	NA	-	-	-	-	NA	-	-	-	NA	NA	-	NA	NA	NA	NA	NA	NA	NA
Residential	-	-	-	-	NA	-	X	-	-	-	X	-	-	-	-	X	X	X	X	-	-	NA	NA	-	-	-
Potential Background Soil	X	-	-	-	NA	-	X	X	X	X	X	X	X	-	-	X	X	X	X	-	-	-	-	-	-	-
Groundwater for Terrestrial Plants																										
Potential Background	U	X	U	-	NA	-	-	-	-	-	-	NA	NA	-	-	NA	NA	-	-	U	U	NA	NA	U	U	U
Onsite	U	X	U	-	NA	X	X	X	X	X	X	NA	NA	X	X	NA	NA	X	X	U	U	NA	NA	U	U	U

Environmental Attribute/Location	Constituent of Potential Environmental Concern																									
	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium (Total)	Cobalt	Copper	Lead	Manganese	Mercury	Molybdenum	Nickel	Silver	Selenium	Thallium	Vanadium	Zinc	Cs-137	K-40	Ra-226	Ra-228	Th-228	Th-230	Th-232
Soils and Wastes for Soil Invertebrates																										
Smelter Waste	-	-	X	X	U	-	X	U	X	-	X	-	U	-	U	-	U	U	X	-	-	NA	NA	U	U	U
Smelter Soil	X	X	X	X	U	-	X	U	X	X	X	X	U	X	U	X	U	U	X	-	-	U	U	U	U	U
Waste Disposal Waste	-	-	X	X	U	-	X	U	X	-	X	-	U	X	U	-	U	U	X	-	-	NA	NA	U	U	U
Management Waste Unit Waste	-	-	X	X	U	-	X	U	X	-	X	X	U	X	U	-	U	U	X	-	-	NA	NA	U	U	U
The Nature Conservancy (East)	-	-	X	-	NA	-	X	U	X	-	X	-	U	-	U	-	U	U	X	-	-	NA	NA	U	U	U
The Nature Conservancy (North)	-	-	-	NA	NA	-	X	NA	-	-	-	-	NA	-	U	-	NA	NA	-	NA	NA	NA	NA	NA	NA	NA
Agricultural (North)	-	-	-	-	NA	-	X	U	-	-	-	X	U	-	U	-	U	U	-	-	-	NA	NA	U	U	U
Agricultural (East)	-	-	-	NA	NA	-	X	NA	-	-	-	-	NA	-	U	-	NA	NA	-	NA	NA	NA	NA	NA	NA	NA
Residential	-	-	-	-	NA	-	X	U	-	-	-	-	U	-	U	-	U	U	-	-	-	NA	NA	U	U	U
Potential Background Soil	-	-	X	-	NA	-	X	U	X	-	X	X	U	-	U	-	U	U	X	-	-	U	U	U	U	U
Soils and Waste for Birds and Mammals																										
Smelter Waste	X	-	X	X	X	X	-	-	X	-	X	X	X	-	X	X	X	X	X	-	-	NA	NA	-	-	-
Smelter Soil	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	-	-	-	X	-	-	-
Waste Disposal Waste	X	-	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	-	-	NA	NA	-	-	-
Management Waste Unit Waste	X	-	X	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	-	-	NA	NA	-	-	-
The Nature Conservancy (East)	X	-	X	-	NA	X	X	-	X	X	X	X	NA	X	-	X	X	X	X	-	-	NA	NA	-	-	-
The Nature Conservancy (North)	-	-	-	NA	NA	X	-	NA	-	-	-	X	NA	-	-	-	NA	NA	X	NA	NA	NA	NA	NA	NA	NA
Agricultural (North)	X	-	-	-	NA	X	-	-	-	-	-	X	NA	-	-	X	X	X	X	-	-	NA	NA	-	-	-
Agricultural (East)	-	-	-	NA	NA	X	-	NA	-	X	-	X	NA	-	-	-	NA	NA	X	NA	NA	NA	NA	NA	NA	NA
Residential	X	-	-	-	NA	X	-	-	-	X	-	X	NA	-	-	X	X	X	X	-	-	NA	NA	-	-	-
Potential Background Soil	X	-	-	-	NA	X	X	-	X	X	-	X	X	-	X	X	X	X	X	-	-	-	-	-	-	-

Source: USEPA, 2008. Technical Memorandum Screening-Level Ecological and Human Health Risk Assessment, Halaco Site, Oxnard California (Table 3-20). Prepared for the U.S. Environmental Protection Agency, Region 9. Prepared by CHM2Hill. December 2008. http://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/ViewByEPAID/CAD009688052?OpenDocument. Accessed June 15, 2009.

Key:
- \- Maximum concentration does not exceed screen value.
- X Maximum concentration exceeded screening value – potential risk.
- NA No site data.
- NE Not Evaluated.
- U Uncertainty – no screening value.

Notes:
1. Please refer to Appendix A of the USEPA's Technical Memorandum Screening-Level Ecological and Human Health Risk Assessment for the maps depicting the on- and off-site locations referenced in the table.
2. Shaded rows indicate sample locations are within the Halaco Site.

- Whether or not groundwater contamination has moved off-site;
- Whether or not Halaco's operations generated dioxins or furans;
- Whether or not fuels and oils used by Halaco contaminated soil or groundwater; and,
- Whether or not the waste disposal areas have the potential to produce ammonia and other gases.

Following completion of the Preliminary Plan, in September 2009 the USEPA published a "Field Sampling Plan" for implementation of the additional soil, soil gas, geotechnical, waste material, groundwater, surface water and air sampling and analysis that needs to be conducted within the Halaco Site and its surrounding areas before a remediation plan can be fully developed (USEPA, 2009b). As indicated in the Field Sampling Plan, it has been established that some contaminants associated with the Halaco Site have migrated off-site, including locations within the property owned by TNC, the Oxnard Industrial Drain, the J Street Lagoon, its surrounding wetland areas, and potentially nearby beach dunes. Additional soil and geotechnical sampling and analysis at these locations, as well as surface water sampling and analysis of the Oxnard Industrial Drain, J Street and Hueneme Drains, the lagoon and ocean, the ditch south of the Halaco Site's waste management unit, and TNC property will be completed; shallow groundwater monitoring wells west and east of the Halaco Site will also be completed (USEPA, 2009b).

To date two removal actions have been funded by the USEPA to address immediate risks associated with the Halaco Site. The first removal action, completed by the Halaco Site property owners between August 2006 and February 2007, included the removal of drums and other hazardous substances from the Halaco Site, and the installation of fencing, silt curtain, and straw wattles around the waste pile (USEPA, 2009b). The second removal action was completed in 2007 to stabilize and secure the Halaco Site and limit off-site migration of contaminated wastes; this action involved re-grading the waste pile to reduce the steepness of the slopes, placing matting on the slopes to reduce erosion, stabilizing the banks along the lower portion of the Oxnard Industrial Drain, removing an estimated 9,000 cubic yards of waste from the smelter area, removing an estimated 7,600 cubic yards of material from a wetland area adjacent to the property, and installing more than 6,000 feet of fencing around the perimeter of the Site's waste management area (USEPA, 2009b).

Once the extent and types of contamination are better understood, the USEPA will develop a proposed remediation plan for public and agency review and comment. The specific types of remediation action(s) undertaken by the USEPA, on- or off-site, will be dependent on the location-specific extent and severity of potential health risks posed to both the public and biota, the details of which are currently unknown (Praskins, 2009). These risks will then be weighed against the types and severity of the physical impacts that would result from remediation (for example, the effects of earth disturbances in wetland areas and other sensitive habitat areas) and discussed with affected property owners and regulatory resource agencies prior to any location-specific remediation action(s). As of the time of preparation of this Feasibility Study, the USEPA could not predict the types or geographic breadth of the remediation actions that it will undertake due to the need for the additional testing and analysis outlined in the Field Sampling Plan (Praskins, 2009).

2.4 LAND USE AND INFRASTRUCTURE

Lands within the project site are sparsely developed and composed primarily of beach, agriculture, open space, recreation and limited industrial uses. For the purpose of describing the existing land uses within the project area, the project area was subdivided into ten Sub-Areas, as shown in Figure 1-8. A description of these sub-areas is included in Table 2-5.

Table 2-5. Existing Land Uses in the Project Area

Sub-Area	Location	Jurisdiction	Existing Land Uses
25-Acre Sub-Area (Gateway Park [10 acres]; City of Oxnard Exclusion Property [15 acres]).	East of Perkins Road, south of Hueneme Road, to the west of the Oxnard Industrial Drain, and to the north of the 280-Acre Sub-Area (TNC Property).	City of Oxnard	Agriculture. The Sub-Area is adjacent to a paved site that may have served as a storage site for the adjacent railroad.
280-Acre Sub-Area (TNC Property)	North of McWane Boulevard: bordered to the west by Weyerhaeuser Company; to the north by the 25-Acre Sub-Area (Gateway Park and City of Oxnard Exclusion Properties); to the east by a railroad spur; and, to the south by additional TNC property and the Halaco Site. South of McWane Boulevard: bordered to the west by the Halaco Site; to the south by 90-Acre and 260-Acre Sub-Areas (the City of Oxnard and SCC Properties); to the southeast by the Reliant Power Plant; and, and to the east by the 20-Acre Sub-Area (MWD Exclusion Property), 360-Acre Sub-Area (Southland Sod Farms Property), Edison Drive and transmission lines.	City of Oxnard; Partially located within the Coastal Zone	Open Space and Agriculture. The Oxnard Industrial Drain flows from the northeast corner to southwest corner of the portion of the sub-area north of McWane Boulevard. Remnants of a large drainage pipe (no longer in use) remain above ground in the southern portion of the Sub-Area.
35-Acre Sub-Area (Halaco Site)	Bordered to the north by Weyerhaeuser Company, to the north and east by the 280-Acre Sub-Area (TNC Property), and to the southeast, south, southwest and west by 90-Acre Sub-Area (City of Oxnard Property).	City of Oxnard; Located within the Coastal Zone	Abandoned Industrial (the Halaco foundry and waste pile).The Oxnard Industrial Drain flows from the northern portion to the southern portion of this Sub-Area.
90-Acre Sub-Area (City of Oxnard Property)	Bordered to the north by the Halaco Site, the 280-Acre Sub-Area (TNC Property) and Oxnard Waste Water Treatment Facility, to the west and northwest by Hueneme Beach (City of Port Hueneme), to the east and southeast by the 260-Acre Sub-Area (SCC Property), and to the south and southwest by the ocean.	City of Oxnard; Located within the Coastal Zone	Open Space and Recreation. The J Street Lagoon is located within this Sub-Area, with inflow from the Hueneme, J Street and Oxnard Industrial Drains.
20-Acre Sub-Area (MWD Exclusion Property)	Bordered to the north and west by the 280-Acre Sub-Area (TNC Property), to the east by 360-Acre Sub-Area (Southland Sod Farms Property), transmission lines and Edison Drive, and to the south by the Reliant Power Plant and the 260-Acre Sub-Area (SCC Property).	City of Oxnard; partially within Coastal Zone	Agriculture.
360-Acre Sub-Area (Southland Sod Farms Property [North and South])	Bordered to the north by McWane Boulevard, to the east by Arnold Road, to the south and southeast by VCGP, the 40-Acre Sub-Area (Agromin and Duck Club Annex Properties) and Oxnard Drainage Ditch No. 3, and to the southwest and west by the 260-Acre Sub-Area (CCS Property), Reliant Power Plant, the 20-Acre Sub-Area (MWD Exclusion Property), 280-Acre Sub-Area (TNC Property), and Edison Drive.	Unincorporated Ventura County; Oxnard Sphere of Influence; partially within the Coastal Zone	Agriculture (sod farms).
40-Acre Sub-Area (Agromin Property [20 acres] and Duck Club Anex Property [20 acres])	Bordered to the north and west by the 360-Acre Sub-Area (Southland Sod Farms Property) to the south by the 260-Acre Sub-Area (SCC Property), NBVC Point Mugu and VCGP, and to the east by Arnold Road.	Unincorporated Ventura County; Oxnard Sphere of Influence; partially within Coastal Zone	Shoreline Organics recycling facility (green waste composting for municipalities) (Agromin Site).

Sub-Area	Location	Jurisdiction	Existing Land Uses
260-Acre Sub-Area (SCC Property)	Bordered to the north by the 360-Acre Sub-Area (Southland Sod Farms Property), 20-Acre Sub-Area (MWD Exclusion Property) and 280-Acre Sub-Area (TNC Property), to the east and northeast by the 40-Acre Sub-Area (Agromin and Duck Club Annex Properties and VCGP, to the southeast by NBVC Point Mugu, and to west/northwest by the 90-Acre Sub-Area (City of Oxnard Property). This Sub-Area Surrounds the majority of the Reliant Power Plant.	City of Oxnard; mostly within Coastal Zone	Open Space, Informal Recreation[1] (coastal access along Arnold Road) and Industrial (includes former tank farm area and surrounds Reliant Power Plant).
Reliant Power Plant (50 acres)	Surrounded by the 260-Acre Sub-Area (SCC Property) on all sides except along its northern border, where it is flanked the 360-Acre Sub-Area (Southland Sod Farms Property), 20-Acre Sub-Area (MWD Exclusion Property) and 280-Acre Sub-Area (TNC Property).	City of Oxnard; Located within the Coastal Zone	Industrial (power plant, transmission lines and related facilities).
Ventura County Game Preserve (570 acres)	Bordered to the west by the 40-Acre Sub-Area (Agromin and Duck Club Annex Properties) to the south by the NBVC Point Mugu and Oxnard Drainage Ditch No. 3, to the east by NBVC Point Mugu, and to the north by Casper Road.	Unincorporated Ventura County; partially within Oxnard Sphere of Influence and Coastal Zone	Recreational Facility (managed waterfowl-hunting club).

1 Informal Recreation includes typical beach activities (e.g. hiking/jogging, birding, surfing, sunbathing, paragliding/ ultralights, etc.).

In addition to the land uses listed in Table 2-5, the project area is within the vicinity of notable types of infrastructure associated with transportation (railroads and roads) and utilities (gas and oil pipelines, power lines, communications, storm drains and open channels, water and sewers). The location of this infrastructure relative to the project area is summarized below from the *Ormond Beach Restoration Feasibility Study: Infrastructure Investigation Report* (Everest International Consultants, Inc., 2004); maps of this infrastructure are provided in Appendix A.

- **Railroads.** The Union Pacific Railroad runs along the Ventura County coastline and passes through the City of Oxnard with an interchange station. At the interchange station, the Ventura County Railroad branches from the Union Pacific Railroad and runs southward parallel to San Simeon/Edison Drive, then crosses Hueneme Road where it turns westward to the City of Port Hueneme. In the project area, the main line travels northeast to southwest, crosses Hueneme Road, and turns west toward Port Hueneme about halfway between Arcturus Avenue and Perkins Road. One spur splits off the main line north of Hueneme Road, continues southward parallel to San Simeon/Edison Drive, and terminates at Arcturus Avenue and McWane Boulevard. A second line splits off just south of the main line's crossing of Hueneme Road, continues south, turns east then southeast, and terminates at the Reliant Power Plant. A third line splits off just east of Perkins Road, continues south, and terminates just north of McWane Boulevard.
- **Roads.** The nearest freeway corridor serving the project area is the Pacific Coast Highway (State Highway 1), which runs north-south a few miles east of the project area. The major road in the project area is Hueneme Road, which is an east-west running arterial located on the northern side of the project area. Some traffic signals are found along Hueneme Road within the project area, and are located at the intersections of Hueneme Road with J Street, Perkins Road, and Saviers Road. Other major roads in the project area include the following north-south running roads: J Street; Perkins Road; Arcturus Avenue; Edison Drive; Arnold Road; and, Casper Road.
- **Gas and Oil Pipelines.** Underground gas lines are found along sections of Perkins Road, Arcturus Avenue, Edison Drive, and McWane Boulevard. The Shell Pipeline Company has indicated that it does not have any facilities in the project area. During field observations, a marker for an underground petroleum pipeline that belongs to the Edison Pipeline and Terminal Company was found approximately 300 feet south of the southern border of the existing Halaco site. Additional markers were found to the northwest of this marker. It is not known if the pipeline is active or abandoned.

- **Power Lines.** A major power line of overhead cables extends from the Reliant Power Plant northward along Edison Drive and is supported by structural towers. Two overhead power lines run east and west parallel to the main line. These three sets of power lines are all found on the east side of Edison Drive. Overhead power lines are also found along sections of the key roads in the project area (i.e., Hueneme Road, Perkins Road, Arcturus Road, Arnold Road, Casper Road, McWane Boulevard). There are some cables located off-road in agricultural areas, such as the east-west line between Arnold Road and Casper Road, and the north-south line between Hueneme Road and McWane Boulevard.
- **Communications.** The project site includes communication facilities owned by Verizon. Underground communication lines are located primarily along Arcturus Road and Perkins Road, while overhead communication lines are located along Casper Road, Arnold Road, Edison Drive, McWane Boulevard, and Hueneme Road.
- **Storm Drains and Open Channels.** Storm drains are found along sections of Hueneme Road, Arcturus Avenue, and Edison Drive. A few open channels are located in the vicinity of the project area and include: the open channel along J Street (J Street Drain) that discharges into the wetland area located along the beach; the industrial drain that runs parallel to the Ventura County Railroad, crosses Hueneme Road, and continues southward to the Pacific Ocean (Oxnard Industrial Drain); and, the channel that runs parallel to the beach (East-Hueneme Drain). Additional open channels are located east of Edison Drive, and Arnold and Casper Roads.
- **Water.** Geographic Information System (GIS) data obtained from the City of Oxnard indicates that water pipelines and fire hydrants are present in and along all of the roads within that portion of the project site which is located within the jurisdictional boundaries of City of Oxnard.
- **Sewers.** Sewer lines are mainly found in the northern part of the project area, with the exception of a 30- to 48-inch diameter sewer line that extends into the ocean along the alignment of Perkins Road. An abandoned historical sewer line is located in the 280-acre Sub-Area (TNC property). It is an above ground, concrete pipe approximately four feet in diameter, and is believed to have been built in the 1920s. It is in an advanced state of deterioration (e.g., broken concrete); it also appears that some segments of it have been removed.

2.5 CULTURAL RESOURCES

An examination of cultural resources within the project area was conducted in 2004 and 2005 (Wishtoyo Foundation and Topanga Anthropological Consultants, 2005). The examination included literature searches, field surveys, review of current and historic topographic maps, aerial photographs, subsurface, submarine and offshore sediment transport maps, other geomorphic and paleontological data, completion of a cultural resources records search at the Archaeological Information Center at California State University at Fullerton, and review of information from the collections of the Museum of Ventura County and Natural History Museum of Los Angeles County. The following section summarizes the primary findings and conclusions of this effort.

It is generally accepted that prehistoric resources are often found in association with stream and wetland areas within coastal alluvial plains. Within the Oxnard Plain, the two primary Chumash settlements associated with the Santa Clara River are the Kanaputeqnon and Kasunalmu. The Kanaputeqnon are believed to have been located in the vicinity of Montalvo, where the river turned south to flow across the Oxnard Plain prior to the 1812 earthquake. The Kasunalmu are believed to have settled along Gonzales Road, approximately one-quarter mile west of Oxnard Boulevard in the City of Oxnard. A third settlement, the Muwu, has been documented south of the Kasunalmu village in the vicinity of what is now NBVC Point Mugu. In addition, historic wetland areas within the project site that were created by surface water impounded behind Ormond Beach's historic sand dunes extended from the City of Point Hueneme to Point Mugu, and may have been utilized by small settlements associated with the Wene'mu, Shishlomow and Shalikuwewech.

Changes in the locations of the above-referenced Chumash settlements, as well as other settlements, likely corresponded to changes in the channel of the Santa Clara River. Because there have been numerous changes (e.g., migrations) to the river channel over the last 3,000 years, it is believed that these settlements were occupied for relatively short periods of time; as such, the project site generally contains fewer artifacts and plant and animal remains than are typically found at sites that have been occupied for longer periods of time. None-the-less, the project area is considered to have a very high potential for the occurrence of buried archaeological resources between 200 and 3,000 years antiquity.

Within the project area several site-specific and linear archaeological studies have been completed. Table 2-6 lists the cultural resources sites (prehistoric and historic) associated with these studies.

Table 2-6. Potential Cultural Resources Observed in the Project Area

Site Number	Material Observed	Date Observed	Notes
VEN-555 loci A and B	Scatterings of weathered Pismo clam (VN-127)	1978	A supplemental site survey filed in 1990 did not find site VEN-555, and suggests that a small amount of shell that was observed was not deposited as a result of cultural activity (VN-900).
VN-506	Shell concentration	1986	May indicate the presence of a buried archaeological site.
VN-635	Two shell concentrations	1988	May indicate the presence of buried archaeological sites.
VN-1961	Quartzite flake	2001	Recorded as isolate 56-100156.
(N/A)	Shell scatter and sandstone cobbles	9/10/2004 and 10/1/2004	Further study is necessary to determine if shells and cobble on soil surface were recently placed there.
(N/A)	Broken concrete drainage pipe	9/10/2004 and 10/1/2004	Identified as part of the 1898 Oxnard Sugar Beet Company field drain or an early 20th century upgrade.
(N/A)	Pieces of broken marine shell	10/1/2004	Shell identified as Pismo clam and mussel.
(N/A)	Barn	10/1/2004	Appears to be more than 50 years old.
(N/A)	Light shell scatter	10/1/2004	May indicate the presence of an archaeological site in the area.

Within the project area fill for agricultural and other development and the deposition of material from historic floods has likely buried most or all of the archaeological sites that may be present. Burial of these sites has probably helped preserve them from disturbance, but has also concealed them. Some sites may be buried at relatively shallow depths (ten feet or less from grade level). Soils that were deposited under water in old lagoons or in low areas between the natural levies of old river channels are not expected to contain cultural resources. However, soils that have been deposited at comparatively higher elevations, such as the tops of historic river levees and adjacent to historic marshes and wetlands are likely to contain such resources. Historic houses and related features are present on some parcels that were not surveyed as part of the project's cultural resources investigation, and these structures may be of historic significance. However, for those properties surveyed, with the exception of the barn noted in Table 2-6 and a broken concrete drainage pipe associated with the Oxnard Sugar Beet Company (see Section 6.1.4.1 [Alternative 10, Cultural Resources]) , no other structures of potentially historic significance were observed at the time of the project's cultural resources survey.

3. OPPORTUNITIES AND CONSTRAINTS

In addition to issues associated with biological resources, hydrology, hydraulics and geomorphics, potential soil and surface water contamination, land use and infrastructure, and cultural resources, key logistical opportunities and constraints related to land availability and supplemental water sources, public recreation and education, and potential funding sources and land management partners have been identified for the project. Summaries of these opportunities and constraints are provided in the following sections.

3.1 LAND AVAILABILITY AND POTENTIAL SUPPLEMENTAL WATER SOURCES

3.1.1 Land Availability

As addressed in Section 1.1 (Project Background) the SCC's goal is to restore and enhance over 1,000 acres of wetland habitat in the project area. The SCC acquired its first property within the project area in June 2002, which totaled 260 acres. With SCC funding, TNC purchased an additional 280 acres of land adjacent to (north/northwest of) the SCC's property in August 2005. Figure 1-8 provides a map of these properties as well as the other surrounding properties that are of interest. Acquisition of additional lands surrounding the SCC and TNC properties to achieve the maximum acreage needed for the unconstrained alternatives presented in this Feasibility Study is, however, potentially limited by a number of existing land uses, as follows:

- Active farmland (e.g., sod farms, cultivated crops);
- Existing and past industrial uses, including the Agromin Site, Reliant Power Plant, and Halaco Site; and,
- Active managed duck clubs (the VCGP).

Although the SCC has been pursuing the acquisition of the remaining acreage needed for the unconstrained alternatives, their availability, and the timing of their availability, is currently unknown. Due to this uncertainty, it is possible that implementation of the project may require phasing to accommodate future land purchases. Phasing of the project may, however, provide opportunities for the development and refinement of adaptive management techniques that promote long-term habitat viability and sustainability. Phasing of the project in response to land acquisition may also support other logistical issues, such as development of a final preferred alternative design plan that is a combination of one or more of the preliminary alternatives presented in this Feasibility Study and future project funding.

3.1.2 Potential Supplemental Water Sources

At the time that technical investigations of the project site's existing conditions were initiated, which occurred prior to development of the alternatives evaluated in this Feasibility Study, a preliminary evaluation of supplemental water sources to support wetland restoration and enhancement, if needed, was undertaken (Everest International Consultants, Inc., 2005). The preliminary evaluation included assessment of the Hueneme, East Hueneme, J Street, and Oxnard Industrial Drains, the Oxnard Drainage Ditch Number 3 (ODD #3), the drainages bordering the VCGP, the drainage channel flanking the Reliant Power Plant, the J Street Lagoon, and the salt marshes and flats located within the City of Oxnard/beachfront (90 acres) property and those surrounding the Reliant Power Plant. The preliminary evaluation additionally noted the possibility of using the Calleguas Municipal Water District's (CMWD's) brine line and the Groundwater Recovery Enhancement and Treatment (GREAT) Program (e.g., the Oxnard brine line) as supplemental water sources upon their completion. The preliminary evaluation concluded that there were several data gaps regarding these supplemental water sources, particularly as related to water quality, and that additional analysis was needed (Everest International Consultants, Inc., 2005).

Parallel to the preliminary evaluation addressed above, an additional assessment of potential water sources was completed. As identified in the *Potential Water Sources for the Ormond Beach Restoration Feasibility Plan* (Kennedy/Jenks Consultants, 2005), five supplemental water sources other than groundwater were identified; Table 3-1 lists these water sources and the opportunities and constraints associated with each.

Table 3-1. Potential Supplemental Water Sources

Water Source[1]	Opportunities	Constraints
CMWD Brine Line	1) Estimated Capacity: 17.5 million gallons per day (MGD) 2) The brine line would be developed as part of a regional salinity management conveyance system that has been endorsed by CMWD.	1) Ormond Beach would be "at the end of the line" in terms of the brine line's flow sequence. If there were competing uses for the brine line effluent, the Ormond Beach restoration effort would only be allotted any remaining flow after other uses (e.g., the Duck Club properties) were allotted their share. 2) Recycled water demand is greatest during summer months, so the flows from Waste Water Treatment Plants (WWTPs) into the brine line could be lower during the summer if WWTPs recycle directly from the treatment facility. 3) Use of this water source may not be suitable for aquatic life without prior treatment to remove constituents exceeding water quality criteria.
City of Oxnard Brine Line	1) Estimated Capacity: 20 MGD 2) As part of the GREAT Program, the Oxnard brine line would serve the following purposes: enable the City to reduce the hydraulic and mineral loading of its wastewater treatment plant; and, provide a water supply for wetland restoration.	1) Some wastewater sources that would be excluded from the GREAT Program, and consequently would not contribute to the project would include the: Santa Clara Wastewater Company, which was eliminated due to the presence of hydrocarbons in its wastewater; and, the Ventura Regional Sanitation District, which was eliminated due to its isolated location.
Seawater Effluent from the Reliant Power Plant	1) Estimated Capacity: 688.2 MGD	1) The Reliant Power Plant has pre-existing agreements for its wastewater; therefore, it is unknown how much of this effluent would be available for the project. 2) Wastewater discharged from Reliant Power Plant exceeded National Pollutant Discharge Elimination System (NPDES) limits during the 5-year period between December 1994 and January 2001.[2]
Agricultural Water from United Water Conservation District (UWCD)	1) Estimated Capacity: 17.6 MGD (delivery)[3]	1) UWCD delivers approximately 17.6 MGD to its customers. Because of these pre-existing commitments, it is difficult to predict the volume of water that could be made available for the project. 2) A key component to the UWCD system is the Pumping Trough Pipeline (PTP) which directs water to agricultural use and groundwater recharge. The demand for PTP water (and its availability for the project) varies over three cycles: climactic cycles (weather), seasonal cycles, and diurnal cycles.
Recycled Water from the City of Oxnard:	1) Estimated Capacities: - New Tertiary Treatment Facility: 5.0 MGD (Phase 1); 32.6 MGD (Phase 2) - New Advanced Water Treatment Facility (AWTF): 3.8 MGD (Phase 1); 15.3 MGD (Phase 2) - Converted Ocean View Pipeline: 3.0 MGD	1) While the current agricultural demand from the Ocean View Pipeline (under conversion to convey recycled water) totals approximately 3,400 acre feet per year (AFY), the pipeline is capable of delivering approximately 6,100 AFY (assuming a velocity of 6 feet per second and operation 365 days per year). However, assuming no other irrigation sources are developed within the City, the Ocean View Pipeline would need to be paralleled with a 30-inch diameter pipeline in order to meet the recycled water demand projected in Phase 2 of the GREAT Program, which does not include the project efforts. 2) The GREAT Program indicates that under average year conditions

Water Source[1]	Opportunities	Constraints
	2) The Oxnard WWTP currently produces secondary effluent that is discharged to the ocean outfall. As part of the GREAT Program, filtration and improved disinfection facilities would be constructed to produce a tertiary effluent that would allow for direct use of the recycled water, which may include wetland restoration efforts.	and full implementation of the recycled water facilities, the demand for the recycled water will equal supply; the project is not included in the demand forecasts. However, recycled water may be available during wet years and during wet winter months when irrigation demands drop.

1 For further information on the characteristics of each water source, refer to the *Potential Water Sources for the Ormond Beach Restoration Feasibility Plan* (Kennedy/Jenks Consultants, 2005).
2 The U.S. Environmental Protection Agency issues NPDES (National Pollutant Discharge Elimination System) permits for five categories of stormwater discharges, which includes discharge associated with industrial activity (USEPA, 2008b). The following NPDES limits were exceeded: 30-day average for copper, chronic toxicity limit, and total suspended solids (Reliant Energy, 2002).
3 The UWCD manages the delivery of surface water and groundwater resources within its boundaries for agricultural use and groundwater recharge.

Following the completion of the *Preliminary Evaluation of Potential Water Sources* and the *Potential Water Sources for the Ormond Beach Restoration Feasibility Plan*, the alternatives evaluated in this Feasibility Study were developed. As currently designed, only Alternative 2 could potentially require a supplemental water source. As addressed in Section 5.2 (Restore Seasonally Open Wetland Habitats and Ponds [Alternative 2]), the seasonal pond at the center of this alternative would be non-tidal, and would be excavated such that precipitation and groundwater would be its water sources. Because precipitation is strongly seasonal, with nearly all rainfall occurring during the winter and spring, the pond's surface water area would fluctuate significantly with the seasons; the minimum extent of the pond's surface water would depend on the area of the ground surface which falls below the dry season water table. If final design calls for this alternative to always maintain a specific volume of water in the pond, a supplemental water source may be needed; however, it is also possible that final design and grading plans may be able to excavate the pond to a depth such that the prescribed volume of water is maintained. Consequently, implementation of the project, under any alternative, may not require a supplemental water source. A final determination for supplemental water source needs, if any, cannot be predicted until final design plans for the project are completed.

3.2 PUBLIC RECREATION AND EDUCATION

Implementation of the project could represent a significant opportunity to increase public access to the coast for recreational purposes, and provide public education on coastal wetland ecosystems, flora and fauna. Due to the project area's location and limited points of access, the beach itself is underutilized by the public in comparison to most other Southern California beaches. However, the limited access and development along this portion of the coast has helped maintain its natural qualities, which provides for unusual opportunities for habitat restoration. Through careful planning and diligent management, it should be possible to augment recreational and educational uses while also enhancing habitat quality and ecosystem functions. The following is a summary of some opportunities for public access and education that have been identified within the project area, as provided in the *Recreation and Education Opportunities Report for the Ormond Beach Wetlands Restoration Project* (Aspen Environmental Group, 2005):

Greenbelt and Trails. The Oxnard, Camarillo and Ventura Greenbelt could be extended to include the project area. A trail system could also be created to connect various portions of the project area for continuous access, and serve as an extension of the California Coastal Trail. As with pedestrian trails, bike trails could also be created within the project area and incorporated into the City of Oxnard's Bicycle Facilities Master Plan.

Recreation and Educational Facilities. The project is planned to include a future visitor center which could include educational programs targeting neighborhood schools, birders, and nature enthusiasts. A Chumash cultural center could also be constructed or combined with the visitor center. Additional recreational facilities that could be introduced include bird blinds and observation decks and boardwalks near the dunes, but away from sensitive habitat areas.

Improving future uses of the project area for recreational and educational purposes would have to involve working around or correcting certain unfavorable aspects of the area's current conditions while maintaining compatibility with the project's primary purpose of habitat restoration. Because public recreation and education are important but secondary goals of the project, it might be necessary to make "trade-offs" between maximizing recreational and educational opportunities while ensuring the success of the habitat restoration. Some of the issues that have been identified to date which pose potential constraints to public recreation and education include:

- Limited parking and vehicular and pedestrian (e.g., trail) access;
- Physical barriers to pedestrian access such as channels and property line fences;
- Illegal dumping;
- Public uses which can disturb sensitive species and their habitat such as the western snowy plover and California least tern (e.g., dog walking, paragliding and ultralight flights, the discharging of firearms, off-road cycling and vehicle use, dune exploration, and camping);
- Prominent industrial uses (e.g., the Reliant Power Plant, its associated transmission lines, the Oxnard Wastewater Treatment Plant and the Halaco Site), which diminish visual quality and the public's perceived recreational/outdoor "experience;" and,
- Restrictions due to the USEPA's investigation and long-term remediation plans for the Halaco Site.

As addressed in Section 1.3 (Prior Project Studies and Reports), the Graduate Design 606 Studio of the California State Polytechnic University of Pomona is currently working with the SCC to develop an "Access Vision Plan" for the project. Once complete, the Access Vision Plan will be factored into future phases of the project, including refinement and optimization of the final alternatives.

3.3 POTENTIAL FUNDING SOURCES

Restoring, enhancing and creating native wetland habitats and providing public education and environmentally sensitive recreational opportunities are costly endeavors. None-the-less, preserving open space and restoring wetlands in California and the nation are important for the sustainability and health of ecosystems. These needs have triggered the development of federal, State, and private assistance programs that work to protect, enhance, and restore native habitats.

The project would require funding for the various aspects of its implementation, including: land acquisition; ecological enhancement and restoration; recreational and educational amenities and programs; programs related to the protection and conservation of agricultural lands; and, watershed management, flood control, and water quality improvement and/or protection. Table 3-2 summarizes a few of the funding sources that have been identified for various aspects of the project as of February 2007. For a complete list of potential funding sources, please refer to the *Ormond Beach Wetland*

Restoration Feasibility Study Potential Project Funding Sources Report (Aspen Environmental Group, 2007).

Table 3-2. Potential Funding Sources

Project Aspect	Potential Funding Source	Agency
Land acquisition for conservation, habitat enhancement and restoration, or recreation	Habitat Conservation Fund	State Department of Parks and Recreation (DPR)
	American Land Conservation Fund	The Conservation Fund
	Land and Water Conservation Fund (Propositions 40 and 84)	State Wildlife Conservation Board, SCC
	Coastal Watershed and Wetland Protection Program (Proposition 50)	State Wildlife Conservation Board
	Coastal and Estuarine Land Conservation Program	NOAA
	Wetlands Recovery Project	SCC
Habitat enhancement and restoration planning and implementation	Coastal Resources Grant Program	California Resources Agency
	Native Plant Conservation Initiative	National Fish and Wildlife Foundation
	Coastal Counties Restoration Initiative	National Fish and Wildlife Foundation, NOAA, National Association of Counties
	Migratory Bird Conservancy	National Fish and Wildlife Foundation, Migratory Bird Conservancy
	Proposition 40, 50 and 84 Grants	State Water Resources Control Board, State Department of Water Resources, DPR, SCC, State Wildlife Conservation Board, State Conservation Corps
	Community Based Habitat Restoration Program/ Individual Program Grant and Regional Partnership Grant	NOAA
Adding or enhancing recreation, education, and access facilities	California Coastal Trail Program, Public Access Program, Urban Waterfronts Program	SCC
	Murray-Hayden Urban Parks and Youth Services Program (Proposition 40)	DPR
	Per Capita Grant Program (Proposition 40)	DPR
	Land and Water Conservation Program	State Wildlife Conservation Board
	Recreational Trails Program (Non-Motorized)	Federal Highway Administration, DPR
	Kodak American Greenways Award Program	The Conservation Fund
	Nature Education and Research Grants (Proposition 84)	DPR
	Local and Regional Parks Development and Public Outreach (Proposition 84)	DPR
	Housing Urban, Suburban and Rural Parks Account (Proposition 1C)	State Department of Housing and Community Development
	Urban Greening Projects (Proposition 84)	Administrating agency unknown
Short and long-term maintenance, monitoring, and management of resources	Environmental Grants Program	Patagonia
	Community Based Habitat Restoration Program/ Individual Program Grant and Regional Partnership Grant	NOAA
	Watershed Assistance Grants	USEPA
Agricultural lands conservation and protection	Wetlands Reserve Program	U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS)
	Farm and Ranch Lands Protection Program	USDA, NRCS
	California Farmland Conservancy Program (Proposition 40)	State Department of Conservation
	Land and Water Conservation Program	State Wildlife Conservation Board
	Planning Grants (Including Agricultural Lands) (Proposition 84)	Administrating agency unknown
	Agricultural Preservation Program	SCC

Project Aspect	Potential Funding Source	Agency
Watershed management and flood control protection	Integrated Watershed Management Program and Integrated Regional Water Management Program (Propositions 40, 50 and 84)	State Water Resources Control Board, State Department of Water Resources
	Watershed Protection and Flood Prevention Program	USDA, NRCS
	Watershed Assistance Grants	USEPA, River Network
	Flood Control Prevention (Proposition 84)	State Department of Water Resources
	Stormwater Flood Management (Proposition 1E)	State Department of Water Resources
	Statewide Flood Protection Corridors and Bypasses (Proposition 1E)	State Department of Water Resources
Water quality	Clean Beaches Program (Propositions 50 and 84)	State Water Resources Control Board
	Beaches Environmental Assessment and Coastal Health (BEACH) Act Grants	USEPA
	Integrated Watershed Management Program and Integrated Regional Water Management Program (Propositions 40, 50 and 84)	State Water Resources Control Board, State Department of Water Resources
	Coastal Watershed and Wetland Protection Program (Proposition 50)	State Wildlife Conservation Board
	Beaches, Watershed and Water Quality Program (Proposition 40)	SCC
	Safe Drinking Water and Protection of Water Quality (Proposition 84)	State Department of Water Resources

Note: For a full list of potential funding sources and contact information for each source, as well as approved State propositions that would be applicable to wetland restoration as of February 2007, please refer to Tables 1 through 3 of the *Ormond Beach Wetland Restoration Feasibility Study Potential Project Funding Sources Report* (Aspen Environmental Group, 2007).

3.4 POTENTIAL LAND MANAGEMENT PARTNERS

Several resource agencies and private and public entities have expressed interest in managing the project. It is noted, though, that most of the entities outlined below historically have avoided taking on new land management responsibilities unless a separate party secures a significant new source of funding to supplement their respective operating budgets. However, given that a new, long-term management partner will not be needed until the construction phase of the project is complete, this issue does not need to be resolved in the near future. For further information on management activities and other concerns expressed by the agencies and entities noted below, please refer to the *Ormond Beach Wetland Restoration Study Potential Land Management Partners Report* (Aspen Environmental Group, 2005). The following paragraphs summarize the principal public and private organizations that have been identified as potential land management partners

Santa Monica Mountains Conservancy. The Santa Monica Mountains Conservancy (SMMC) manages land through the Mountains Recreation Conservation Authority (MRCA). The SMMC consists of approximately five employees who are involved in program administration, while the MRCA has approximately 85 employees who are focused on land management activities. The SMMC office is located in Malibu, approximately 40 minutes by automobile from the project site.

The SMMC could be involved in the future management of the project. As this agency is not tied to jurisdictional boundaries, it is at large to become involved in land management throughout the region on a short- or long-term basis. Rangers can provide services that include exotic species removal, trash disposal, and facility cleaning.

California Department of Fish and Game. The CDFG owns and manages numerous properties in Southern California ranging in size from a few acres to thousands of acres. CDFG focuses on wildlife in choosing what lands to acquire and manage. The project area would be under the responsibility of CDFG's San Diego office.

In order for the project to be managed by CDFG, it would be established as an Ecological Reserve. As part of this process, the Wildlife Conservation Board (the branch of CDFG that acquires land) acquires title to the land in fee or gains control through a binding agreement. Once property is acquired, CDFG staff can prepare a proposal to the California Fish and Game Commission for consideration. If the Commission agrees with the proposal, a notice is issued to the public for a 45-day review. If necessary, a public hearing is held to consider the proposed Ecological Reserve. Once the public review and comment process is complete, the proposal goes to the Office of Administrative Law for adoption.

While CDFG is interested in managing the project, it has indicated that staffing is a significant concern. There are currently no reserve managers for lands north of Orange County.

U.S. Fish and Wildlife Service. The Ventura Office of the U.S. Fish and Wildlife Service (USFWS) has indicated an interest in managing the project under the National Wildlife Refuge (NWR) system, and has also suggested that project area may be established as an Overlay Refuge with the adjacent NBVC Point Mugu. Adding a new unit to the NWR system requires an act of Congress, which would take at least one year to complete. All lands to be considered for the NWR system must go through the approval process, and there is no certainty that Ormond Beach would ultimately be included.

The USFWS has expressed concern that it will not have the funding, manpower, or needed on-site facilities to manage the project. However, the USFWS was supportive of partnering with another entity to provide on-site management (e.g., the CDFG or SMMC). According to the USFWS, at least one ranger/refuge manager with some enforcement capability should be permanently available onsite to address a number of issues that the project would face as an Urban Refuge, including: off-road vehicle use; trespassing, dogs; and, gang-related activity. The USFWS has also suggested that project fencing would be necessary in some areas.

National Park Service. The National Park Service (NPS) may not be able to manage the project unless it is located within the boundary of the Santa Monica Mountains National Recreation Area. A boundary adjustment would require an act of Congress; two to three years may be needed to receive Congressional approval. The NPS may consider partnering with the USFWS or the CDFG in the management of project, although there is not much of a precedent for this type of approach. Keys issues related to NPS involvement would include full remediation of any project site contamination, completion of the project itself, and incorporating and developing visitor centers, trails, and similar recreational amenities.

The Nature Conservancy. TNC is a leading international nonprofit organization with the mission of preserving the plants, animals and natural communities that represent the diversity of life on earth by protecting the lands and waters they need to survive. With SCC funding, the TNC acquired 280 acres of land in the project area that were previously co-owned by MWD and the City of Oxnard. TNC typically does not manage lands that it acquires over the long-term and thus is not considered a viable long-term management entity. However, TNC remains a key partner for the acquisition of lands and the restoration of wetland habitats in the project area.

Public Universities. Local public universities have expressed an interest in monitoring the progress and success of the project. These universities would benefit the project by providing much of the onsite monitoring in exchange for permission to use the data collected for their research purposes. Research universities known or expected to be interested in the project's monitoring and potentially project maintenance include: University of California, Los Angeles (Environmental Science and Engineering Program); University of California, Santa Barbara (Donald Bren School of Environmental Science and Management); and, California State University, Channel Islands (Environmental Science and Resource Management Program).

4. ANTICIPATED REGULATORY REQUIREMENTS

Prior to its implementation, environmental review of the project under the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) will be required. Additionally, implementation of the project will require the acquisition of several federal, State and local regulatory permits or approvals. The following agencies have been identified as having jurisdiction over the project, or are otherwise anticipated to have regulatory authority over the project:

- **Federal:** USACE; USEPA; USFWS; and, National Marine Fisheries Service (NMFS).
- **State:** State Historic Preservation Officer (SHPO) and Advisory Council on Historic Preservation (ACHP); CDFG; State Water Resources Control Board (SWRCB) and Los Angeles Regional Water Quality Control Board (LARWQCB); CCC; and, California Air Resources Board (CARB).
- **Local:** Ventura County Planning Division; Ventura County Air Pollution Control District (VCAPCD); Ventura County Watershed Protection District (VCWPD); City of Oxnard; and, City of Port Hueneme.

Table 4-1 summarizes the applicable statutes and regulations that would be enforced by the agencies listed above, as well as the anticipated requirements that may be placed on the project. For a detailed discussion of regulatory requirements of the USACE and other agencies with jurisdiction over the project, please refer to the *Ormond Beach Wetland Restoration Feasibility Study Anticipated Regulatory Requirements Report* (Aspen Environmental Group, 2006).

Table 4-1. Anticipated Regulatory Requirements

Statute/Regulation and Agency	Applicability	Project Requirements/ Actions
California Environmental Quality Act (CEQA) *SCC as State Lead Agency*	As a public agency within California, any project that is undertaken by the SCC which may cause a physical change in the environment is subject to review and approval under CEQA.	It is anticipated that preparation of an Environmental Impact Report (EIR) will be required for the project. A joint EIR/EIS or EIS/EIR may be prepared pursuant to CEQA and NEPA (below).
National Environmental Policy Act (NEPA) *USACE as Federal Lead Agency*	As a federal action agency, the USACE ensures compliance with NEPA for projects proposing to impact waters of the U.S.	It is anticipated that an Environmental Impact Statement (EIS) will be required for the project in conjunction with the USACE regulatory permit process. A joint EIR/EIS or EIS/EIR may be prepared pursuant to CEQA and NEPA.
Section 404 Clean Water Act (CWA) *USACE*	Regulates the discharge of dredged material, placement of fill material, and certain types of excavation within “waters of the U.S.”	General Permits are issued for general categories of projects having minimal impacts to the aquatic ecosystem on an individual and cumulative basis. Individual Permits are issued for individual projects, including those that would exceed the minimal impacts threshold.
Section 10 River and Harbor Act *USACE*	Regulates any work or structures within Section 10 jurisdiction (extending three [3] nautical miles from the Mean High Tide line to the limit of the territorial seas).	No additional regulatory requirements other than those required under Section 404 of the CWA are anticipated for the project.
Section 103 Marine Protection, Research, and Sanctuaries Act *USACE*	Permits issued for the transportation of dredged material to be dumped in the ocean.	If ocean disposal is proposed as part of the project, a permit would be required for the transport and disposal of material at an approved ocean dredged material disposal site (e.g., site LA-2, which is located approximately six [6] miles south-southwest of the entrance to Los Angeles Harbor).

Statute/Regulation and Agency	Applicability	Project Requirements/ Actions
1996 Sustainable Fisheries Act *NMFS*	Requires federal agencies to consult with NMFS on all federal actions or proposed actions that may adversely affect Essential Fish Habitat.	It is expected that the project will involve federal consultation with NMFS.
Migratory Bird Treaty Act *USFWS; CDFG*	Prohibits the take, possession, import, export, transport, selling, purchase, barter, or offering for sale, purchase or barter, any migratory bird, eggs, parts, and nests, except as authorized under a valid permit.	A recent Federal Court decision held that federal agencies are only bound by the Migratory Bird Act when the agency itself is actually taking the migratory birds, as such, consultation with the USFWS for the project would not be expected. However, it is likely that a CDFG Streambed Alteration Agreement (SAA) will be required. The CDFG often includes conditions in its authorizations that protect migratory birds, which would minimize potential Migratory Bird Treaty Act issues. Measures protecting migratory birds may also be incorporated into other agency authorizations.
Fish and Wildlife Coordination Act *USACE in coordination with USFWS, NMFS, and CDFG*	Requires federal agencies to consult with USFWS, NMFS, and state wildlife agencies for activities that affect, control, or modify waters of any stream or bodies of water.	The USACE has entered into a Memorandum of Agreement (MOA) with the USEPA, USFWS, and NMFS that enables the agencies to collaborate during the Section 404 permit review process. The USFWS or NMFS may recommend denial of a permit application, the incorporation of additional permit conditions to minimize adverse effects, or mitigation actions. Under this act, the USFWS, NMFS and CDFG have responsibility for project review.
Federal Endangered Species Act (ESA) *USFWS or NMFS*	Applies to activities that "may affect" a federally listed threatened or endangered species or its designated critical habitat.	The USACE (as federal lead agency) submits a biological report (e.g., Biological Assessment [BA]) to the USFWS and/or NMFS. USFWS/ NMFS issues a Biological Opinion (BO) that is used by the lead agency in making its permit decision. Given that the project would improve the functions and values of the project area, it is expected that USFWS will issue a BO authorizing species take incidental to the restoration and enhancement activities.
California Endangered Species Act (CESA) *CDFG*	Requires projects to obtain an incidental "take" permit for a State-listed threatened or endangered species only if specific criteria are met.	A project must complete the CESA process before it can obtain a SAA from CDFG. The CESA process can be coordinated with the federal ESA process for species that are both federal- and State-listed. If CDFG determines the federal BO to be consistent with CESA, a separate take permit is not required.
Section 1600 of the California Fish and Game Code *CDFG*	Requires any project that may substantially adversely affect existing fish or wildlife resources to notify CDFG and to obtain a Lake or SAA, per CDFG review.	As a Responsible Agency pursuant to CEQA, CDFG must consider the certified CEQA document before it will issue a SAA. The CDFG will propose measures necessary to protect the fish or wildlife that could be affected by the project.
Section 106 National Historic Preservation Act *SHPO or Tribal Historic Preservation Officer (THPO)*	Applies to projects that adversely affect historic properties listed or eligible for listing on the National Register of Historic Places (NRHP).	If any properties/structures in the project area are eligible for the National Register of Historic Places (NRHP), the USACE (as the federal lead agency) would enter into a MOA with the SHPO/THPO and the Advisory Council on Historic Preservation. The MOA would specify the measures the USACE would take to avoid or reduce effects on historic property(ies).

Statute/Regulation and Agency	Applicability	Project Requirements/ Actions
Section 401 Clean Water Act Water Quality Certification; Porter-Cologne Act Waste Discharge Requirements *SWRCB/RWQCB*	Requires that any applicant for a federal permit or license that may result in a discharge of pollutants into "waters of the U.S." obtain a Water Quality Certification (WQC) or waiver from the RWQCB, certifying that the activity complies with all applicable State water quality standards, limitations, and restrictions.	Project activities requiring a Section 404 or Section 10 permit from the USACE will also require a conditional Section 401 WQC or Waste Discharge Requirements. The Los Angeles RWQCB will require CEQA to be completed before it will issue an authorization for the project.
Section 402 Clean Water Act National Pollution Discharge Elimination System (NPDES) Requirements *SWRCB*	Regulates discharges of "pollutants" from point sources to "waters of the U.S." through the issuance of NPDES permits.	If one acre or more of ground will be disturbed by project-related activities, it will be necessary to prepare a Storm Water Pollution Prevention Plan (SWPPP) and submit it and a Notice of Intent and applicable fee to the SWRCB to use its NPDES General Permit for Discharges of Storm Water Associated with Construction Activity.
Coastal Act and Coastal Zone Management Act *CCC*	Requires activities within or outside the coastal zone that directly affect any natural resources, land uses, or water uses of the coastal zone to remain consistent with approved State coastal zone management programs.	Due to its partial location with the Coastal Zone, implementation of the project is expected to require a Coastal Development Permit, as well as a federal Coastal Consistency Determination from the CCC.
Clean Air Act (CAA) (federal and State) *USEPA, CARB, VCAPCD*	The federal CAA directs the attainment and maintenance of National Ambient Air Quality Standards. The California CAA mandates achieving the health-based California Ambient Air Quality Standards.	Due to the breadth of construction-related activities, coordination and potentially permitting will be required through the VCAPCD, per the Ventura County Air Quality Management Plan.
Local Approvals *County of Ventura, City of Oxnard, City of Port Hueneme*	Determines project consistency with county and city land use plans and ordinances.	Conversion of protected agricultural land to habitat in the Coastal Zone could trigger permit requirements per the Coastal Area Plan of the Ventura County General Plan. Any alterations to the Hueneme Drain, J Street Drain, or Oxnard Industrial Drain would additionally require an encroachment permit from the Ventura County Watershed Protection District (VCWPD). The project would require an encroachment permit from the City of Oxnard for any activities that would affect city roads or other facilities.

As noted above, project review and approval under CEQA and NEPA will be required prior to its implementation. It is currently anticipated that a joint EIR/EIS will be necessary. Under CEQA, the SCC will be acting as the project's Lead Agency. Under NEPA, it anticipated that the USACE will be acting as the Lead Agency, as addressed below. The environmental review process will additionally involve participation be numerous interested, Responsible and Trustee Agencies, as well as the public.

As a federal action agency, the USACE's regulatory review routinely includes ensuring compliance with NEPA. As such, the USACE is usually the federal Lead Agency for projects that would affect waters of the Unites States; implementation of the project would affect waters of the Unites States. Other regulatory agencies such as the USFWS, NMFS, USEPA, SHPO and ACHP often assert their jurisdiction or address their statutory requirements through coordination or consultation with the USACE, or another federal agency that may act as the Lead Agency under NEPA. As part of its permitting process, the USACE must also ensure that a proposed project complies with all other applicable federal resource protection laws, such as the Endangered Species Act, the National Historic Preservation Act, the Coastal Zone Management Act, the Magnuson-Stevens Fishery Conservation and Management Act, and Section 401 of the Clean Water Act (see Table 4-1). Similarly, the SCC must also ensure that all applicable State and local laws, ordinances and regulations are addressed and complied with as part of the environmental review process, including coordination with appropriate regulatory agencies and jurisdictions.

It is not unusual for the environmental review process for a joint CEQA/NEPA document to take two to three years, or more, to complete. The process typically involves the following steps:

- Project Definition/Refinement;
- Public and Agency Noticing and Public Scoping Meetings;
- Preparation, Publication and Circulation of a Draft EIR/EIS;
- Coordination and Completion of Public Meetings on the Draft EIR/EIS;
- Responding to Public and Agency Comments on the Draft EIR/EIS;
- Preparation, Publication and Circulation of a Final EIR/EIS; and,
- Completion of the Final EIR/EIS's Decision Making Process.

5. PROJECT ALTERNATIVES

Three broad strategies were identified for developing the project's restoration alternatives. These strategies include:

- **Alternative 1:** Creation of a new tidal lagoon with a permanent open connection to the ocean;
- **Alternative 2:** Restoration of historic wetland habitat mosaic with intermittingly open inlets and seasonal ponds; and,
- **Alternative 3:** Enhancement of existing habitats with minimal hydrologic and ground surface modifications.

Each of these strategies has two variants that bracket the range of the project site that is available for restoration. The "unconstrained" variant (Figure 5-1) encompasses the maximum feasible acreage of the project site whereas the "constrained" variant (Figure 5-2) is limited to those properties that are currently owned by the SCC and TNC. For the purposes of this Feasibility Study's constrained alternatives, it is assumed that the southern 230 acres of the Southland Sod Farm will be acquired, as shown in Figure 5-2. Each restoration alternative is then fit to each variant's footprint. For example, the unconstrained variant of Alternative 1 (Alternative 1U), maximizes the footprint of the tidal lagoon and adjacent tidal wetlands. The constrained variant of Alternative 1 (Alternative 1C), consists of the smallest tidal lagoon possible while maintaining the same nominal function of an open inlet, but compromises by reducing wetland extent.

The guiding principle behind each alternative's design is to restore habitats through both topographic and hydrologic modifications that together sustain ecologic functions. This integration of habitat with the underlying geomorphic and hydrologic processes ensures that the designs can be sustained. The concept of sustainability is complex, the elements of which are further addressed in Sections 6 (Alternatives Analysis) and 7 (Comparative Evaluation of the Alternatives); it is noted, though, that some of the alternatives presented below would be, ecologically and geomorphically, more sustainable in that they would be more stable and self-sustaining. As such, they would be more likely to require less on-going management cost or adaptive management.

The descriptions of the alternatives in this section correspond to expected conditions within the first decade following project construction. During this first decade, an alternative's design grading plan would largely determine the physical layout of the project site. It is assumed that vegetation, which would be planted as part of project design, would have fully colonized the project site. In addition, the project site would have been exposed to, and adapted, to some degree, to seasonal and inter-annual climatic variability.

The designs also anticipate long-term changes in physical processes that would act on the project site. Because of its coastal location, a significant long-term change would be future sea level rise. Sea level rise would elevate the tidal water levels which determine tidal wetland habitat type, magnify the impact of extreme storm events, and shift the coastline landward. These alternatives are designed to anticipate the impact of three feet of sea level rise. While uncertainty remains as to future rates of sea level rise because of uncertainty about future carbon emission rates and the oceans' response, it is reasonably certain that three feet of sea level rise will occur between 50 and 100 years from the present (Isenberg, 2008).

These restoration alternatives are compared with the option of taking no action on the project site, summarized below as Alternative 4 (the "No Project Alternative").

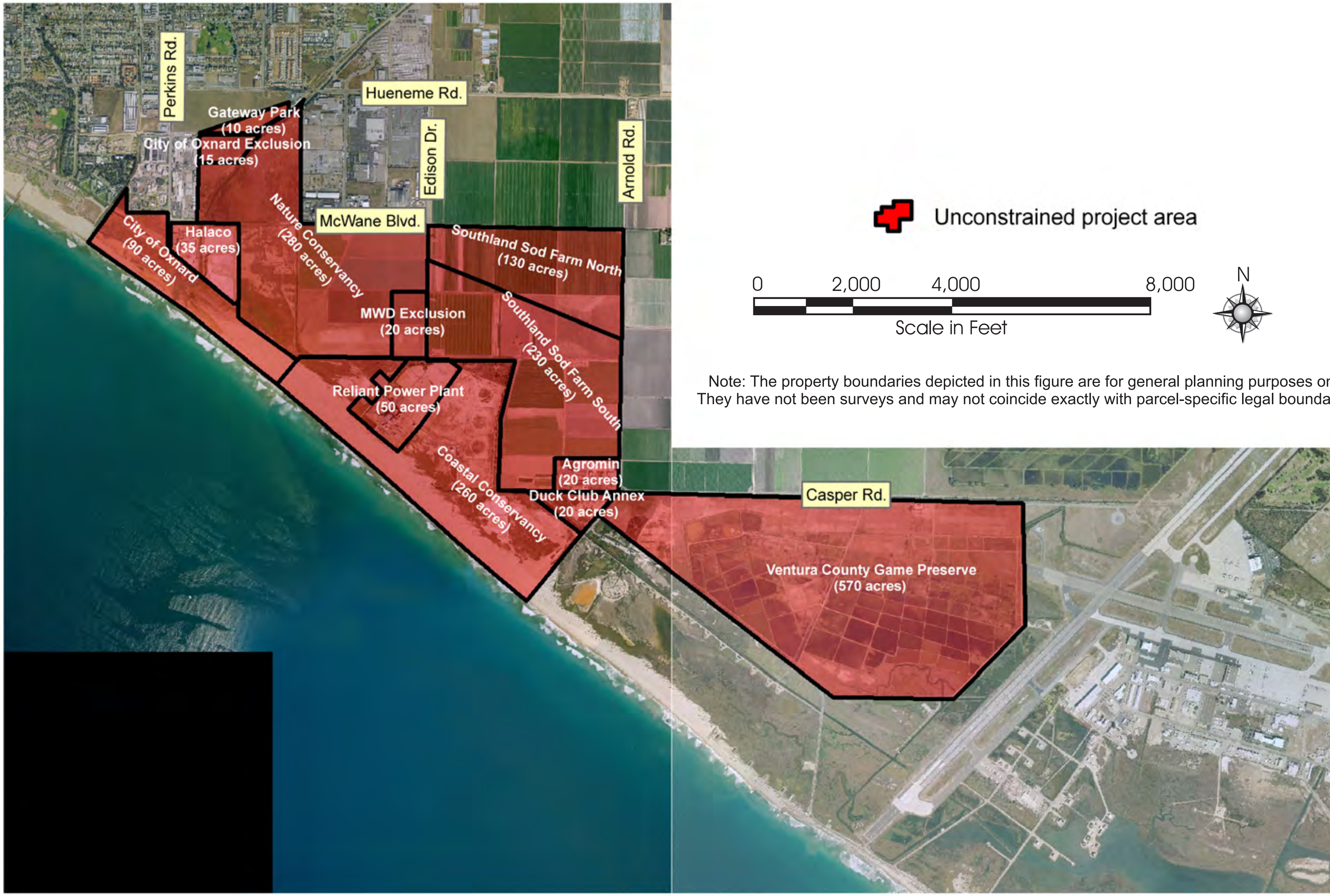
5.1 CREATE NEW TIDAL LAGOON (ALTERNATIVE 1)

This alternative features a large tidal lagoon permanently connected to the ocean by an inlet channel (Figures 5-3 and 5-4). Creation of a tidal lagoon departs from the project area's historic conditions, but is consistent with the regional goal of replacing subtidal habitat lost throughout Southern California. The lagoon would be fringed with tidal southern coastal salt marsh. The salt marsh would transition to dune habitat towards the ocean and to coastal grassland landward. On the southeastern parcel (the VCGP), the site would be reconfigured to expand salt marsh habitat, enhance managed duck habitat, and create coastal grassland uplands. Freshwater inputs to the project site would be re-routed to complement the design. The common aspects of these components of Alternative 1 are described below; specifics of the unconstrained and constrained variants are then detailed in Sections 5.1.1 and 5.1.2.

The proposed open-water lagoon would cover a substantial portion of the project site. As shown in Figure 5-5, its maximum depth would be approximately 4.6 feet below mean lower low water (MLLW) or 4.8 feet below North American Vertical Datum of 1988 (NAVD88), providing subtidal habitat for fish and benthic species. A permanent inlet would connect the lagoon to the ocean, which would supply the regular tidal water level fluctuations and consistent salinity needed to sustain tidal habitat. To ensure that the inlet remains open, a jetty on the north side of the inlet is recommended. The jetty would provide additional resistance to inlet closure and limit lateral migration of the inlet by deflecting the predominant sand transport away from the inlet's mouth.

A progression of habitats would surround the proposed tidal lagoon. The delineation of these habitats has been determined by their hydraulic connection and ground elevation relative to the tides. The project site's existing beach and foredune system, which is supplied with sand by alongshore transport, would be largely unchanged except for the incision for the new inlet. Windblown sand from the beach and foredunes would support re-introduced backdune habitat, typified by vegetated swales and depressions. The tidal lagoon would sustain a fringing salt marsh with regular fluctuations of water level and consistent salinity. As elevations gradually increase, the marsh would transition to coastal grassland, which would be configured with slight depressions to pond rainfall and create seasonal wetlands. It would also include expansion of existing stands of willow scrub. The portion of coastal grassland adjacent to the salt marsh, denoted as "transitional," represents that portion of the project site that is likely to become future salt marsh in response to three feet of sea level rise. The actual transitions between these habitats would not be the sharp boundaries, as shown for convenience in Figures 5-3 and 5-4. Rather, the habitats would blend at their boundaries, with a mixture of characteristic vegetation spanning the transition from one habitat to another. Please refer to Section 6.1.1 for more information on the biological specifics of each habitat type.

Alternative 1 accommodates freshwater flows entering the project site from the adjacent watershed by routing them through treatment wetlands and then incorporating them into the project site's hydrology. Treatment wetlands trap watershed pollutants, minimizing their distribution throughout the project site and into the ocean. The specific design of treatment wetlands depends on the pollutants to be removed, so these features will be further refined after subsequent studies clarify the type and extent of watershed pollution. The larger drains which flow throughout the year would be connected to the tidal lagoon. This creates brackish habitat between saline and fresh water. Connection to the lagoon would also be likely to improve flood conveyance. Freshwater flow can pass through the permanently open inlet rather than becoming impounded behind in the existing beach berm.

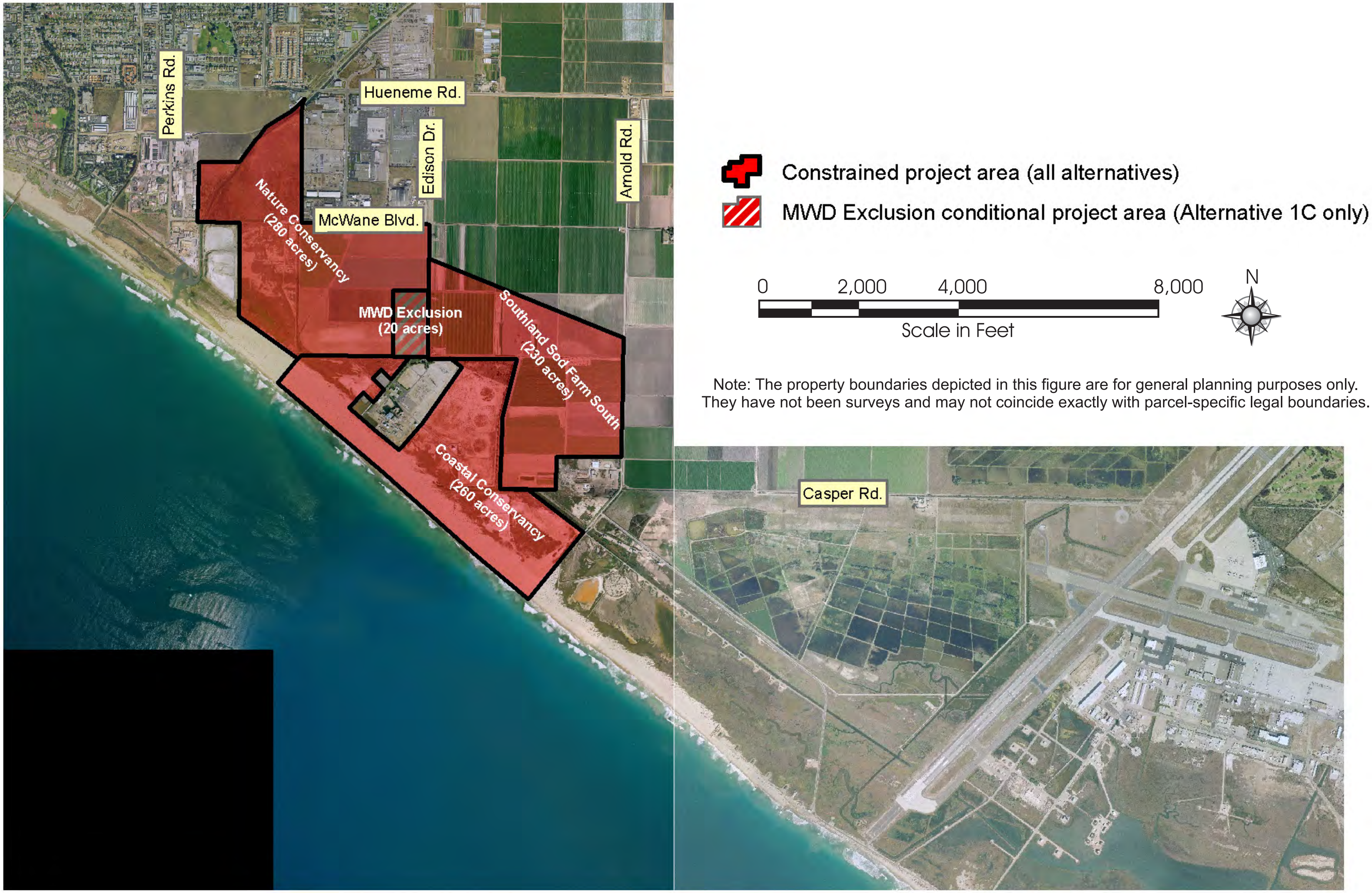


Aspen Environmental Group

Source: Philip Williams & Associates, Ltd., 2009.

Figure 5-1

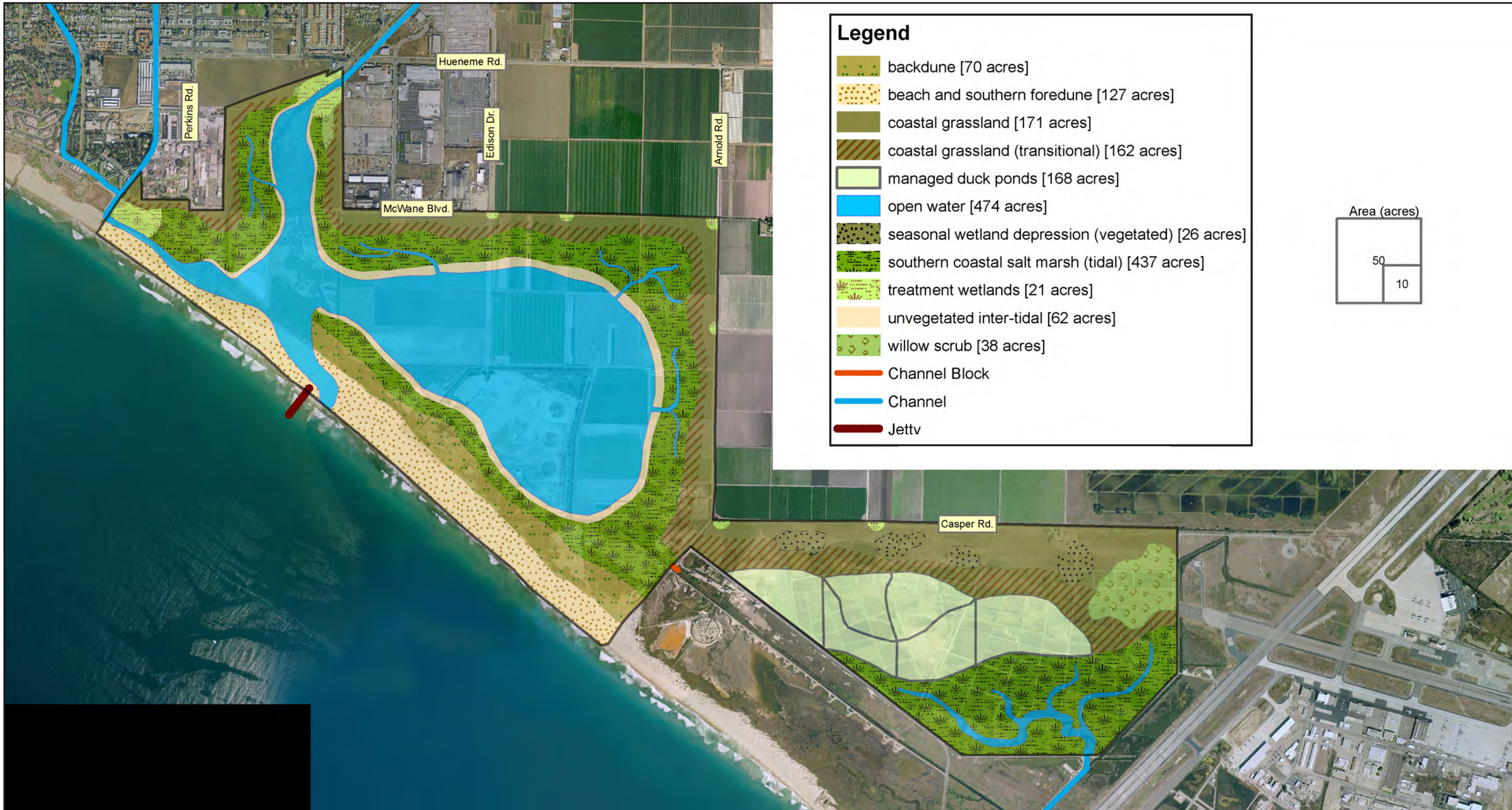
Boundaries of the Unconstrained Alternatives



Aspen Environmental Group

Source: Philip Williams & Associates, Ltd., 2009.

Figure 5-2
Boundaries of the Constrained Alternatives



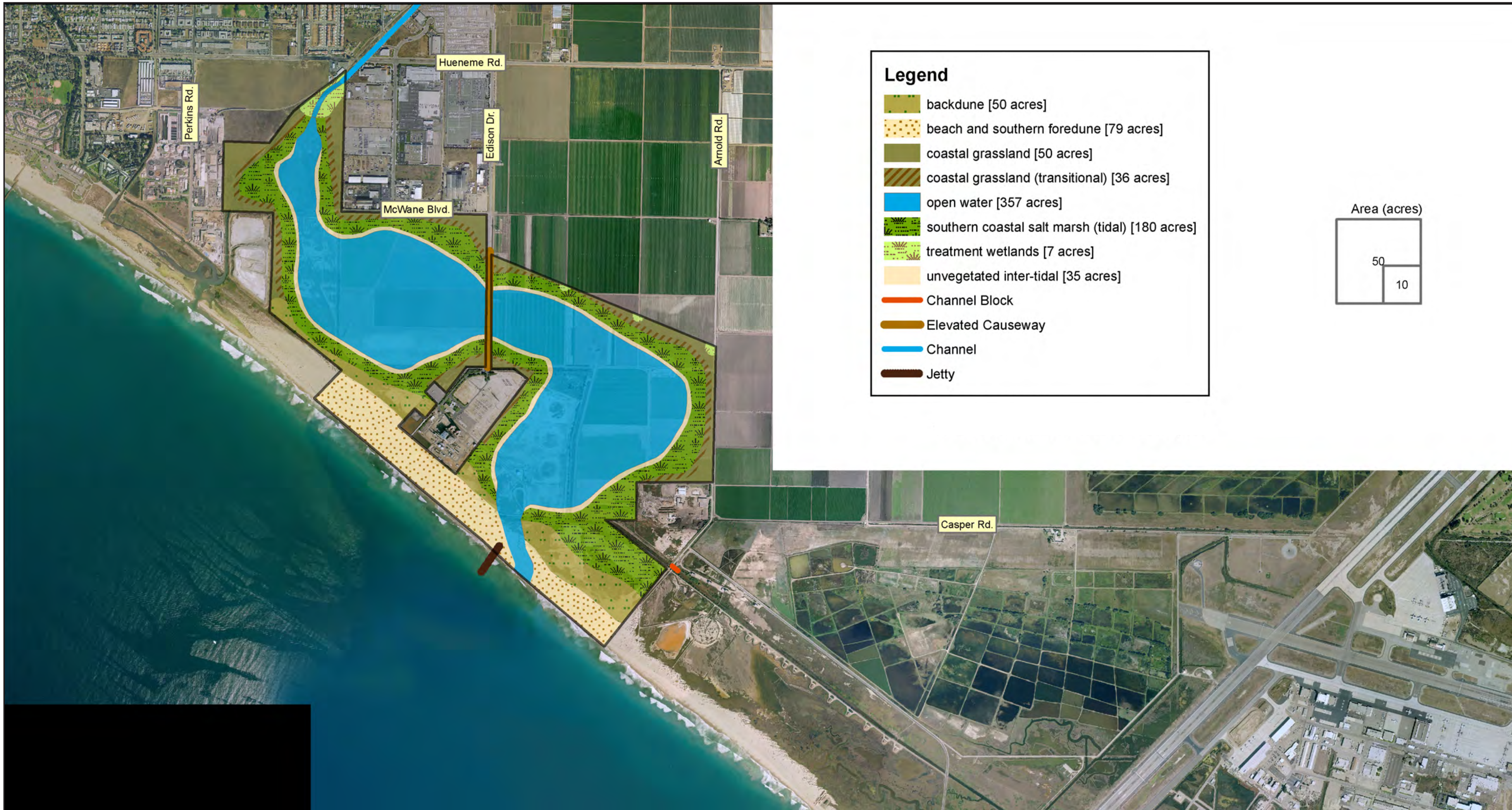
Aspen Environmental Group

Source: Philip Williams & Associates, 2009.

0 1000 2000 4000
Scale in Feet

N

Figure 5-3
Preliminary Habitat Map for Alternative 1U

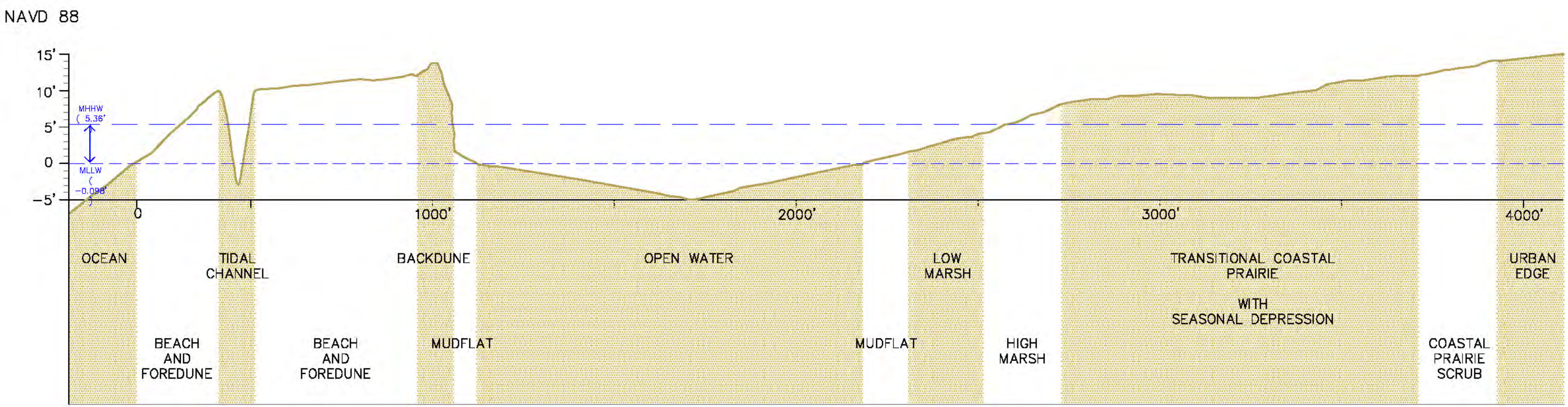


Aspen Environmental Group

Source: Philip Williams & Associates, 2009.

0 1000 2000 4000
Scale in Feet
N

Figure 5-4
Preliminary Habitat Map for Alternative 1C



Source: Wetlands Research Associates, 2009.

Figure 5-5
Conceptual Cross Section Across New Tidal Lagoon

The existing ODD #3, which currently cuts across the land slated for the lagoon and drains to the southeast, would be reconfigured. A large subsurface drain which delivers water to ODD #3 within the project area may either be re-routed parallel to Arnold Road and re-connected with the ODD #3 south of the channel block, or filtered through a treatment wetland at the edge of the lagoon before spilling into the lagoon.

5.1.1 Unconstrained (Alternative 1U)

Alternative 1U leverages the extensive project area to provide both a variety of wetland habitats and the flexibility for the habitats to adapt to future change, such as sea level rise (Figure 5-3). At approximately 450 acres each, open water habitat and tidal salt marsh would be the two largest habitat areas. Coastal grassland would fringe the tidal salt marsh to permit a gently-sloped transitional zone for transgression of the salt marsh in response to sea level rise. Because of the unconstrained project area, the tidal inlet can be located in the northern half of the site's coastline.

Alternative 1U integrates flows from all three drains in the local discharge network. The Oxnard Industrial, J Street, and Hueneme Drains would flow first into treatment wetlands just inside the project site's boundaries, and then into the lagoon. Their previous outlet, the J Street lagoon, would be incorporated into the new lagoon. This permanent connection to the ocean, which enhances flood conveyance, is of particular value for the J Street Drain since it currently poses the largest flood risk to developed areas of the City of Oxnard.

Actions on the southeastern portion of the site, the existing VCGP, would be implemented only for the unconstrained variant. The design restores salt marsh habitat to muted tidal exchange via Mugu Lagoon while re-configuring management of a portion of the existing VCGP managed duck ponds. The salt marsh restoration would expand northward from existing salt marsh. To provide muted tidal exchange with Mugu Lagoon, the existing channels and culverts would be upgraded. Modifications to the managed duck ponds would optimize the environment for ducks, seeking to maintain or enlarge the total duck population the ponds can support by increasing population density. In addition to these hydrologic changes, a graded berm would be created along the northern boundary of the VCGP. This berm would serve multiple purposes. It would raise this area above elevations that are prone to coastal flooding. The southern face of the berm would also create a transitional zone for tidal marsh transgression in response to future sea level rise. Additionally, the fill required to form the berm would provide for onsite placement of the soil excavated from the proposed tidal lagoon, thereby reducing construction costs.

5.1.2 Constrained (Alternative 1C)

Alternative 1C would require modifications to the configuration of the lagoon, habitats, and integration with watershed inflow and infrastructure, as shown in Figure 5-4. The lagoon would dominate the project site, restricting the amount of other habitats that could be included.

For Alternative 1C, an additional parcel would need to be added to the previously defined constrained project area. The added parcel, currently owned by MWD, lies at a key constriction of the lagoon; without this parcel, the connection between the east and west sides of the lagoon would be severely restricted. This parcel adds 20 acres to the project area and lies immediately to the west of Edison Drive, enhancing the lagoon's connectivity across this road.

Within the constrained project area, the lagoon would fill 357 acres, which approaches the minimum size needed to maintain an open inlet. The lagoon's inlet would be located downstream from the Reliant Power Plant relative to the alongshore sand transport. This location would reduce the risk lateral inlet migration interfering with the power plant and its offshore outfall. Because of the reduced tidal prism and the limited tolerance for lateral inlet migration, a jetty at the inlet's mouth would be a likely necessity.

The lagoon's size relative to the project site would limit the area available for fringing salt marsh and coastal grassland habitat. The tidal salt marsh habitat would total 180 acres and the coastal grassland would total approximately 90 acres. The transitional coastal grassland would be quite narrow around the lagoon's salt marsh. This would limit the extent to which the salt marsh could transgress landward in response to sea level rise.

The persistence of infrastructure immediately adjacent to, and surrounded by, the project area would require measures to protect and access this infrastructure. Situated in the middle of the project area, the Reliant Power Plant would require an elevated causeway over the lagoon for access. At the very least, this causeway would carry a roadway. If the power plant also needs to maintain railroad access (a spur currently traverses the project site from McWane Boulevard to the northwest side of the power plant property [see Appendix A, Figure A-1]), the causeway would also need to carry this rail line. In addition, the presence of the lagoon may expose the power plant, the Halaco Site, and the Agromin facilities to increased coastal flood risk. Additional assessment will be necessary to determine if flood defenses are required at these sites.

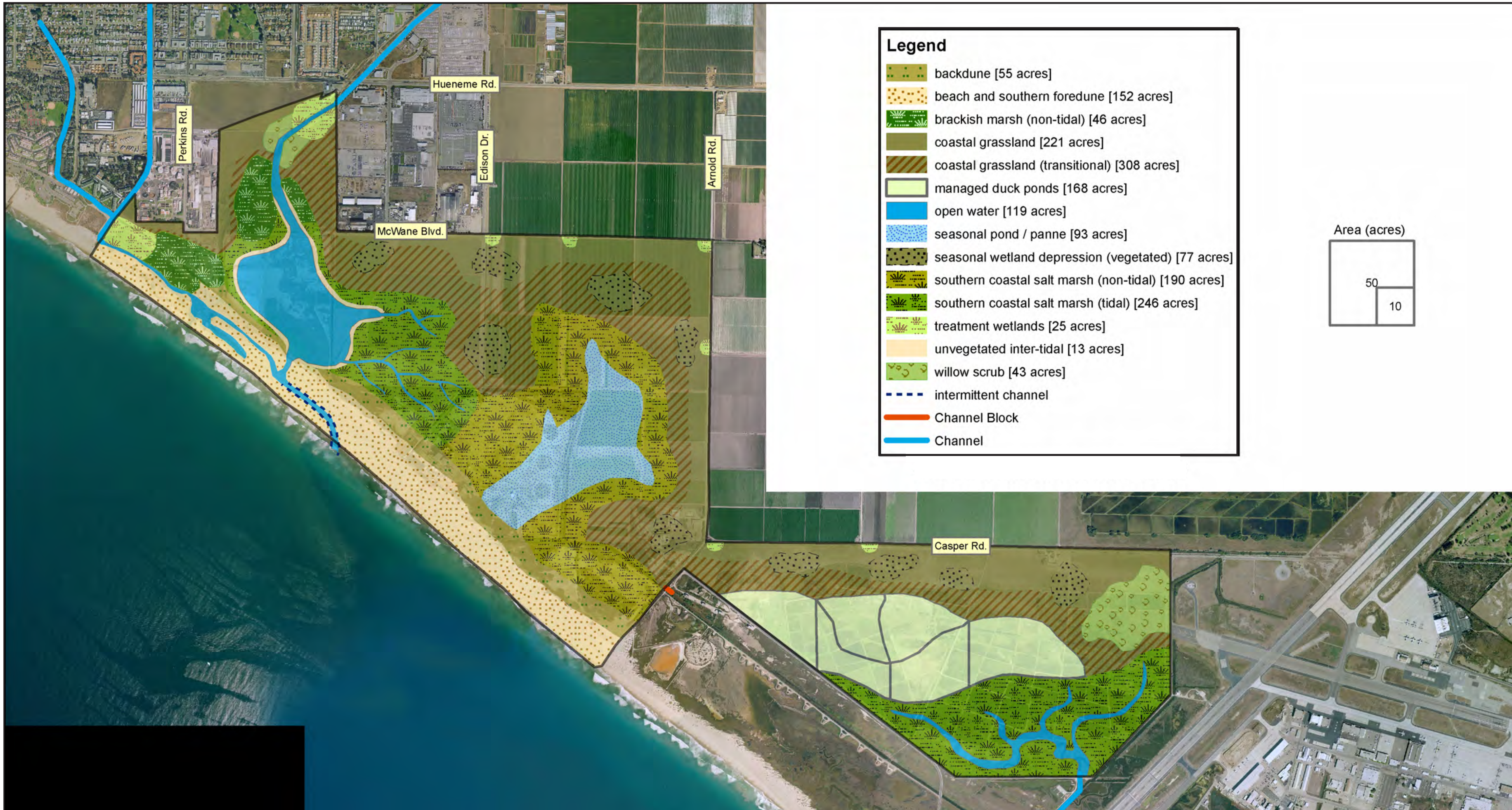
Only the Oxnard Industrial Drain would cross the constrained project boundary and it is incorporated into the design.

5.2 RESTORE SEASONALLY OPEN WETLAND HABITATS AND PONDS (ALTERNATIVE 2)

Alternative 2 would restore a mosaic of wetland habitats modeled after historic conditions as represented in 19th century maps. The predominant features would be a lagoon intermittingly connected to the ocean and a seasonal pond supplied by precipitation and ground water (Figures 5-6 and 5-7). Under these conditions evaporation would concentrate salts in the soil, creating basins edged by saline and brackish water species in fringing areas. Open water habitat would be seasonally subject to tidal exchange, resulting in fringing salt marsh vegetation. Beach and foredune habitats would be similar to existing conditions and supplemented with expanded backdune habitat.

The design of the open water, intermittently tidal lagoon on the northwestern side of the site would follow the historic ponds found on the project area in the 19th century. At low tide, as shown in Figure 5-6, the pond's depth would be two feet over most of its area. A lagoon of this size does not have sufficient tidal exchange to maintain a permanently open inlet. During periods of increased wave action, alongshore sand transport would deposit more sand in the inlet channel than tidal exchange between the ocean and lagoon can scour, causing the inlet to close. Once closed, the lagoon mouth would re-open when freshwater flows from watershed flooding or strong waves associated with winter storms incise a new inlet.

The seasonal pond at the center of the project area would be non-tidal, and instead would be excavated such that precipitation and groundwater would be its water sources. However, since precipitation is strongly seasonal, with nearly all rainfall during the winter and spring, the pond's area would fluctuate significantly with the seasons. Figure 5-6 depicts the pond as it would be at its fullest, rainy-season extent. Once the rain stops in the spring, the pond would then decrease in size as evaporation lowers



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Source: Philip Williams & Associates, 2009.

0 1000 2000 4000
Scale in Feet
N

Figure 5-6
Preliminary Habitat Map for Alternative 2U

Source: Philip Williams & Associates, 2009.

0 1000 2000 4000
Scale in Feet
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Figure 5-7
Preliminary Habitat Map for Alternative 2C

water levels and ultimately reach a minimum size just before the next winter's rains. The minimum extent would depend on the area of the ground surface which falls below the dry season water table. As currently conceived, the pond's area would shrink in the dry season to be only one quarter to one third of its fullest winter extent. Inputs from saline groundwater, evaporation of only fresh water and occasional wave overtopping by ocean storm events would create elevated salinity within the pond and leave behind salt-encrusted soils during the dry season when the pond shrinks in size.

A progression of habitats would surround the tidal lagoon and seasonal pond. The delineation of these habitats has been determined by their hydraulic connection and ground elevation relative to the tides. The project site's existing beach and foredune system, which is supplied with sand by alongshore transport, would be largely unchanged except for intermittent incision by the lagoon inlet. Windblown sand from the beach and foredune would support re-introduced backdune habitat. The tidal lagoon would sustain fringing salt marsh vegetation with water levels that fluctuate with the tides when the inlet is open and change slowly when the inlet is closed. Non-tidal salt marsh would fringe the seasonal pond. At the end of summer and early fall, when water levels in the seasonal pond are at their lowest point, the exposed land at the edges of the seasonal pond would consist of a salt panne habitat (e.g., exposed soils with high loading with salt particles). As elevations gradually increase, the marsh would transition to coastal grassland, which has been configured with slight depressions to pond rainfall and create seasonal wetlands. It would also include expansion of existing stands of willow scrub. The transitional coastal grassland represents the area that would be likely to become salt marsh in response to three feet of sea level rise.

Management actions for the surface water drains and ODD #3 would be the same as Alternative 1 (Create New Tidal Lagoon). In summary, the surface drains would pass through treatment wetlands and then integrate with the site's hydrology. ODD #3 terminates at the project boundary and the subsurface drain which connects to ODD #3 would be routed around the project area or directed into the lagoon.

5.2.1 Unconstrained (Alternative 2U)

Alternative 2U would allow for both restored ponds to be nearly 100 acres in size and fringed with even larger areas of vegetated wetland habitat. The uplands portion of the project site would include relatively large swaths of coastal grassland, including transitional coastal grassland to accommodate three feet of sea level rise.

For Alternative 2U (Figure 5-6), the connection between the existing J Street Lagoon and the lagoon would be restricted to a juncture just before the inlet channel breaches the dunes and connects to the ocean. This limited connection, along with the current bed elevation of the J Street Lagoon above MHHW, would preserve the brackish salinity characteristics in the J Street Lagoon that are favored by the tide water goby. Only the Oxnard Industrial Drain would connect directly to the lagoon.

Management actions on the southeast portion of the site, where VCGP is currently located, would be identical to those proposed for Alternative 1U.

5.2.2 Constrained (Alternative 2C)

The exclusion of specific parcels from the project area required adjustments to Alternative 2C's design (Figure 5-7). For each excluded parcel (Figure 5-1), these adjustments would include:

- **City of Oxnard:** Loss of the limited connection to the J Street and Hueneme Drains, as well as to the J Street Lagoon.

- **Halaco Site:** Reduction in the size of the proposed lagoon, eliminating the land area that included the historic lagoon.
- **Reliant Power Plant:** Loss of marsh habitat and added flood exposure along the power plant's northwest boundary with the lagoon.
- **Northeast Sod Farm:** Reduction in the transitional coastal grassland, thereby limiting the capacity of the design to adapt to sea level rise.

With the exclusion of both the City of Oxnard parcel at the north end of the beach and the power plant, the location for the lagoon's inlet would be constrained. As depicted in Figure 5-7, the inlet would be as far from the power plant and its ocean outfall pipes as possible, and a jetty to limit lateral migration would be included.

5.3 ENHANCE EXISTING NON-TIDAL WETLAND HABITATS (ALTERNATIVE 3)

Existing non-tidal habitats would be enhanced under Alternative 3 by undertaking minimal grading to expand backdunes, non-tidal salt marsh, and brackish marsh in regions that can support these habitats (Figures 5-8 and 5-9). Coastal grassland habitat, graded with seasonal wetland depressions would cover the remaining inland portion of the project area. This approach would minimize construction costs as well as changes to existing hydrologic conditions.

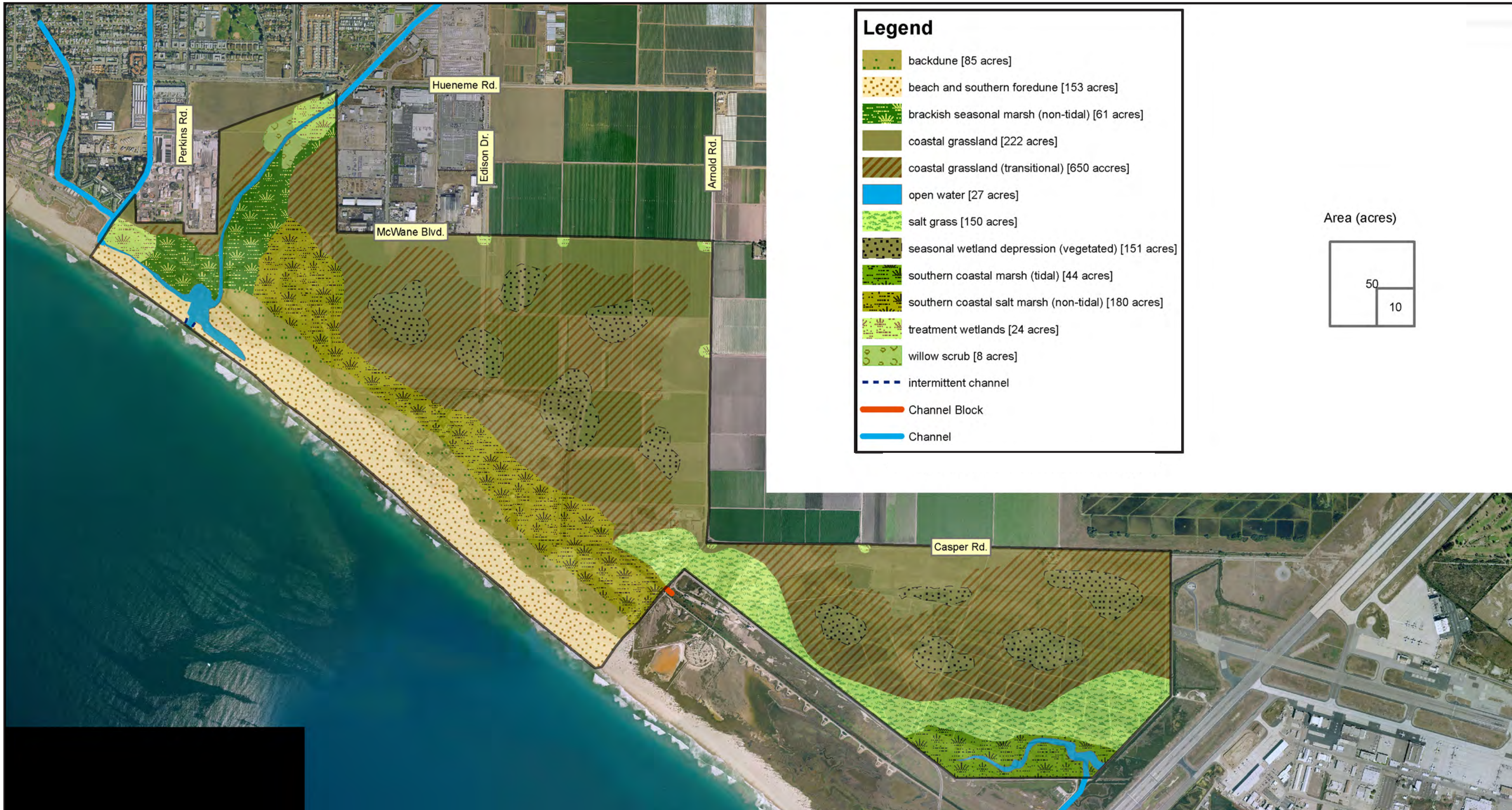
The excavation requirements for this alternative would be minimal. Instead, the existing surface would be re-graded to remove roads and drainage canals, create local topography that would define seasonal wetlands within the coastal grassland, and expand existing wetland habitats.

Examples of backdune, non-tidal salt marsh, and brackish marsh already exist in the project site. These habitats could be expanded with minimal change to existing hydrologic conditions, as described below:

- Backdune habitat is supported by coastal wind and wave processes shaping the land surface immediately landward of the beach and dunes. Currently, only a small portion of backdune remains within the project area, to the southeast of the Reliant Power Plant, since much of the region immediately behind the dunes has been impacted by development. However, the healthy beach and foredune system should be capable of supporting a more extensive backdune habitat.
- Non-tidal salt marsh would replicate and expand existing, onsite examples of this habitat located at the end of Arnold Road and northeast of the power plant. This habitat is supported by direct rainfall and seasonal fluctuations in the groundwater table, with occasional wave overtopping during ocean storm events.
- Brackish marsh exists along the surface drains and the J Street Lagoon where fresh water from the watershed mingles with salt from the ocean to create fluctuating intermediate salinity levels.

Landward of the regions directly influenced by coastal processes, the habitat would transition to coastal grassland. The transitional portion of the coastal grassland would represent the land area that would be susceptible to coastal flooding during extreme storm events.

Existing hydrologic conditions would be changed to the least extent possible. Surface drains flowing into the project area would be nearly unchanged, except for the addition of treatment wetlands to buffer the project site from watershed pollutants. The existing ODD #3, which currently cuts across the project area and drains to the southeast, would instead end at the project boundary. A large subsurface drain which delivers water to ODD #3 within the project area would be re-routed parallel to Arnold Road and re-connected with ODD #3 south of the channel block.



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Source: Philip Williams & Associates, 2009.

0 1000 2000 4000
Scale in Feet
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Figure 5-8
Preliminary Habitat Map for Alternative 3U

Aspen Environmental Group

Source: Philip Williams & Associates, 2009.

0 1000 2000 4000
Scale in Feet

N

Figure 5-9
Preliminary Habitat Map for Alternative 3C

5.3.1 Unconstrained (Alternative 3U)

The expansion of existing habitat, the creation of coastal grassland, and minimal hydrologic modifications, as described above, are readily applied to Alternative 3U, as shown in Figure 5-8.

The VCGP managed duck ponds would be abandoned and largely converted to coastal grassland with seasonal wetland depressions. A portion of existing salt marsh in the southeast corner of the VCGP would be maintained. Tidal flows to this salt marsh would be supplied by the existing channel and culvert connection with Mugu Lagoon. Between the salt marsh and coastal grassland, existing patches of salt grass habitat would be expanded.

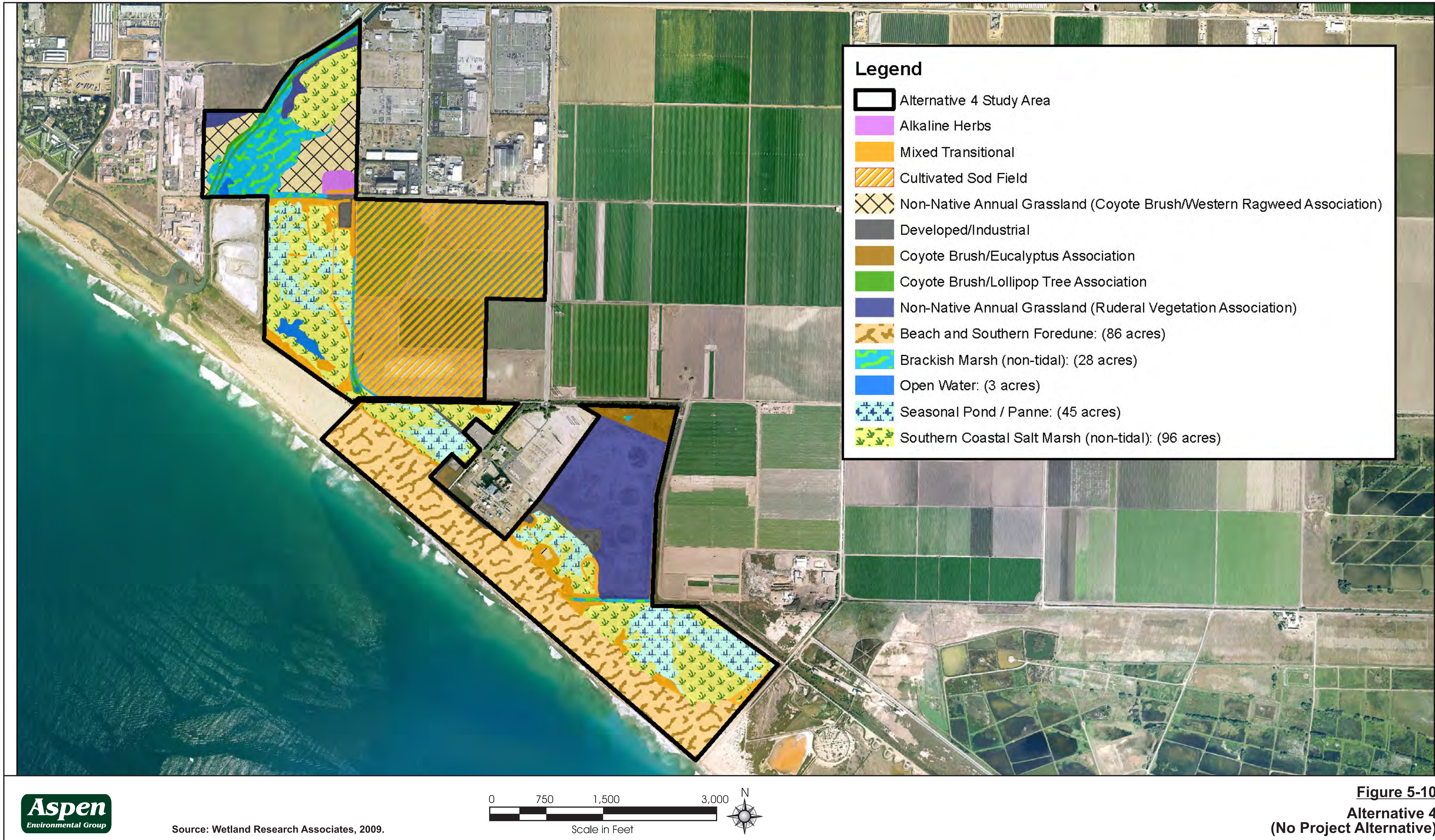
5.3.2 Constrained (Alternative 3C)

The topographic and hydrologic gradients for Alternative 3C would be minimal. Therefore, the habitats could be laid out identically to Alternative 3U, but with no action on the excluded parcels. The resulting habitat configuration is shown in Figure 5-9.

5.4 NO PROJECT ALTERNATIVE (ALTERNATIVE 4)

The No Project Alternative (Alternative 4) project area is defined by the boundaries of the SCC and TNC properties, as shown on Figure 5-10, for a total of 540 acres. This project area does not include the 230-acre southern portion of the Southland Sod Farm. Under this alternative there would be no construction of seasonal wetland depressions, no conversions of wetlands to coastal grassland, and no grading. Although existing habitats would be enhanced though plantings, weeding, and other maintenance efforts, the specifics regarding these activities, or their implementation, have not been established by the SCC or TNC to date.

The central portion of Alternative 4 would be dominated by a 130-acre cultivated sod field. The next largest habitat types would be 96 acres of non-native grassland, located primarily in the northern and southern sections of the project area, and 96 acres of non-tidal southern coastal salt marsh, which would be spread throughout the site. There would be 28 acres of non-tidal brackish marsh adjacent the non-native grassland in the northern section of the project area, and 45 acres of seasonal pond/panne adjacent to and intermixed among the non-tidal southern coastal salt marsh habitat. The portion of the project area abutting the ocean would consist of 86 acres of beach and southern foredune. Other habitat types within Alternative 4 project area would include 21 acres of mixed transitional vegetation, nine acres of developed/industrial land uses, three acres of open water, and three acres of alkali meadow (saline/haline herbs), as well as areas of coyote brush/eucalyptus and coyote brush/lollipoptree associations.



Source: Wetland Research Associates, 2009.

Figure 5-10
Alternative 4
(No Project Alternative)

6. ALTERNATIVES ANALYSIS

The following section provides an analysis of the seven project alternatives described in Section 5 (Project Alternatives). The analysis is presented on a subject-specific basis for habitat distributions and biological resources, hydrologic, hydraulic and geomorphic conditions, land use and infrastructure, cultural resources, and soil management, construction quantities and cost estimates. The analysis methodology used for all alternatives is described within the first alternative's section; subsequent sections only discuss analysis results. The analysis is not intended to be an impact evaluation, or otherwise a mechanism for identifying measures that could mitigate potential adverse impacts. The purpose of the analysis is to provide an overall characterization of what would likely occur to the above-referenced subject areas if any one of the alternatives were to be implemented.

As noted in Section 1.2 (Project Purpose and Scope), the final alternative chosen for implementation could be some type of hybrid of one or more of the alternatives presented in Section 5 (Project Alternatives). As such, the analysis presented in this section should be considered preliminary; its overall conclusions will very likely shift with future refinement and optimization of the preliminary alternatives presented in this Feasibility Study. It is additionally noted that under Alternative 4 (the No Project Alternative) no soil management, construction quantities and cost estimates are provided. Although it is assumed that under this alternative the SCC and TNC would eventually undertake some type of habitat restoration and enhancement on their respective properties, the specifics and timing of such activities have not been identified to date; consequently, the soil management and construction quantities and costs associated with this alternative cannot be predicted with reasonable certainty.

In addition to the analysis provided below, Section 7 (Comparative Evaluation of the Alternatives) compares and contrasts the alternatives and includes summary tables of the acreages of habitat created, restored and enhanced by each alternative, as well as a ranking of the alternatives according to a suite of 26 project-specific criteria.

6.1 CREATE NEW TIDAL LAGOON (ALTERNATIVE 1)

6.1.1 Habitat Distributions and Biological Resources

6.1.1.1 Methodology

Delineation of Habitat Areas. The delineation of the alternatives' coastal wetland habitat types is determined by the vertical elevation of the graded land relative to the tidal elevations within the project area. The vertical elevations assigned to these habitat boundaries were selected based on a review of observed Southern California habitats and wetland restoration projects (Sullivan, 2001; Santa Monica Bay Restoration Commission et al., 2008). For Alternatives 1 and 2 (constrained and unconstrained), the relationship between habitat elevations and tidal elevations in the lagoon are summarized below and depicted visually in Figure 5-5. Note that the tidal elevations within the lagoon are dependent on the specific alternative, as described below in Section 6.1.2.

- Deepest Subtidal: 6 feet below lagoon MLLW to ensure sufficient water depth for pelagic species;
- Subtidal to Intertidal Mudflat: lagoon MLLW;
- Intertidal Mudflat to Southern Coastal Salt Marsh: 1.5 feet above lagoon MLLW;
- Southern Coastal Salt Marsh to Transitional Coastal Grassland: 2.5 feet above lagoon MHHW; and

- Transitional Coastal Grassland to Coastal Grassland: 5.5feet above lagoon MHHW, which is 3 feet above the salt marsh – grassland boundary, in accordance with the anticipate sea level rise used for planning (please refer to Section 2.2).

Buffer Area Between Wetlands and the Project's Boundaries. To quantify the buffer area between the alternatives' upper wetland boundary and the project site's boundaries, three characteristic transects across the project area were first identified. Then, the distance between the project boundary and the outer edge of the wetland habitat was measured along each transect and averaged. The transects were perpendicular to and equally spaced across the project area's northern boundary. For the unconstrained case, this boundary was McWane Boulevard. For the constrained case, the boundary was the northwest-southeast boundary between Edison Drive and Arnold Road. Details of the transects are provided in Appendix B.1.

Habitat Response to Sea Level Rise. A preliminary estimate of habitat response to sea level rise was conducted by partitioning the proposed grading surfaces into three elevation-based areas for current mean sea level, and a future mean sea level increased by three feet. The three areas are subtidal, intertidal and supratidal. These three areas are roughly equivalent to open water, wetlands/mudflats, and grassland/transitional habitats. The areas were estimated from the hypsometry curves calculated for each alternative. (See Section 6.1.2.1, below for a description of tidal elevations and hypsometric curves.) Details of the methodology are provided in Appendix B.2. The analysis assumes no change in the ground surface over the time period which sea level increases by three feet. This assumption is reasonable for a first approximation, since geomorphic change, such as erosion and sedimentation, is likely to be concentrated at the coastline. The actual evolution of habitats in response to sea level rise would be governed by a complex interaction between water levels (both average and extreme), hydraulic connectivity, geomorphic change, and biogenic processes. A more detailed predictive model which accounts for these additional components could be developed at later planning stages.

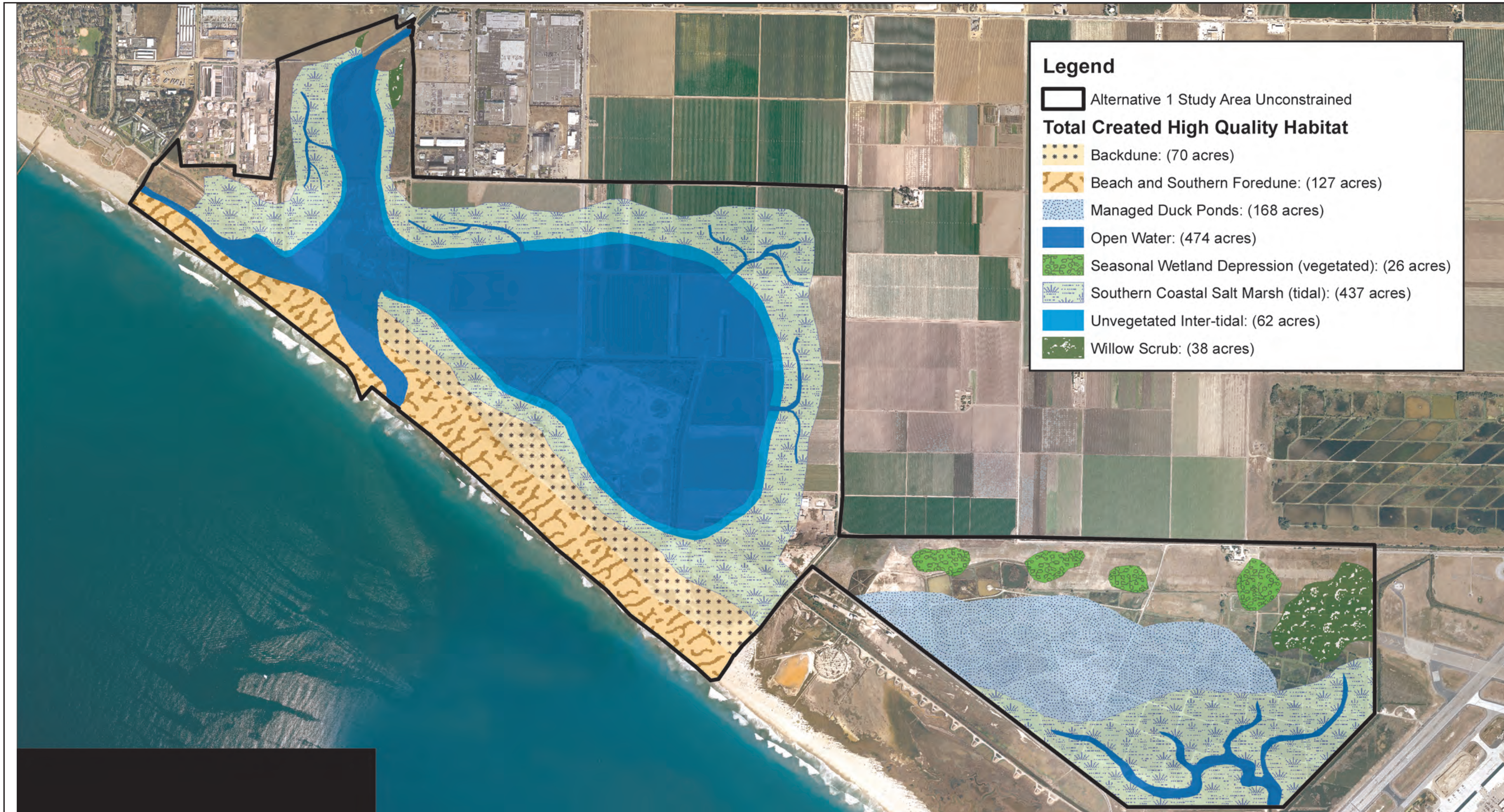
6.1.1.2 Unconstrained (Alternative 1U)

The preliminary habitat map for Alternative 1U is provided in Figure 5-3, and the extent and acreage of high quality habitat created and habitats supporting special status species are provided in Figure 6-1. In comparison to all of the other alternatives, Alternative 1U would maximize the project's:

- Net restored aquatic wetland habitat value (973 acres);
- Benefits to listed species;
- Creation of high quality habitat (1,412 acres); and,
- High quality habitat preserved and created (1,394 acres).

In addition, Alternative 1U would be the best at minimizing the potential for colonization by invasive species since it has 973 acres of habitat types least impacted by invasive plant species (i.e., subtidal and intertidal habitats). Alternative 1U would also have no barriers to wildlife migration or plant dispersal corridors.

Alternative 1U would result in the most habitat for the light-footed clapper rail (499 acres), California least tern (671 acres), Belding's savannah sparrow (604 acres), western snowy plover (259 acres), and brown pelican (474 acres). Alternative 1U would also result in the second greatest habitat acreage for Least Bell's vireo (38 acres).



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Source: Wetland Research Associates, 2009.

Figure 6-1
Extent of High Quality Habitat/Habitats Supporting Special Status Species for Alternative 1U

In terms of support of native species, Alternative 1U would result in the most fish habitat (474 acres), benthic habitat (536 acres), and salt marsh vegetation habitat (447 acres). Alternative IU would also create the second greatest backdune community habitat (70 acres) for the support of native species. In addition, Alternative 1U is one of only two alternatives that would result in managed waterfowl habitat (168 acres).

When the Alternative 1U ground surface is subjected to three feet of sea level rise, the predicted tidal areas change by the percentages shown in Table 6-1. Almost one-third (30 percent) of the total project area would be affected, with a loss of supratidal area. The existing supratidal area would be converted to a combination of subtidal and intertidal areas, with a slightly larger increase in intertidal area (17 percent versus 13 percent). Subtidal and intertidal areas are pre-conditions for open water and coastal wetland habitat, respectively.

Table 6-1. Change in Subtidal, Intertidal, and Supratidal Areas in Response to Three Feet of Sea Level Rise

Alternative	Percent Change in Subtidal Area	Percent Change in Intertidal Area	Percent Change in Supratidal Area
Alternative 1U	13	17	-30
Alternative 1C	17	2	-19
Alternative 2U	20	21	-41
Alternative 2C	27	4	-31
Alternative 3U	9	39	-48
Alternative 3C	0	38	-38
Alternative 4	0	28	-28

The only major weaknesses of Alternative 1U are that it would not minimize edge effects (in comparison to Alternatives 2 and 3), and that it would not provide tidewater goby habitat.

6.1.1.3 Constrained (Alternative 1C)

The preliminary habitat map for Alternative 1C is provided in Figure 5-4, and the extent and acreage of high quality habitat created and habitats supporting special status species are provided in Figure 6-2. Alternative 1C would provide 572 acres of total new aquatic habitat within the project area, including subtidal, intertidal, and non-tidal wetlands, and it would be quite effective at minimizing the potential for colonization by invasive species. Alternative 1C would also result in 357 acres of brown pelican habitat, 357 acres of fish habitat and 392 acres of benthic habitat.

When the Alternative 1C ground surface is subjected to three feet of sea level rise, the predicted tidal areas change by the percentages shown in Table 6-1. About one-fifth (19 percent) of the total project area would be affected, with a loss of supratidal area. The existing supratidal area would be converted primarily to subtidal area (17 percent) with only a small increase in intertidal areas (2 percent). Subtidal and intertidal areas are pre-conditions for open water and coastal wetland habitat, respectively.

The principal weaknesses of Alternative 1C are that it would create only nine habitat types in total, and it would avoid only 28 percent of the project area's existing highest quality habitat. Additionally, it would provide only a 150-feet maximum buffer distance from development, and would not provide Least Bell's vireo habitat, tidewater goby habitat, or seasonal open water community habitat in the support of native species. In comparison to Alternatives 2 and 3, Alternative 1C would create the least amount of beach and foredune community habitat (79 acres).

6.1.2 Hydrologic, Hydraulic and Geomorphic Conditions

6.1.2.1 Methodology

Tidal Elevations and Range. The vertical extent of tidal water level variation in the ocean determines the maximum potential tide range within the adjacent lagoon. Key vertical tidal elevations for the ocean, as observed at Santa Monica, the closest NOAA gage to the project site, are presented in Table 6-2.

Table 6-2. Ocean Vertical Tidal Datum for Santa Monica (NOAA Station ID 9410840)

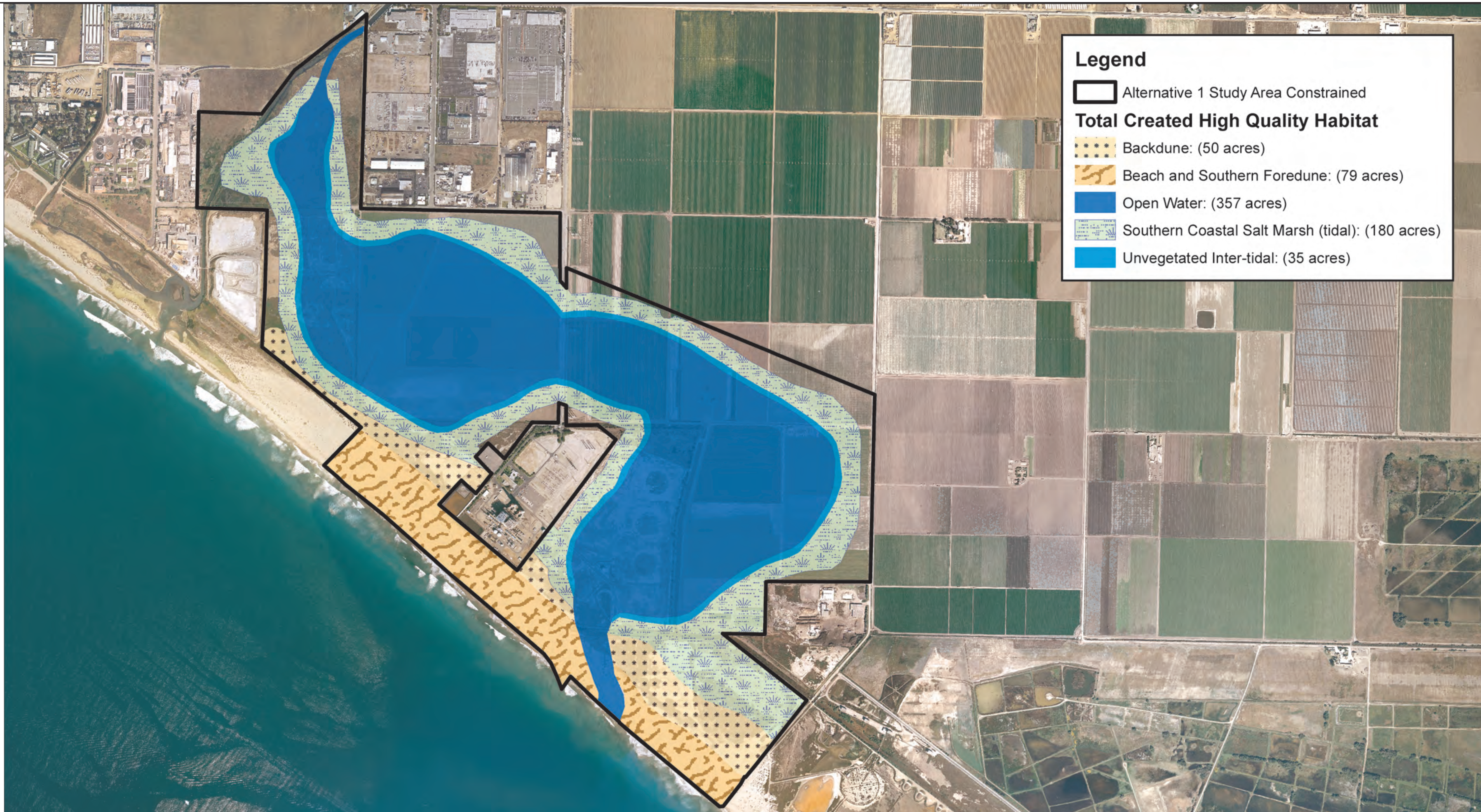
Tidal datum	Elevation (feet MLLW)	Elevation (feet NAVD88)
Highest Observed Water Level (11/30/82)	8.5	8.31
Mean Higher High Water (MHHW)	5.42	5.23
Mean High Water (MHW)	4.69	4.5
Mean Tide Level (MTL)	2.81	2.62
Mean Low Water (MLW)	0.93	0.74
North American Vertical Datum (NAVD88)	0.19	0
Mean Lower Low Water (MLLW)	0	-0.19
Lowest Observed Water Level (12/17/1933)	-2.84	-2.65

However, the inlet's narrow cross-sectional area and corresponding friction losses limit the tidal exchange between the lagoon and the ocean. As a result, the tide range within the lagoon is typically less than the oceanic tide range. To estimate the amount of tidal damping, Keulegan (1967) solves the equations of motion for a simplified channel flow to develop an analytic model of lagoon tide range. This analysis yields a dimensionless parameter *K*, known as the coefficient of repletion, which is defined as:

$$K = \frac{TA_{avg}}{2\pi A_b}\sqrt{\frac{2g}{a_0\left[k_{en} + k_{ex} + \frac{fL}{4R}\right]}}$$

where T equals tidal period, A_{avg} equals average channel cross-sectional area, A_b equals surface area of bay, g equals gravitational acceleration, a_0 equals ocean tide amplitude, k_{en} equals entrance loss coefficient, k_{ex} equals exit loss coefficient, f equals Darcy-Weisbach friction factor, L equals inlet length, and R equals inlet hydraulic radius. The repletion coefficient is then used in the analytic solution of the equations of motion to determine the ratio of the lagoon's diurnal tide amplitude relative to the ocean tide amplitude. The diurnal tide amplitude is the water level difference during the larger of the two unequal tidal cycles occurring each day, calculated as MHHW minus MLLW. Because of its larger size, this tide range best correlates with geomorphic conditions.

Estimates for the value of these parameters were made for the lagoons of Alternatives 1 and 2. An estimate for the inlet's cross-sectional area comes from Jarret's (1976) relationship between inlet channel size and tidal prism. Choosing values of these parameters appropriate for the alternatives (see Appendix B.3), yields the estimates for the coefficient of repletion and the ratio of bay tidal amplitude to ocean tidal amplitude. To reference this tidal range to explicit tidal elevations, it is assumed that the lagoon shares the same value for MHHW as the ocean. This is consistent with observations at many



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Source: Wetland Research Associates, 2009.

Figure 6-2
Extent of High Quality Habitat/Habitats Supporting Special Status Species for Alternative 1C

tidal inlets, including nearby Mugu Lagoon (RMA, 2003). Much of the tide range reduction inside lagoons is caused by reduced tidal exchange near low tides, when the water depths in the inlet are shallow and strongly influenced by friction energy losses. MLLW inside the lagoon is then estimated as MHHW minus the lagoon tidal range predicted by the coefficient of repletion. MTL inside the lagoon is estimated as the midpoint between MHHW and MLLW.

Hypsometry, Tidal Volume and Tidal Prism. A hypsometric curve shows the distribution of graded ground surface elevations as a function of cumulative area. Because of the sensitivity of habitat area to elevation, particularly in relationship to tidal elevations, these types of curves provide useful insight into the alternatives and serve as the basis for preliminary graded volume calculations. For each alternative, a hypsometric curve was generated in several steps. First, the appropriate elevation was assigned to the each alternative's key habitat boundaries by combining the tidal range estimates for each alternative with the habitat elevation assumptions described in Section 6.1.1.1. The habitat boundaries were then converted into a set of contour lines. These contour lines were interpolated to create an approximation of the alternatives' ground surface in three dimensions. The linear interpolation was conducted over the entire project area, using grid cells with a 50-meter (167 feet) spatial resolution. Finally, the interpolated surface was sorted according to the grid cells' elevation and related to the cumulative area to estimate the hypsometry. Examples of the hypsometric curves derived for the unconstrained alternatives are shown in Figure 6-3. Details of the methodology are provided in Appendix B.4.

The elevation versus depth relationship expressed by a hypsometric curve can be integrated to estimate the volume between two specified elevations. When the specified elevations are selected according to the lagoon tidal ranges described above, the resulting volumes can be related to tidal function. For example, integrating between MHHW and the lowest elevation provides an estimate of the diurnal tidal volume, the volume which is filled with tidal flow at least once per day. Similarly, the diurnal tidal prism, the average quantity of water which enters and exits the lagoon during the larger of a day's two tides, can be estimated by integrating between MHHW and MLLW.

Inlet Closure Stability. Alternatives 1 and 2 feature a tidal lagoon that is permanently (Alternative 1) or intermittently (Alternative 2) connected to the ocean through an inlet channel. When open, the inlet channel provides the mechanism for supporting intertidal and subtidal habitats within the lagoon. The inlet also provides connectivity for the transport of energy and nutrients and for organisms to move between the lagoon and coastal waters. During high runoff from the watershed, an open inlet also reduces flood risk by preventing water from backing up in the channels that drain to the lagoon.

The ability of the inlet to remain open largely depends upon the relative balance between alongshore sand transport and tidal currents within the inlet. Waves transport sand alongshore and into the mouth of the inlet, where a portion of the material is deposited during flood tides. Strong ebb tidal currents, which are primarily controlled by the lagoon's tidal prism, scour this material and maintain the inlet's opening. Natural variations in the strength of these two processes can shift the short-term balance of these two processes. For instance, inlet closure is more likely when large waves from energetic coastal storms coincide with weak neap tides. When averaged over multiple years, the wave climate exhibits a relatively consistent seasonal pattern. However, tidal currents change as the lagoon's tidal prism and morphology evolve. For this reason, changes to tidal prism largely control the long-term closure potential. Once closed, a lagoon re-opens when runoff from the watershed raises water levels in the lagoon to the point that flow overtops the beach barrier berm. Occasionally, strong waves associated with winter storms may assist this re-opening by eroding some or all of the beach barrier berm.

This balance between deposition and erosion within the inlet channel forms the basis for two geomorphic models used to assess inlet stability. The first model, developed by Johnson (1973), uses empirical data from existing inlets to derive a threshold for closure as a function of tidal prism versus wave energy. Using Johnson's analysis and measurements of the offshore wave field, it has been estimated that 1,500 acre feet of diurnal tidal prism serves as a minimum threshold for maintaining a permanently open tidal inlet at Ormond Beach (PWA and WRA, 2007). A second method developed by Escoffier (1977) compares an inlet channel's velocity versus its cross-sectional area to estimate equilibrium geomorphic conditions. In particular, the smaller of the two intersection points between an inlet's geomorphic stability curve and its velocity curve provides an estimate of the minimally stable cross-sectional area for stable conditions (e.g., the example point labeled in Figure 6-4 for Alternative 2C). If the expected cross-sectional area, as predicted from the tidal prism (Jarrett, 1976) is closer to the minimally stable cross-sectional area, natural variations such as storms and neap tides are more likely to cause closure. The Channel Equilibrium Area software (Seabergh and Kraus, 1997) was used to conduct the Escoffier analysis for the restoration alternatives. Details of this analysis are included in Appendix B.5.

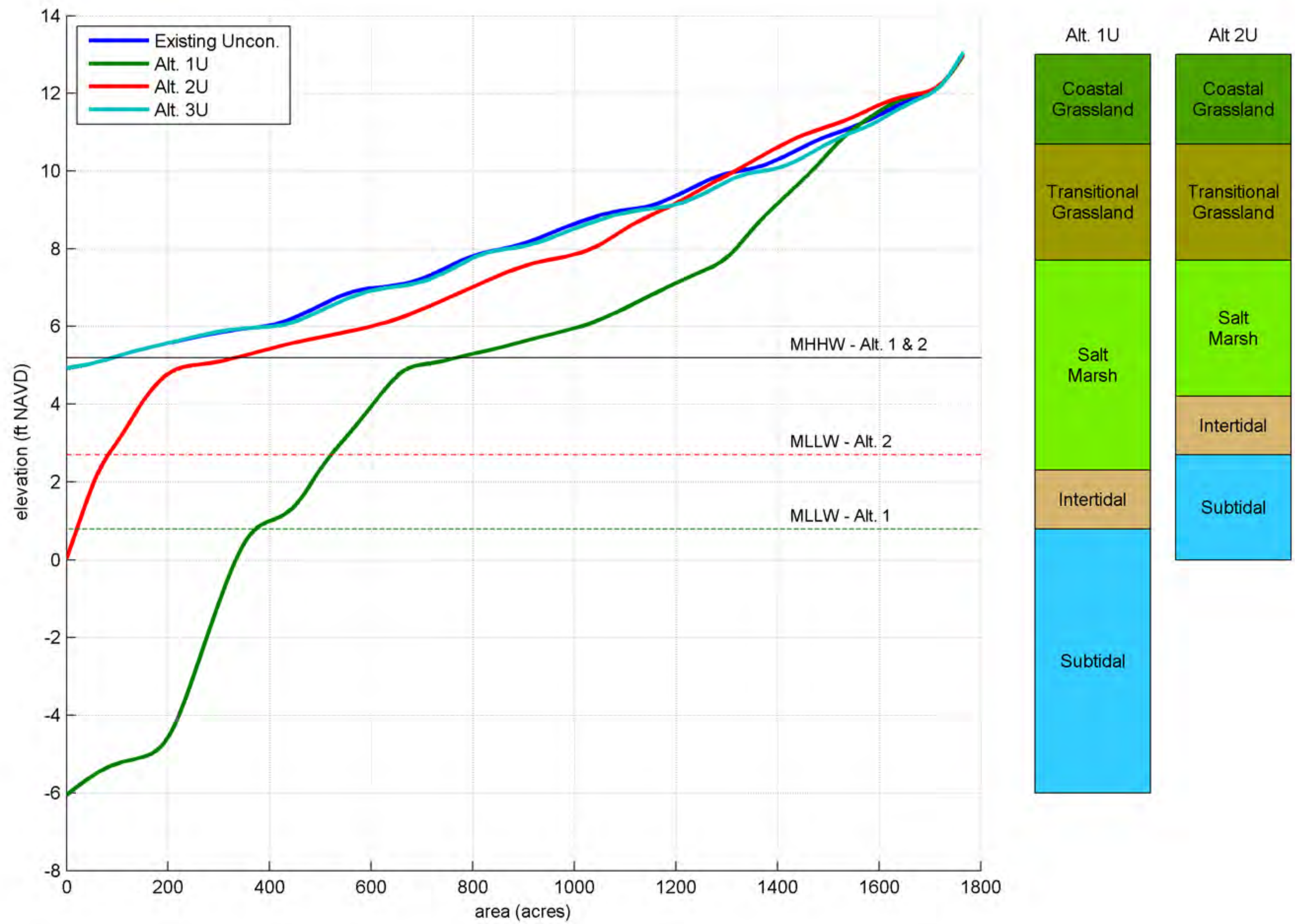
The characteristics of two similar existing inlets, Mugu Lagoon and Bolsa Chica, provided additional context for interpreting the geomorphic models:

- The adjacent Mugu Lagoon presently remains open without management, although in the past dredging was used to maintain the inlet (Warme, 1971). The addition of rip-rap to stabilize the inlet's location may contribute to its present-day ability to avoid closure. Although adjacent to the project site, the wave field and sand transport conditions at Mugu Lagoon are probably altered by the depths of the Hueneme Canyon immediately offshore. This canyon disperses wave energy and captures sand. In combination, the canyon reduces the potential for wave-transported sand to close Mugu Lagoon's inlet.
- Bolsa Chica is a recently constructed tidal lagoon that includes 366 acres of a fully tidal basin and 200 acres of a muted tidal basin to yield approximately 1,600 acre feet of diurnal tidal prism. It is located on a more sheltered coast with less littoral transport than Ormond Beach. Two jetties flank its inlet.

Lateral Inlet Stability. A second form of inlet stability refers to the lateral migration of the inlet channel. Migration typically occurs as the inlet mouth moves in the direction of net alongshore sediment transport, elongating the inlet channel (van Rijn, 1998). Eventually, the channel can no longer sustain sufficient velocity to scour sand from this longer channel, leading to inlet closure (Battalio et al., 2007). Inlet re-opening frequently occurs at the inlet's earlier up-coast location, so the cycle of channel elongation repeats.

Data, much less predictive capability, for lateral inlet stability is sparse (Mehta, 1996). In the absence of general procedures and principles for predicting lateral migration, observed rates of lateral migration at the nearby Mugu Lagoon inlet provide the best indication of potential lateral migration for the project's alternatives. Warme (1971) interprets historic maps and geomorphic evidence to infer a migration range of 4,000 feet. Onuf (1987) confirms this interpretation with observations of 4,300 feet of lateral migration in the late 1970s to the early 1980s.

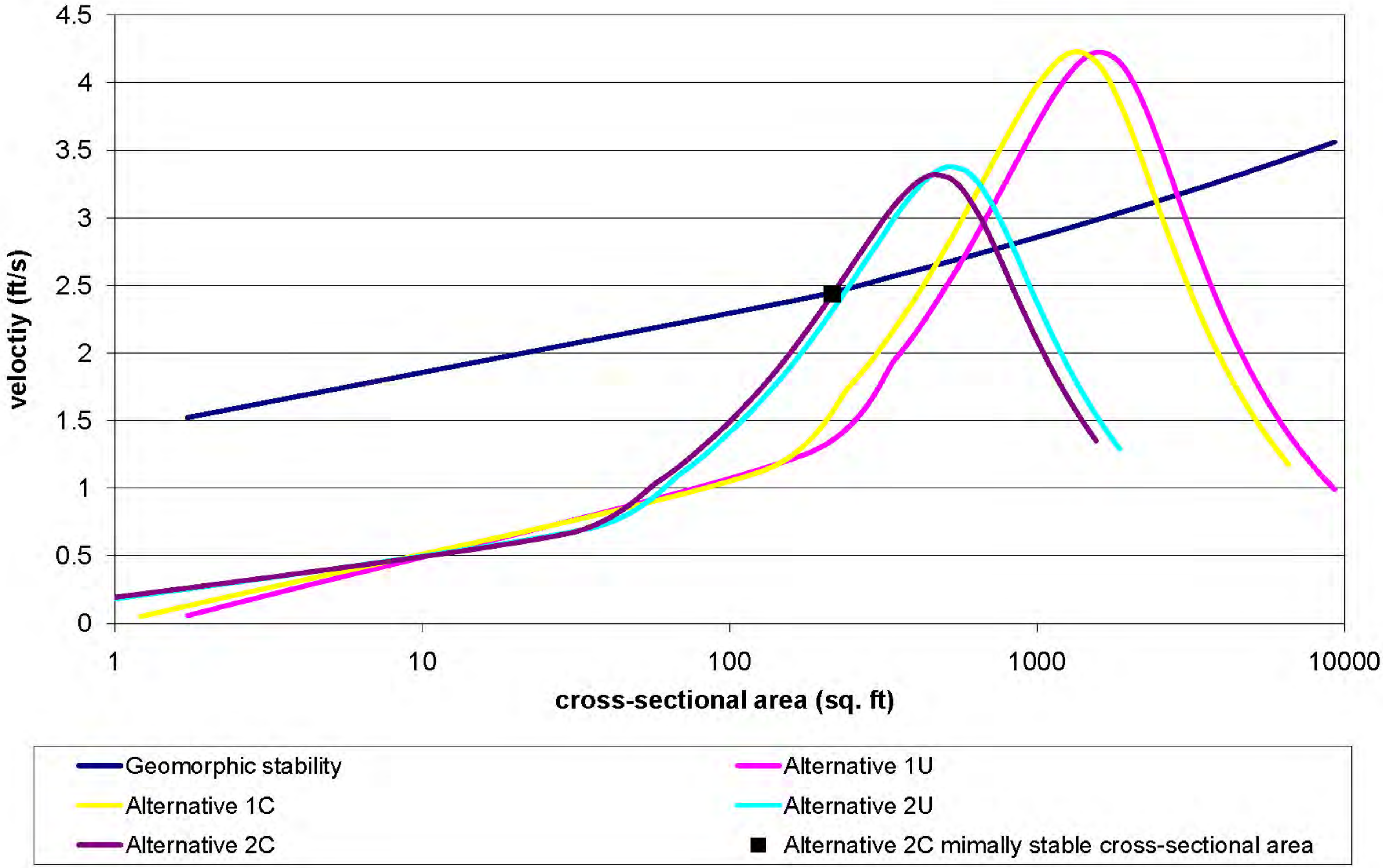
Water Quality. The primary causes of poor water quality are assumed to be either on-site soils or the drains which convey watershed pollutants into the project area. However, the type and magnitude of contamination from these sources is not well defined. In the absence of specific data about contaminant loading, the alternatives can be assessed with respect to the physical processes which would offset contaminant loading. When the inlet is open, poor water quality can be mitigated by mixing with the ocean water, which is assumed to be relatively free from contamination. The rate at which ocean water



Aspen Environmental Group

Source: Philip Williams & Associates, 2009.

Figure 6-3
Hypsometric Curves
Unconstrained Variants to Alternatives



Source: Philip Williams & Associates, Ltd., 2009.

Figure 6-4

Inlet Stability - Escoffier Analysis

would mix with and mitigate poor water quality can be characterized by the hydraulic residence time. This parameter represents the average length of time that water remains within the project site before it is flushed to the ocean. It can be estimated as the ratio of tidal volume over tidal prism. The unit of time associated with the tidal prism is the average length of a tidal cycle, 12.4 hours. Shorter residence times correlate with better water quality since contaminants are more rapidly removed from the project area.

6.1.2.1 Unconstrained (Alternative 1U)

Tidal Elevations and Range. Based on the Keuglegan method described above and detailed in Appendix B, the predicted diurnal tidal range for Alternative 1U is 4.4 feet, 81 percent of the existing tide range of the ocean. This predicted decrease in tide range is consistent with the observed lagoon water levels at similarly-sized, continuously-open lagoons such as Mugu Lagoon and the Tijuana Estuary. In Mugu Lagoon, the tide range decreases by 82 percent as compared to the oceanic tide range (PWA, 2000; RMA, 2003). In the Tijuana Estuary, the tide range also decreases by approximately 80 percent as compared to the oceanic tide range (PWA, 1991). The corresponding values for MTL and MLLW are shown in Table 6-3.

Table 6-3. Estimated Lagoon Tidal Elevations, Alternatives 1 and 2

	Alternative 1		Alternative 2		
(In Feet NAVD)	Unconstrained (Alternative 1U)	Constrained (Alternative 1C)	Unconstrained (Alternative 2U)	Constrained (Alternative 2C)	Ocean
MHHW	5.2	5.2	5.2	5.2	5.2
MTL	3.0	3.3	4.0	4.1	2.6
MLLW	0.8	1.4	2.7	2.9	-0.2

Hypsometry, Tidal Volume and Tidal Prism. The hypsometry of Alternative 1U (Figure 6-3) clearly demonstrates the deep, subtidal lagoon which sets the elevation for over 600 acres of the project area. The remaining portion of the project area with elevations higher than five feet comprises the extensive salt marsh and grassland habitats of this alternative. The tidal volume of this grading surface is estimated as more than 4,000 acre feet (Table 6-4). Because of the relatively large subtidal volume relative to the total tidal volume, the tidal prism is approximately half of the tidal volume.

Table 6-4. Estimated Tidal Volume, Tidal Prism and Resident Rate

Alternative	Tidal Volume (Acre Feet)	Tidal Prism (Acre feet)	Residence Time (Days)
Alternative 1U	4,100	2,200	0.94
Alternative 1C	2,700	1,600	0.86
Alternative 2U	490	470	0.54
Alternative 2C	420	360	0.60
Alternative 3U	14	14	0.51
Alternative 3C	0	0	-
Alternative 4	14	14	0.51

Inlet Closure Stability. Based on the lagoon's tide range and hypsometry, the estimated tidal prism for Alternative 1U is 2,200 acre feet (Table 6-4). This tidal prism is substantially larger than the 1,500 acre feet threshold derived from Johnson (1976), thereby providing a factor of safety to increase the likelihood of an open inlet. The Escoffier analysis (Figure 6-4) also indicates that this alternative would probably maintain an open inlet since its expected cross-sectional area (1,720 square feet) significantly exceeds its minimally stable cross-sectional area (670 square feet).

Lateral Inlet Stability. Under Alternative 1U, the tidal inlet could be located in the northwestern portion of the project site's coastline, as shown in Figure 5-3. The northwesterly placement would provide a larger extent for southeasterly migration of the inlet in response to the predominate direction of alongshore sand transport. For this alternative, the coastline is longer than the 4,000 feet of lateral migration observed at Mugu Lagoon (Warme, 1971; Onuf, 1987). Because of the length of shoreline is longer than potential lateral migration, a jetty may not be necessary to constrain the location of the inlet for this alternative. However, further analysis of the processes affecting inlet geomorphology (ocean wave, littoral sediment transport, and lagoon tidal prism) would be necessary before foregoing the jetty.

Water Quality. The estimated residence time for Alternative 1U is 0.94 days (Table 6-4). Because the inlet for this alternative is expected to always be open, this residence time approximates "worst-case" conditions.

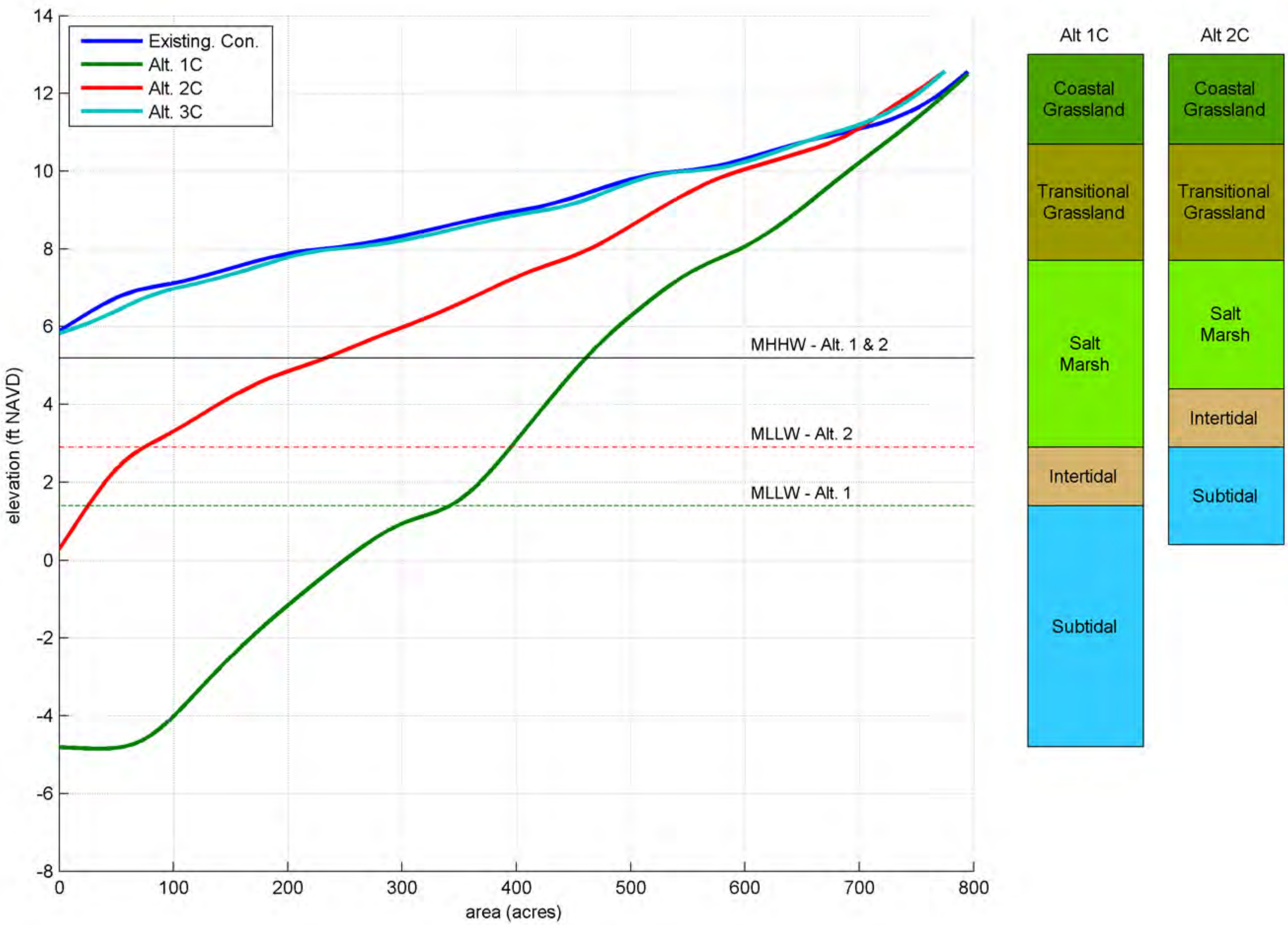
6.1.2.2 Constrained (Alternative 1C)

Tidal Elevations and Range. Based on the Keuglegan method described above and detailed in Appendix B, the predicted diurnal tidal range for Alternative 1C is 3.8 feet, 70 percent of the existing tide range of the ocean. The decrease in the predicted lagoon tide range between the unconstrained and constrained variants of Alternative 1 is consistent with the increasing importance of friction in the inlet channel as the dimensions of the lagoon decrease between Alternative 1U and 1C. In particular, Jarrett (1976) predicts that the cross-sectional area of the inlet channel will decrease by approximately 30 percent from Alternative 1U to Alternative 1C. Frictional losses within this smaller channel extract more energy, resulting in smaller lagoon tide ranges for Alternative 1U. The corresponding values for MTL and MLLW are shown in Table 6-3.

Hypsometry, Tidal Volume and Tidal Prism. The hypsometry of Alternative 1C is displayed in Figure 6-5. The hypsometric curve indicates that more than half of this alternative's ground surface is below MHHW (5.2 feet), which limits the area available for wetlands and grassland. The tidal volume of this grading surface is estimated to be 2,700 acre feet and the tidal prism is estimated to be 1,600 acre feet (Table 6-4).

Inlet Closure Stability. Based on the lagoon's tide range and hypsometry, the estimated tidal prism for Alternative 1C is 1,600 acre feet (Table 6-4). This tidal prism is just larger than the 1,500 acre feet threshold derived from Johnson (1976), suggesting the inlet is expected to remain open. The Escoffier analysis (Figure 6-4) also indicates that this alternative would probably maintain an open inlet since its expected cross-sectional area (1,220 square feet) significantly exceeds its minimally stable cross-sectional area (540 square feet).

Lateral Inlet Stability. The reduced length of coastline within the constrained project area justifies a southeastern location for the inlet for Alternative 1C, downstream from the Reliant Power Plant relative to the alongshore sand transport, as shown in Figure 5-4. This location reduces the risk of lateral inlet migration interfering with the power plant and its offshore outfall, the most significant infrastructure on the coastline. Because of the proximity of the inlet to the Reliant Power Plant, a jetty on the north side of the inlet would be a likely necessity to ensure the inlet does not migrate towards the power plant. A portion the VCNB Point Mugu property would be located 4,000 feet downstream of the north jetty. This distance corresponds to the observed migration distance of the Mugu Lagoon inlet and hence the potential migration distance of the inlet. If the potential for encroachment on the VCNB Point Mugu property is not acceptable, a second jetty on the southern side of the inlet could be required.



Source: Philip Williams & Associates, 2009.

Figure 6-5

**Hypsometric Curves
Constrained Variants to Alternatives**

Water Quality. The estimated residence time for Alternative 1C is 0.86 days (Table 6-4). Because the inlet for this alternative is expected to always be open, this residence time approximates the worst-case conditions.

6.1.3 Land Use and Infrastructure

As described in Section 5 (Project Alternatives), each of the three alternatives addressed in this Feasibility Study includes an unconstrained option and a constrained option. Several key land uses that are located within boundaries of the unconstrained options that would not be affected under the constrained options as depicted in Figures 5-1 and 5-2. These land uses differentiate the unconstrained and constrained alternatives, as described in Table 6-5, below.

Table 6-5. Expected Land Use Conversion(s)

Property	Unconstrained	Constrained
Halaco Site	Following the completion of ongoing remediation activities by the USEPA, this former metal recycling facility (operated between early 1960s and 2004) would be converted to wetland restoration area.	Future long-term use of this site is not known, except that the USEPA will complete current remediation activities.
Reliant Power Plant	Existing power plant infrastructure would be removed and the site would be converted to wetland restoration. An alternative source of energy to the power plant's service area would likely be required.	Current power plant operations would continue.
Agromin Site/Duck Club Annex	This private property would be obtained from Shoreline Organics and current green waste composting activities would be converted to wetland restoration. Similarly, the currently undeveloped Duck Club Annex would be converted to wetland restoration.	Current green waste composting activities would continue (owned/operated by Shoreline Organics). Duck Club Annex property would likely remain undeveloped.
VCGP	If the VCGP agrees to being included in a cooperative habitat restoration project, the area would be transformed into more productive habitat while allowing for improved duck hunting a few months of the year. VCGP activities and facilities, such as the duck blinds, would continue without disturbance. Pedestrian trails would be provided for public use during the non-hunting season.	Present duck hunting activities and management would continue.
Gateway Park/ City of Oxnard Exclusion Property	Agricultural and open space/undeveloped uses would be removed and the properties would be converted to wetland restoration.	Current agricultural and open space uses would continue. Future uses of the property could include development, if proposed.
City of Oxnard Beach-Front Property	Existing wetland habitats would be enhanced and restored.	Current conditions and uses of the property would remain; degraded wetland habitats would not be enhanced or restored.
MWD Exclusion Property	Agricultural uses would be removed and the property would be converted to wetland restoration.	Current agricultural uses would continue. Future uses of the property could include development, if proposed.
Southland Sod Farms North	Agricultural uses would be removed and the property would be converted to wetland restoration.	Current agricultural uses would continue. Future uses of the property could include development, if proposed.

The following provide a discussion of the land uses and infrastructure that would be affected under the unconstrained and constrained versions of Alternative 1 (New Tidal Lagoon).

6.1.3.1 Unconstrained (Alternative 1U)

Alternative 1U would create approximately 1,756 acres of habitat and require approximately 12,108,000 cubic yards of earthwork. Among the alternatives, this alternative would result in the greatest volume of earth movement and subsequently, the greatest potential for construction activities that affect surrounding land uses and the built environment. Under Alternative 1U, all existing infrastructure and land uses located within the project site would be converted to wetland habitat. As described in Section 2.4 (Land Use and Infrastructure), the project area is within the vicinity of several notable types of land uses. Table 6-6 identifies all surrounding land uses that may be affected by implementation of Alternative 1U. At this time, it is not known where existing land uses would be relocated.

As also described in Table 6-6, Alternative 1U would result in the removal and/or relocation of multiple infrastructure features, including both overhead and underground facilities. These removal/relocation efforts would be concentrated mostly in the northwestern portion of the project area, east of Perkins Road and south of Hueneme Road. Removal of other types of infrastructure, including structures, machinery, and other equipment, would also be necessary at several industrial sites within the project area, including the Reliant Power Plant, the Halaco Site, and the Agromin Site.

Table 6-6. Alternative 1U Land Use and Infrastructure Conversion(s)

Sub-Area[1]	Surrounding Use(s)	Existing Use(s)	Infrastructure Potentially Removed / Relocated
25 acre Sub-Area (Gateway Park and City of Oxnard Exclusion Property)	• Business and residential developments to the north and west • Industrial uses to the east • Open Space/ Undeveloped to the south	Agriculture	• Railroad spur adjacent to Oxnard Industrial Drain • Open channel storm drain (Oxnard Industrial Drain) • Sewer line adjacent to Oxnard Industrial Drain and railroad spur.
280-Acre Sub-Area (TNC Property)	• North of McWane Boulevard: the Weyerhaeuser Company is to the west and a railroad spur is to the east • South of McWane Boulevard: Ormond Beach is to the south, Reliant Power Plant is to the southeast, Edison Drive is to the east	Open Space and Agriculture	• Railroad spur between McWane Boulevard and Reliant Power Plant, parallel Edison Drive • Gas Line along northern and eastern borders • Overhead and underground communication lines along McWane Boulevard and parallel to the east side of Perkins Road • Open channel storm drain (Oxnard Industrial Drain) • Water pipeline along Edison Drive and McWane Boulevard • Sewer lines and manholes along McWane Boulevard • Abandoned Historical Sewer between McWane Boulevard and railroad spur to Reliant Power Plant • Electrical distribution lines along McWane Boulevard and transmission lines parallel to Edison Drive
35-Acre Sub-Area (Halaco Site)	• Weyerhaeuser Company is to the north • Ormond Beach is to the south and southeast and west/southwest	Superfund Site (former Halaco); west portion of this Sub-Area is the former Halaco foundry, and east portion of Sub-Area is former Halaco Waste Pile	• Underground communication line in northwest portion of the foundry • Open channel storm drain (Oxnard Industrial Drain) between the foundry and waste pile areas • Underground water pipelines fire hydrants along McWane Boulevard and along Perkins Road • Sewer line and manholes along McWane Boulevard and Perkins Road • Gas pipeline along Perkins Road • Electrical distribution lines along McWane Boulevard and Perkins Road

Sub-Area[1]	Surrounding Use(s)	Existing Use(s)	Infrastructure Potentially Removed / Relocated
			• Overhead and underground communication lines parallel to McWane Boulevard and Perkins Road
90-Acre Sub-Area (City of Oxnard Property)	• Halaco Site, Oxnard Wastewater Treatment Plant and open space (TNC property) to the north • Ocean to the south • Recreation and open space (Hueneme Beach and SCC property) to the west and east	Open Space and Recreation	• Petroleum pipeline parallels the Sub-Area's north property line and coastline • Open channel storm drain (Oxnard Industrial Drain) • Sewer line extending from Perkins Road to Ocean
20-Acre Sub-Area (MWD Exclusion Property)	• Agriculture to the north, west and east • Reliant Power Plant and open space (SCC property) to the south	Agriculture	• Two underground gas pipelines extending north adjacent to Edison Drive from Reliant Power Plant • Transmission lines extending north adjacent to Edison Drive from Reliant Power Plant • Overhead communication line extending north adjacent to Edison Drive from Reliant Power Plant • Open channel storm drain extending north adjacent to Edison Drive • Underground water pipeline extending north adjacent to Edison Drive from Reliant Power Plant
360-Acre Sub-Area (Southland Sod Farms Properties [North and South])	• Agriculture to the west, north and east • McWane Boulevard to the north • Arnold Boulevard to the east • VCGP, ODD # 3, and NBVC Point Mugu to the south • Edison Drive to the west and southwest	Agriculture (Southland Sod Farms)	• Gas pipeline parallel to Edison Drive • Three transmission lines parallel to the east side of Edison Drive • Electrical distribution lines parallel to the west side of Arnold Road and along Casper Road, McWane Boulevard. and between Casper Road and Arnold Road • Overhead communication line along Casper Road, Arnold Road and Edison Drive and parallel to the north side of Casper Road • Open channel storm drain along Edison Drive, parallel to the north side of Casper Road from Edison Drive, and parallel to the west side of Arnold Road
40-Acre Sub-Area (Agromin Property [20 acres] and Duck Club Annex Property [20 acres])	• Cultivated crops and sod farms to the north, west and east • VCGP and NBVC Point Mugu to the south and southeast • Open space and recreation to the south and southwest (SCC property)	Shoreline Organics Agromin recycling facility (green waste composting for municipalities)	• Infrastructure (structures/equipment) associated with green waste composting activities • Overhead electrical distribution lines • Overhead communication line • Open channel storm drain (ODD #3)
260-Acre Sub-Area (SCC Property)	• NBVC Point Mugu Air Station to the southeas • VCGP to the east • Agriculture to the north and west	Open Space, Informal Recreation (coastal access along Arnold Road), and Industrial (Reliant Power Plant and former tank farm area)	• Petroleum pipeline parallel to the coastline, leading into Reliant Power Plant • Three transmission lines leading to/from Reliant Power Plant adjacent to Edison Drive • Electrical distribution line from Casper Road • Overhead communication line into southeast portion of Sub-Area from Casper Road

Sub-Area[1]	Surrounding Use(s)	Existing Use(s)	Infrastructure Potentially Removed / Relocated
Reliant Power Plant (50 acres)	• Agriculture to the north • Open space and recreation to the east, west and south (SCC property)	Industrial (power plant, transmission lines and related facilities).	• Reliant Power Plant and associated underground petroleum and gas pipelines, transmission lines, overhead communication lines, underground water pipelines and outfall.
VCGP (570 acres)	• ODD # 3 to the south and west • Agriculture to the north • Mugu Game • Preserve to the northeast • NBVC Point Mugu to the east and south	Recreational facility (private waterfowl-hunting club)	• Electrical distribution line along Casper Road • Overhead communication line along Casper Road • Open channel storm drain along Casper Road to the north, and the ODD #3 to the south/southwest • Open channel storm drain in southeast portion of the Sub-Area

[1] Please refer to Figure 1-8 for a map of the Sub-Areas outlined in Table 6-6.

Existing roadways that cross through the project site, including those identified above in Table 6-6, would provide access to portions of the project area during construction, and would be removed and/or relocated outside of the project site to provide for full wetland restoration. Roadways to be removed and/or relocated would include portions of McWane Boulevard, Edison Drive, Arnold Road, and Casper Road. Based on construction phasing, it is not known at this time which road(s) would be used for construction access, or which road(s) would be relocated following the completion of construction.

Surrounding land uses noted in Table 6-6 would be affected by construction-related traffic, noise, aesthetics and air quality emissions, particularly as related to the movement of construction vehicles and equipment. Residential and business developments located to the north of Hueneme Road may be affected by noise and congestion resulting from construction-related traffic to and from the project site. Construction activities may occur in phases based on land availability; under this scenario, site-specific construction-related effects would not occur over the entire duration of project construction.

In order to maximize the project's long-term success, development of Alternative 1U would require that the SCC enter into management agreements with various agencies and organizations. For instance, cooperative management of the VCGP area could provide for continued use of this property following implementation of the project. Under Alternative 1U, approximately 474 acres of the project site would be occupied by a contiguous open water lagoon. This area would be useful as wildlife habitat but would not be usable for purposes of public recreation. Additionally, as described above, the VCGP would be converted to managed duck ponds (168 acres), southern coastal salt marsh, willow scrub, coastal prairie, and seasonal wetland depression. Existing physical characteristics of the VCGP area would not be maintained; however, VCGP activities and facilities would continue without disturbance. Pedestrian trails would be provided for public use during the non-hunting season.

6.1.3.2 Constrained (Alternative 1C)

Alternative 1C would avoid the conversion of existing land uses on the properties identified in Table 6-6. Because this alternative would leave these properties in place while implementing wetland restoration across the rest of the project area, it may result in increased flood risks to these properties and thus may require the implementation of additional flood control features.

Alternative 1C would require use of the 20-acre MWD property located adjacent to and west of Edison Drive (Figure 5-2). This 20-acre parcel would enhance the connectivity of the east and west sides of the lagoon, which would encompass approximately 360 acres. This site does not include any infrastructure related to transportation (railroads and roads) or utilities (gas and oil pipelines, power lines, communications, storm drains and open channels, water and sewers). Use of this area would require cooperative management and/or agreements between the SCC and MWD.

As described in Section 5.1.2, Alternative 1C includes the construction of an elevated causeway over the lagoon to maintain vehicle access between the Reliant Power Plant and McWane Boulevard. The elevated causeway would be built to accommodate one roadway, and could be built to accommodate one railway as well, depending on the operational needs of the Reliant Power Plant. The SCC would need to coordinate with the City of Oxnard to determine the causeway's design and operational requirements.

In comparison with Alternative 1U, this alternative includes a smaller area of restored wetland habitat, but would offer greater opportunities for public use and passive recreational activities due to a smaller open water lagoon area (357 acres under Alternative 1C versus 474 acres under Alternative 1U). As noted in Table 6-6, this constrained alternative would not include development of the VCGP; therefore, existing recreational uses and features of the VCGP would not change. Because Alternative 1C does not include the conversion of land uses at the Reliant Power Plant or the Agromin Site, existing infrastructure would remain in place and current operations would continue. At this time, it is not known what the future use of the Halaco Site would be.

6.1.4 Cultural Resources

As noted in Section 5.1 (Create New Tidal Lagoon [Alternative 1]), the two primary Chumash settlements identified within the project area are associated with the Santa Clara River and include the Kanaputeqnon and Kasunalmu. Because there have been numerous changes to the river channel over the last 3,000 years, it is believed that these settlements were occupied for relatively short periods of time; as such, the project area generally contains fewer artifacts and plant and animal remains than are typically found at sites that are occupied for longer periods of time. None-the-less, cultural resource surveys of the project area have concluded that the project area has a very high potential for buried archeological resources. The following analysis discusses the potential effects of Alternatives 1U and 1C in relation to the cultural resource sites identified in Table 2-6; it is noted that prior to project implementation additional cultural resource surveys of the project area would be needed as part of the project's environmental review process.

6.1.4.1 Unconstrained (Alternative 1U)

The primary features of Alternative 1U include a large tidal lagoon fringed by tidal southern coastal salt marsh with transitions to dune habitat towards the ocean and coastal prairie towards land. On the southeastern parcel, the existing managed duck ponds would be enhanced, the salt marsh habitat would be expanded, and coastal prairie uplands would be created. The following effects to currently known cultural resources within the project area (as identified in Table 2-6) could occur as a result of implementation of Alternative 1U:

Site VEN-555 loci A and B. Site VEN-555 is located within the project boundaries for the unconstrained alternatives (Figure 5-1). Restoration activities affecting Site VEN-555 would include southern coastal salt marsh (tidal), backdune with transitions to beach and southern foredune, and the southwest edge of the tidal lagoon. A 1978 survey indicated that scatterings of weathered Pismo clam are present; however, a supplemental survey in 1990 did not find site VEN-555, which suggests that the shell scattering may not have been the result of pre-historic human activity. None-the-less, the project area has a very high potential for buried archeological resources, and restoration activities related to Alternative 1U could unearth and disturb sensitive cultural resources.

Site VN-506. A 1986 survey noted a shell concentration that indicates the potential for buried archeological resources. However, Site VN-506 is located northeast of the boundaries of the unconstrained project area. Therefore, restoration activities related to Alternative 1U would not have the potential to disturb potential cultural resources at this site.

Site VN-635. A 1988 survey identified shell concentrations that indicate the potential for buried archeological resources. However, as with Site VN-506, Site VN-635 is located northeast of the boundaries of the unconstrained project area. Therefore, restoration activities related to Alternative 1U would not have the potential to disturb cultural resources that may be associated with this site.

Site VN-1961. Site VN-1961 is located north of the project site and has been recorded as an isolate find of quartzite flake. Due to its proximity outside of the boundaries of the unconstrained project area, Alternative 1U would not have the potential to disturb potential cultural resources at this site.

Shell Scatter and Sandstone Cobbles. The site of these materials is located within the boundaries of the unconstrained project area (Figure 5-1). Excavation and analysis of this site indicate that the soil with shell on the surface is historic fill and may cover archeological deposits. Restoration activities associated with Alternative 1U would require excavation at this site, and thus would have the potential to unearth and disturb sensitive cultural resources, if present.

Broken Concrete Drainage Pipe. This drainage pipe is located within the boundaries of the unconstrained project area as part of what was the 1898 Oxnard Sugar Beet Company field drain or an early twentieth century upgrade.This type of concrete pipe is no longer being produced and could be considered a historic resource. If restoration activities associated with Alternative 1U were to occur, the pipe should be relocated to a museum or a similar venue.

Pieces of Broken Marine Shell. The site of these materials is located within the boundaries of the unconstrained project area (Figure 5-1). The shell was identified as Pismo clam and was discovered in the Arnold Paelochannel, which is an old and inactive channel of the Santa Clara River. The location of the shell concentration is an area where archaeological resources could be expected to occur. The site of these materials would be intensively excavated for the unconstrained alternatives, and, therefore, implementation of Alternative 1U would have the potential to unearth and disturb sensitive cultural resources, if present.

Barn. The site of this structure is located in the northeast corner of the Southland Sod Farm property. The barn was used as a storage shed and appears to be more than fifty years old. As such, it could be eligible as a historic resource. Restoration activities associated with Alternative 1U would require demolition of this structure, which would be replaced with southern coastal salt marsh (tidal), and transitional and non-transitional coastal grassland. As such, additional evaluation of this structure would be needed for implementation of Alternative 1U.

Light Shell Scatter. The site of these materials is located within the boundaries on the unconstrained alternatives project area, east of Edison Drive. The shell may indicate the presence of an archaeological site. Restoration activities associated with Alternative 1U in the vicinity of this site would include southern coastal salt marsh (tidal), backdune with transitions to beach and southern foredune, and would border the southeast edge of the tidal lagoon. As such, restoration activities associated with Alternative 1U could unearth and disturb sensitive cultural resources, if present.

6.1.4.2 Constrained (Alternative 1C)

The primary features of Alternative 1C are a tidal lagoon fringed by tidal southern coastal salt marsh with transitions to dune habitat towards the ocean and coastal grasslands towards land. The properties noted in Table 6-5 would not be included under Alternative 1C, except for the 20-acre MWD Exclusion property. However, with one exception, the properties noted in Table 6-5 do not contain any recorded cultural resource sites. Therefore, restoration activities and potential disturbances to cultural resources within the boundaries of the constrained alternatives project area (Figure 5-2) would be nearly identical to those of the unconstrained alternatives, including Site VEN-555 loci A and B, the shell scatter and sandstone cobbles site and broken concrete drainage pipe, the pieces of broken marine shell, the barn located on the Southland Sod Farm property, and the light shell scatter site located east of Edison Drive. Please refer to Section 6.1.4.1, above, for a description of these resources.

6.1.5 Soil Management, Construction Quantities and Cost Estimates

6.1.5.1 Background and Methodology

As referenced in Section 1.2 (Study Purpose and Scope), construction quantities and cost estimates for implementation of each of the alternatives have been prepared, with the exception of Alternative 4 (the No Project Alternative). The cost estimates do not include land acquisition costs or maintenance/ management costs for any of the alternatives. The paragraphs below provide a summary of the background and methodology used for these estimates. Appendix C provides the alternative-specific details and assumptions used for these estimates.

Property-Specific Considerations. Under the unconstrained alternatives (Alternatives 1U, 2U and 3U), the project site includes two properties that required special consideration for the purposes of the project's costing analysis: the Halaco Site and the Reliant Power Plant. In the construction cost estimates, it was assumed that the existing material (e.g., contaminated soil) associated with the Halaco Site would be treated and removed by others as part of future remediation activities. Additionally, it was assumed that the Reliant Power Plant would be decommissioned and removed by others. Therefore, the project's construction cost analysis did not include estimates associated with these efforts.

Earthwork. The volumes of material to be removed from the project site for the six alternatives were estimated using the Autodesk Land Development software. The estimates were based on a 2001 topographic survey in AutoCAD format, AutoCAD files that show topographic information for the alternatives, and PDF files showing graphic layouts of the alternatives for both the constrained and unconstrained alternatives. For the purposes of the costing analysis, the project site was grouped into two major areas, as follows and as shown in Figure 6-6:

- The northwestern portion of the project site (Northwest Area), where a lagoon would be developed under Alternatives 1 and 2; and,
- The southeastern portion of the project site (Southeast Area) where the existing managed duck ponds are located.

Soil Management Options. Soil and surface water investigations of the project site were conducted in 2006 (AMEC Earth and Environmental, Inc., 2006). Thirty boreholes were drilled and ten surface water samples were collected throughout the project site. The results of the investigations provided information on the characteristics of the soil materials including classification, grain sizes, ground water elevations, and chemical content. While more detailed information will be needed for subsequent design phases of the project, the 2006 site investigation provided adequate information for determining appropriate disposal options and estimating the volume of material suitable for each alternative.

Several options were considered for the beneficial use and disposal of excavated materials. These beneficial use and disposal options were based on the above-referenced site investigation and sediment management scenarios designed and/or implemented for similar projects within southern California (e.g., Batiquitos Lagoon, Agua Hedionda Lagoon, San Dieguito Lagoon, Bolsa Chica Wetlands, and Buena Vista Lagoon). The options include beneficial use of material as beach fill, onsite upland fill, over-excavated pit disposal, and offsite landfill disposal, as follows:

- **Beach Fill:** Beach-suitable material would be excavated and/or dredged and then placed on the beach in the immediate vicinity of the project site. The boring logs included in the project's soil and surface water investigation report (AMEC Earth and Environmental, Inc., 2006) indicated the presence of silty sand or silty gravelly sand in 18 of the 30 boreholes. Sandy material, where present, was found mostly at or below elevation -1 feet, NAVD88, which is an average of about 10 feet below the existing ground level. Never-the-less, sandy material was found near the existing ground surface in five borehole locations. Based on this information and a study of the locations of these boreholes relative to the proposed grading configurations of the alternatives, it was assumed that 20 percent of the material excavated from the project would be suitable for use as beach fill.
- **Onsite Upland Fill:** A portion of the material excavated from the cut (excavated) areas could be placed in onsite upland areas. This material would be dried if excavated below ground water, compacted, and graded as needed for open space/wildlife habitat land uses.
- **Over-Excavated Pit Disposal:** This option is based on the over-dredged pit disposal used for construction of the Batiquitos Lagoon Enhancement Project in Carlsbad, California. This option would be used under Alternative 1 (Create New Tidal Lagoon) for the Northwest Area, where a lagoon would be formed from deep excavation. Based on the project's soil and surface water investigation report (AMEC Earth and Environmental, Inc., 2006), sand would likely be found at and below the bottom elevation of the lagoon. Therefore, material unsuitable for beach fill excavated above the lagoon bottom would be stockpiled on site. Material would then be overdredged (i.e., dredged deeper than needed to achieve ultimate project design depths) and the deeper beach-suitable sand would be placed on the beach as beach fill. The pit would then be backfilled with the stockpiled material. It was assumed that 25 percent of the total volume of excavated material under Alternative 1 could be disposed of using this option.
- **Offsite Landfill Disposal:** This disposal option is based on disposal of material in an approved landfill. After the above disposal options have been exhausted, the remaining material would be disposed of at a nearby landfill as either daily cover or waste. One possible landfill site would be the Simi Valley Landfill, which is about 35 miles from the project site. The material would be excavated or dredged, dried, and hauled to the landfill on trucks. The costs include excavation, drying, hauling, and landfill tipping fees.
- **Offsite Disposal on Adjoining Property:** Depending on the schedule of the construction, it may be possible to dispose of the excavated materials to nearby properties if the land development of such properties warrants a need for these materials as backfill or grading. This option would mutually benefit the restoration project and the materials receiver. Compared with the Offsite Landfill Disposal option, the cost savings to the restoration project would include the much reduced transportation cost and any landfill tipping fees. The cost of this disposal option was not analyzed, however, because there has not been any development of the adjoining properties identified.

Miscellaneous Infrastructure. A visitor/nature center has been factored into all of the alternatives. For the purposes of the cost analysis, a visitor/nature center building approximately 2,500 to 5,000 square feet in size was used. There would also be visitor parking, viewing platforms, and pedestrian trails. For the constrained variant of Alternative 1 (Alternative 1C), an elevated causeway at Edison Drive to bridge this alternative's lagoon and provide vehicle access to the Reliant Power Plant was also factored into the costing analysis.

Note: Property boundaries depicted in this figure are for planning purpose only.

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Source: Everest International Consultants, Inc., 2009.

Figure 6-6

Areas for Cost Estimating Purposes

Jetties. For some of the alternatives, to stabilize ocean inlets/outlets, a single jetty would likely be needed. For the purposes of this Feasibility Study, detailed jetty design information was not prepared. As such, a nominal cost similar to the jetty constructed as part of the Batiquitos Lagoon Enhancement Project was used to obtain an order of magnitude cost estimate.

Other Costs. The construction cost estimates include a contingency of 25 percent to account for unpredictable costs such as those associated with onsite conditions at the time of project implementation. Several other costs were considered in addition to the construction cost for estimating the total development cost of any of the alternatives (Alternatives 1 through 3). These costs, which include preliminary engineering, environmental review, final engineering design, construction management, and environmental monitoring were estimated as percentages of the construction cost estimates. The percentages used are listed in Table 6-7.

Table 6-7. Estimates of Other Costs as Percentages of Construction Cost

Item	Percentage of Construction Cost (Percent)
Preliminary Engineering	1.0
Environmental Review	1.0
Final Engineering Design	3.5
Construction Management	3.5
Environmental Monitoring	1.0
Total	10.0

6.1.5.2 Unconstrained (Alternative 1U)

The volumes of cut (excavation) and fill are listed in Table 6-8. Alternative 1U would have the largest volume that would need to be exported, with approximately 11 million cubic yards and 0.2 million cubic yards from the Northwest Area and Southeast Area, respectively (see Figure 6-6).

Table 6-8. Cut and Fill Volumes for Alternative 1U

Cut/Fill/Export	Earthwork Volume (Thousand Cubic Yards)	
	Northwest Area	Southeast Area
Cut	11,037	1,071
Fill	0	854
Net Export	11,037	217

The estimated cost to implement Alternative 1U would be approximately $757 million (2009 U.S. dollars). With a project area of 1,756 acres, the estimated cost per acre would be $431,000. Earthwork (excavation, fill, and soil disposal) would comprise about 70 percent of the total cost. Other construction items would include planting, infrastructure construction, demolition, and jetty construction as well as protection and relocation of existing utilities. The estimated implementation cost estimate for Alternative 1U is summarized in Table 6-9, and detailed in Appendix C.

Table 6-9. Alternative 1U Cost Estimate

Items (Percent)	Alternative 1U Costs (In Thousands of 2009 U.S. Dollars)
Construction	$688,310
Preliminary Engineering (1.0)	$6,880
Environmental Review (1.0)	$6,880
Final Engineering Design (3.5)	$24,090
Construction Management (3.5)	$24,090
Environmental Monitoring (1.0)	$6,880
Total	$757,130
Cost Per Acre	$431

6.1.5.3 Constrained (Alternative 1C)

The volumes of cut and fill for Alternative 1C are summarized in Table 6-10. In the Northwest Area, the volume of material that would need to be exported offsite is approximately 7.5 million cubic yards. No earthwork would be carried out in the Southeast Area (Figure 6-6).

Table 6-10. Cut and Fill Volumes for Alternative 1C

Cut/Fill/Export	Earthwork Volume (In Thousand Cubic Yards)	
	Northwest Area	Southeast Area
Cut	7,536	0
Fill	0	0
Net Export	7,536	0

The estimated cost to implement Alternative 1C would be approximately $519 million (2009 U.S. dollars). With a project area of 794 acres, the estimated cost per acre would be $654,000. Earthwork (excavation, fill, and soil disposal) would comprise about 70 percent of this total. Other construction items would include planting, infrastructure construction, demolition, and jetty construction as well as protection and relocation of existing utilities. The implementation cost estimate for Alternative 1C is summarized in Table 6-11; a detailed cost estimate is provided in Appendix C.

Table 6-11. Alternative 1C Cost Estimate

Items (Percent)	Alternative 1C Costs (In Thousands of U.S. Dollars)
Construction	$472,120
Preliminary Engineering (1.0)	$4,720
Environmental Review (1.0)	$4,720
Final Engineering Design (3.5)	$16,520
Construction Management (3.5)	$16,420
Environmental Monitoring (1.0)	$4,720
Total	$519,320
Cost Per Acre	$654

6.2 RESTORE SEASONALLY OPEN WETLAND HABITATS AND PONDS (ALTERNATIVE 2)

6.2.1 Habitat Distributions and Biological Resources

6.2.1.1 Unconstrained (Alternative 2U)

The preliminary habitat map for Alternative 2U is provided in Figure 5-6, and the extent and acreage of high quality habitat created and habitats supporting special status species are provided in Figure 6-7. The major strengths of Alternative 2U are that it would maximize benefits to wildlife species by creating 16 habitat types, and also maximize biodiversity by creating 35 habitat type transitions. Alternative 2U would additionally result in:

- Very high benefits to listed species;
- The creation of 1,209 acres of high quality habitat; and,
- Total preservation and creation of 1,190 acres of high quality habitat.

Alternative 2U would not have any barriers to wildlife migration or plant dispersal corridors and would have a maximum buffer distance of 1,300 feet from development. This alternative would result in the creation of 119 acres of tidewater goby habitat, and 43 acres of Least Bell's vireo habitat, 220 acres of western snowy plover habitat and 339 acres of Belding's savannah sparrow habitat.

Alternative 2U is one of only two of the alternatives that would create managed waterfowl habitat, and it would create the same amount of salt marsh vegetation habitat (436 acres) as Alternative 1U. Additionally, in comparison to Alternatives 1 and 3, Alternative 2U would have the greatest acreage of salt panne/seasonal hypersaline community habitat (93 acres) and seasonal open water community habitat (261 acres).

When the Alternative 2U ground surface is subjected to three feet of sea level rise, the predicted tidal areas change by the percentages shown in Table 6-1. About four-tenths (41 percent) of the total project area would be affected, with a loss of supratidal area. The existing supratidal area would be converted to a combination of subtidal and intertidal areas, with a slightly larger increase in intertidal area (21 percent versus 20 percent). Subtidal and intertidal areas are pre-conditions for open water and coastal wetland habitat, respectively. In addition, the increase in sea level would also elevate the groundwater in the semi-perched surface aquifer, leading to more extensive and frequent inundation of the seasonal pond and wetlands.

There are no major weaknesses associated with Alternative 2U.

6.2.1.2 Constrained (Alternative 2C)

The preliminary habitat map for Alternative 2C is provided in Figure 5-7, and the extent and acreage of high quality habitat created and habitats supporting special status species are provided in Figure 6-8. Alternative 2C would create 15 habitat types and 29 habitat type transitions. In addition, Alternative 2C is one of only three of all the alternatives that would provide salt panne/seasonal hypersaline community habitat (90 acres) for the support of native species.

When the Alternative 2C ground surface is subjected to three feet of sea level rise, the predicted tidal areas change by the percentages shown in Table 6-1. About one-third (31 percent) of the total project area would be affected, with a loss of supratidal area. The existing supratidal area would be converted primarily to subtidal area (27 percent) with only a small increase in intertidal areas (4 percent). Subtidal and intertidal areas are pre-conditions for open water and coastal wetland habitat, respectively. In addition, the increase in sea level would also elevate the groundwater in the semi-perched surface aquifer, leading to more extensive and frequent inundation of the seasonal pond and wetlands.

Alternative 2C is less desirable than Alternative 2U since Alternative 2C has barriers to wildlife migration and plant dispersal corridors. In terms of major weaknesses, in comparison to the other alternatives it generally falls mid-range between the overall habitat benefits and disadvantages.

6.2.2 Hydrologic, Hydraulic and Geomorphic Conditions

6.2.2.1 Unconstrained (Alternative 2U)

Tidal Elevations and Range. When the intermittent tidal lagoon on the northwest half of the project area is open, the Keuglegan method (please refer Section 6.1.2 and Appendix B.3) predicts that the diurnal tidal range for Alternative 2U is 2.5 feet, 46 percent of the existing tide range of the ocean. This reduction is consistent with observed tide ranges at other intermittent inlets (e.g., the Russian River [Behrens, 2008]). The corresponding values for MTL and MLLW are shown in Table 6-3. This reduced tidal range contributes to the intermittent closures expected for this alternative's lagoon since flow through the inlet is not always sufficient to counter sand deposition by littoral transport (see section below on inlet closure stability). This estimate of the tidal range represents a typical value; as the inlet narrows towards closure, the tidal range will concurrently decrease towards zero.

Hypsometry, Tidal Volume and Tidal Prism. The hypsometry of Alternative 2U is displayed in Figure 6-3. Only about 300 acres of this alternative lies below the elevation of MHHW (5.2 feet); the large remaining expanse provides ample space for wetlands and grassland. The tidal volume of this grading surface is estimated to be 490 acre feet. Because of its shallow nature, the estimated tidal prism is only slightly less, 470 acre feet (Table 6-4). When the inlet closes (see below), the tidal prism would go to zero.

Inlet Closure Stability. Based on the lagoon's tide range and hypsometry, the estimated tidal prism for Alternative 2U is 470 acre feet (Table 6-4). This tidal prism is considerably smaller than the 1,500 acre feet threshold derived from Johnson (1976), confirming the expectation of an intermittently closed inlet. The Escoffier analysis (Figure 6-4) also indicates that this alternative is marginally stable since its expected cross-sectional area (340 square feet) approaches its minimally stable cross-sectional area (240 square feet).

Lateral Inlet Stability. Alternative 2U consists of both an intermittently open lagoon with a smaller tidal prism and a large extent of coastline within the project area. Together, these factors imply moderate lateral migration and minimal undesired impact. Therefore, this alternative's inlet is not likely to require a jetty.

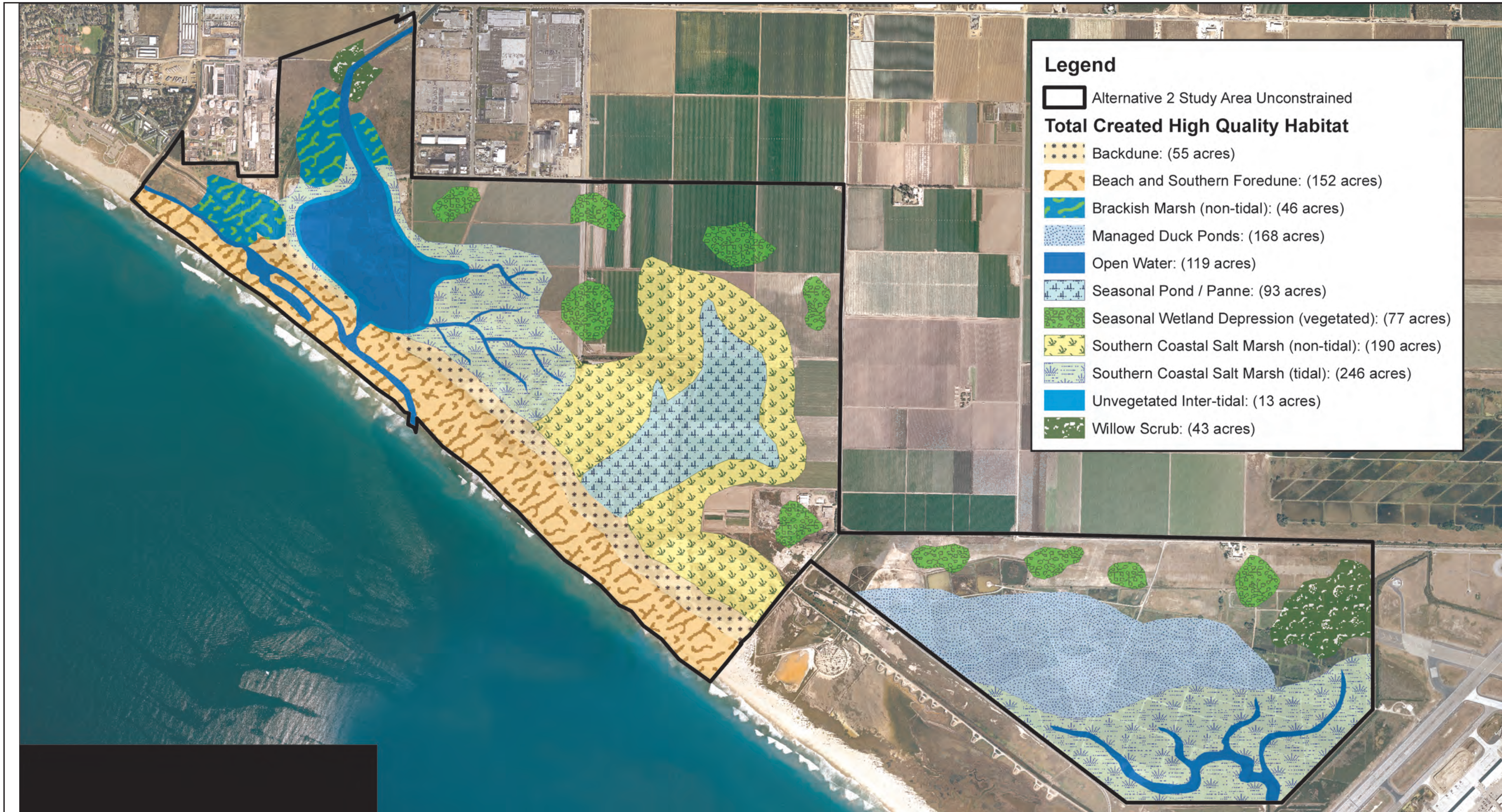
Water Quality. The estimated residence time for Alternative 2U is 0.54 days (Table 6-4). This residence time approximation may not capture the worst-case conditions, which would be likely to occur during a closure event.

6.2.2.2 Constrained (Alternative 2C)

Tidal Elevations and Range. Based on the Keuglegan method described in Section 6.1.2 and detailed in Appendix B.3, the predicted diurnal tidal range for Alternative 2C is 2.3 feet, 42 percent of the existing tide range of the ocean. The corresponding values for MTL and MLLW are shown in Table 6-3. As discussed above, this reduced range is consistent with the intermittent nature of this alternative's lagoon. The tide range is slightly smaller than that of Alternative 2U because of the slight reduction in the lagoon's areal extent due to the constrained project area.

Hypsometry, Tidal Volume and Tidal Prism. The hypsometry of Alternative 2C is displayed in Figure 6-5. Approximately one-quarter of ground surface lies below the elevation of MHHW (5.2 feet); the remaining portion provides space for wetlands and grassland. The tidal volume of this grading surface is estimated to be 420 acre feet. Because of its shallow nature, the estimated tidal prism is only slightly less, 360 acre feet (Table 6-4). When the inlet closes (see below), the tidal prism would go to zero.

Inlet Closure Stability. Based on the lagoon's tide range and hypsometry, the estimated tidal prism for Alternative 2C is 360 acre feet (Table 6-4). This tidal prism is considerably smaller than the 1,500 acre feet threshold derived from Johnson (1976), confirming the expectation of an intermittently closed inlet. The Escoffier analysis (Figure 6-4) also indicates that this alternative is marginally stable since its expected cross-sectional area (290 square feet) only just exceeds its minimally stable cross-sectional area (210 square feet).



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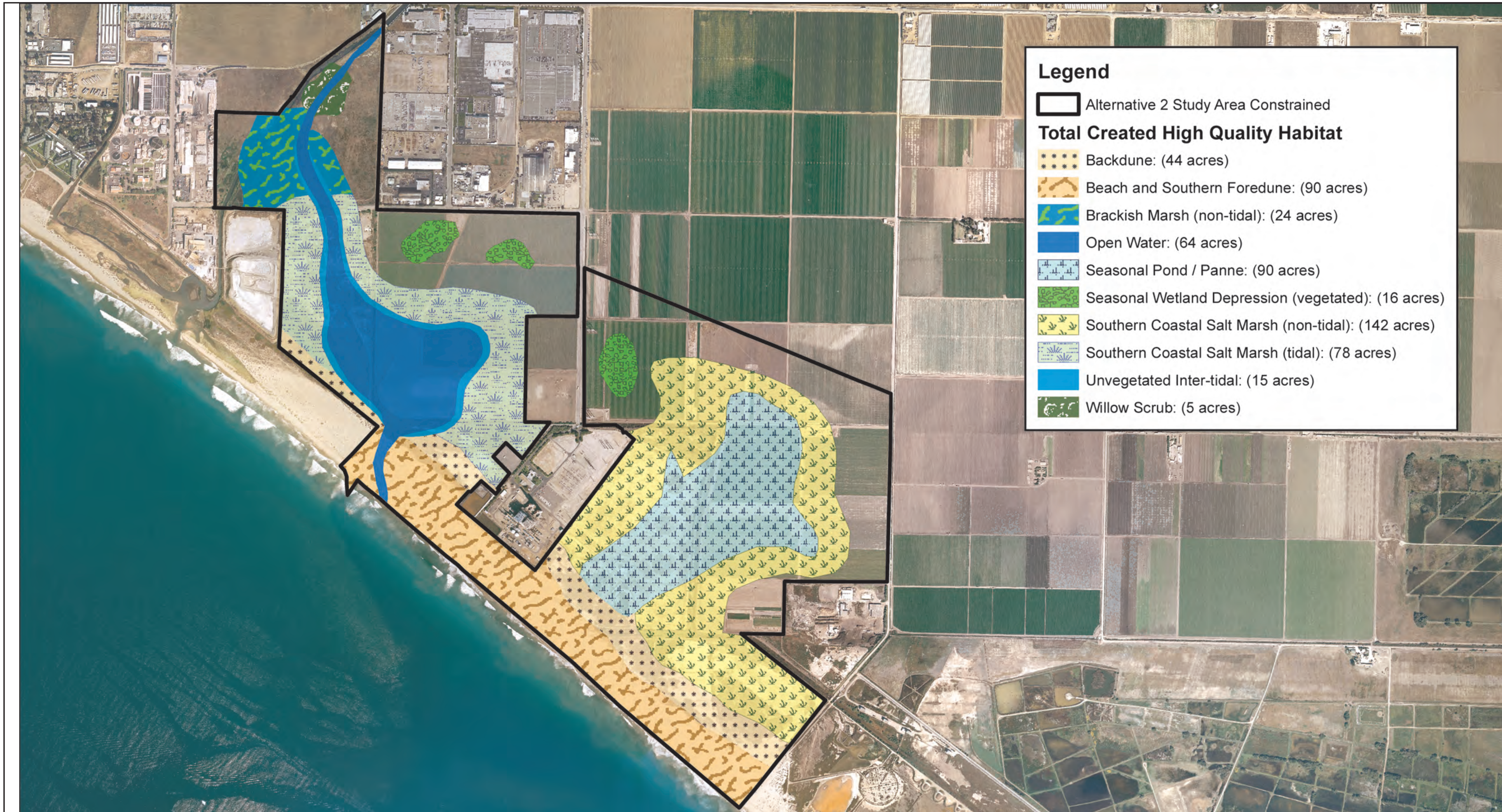
Source: Wetland Research Associates, 2009.

0 1,875 3,750
Scale in Feet

N

Figure 6-7
Extent of High Quality Habitat/Habitats Supporting Special Status Species for Alternative 2U



Source: Wetland Research Associates, 2009.

Figure 6-8
Extent of High Quality Habitat/Habitats Supporting Special Status Species for Alternative 2C

Lateral Inlet Stability. Under Alternative 2C the intermittent lagoon's inlet would be located up-coast of the Reliant Power Plant. Within this stretch of coastline, inlet migration must be managed to avoid encroachment onto non-project areas (e.g., the City of Ormond Beach property to the northwest and the Reliant Power Plant and its ocean outfall to the southeast). If further investigation finds that a single jetty cannot adequately manage the risk of the lateral migration impacting the power plant, a second jetty to the southeast of the inlet may be required in addition to the single jetty already shown in Figure 5-7.

Water Quality. The estimated residence time for Alternative 2C is 0.60 days (Table 6-4). This residence time approximation may not capture the worst-case conditions, which are likely to occur during a closure event.

6.2.3 Land Use and Infrastructure

6.2.3.1 Unconstrained (Alternative 2U)

All land use conversions and infrastructure removal/relocation that would occur under Alternative 1U (see Section 6.1.3.1 and Tables 6-5 and 6-6), would also occur under Alternative 2U. As such, the properties listed in Table 6-5 would all be converted to wetland habitat.

In comparison with Alternative 1, Alternative 2 would convert a smaller area of land to lagoon (open water), and would instead develop a greater area of coastal grassland (221 acres for Alternative 2U versus 171 acres for Alternative 1U), and coastal grassland / transitional (308 acres for Alternative 2U, versus 162 acres for Alternative 1U). This greater area of restored coastal grassland and coastal grassland/transitional habitat would increase passive recreational opportunities.

Cooperative management of the VCGP, located in the southeast portion of the project site, would be exactly the same under Alternative 2U as under Alternative 1U (see Section 6.1.3.1).

6.2.3.2 Constrained (Alternative 2C)

Alternative 2C would not include restoration of the properties listed in Table 6-5. Edison Drive, providing access between the Reliant Power Plant and McWane Boulevard and Hueneme Road, would stay in place to allow for continued operation of the power plant following implementation of this alternative.

Under Alternative 2C construction-related disturbances such as noise, traffic, and air quality effects would be the same as under Alternative 1C. Existing uses and features of the VCGP, City of Oxnard beachfront and exclusion properties, Gateway Park property, MWD Exclusion property, the Duck Club Annex and the northern Southland Sod Farm property would be maintained. Because Alternative 2C would not include the conversion of land uses associated with the Reliant Power Plant property or the Agromin property, existing infrastructure would remain in place and current operations would continue. Due to the USEPA's on-going investigation, it is currently unknown what the future use of the Halaco Site will be.

6.2.4 Cultural Resources

6.2.4.1 Unconstrained (Alternative 2U)

Restoration activities and potential effects to recorded cultural resources (as identified in Table 2-6) associated with Alternative 2U would be nearly identical to Alternative 1U, as addressed in Section 6.1.4.1.

6.2.4.2 Constrained (Alternative 2C)

Although the volume of excavation required for Alternative 2C would be less than that required for Alternative 1C, earth-disturbing activities associated with Alternative 2C would still have the same potential to affect the same cultural resources as under Alternative 1C. Please refer to Section 6.1.4.2 for a summary of these resources.

6.2.5 Soil Management, Construction Quantities and Cost Estimates

6.2.5.1 Unconstrained (Alternative 2U)

The volumes of cut and fill for Alternative 2U are summarized in Table 6-12. The volumes of material that would need to be exported offsite are approximately 3.1 million cubic yards in the Northwest Area and roughly 0.2 million in the Southeast Area (please refer to Figure 6-6).

Table 6-12. Cut and Fill Volumes for Alternative 2U

Cut/Fill/Export	Earthwork Volume (Thousand Cubic Yards)	
	Northwest Area	Southeast Area
Cut	3,290	1,071
Fill	162	854
Net Export	3,128	217

The estimated cost to implement Alternative 2U would be an estimated $293 million (2009 U.S. dollars). With a project area of 1,756 acres, the estimated cost per acre would be $167,000. Earthwork (excavation, fill and soil disposal) would comprise about 65 percent of this total. Other construction items would include planting, infrastructure construction, and demolition as well as protection and relocation of existing utilities. The implementation cost estimate for Alternative 2U is summarized in Table 6-13 and a detailed cost estimate for it is provided in Appendix C.

Table 6-13. Alternative 2U Cost Estimate

Items (Percent)	Alternative 2U Costs (In Thousands of 2009 U.S. Dollars)
Construction	$265,970
Preliminary Engineering (1.0)	$2,660
Environmental Review (1.0)	$2,660
Final Engineering Design (3.5)	$9,310
Construction Management (3.5)	$9,310
Environmental Monitoring (1.0)	$2,660
Total	$292,570
Cost Per Acre	$167

6.2.5.2 Constrained (Alternative 2C)

The volumes of cut and fill for Alternative 2C are summarized in Table 6-14. In the Northwest Area the volume of material to be exported off-site would be an estimated 2.8 million cubic yards. No earthwork work would be needed in the Southeast Area.

Table 6-14. Cut and Fill Volumes for Alternative 2C

Cut/Fill/Export	Earthwork Volume (Thousand Cubic Yards)	
	Northwest Area	Southeast Area
Cut	2,938	0
Fill	180	0
Net Export	2,758	0

The estimated cost to implement Alternative 2C would be an estimated $226 million (2009 U.S. dollars). With a project area of 772 acres, the estimated cost per acre would be $292,000. Earthwork (excavation, fill and soil disposal) would comprise about 65 percent of this total. Other construction items include planting, infrastructure construction, and demolition as well as protection and relocation of existing utilities. A jetty would be built under this alternative. The implementation cost estimate for Alternative 2C is summarized in Table 6-15 and a detailed cost estimate is provided in Appendix A.

Table 6-15. Alternative 2C Cost Estimate

Items (Percent)	Alternative 2C Costs (In Thousands of 2009 U.S. Dollars)
Construction	$205,110
Preliminary Engineering (1.0)	$2,050
Environmental Review (1.0)	$2,050
Final Engineering Design (3.5)	$7,180
Construction Management (3.5)	$7,180
Environmental Monitoring (1.0)	$2,050
Total	$225,620
Cost Per Acre	$292

6.3 ENHANCE EXISTING NON-TIDAL WETLAND HABITATS (ALTERNATIVE 3)

6.3.1 Habitat Distributions and Biological Resources

6.3.1.1 Unconstrained (Alternative 3U)

The preliminary habitat map for Alternative 3U is provided in Figure 5-8, and the extent and acreage of high quality habitat created and habitats supporting special status species are provided in Figure 6-9. Alternative 3U would result in a maximum buffer distance of 4,000 feet from development. In comparison to Alternatives 1 and 2, Alternative 3U would create the greatest salt marsh bird's-beak habitat (637 acres), transitional marsh vegetation community habitat (615 acres), and backdune community habitat (85 acres). Additionally, Alternative 3U is the only alternative that would provide salt grass community habitat for the support of native species (150 acres).

When the Alternative 3U ground surface is subjected to three feet of sea level rise, the predicted tidal areas change by the percentages shown in Table 6-1. Almost one-half (48 percent) of the total project area would be affected, with a loss of supratidal area. The existing supratidal area would be converted mostly to intertidal area (39 percent) with a smaller increase in intertidal areas (9 percent). Subtidal and intertidal areas are pre-conditions for open water and coastal wetland habitat, respectively. In addition, the increase in sea level would also elevate the groundwater in the semi-perched surface aquifer, leading to more extensive and frequent inundation of seasonal wetlands.

The one major weakness of Alternative 3U is that it would not provide seasonal open water community habitat in the support of native species.

6.3.1.2 Constrained (Alternative 3C)

The preliminary habitat map for Alternative 3C is provided in Figure 5-9, and the extent and acreage of high quality habitat created and habitats supporting special status species are provided in Figure 6-10. Alternative 3C would result in a maximum buffer distance of 2,800 feet from development. It would also create 284 acres of salt marsh bird's-beak habitat and 269 acres of transitional marsh vegetation habitat. Alternative 3C would create 157 acres of western snowy plover habitat, 162 acres of California least tern habitat, and five acres of brown pelican habitat. It would not provide light-footed clapper rail habitat, Belding's savannah sparrow habitat, or tidewater goby habitat.

In comparison to Alternatives 1 and 2, Alternative 3C would provide the least amount of fish habitat and benthic habitat for the support of native species (5 acres of each), and is one of three alternatives that would provide no seasonal open water community habitat in the support of native species.

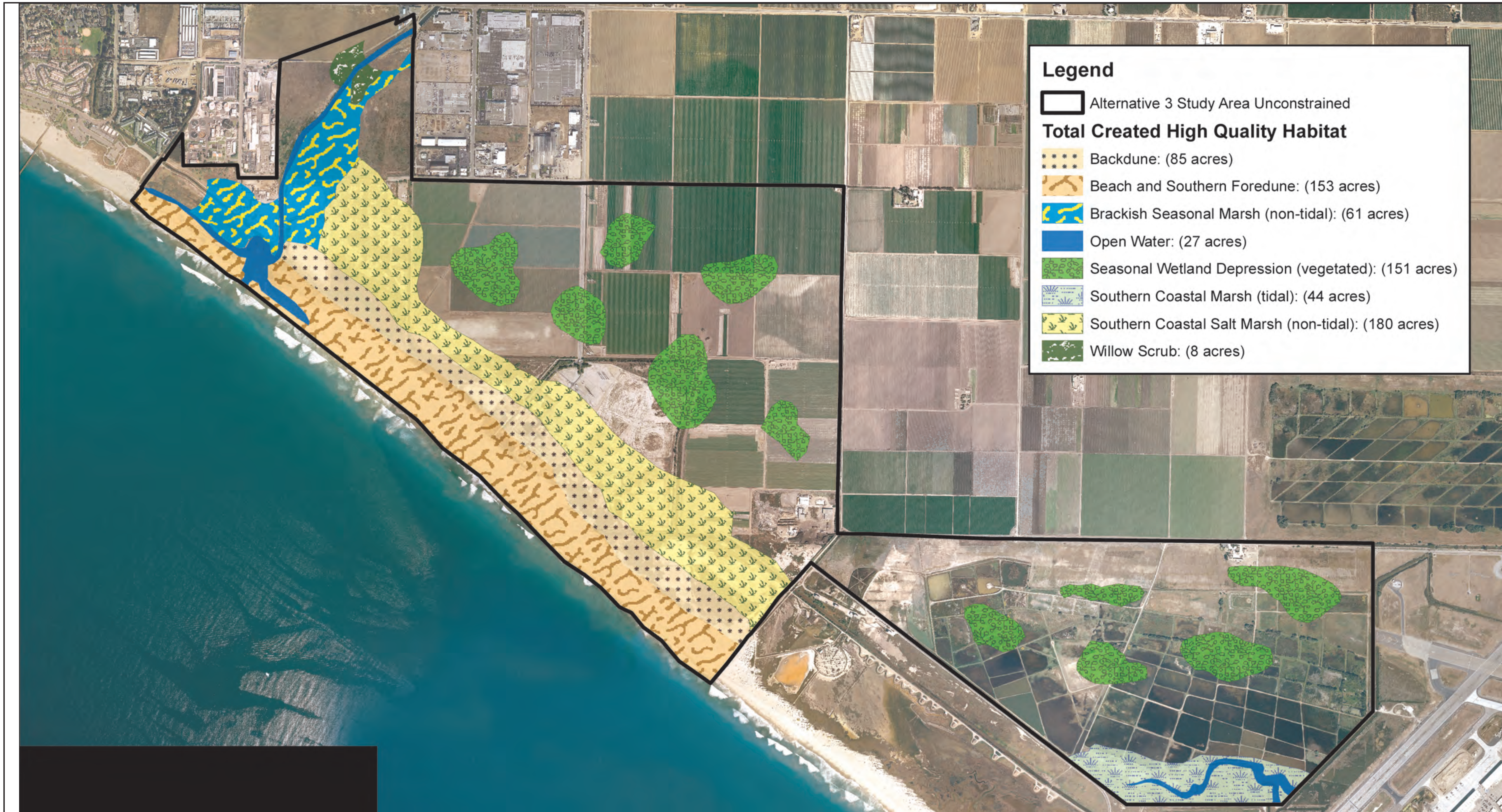
When the Alternative 3C ground surface is subjected to three feet of sea level rise, the predicted tidal areas change by the percentages shown in Table 6-1. About four-tenths (38 percent) of the existing supratidal area would be converted mostly to intertidal area. Subtidal and intertidal areas are pre-conditions for open water and coastal wetland habitat, respectively. In addition, the increase in sea level would also elevate the groundwater in the semi-perched surface aquifer, leading to more extensive and frequent inundation of seasonal wetlands.

The major weaknesses of Alternative 3C are that it would only provide 183 acres of net restored aquatic habitat value and thus would neither maximize benefits to listed species, nor minimize the potential for colonization by invasive species. Additionally, Alternative 3C would only result in 13 habitat type transitions and thus would not maximize biodiversity.

6.3.2 Hydrologic, Hydraulic and Geomorphic Conditions

Because the proposed changes to existing hydrology, hydraulics and geomorphology are limited for Alternative 3, the difference between the unconstrained and constrained alternatives is minimal. As such, the two variants are described simultaneously, with slight differences noted.

Tidal Elevations and Range. Because Alternative 3 (constrained and unconstrained) would not significantly alter the tidal connections of existing conditions, the tidal range remains identical to existing conditions. The bed elevation of the existing J Street Lagoon (see Figure 1-2) lies almost entirely above the ocean tide range (Tetra Tech, 2005) Therefore, even during the intermittent periods when this lagoon is connected to the ocean, the change in water surface elevation due to the tides would be minimal.



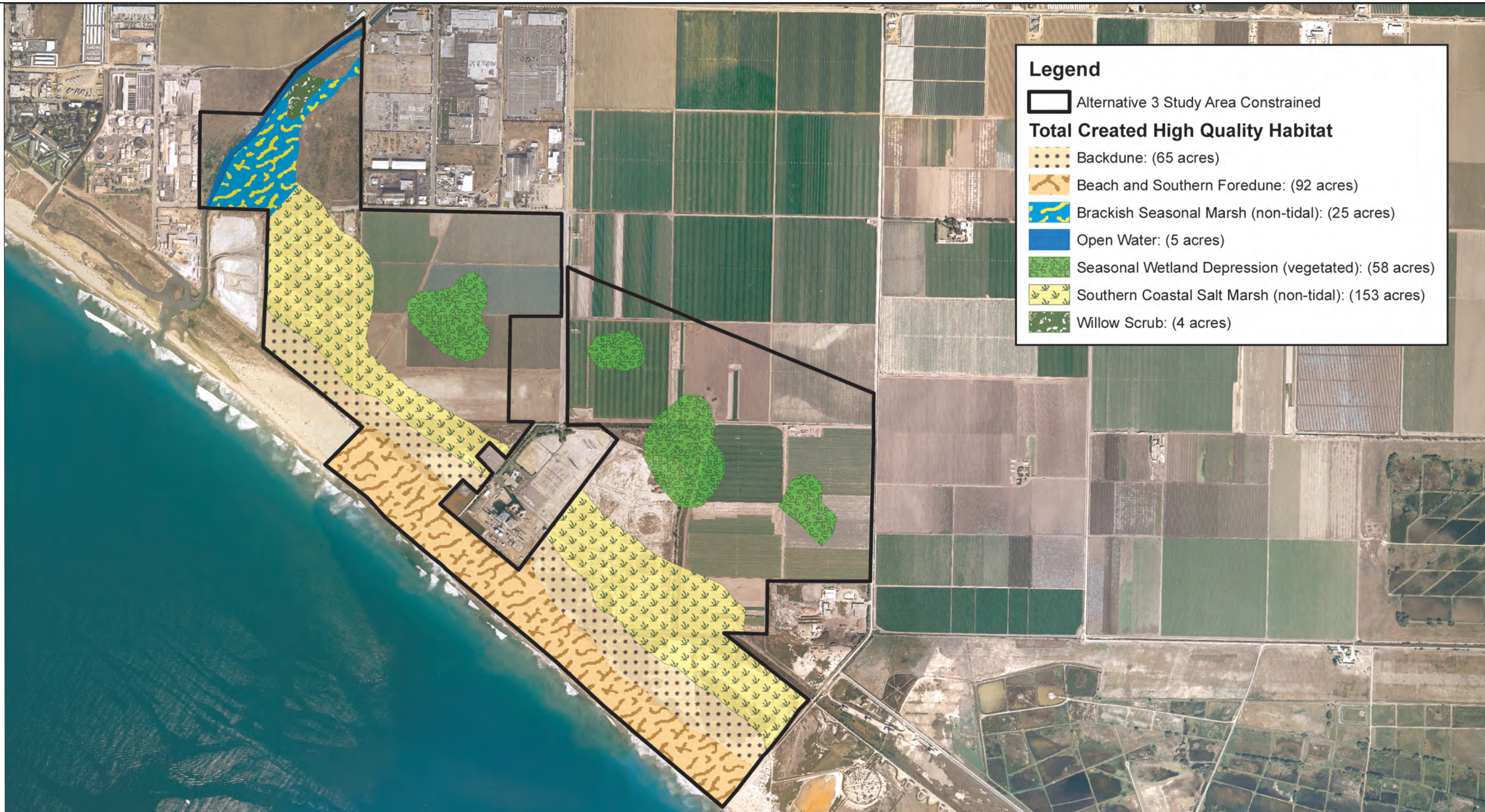
Aspen Environmental Group

Source: Wetland Research Associates, 2009.

0 1,875 3,750
Scale in Feet

N

Figure 6-9
Extent of High Quality Habitat/Habitats Supporting Special Status Species for Alternative 3U



Aspen Environmental Group

Source: Wetland Research Associates, 2009.

Figure 6-10
Extent of High Quality Habitat/Habitats Supporting Special Status Species for Alternative 3C

Hypsometry, Tidal Volume and Tidal Prism. The hypsometry of Alternative 3 is nearly identical to existing conditions, with almost the entire ground surface situated above MHHW (Figures 6-3 and 6-5). Only the unconstrained alternative includes a small amount of tidal volume, 14 acre feet (Table 6-4), which would be created by the existing salt marsh in the southeastern portion of the VCGP. Because of its shallow nature, these wetlands have a tidal prism identical to the tidal volume.

Inlet Closure Stability. Since this alternative would not modify the J Street Lagoon, this inlet would continue to be closed for most of the time and occasionally open when freshwater discharge breaches the beach berm.

Lateral Inlet Stability. Alternative 3 would not modify the existing intermittent inlet between the J Street Lagoon and the ocean. Consequently, it would exhibit similar lateral inlet migration patterns to existing conditions. In the last ten years, the inlet's location has been observed to vary between the midpoint and southern end of the lagoon, a distance of not more than one-half mile (URS, 2005). This amount of lateral migration has not created a documented concern.

Water Quality. The existing J Street Lagoon is not tidal and therefore residence time was not calculated for this project element. As for the existing salt marsh in the southeastern portion of the VCGP (Alternative 3U), the estimated residence time is 0.51 days (Table 6-4).

6.3.3 Land Use and Infrastructure

6.3.3.1 Unconstrained (Alternative 3U)

As with Alternatives 1U and 2U, all of the land use conversions and infrastructure removal/relocation that are outlined in Tables 6-5 and 6-6 that would occur under Alternative 3U. As such, the properties listed in Table 6-5 would all be converted to wetland habitat. However, as shown on Figure 5-8, Alternative 3U would not include any managed duck pond areas, which would be included under both Alternatives 1U and 2U. As such, implementation of Alternative 3U would not provide for the continuation of existing VCGP duck hunting activities. Therefore, it is expected that a cooperative management agreement related to the VCGP property would not be entered into for this portion of the project site, although cooperative management towards other mutual purposes and goals could be established.

Alternative 3U would result in the smallest area of open water (27 acres), and thus would have the potential to offer the greatest area available for passive recreation, such as wildlife viewing, trails and educational programs. In addition, Alternative 3U would include substantially less earth moving activity than Alternatives 1U and 2U (250,000 cubic yards, versus 12,108,000 cubic yards and 4,361,000 cubic yards, respectively); therefore, Alternative 3U would result in the smallest construction-related effects to surrounding land uses among the unconstrained alternatives. As such, residential and business developments in the project area would experience the least noticeable effects, among the unconstrained alternatives, as related to construction traffic, noise, aesthetics and air quality.

6.3.3.2 Constrained (Alternative 3C)

As with the constrained variations of Alternatives 1 and 2, Alternative 3C would not include wetland restoration of the properties listed in Table 6-5. Edison Drive, which provides access between the Reliant Power Plant and McWane Boulevard and Hueneme Road, would stay in place to allow for continued operation of the power plant following project implementation.

With the exception of the No Project Alternative (Alternative 4), this alternative would result in the fewest construction-related effects to surrounding land uses and infrastructure because the lowest intensity of construction activities would be required. Alternative 3C would include three acres of open water habitat, and the movement of approximately 200,000 cubic yards of earth materials. Therefore, this alternative would allow for the greatest area of passive recreation, while also resulting in the lowest construction-related effects associated with the traffic, noise, aesthetics and air quality.

Alternative 3C would not include the conversion of existing land uses or features associated with the VCGP.

6.3.4 Cultural Resources

6.3.4.1 Unconstrained (Alternative 3U)

The primary features of Alternative 3U are the expansion of existing habitat types, the creation of coastal grasslands, and minimal hydrologic modifications. Although Alternative 3U would minimize earth disturbing activities in comparison to Alternatives 1U and 2U, any type of ground disturbance would have the potential to unearth known cultural resources or possibly unearth new (e.g., unknown or unrecorded) cultural resources. As such, Alternative 3U could affect the same cultural resources as Alternatives 1U or 2U. Please refer to Section 6.1.4.1 for a discussion of the known cultural resource sites associated with the unconstrained project area that could be affected by implementation of Alternative 3U.

6.3.4.2 Constrained (Alternative 3C)

The primary features of Alternative 3C are minimal topographic and hydrologic enhancements to existing non-tidal habitats. The project area associated with Alternative 3C is identical to that of Alternatives 1C and 2C, and thus the same cultural resources associated with these alternatives are applicable to Alternative 3C. Although Alternative 3C would result in the least amount of earth disturbance in comparison to the other unconstrained and constrained alternatives, it would still require the cut and fill of approximately 200,000 cubic yards of soil. As noted above in Section 6.3.4.1, any type of earth disturbance, including surface grading, has the potential to impact cultural resources. As such, Alternative 3C would have the potential to affect the same cultural resources as described for Alternatives 1C and 2C. Please refer to Section 6.1.4.2 for a discussion of these resources.

6.3.5 Soil Management, Construction Quantities and Cost Estimates

6.3.5.1 Unconstrained (Alternative 3U)

The volumes of cut and fill for Alternative 3U are summarized in Table 6-16. There would be no export of material under this alternative. Topographic information for the Southeast Area was not available for the purposes of this Feasibility Study; therefore, the cut and fill volumes for Alternative 3U could not be estimated for this case. However, based on other available information (e.g., graphics and description), it was assumed that the amount of cut would be balanced by the amount of fill such that no material would be exported offsite.

In estimating the cost of grading for Alternative 3U, it was assumed that the earthwork would be carried out by scrapers, which move materials directly from cut locations to fill locations (i.e., no "double handling" would be required). This grading work was estimated using a unit cost of $6,450 per acre.

Table 6-16. Cut and Fill Volumes for Alternative 3U

Cut/Fill/Export	Earthwork Volume (Thousand Cubic Yards)	
	Northwest Area	Southeast Area
Cut	250	*
Fill	250	*
Net Export	0	0

* Cut and fill volumes not calculated for this alternative for the Southeast Area.

The estimated cost to implement Alternative 3U would be approximately $41 million (2009 U.S. dollars). With a project area of is 1,755 acres, the estimated cost per acre would be $23,000. Earthwork would comprise roughly 45 percent of this total. Other construction items would include planting, infrastructure construction, and demolition as well as protection and relocation of existing utilities. The implementation cost estimate for Alternative 3U is summarized in Table 6-17 and a detailed in Appendix C.

Table 6-17. Alternative 3U Cost Estimate

Items (Percent)	Alternative 3U Costs (In Thousands of 2009 U.S. Dollars)
Construction	$37,040
Preliminary Engineering (1.0)	$370
Environmental Review (1.0)	$370
Final Engineering Design (3.5)	$1,300
Construction Management (3.5)	$1,300
Environmental Monitoring (1.0)	$370
Total	$40,750
Cost Per Acre	$23

6.3.5.2 Constrained (Alternative 3C)

The volumes of cut (excavation) and fill for Alternative 3C are summarized in Table 6-18. Alternative 3C would require the least amount of earthwork and there would be no export of excavated material under this alternative. In estimating the cost of grading for Alternative 3C, it was assumed that the earthwork would be carried out by scrapers, which move materials directly from cut (excavation) locations to fill locations (i.e., no "double handling" would be required). As with Alternative 3U, this grading work was estimated using a unit cost of $6,450 per acre.

Table 6-18. Cut and Fill Volumes for Alternative 3C

Cut/Fill/Export	Earthwork Volume (Thousand Cubic Yards)	
	Northwest Area	Southeast Area
Cut	200	0
Fill	200	0
Net Export	0	0

For Alternative 3C, proposed topographic information for the Southeast Area was not available at the time of the project's costing analysis, and thus the cut and fill volumes were not estimated for this alternative. Based on other available information, it was assumed that the amount of cut would be balanced by the amount of fill such that no material would be exported offsite.

The estimated cost to implement Alternative 3C would be $23 million (2009 U.S. dollars). With a project area of 774 acres, the estimated cost per acre would be $30,000. Earthwork (excavation, fill, and soil disposal) would comprise about 40 percent of this total. Other construction items would include planting, infrastructure construction, and demolition as well as protection and relocation of existing utilities. The implementation cost estimate for Alternative 3C is summarized in Table 6-19 and a detailed cost estimate is provided in Appendix C.

Table 6-19. Alternative 3C Cost Estimate

Items (Percent)	Alternative 3C Costs (In Thousands of 2009 U.S. Dollars)
Construction	$21,300
Preliminary Engineering (1.0)	$210
Environmental Review (1.0)	$210
Final Engineering Design (3.5)	$750
Construction Management (3.5)	$750
Environmental Monitoring (1.0)	$210
Total	$23,430
Cost Per Acre	$30

6.4 NO PROJECT ALTERNATIVE (ALTERNATIVE 4)

6.4.1 Habitat Distributions and Biological Resources

The preliminary habitat map for Alternative 4 is provided in Figure 5-10, and the extent and acreage of high quality habitat created and habitats supporting special status species are provided in Figure 6-11. Of all of the alternatives, Alternative 4 would be expected to maximize the preservation of existing higher quality habitat, although the actual acreage habitat being preserved ranks lowest when compared to the other alternatives. Alternative 4 would also result in the creation of salt panne/seasonal hypersaline community habitat (45 acres) and would provide some seasonal open water community habitat (45 acres).

When the Alternative 4 ground surface is subjected to three feet of sea level rise, the predicted tidal areas change by the percentages shown in Table 6-1. About three-tenths (28 percent) of the existing supratidal area would be converted to intertidal area. Subtidal and intertidal areas are pre-conditions for open water and coastal wetland habitat, respectively. In addition, the increase in sea level would also elevate the groundwater in the semi-perched surface aquifer, leading to more extensive and frequent inundation of seasonal wetlands.

The major weaknesses of Alternative 4 would be that it would provide the least benefit to listed plant and wildlife species and their habitat, and it would not create any high quality habitat. Of all of the alternatives, Alternative 4 would provide the lowest amount of salt marsh vegetation habitat and no backdune community habitat, fish habitat, or benthic habitat. In sum, Alternative 4 is considered the least preferable alternative from the perspective of biological resources.

6.4.2 Hydrologic, Hydraulic and Geomorphic Conditions

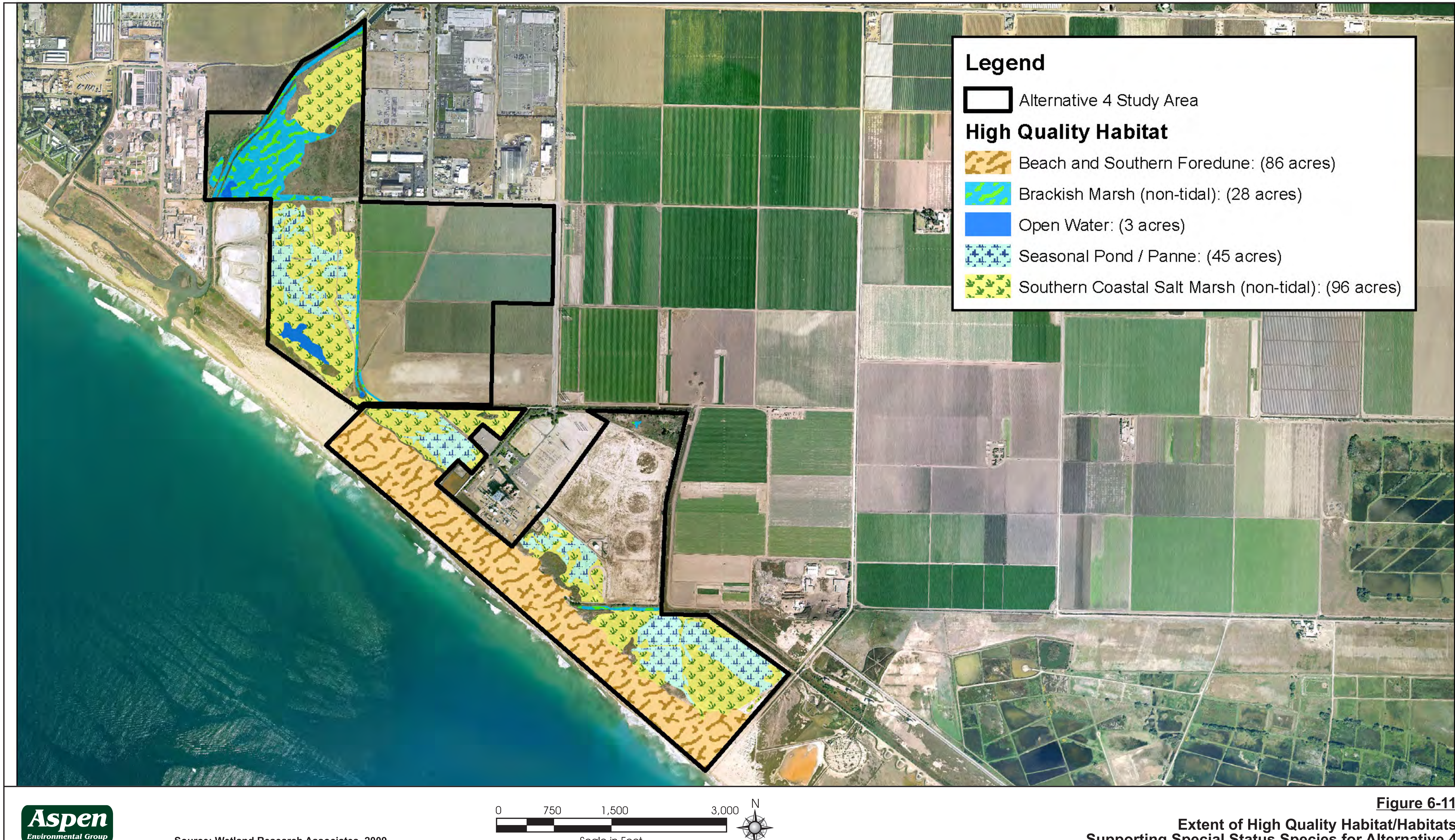
As noted at the beginning of Section 6, under Alternative 4 it is assumed that the SCC and TNC would eventually undertake some type of habitat restoration and enhancement of their respective properties. However, the specifics and timing of such alternatives have not, as yet, been identified. Therefore, under Alternative 4 it is currently assumed that there would be no changes to the hydrologic, hydraulic, and geomorphic conditions described in Section 2.2. These components of the project site would function in a manner similar to Alternative 3, as described in Section 6.3.2.

6.4.3 Land Use and Infrastructure

Under the No Project Alternative, it is likely that the SCC and TNC would restore or enhance habitats within their existing properties. As portrayed in Figure 1-8, the SCC currently owns approximately 260 acres of land surrounding the Reliant Power Plant, while TNC owns approximately 280 acres north and east of the Halaco Site, for a total of 540 acres. Since any future habitat restoration or enhancement under Alternative 4 would be limited to the SCC and TNC properties, it is can be reasonably assumed that no substantial changes to the existing land uses (e.g., open space) of these parcels would occur. Land uses outside of the boundaries of these properties would not be expected to be appreciably affected by any future habitat restoration or enhancement.

6.4.4 Cultural Resources

Although it is assumed that the SCC and TNC would implement some type of habitat restoration and enhancement on their properties in the future, the need for any type of earth disturbing activity is currently unknown. However, both of these properties do contain potentially sensitive cultural resources. As such, if future habitat restoration and enhancement on these properties would involve subsurface excavation or surface grading, sensitive cultural resources could be unearthed.



Source: Wetland Research Associates, 2009.

Figure 6-11

Extent of High Quality Habitat/Habitats Supporting Special Status Species for Alternative 4

7. COMPARATIVE EVALUATION OF THE ALTERNATIVES

7.1 METHODOLOGY

Ultimately, the SCC and its partners will need to weigh the benefits and disadvantages of each of the alternatives developed for this Feasibility Study to determine its "proposed project." To facilitate this process, the DIG developed a suite of 26 evaluation criteria that address the project's overall goals and objectives, as well as other issues associated with its implementation and management. The evaluation criteria fall into five categories, including: habitat restoration; environmental quality; hydrology and geomorphology; sustainability; and, costs and construction. For each criterion identified, the DIG then developed a metric to provide for a consistent comparison between the alternatives. Where possible, the comparative metrics were quantified. Due to their nature, some of the comparative metrics involve a qualitative ranking. All of the criterion were subsequently ranked in terms of their metric-specific preference (e.g., 1st, 2nd, 3rd, etc.); for some criterion two or more of the alternatives are, or are nearly, identical and thus carry the same preference ranking.

Due to the largely quantified nature of the comparative metrics, two additional considerations were required for their evaluation. One involved identification of the specific types and acreages of habitat that would be created by each of the alternatives; the other involved quantification (in acres) of the specific habitats for both special status and native plant and wildlife species that would be created under each alternative. Table 7-1 provides a summary of the habitat acreages that would occur under each alternative, and Table 7-2 provides a summary of these acreages separately for those portions of the unconstrained alternatives that are located northwest and southeast of Arnold Road. Table 7-3 provides a summary of the acreages for special status species and native species (plant and wildlife) that would occur under each alternative. These tables are found at the end of Section 7.

7.2 ALTERNATIVES EVALUATION MATRIX

Table 7-4, also located at the end of Section 7, provides a matrix of the evaluation criteria and metrics outlined above, as well as the results of their evaluation under each alternative. The following discussion summarizes the matrix by each of the five categories referenced in Section 7.1.

Habitat Restoration. Alternative 1U would maximize the net restored aquatic habitat of the project area, whereas Alternative 4 would not provide any restored aquatic habitat. The net restored aquatic habitat of the remaining alternatives would range between 707 acres (Alternative 2U) and 183 acres (Alternative 3C). Alternative 1U would additionally maximize the creation of high quality habitat (1,412 acres) while Alternative 4 would not create any new high quality habitat. Alternative 2U would rank second for the number of acres of high quality habitat created (1,209 acres), as well as preserving 75 percent of its original high quality habitat. Alternative 3U would rank third for the creation of high quality habitat (716 acres) while preserving 99 percent of its original high quality habitat.

Alternative 2U would maximize benefits to wildlife species, followed by Alternative 2C, and Alternatives 2U, 2C, 3U, 3C and 4 would all equally maximize benefits to plant species due to the number of vegetated habitat types created. Alternatives 1U and 1C would maximize benefits to fish species (at 475 acres and 357 acres of subtidal habitat, respectively), whereas Alternatives 3C and 4 would provide the lowest benefits to fish species. Alternative 1U would maximize benefits to special status species, followed by Alternative 2U and then Alternative 3U; Alternatives 3C and 4 would minimize these benefits.

The unconstrained alternatives (Alternatives 1U, 2U and 3U) would minimize barriers between the restored and created habitats, thereby maximizing enhancements to wildlife migration and plant dispersal corridors; Alternatives 2C, 3C and 4 would minimize these enhancements. Alternative 1U would also minimize the potential for colonization by invasive plant species within the project area, followed by Alternative 1C and then Alternative 2U. Alternatives 3U and 3C would do very little to minimize the potential for colonization by invasive species, but would minimize edge effects, with Alterative 3U providing a 4,000-foot buffer distance between existing development and the edge of the restored and enhanced habitat areas, and Alternative 3C providing a 2,800-foot buffer distance. Alternatives 2U and 2C would maximize biodiversity by providing the greatest number of habitat type transitions (35 and 29 transitions, respectively).

Environmental Quality. Alternatives 3U, 3C and 4 would minimize the potential for contaminant exposure. Due to the volume of grading that would be required, Alternative 1U would maximize the potential for contaminant exposure, followed by Alternative 1C. Because Alternatives 3U, 3C and 4 would result in the least amount of open water acreage, they would also result in the shortest resident time of standing water and thus maximize water quality; Alternatives 2U and 2C would rank second and Alternatives 1C and 1U would rank third and fourth, respectively. All of the unconstrained alternatives (Alternatives 1U, 2U and 3U) would maximize the buffering of degraded inflows within the project area, and there would be no appreciable difference between the constrained alternatives (Alternatives 1C, 2C and 3C). Alternative 4 would not buffer degraded inflows into the project area.

Hydrology and Geomorphology. The drains which enter the project area (e.g., the J Street, Hueneme and Oxnard Industrial Drains [please refer to Figure 1-2]) pose a flood hazard since they periodically overtop their banks. In particular, the J Street Drain has a history of flooding property within the City of Oxnard, and is the subject of ongoing studies to reduce flood hazards (URS, 2005; Tetra Tech, 2005). Several of the proposed J Street Drain flood mitigation measures identified to date aim to improve the connectivity between the existing J Street Lagoon and the ocean. All of the alternatives would be compatible with these proposed flood mitigation actions.

Because of its continuously open inlet with the ocean, Alternative 1 is likely to provide the greatest reduction in fluvial flood hazard. The open inlet provides an unimpeded pathway from the drains to the ocean. This pathway prevents ponding of water in the lagoon, which can have a backwater effect that elevates water levels upstream. Alternative 1U is ranked first in Table 7-4 because it is hydraulically connected with all three drains and provides the most direct pathway to the ocean. In contrast, Alternative 1C is ranked second because it only connects to one drain and has a longer, less direct pathway to the ocean. Alternative 2 garners the third place ranking because its proposed lagoon is considerably larger than the existing J Street Lagoon. Therefore, it would probably maintain an open connection with the ocean more frequently and for a longer duration than existing conditions. Both variants of Alternative 2 are given a third place ranking because they cannot be differentiated based on the present level of the project's planning and analysis. Alternatives 2U and 2C have different components which make it difficult to determine which has the greatest overall benefit. For example, Alternative 2U benefits all three drains while Alternative 2C may remain open more often because of its jetty. Alternatives 3 and 4 do not change the existing hydraulic configuration of the project area and therefore would have a negligible contribution towards minimizing fluvial flood hazard. Therefore, they are all assigned fourth, the lowest rank.

Three factors play a role in determining the risk that inlet migration poses to infrastructure: the distance between the inlet and infrastructure; the potential migration distance of the inlet; and, the extent of structural protection, such as a jetty. The infrastructure most at risk is the Reliant Power Plant and its outfall. As noted in Section 6.1.2 (Hydrologic, Hydraulic and Geomorphic Conditions), predicting potential migration distances can be difficult; as a surrogate, the inlet migration extent is assumed to scale with the tidal prism flowing through the inlet. The jetty configuration evaluated below is that described in the text and figures of Section 5 (Project Alternatives). Modifying these jetty configurations remains a design option which may be used to change inlet migration risk during later stages of alternative optimization.

Both variants of Alternatives 3 and 4, which all maintain the existing J Street Lagoon inlet, are ranked first for minimizing the inlet migration to risk infrastructure criterion. The existing inlet is furthest from the Reliant Power Plant and has the smallest tidal prism. In addition, its historic behavior, with migration distance less than 2,000 feet (URS, 2005), has not warranted consideration of a jetty. The second most favorable alternative for this criterion is Alternative 2U because it calls for the removal of the power plant, and has only a moderate tidal prism. Alternative 3U is ranked third based on the removal of the power plant, but would entail more risk than Alternative 2U because of its larger tidal prism. The last two rankings are assigned to Alternatives 1C and 2C because these alternatives place the active inlet in close proximity to the Reliant Power Plant. Alternative 2C ranks fourth, more preferable to Alternative 1C, because of its smaller potential for migration, characterized by its smaller tidal prism.

Sustainability. Alternatives 1 and 2 (constrained and unconstrained) would involve the creation of a lagoon (Alternative 1) or seasonally open ponds (Alternative 2). Alternative 1U would provide the largest tidal prism and thus maximize inlet resistance to closure, followed by Alternatives 1C and 2U and then Alternative 2C. Alternatives 3U and 3C and would minimize inlet migration risks to infrastructure as well as sea level rise effects on the habitats restored, enhanced or created, whereas Alternatives 1U and 1C are the least favorable for these sustainability criteria. Alternative 2U is considered to be the second most favorable for the minimization of inlet migration risks to infrastructure and the third most favorable for the minimization of sea level rise effects on habitat.

Costs and Construction. Although it is likely that the SCC and TNC would eventually undertake some type of habitat enhancement or restoration on their respective properties within the project area, for the purposes of the costs and construction evaluation criteria it has been assumed that no construction-related activities would occur within the reasonably foreseeable future. To this end, and for the purpose of distinguishing the differences between those alternatives that would involve construction, this discussion is focused on Alternatives 1 through 3 (constrained and unconstrained).

Alternatives 3U and 3C would minimize construction-related costs, maximize project cost effectiveness, maximize aquatic habitat cost effectiveness, and minimize construction-related impacts to both existing habitat and wildlife and surrounding land uses and the built environment. For these criteria, Alternatives 3U and 3C would be the most favorable and Alternatives 1U and 1C would be the least favorable, with Alternatives 2U and 2C falling between Alternatives 1 and 3 (constrained and unconstrained).

Alternative 2C would minimize construction-related impacts to existing habitat and wildlife, followed by Alternative 3C. Alternatives 1U and 2U would maximize these impacts, and Alternatives 3C, 1C and 3U would rank second, third and fourth, respectively.

For all of the alternatives it is noted that the restoration costs per acre for this project are similar to the restoration costs per acre of other Southern California coastal wetland restoration projects once inflation is factored into the costs of previously completed restoration projects, such as the Batiquitos Lagoon

Enhancement Project (Carlsbad), Bolsa Chica Wetlands Restoration Project (Huntington Beach), and San Dieguito Lagoon Restoration Project (Del Mar).

7.3 SUMMARY AND CONCLUSIONS

Based upon the results of the alternatives evaluation for the metrics presented in Table 7-4, the unconstrained alternatives are consistently more favorable than their constrained counterparts. The unconstrained alternatives would minimize barriers between habitats, thereby benefitting wildlife migration and maximizing plant dispersal corridors. The constrained project area presents many more issues that affect implementation, long term maintenance, and stability, such as: buffering of inflows; room to transgress in response to sea level rise; barriers to plant and animal migration; the need for a constructed causeway; levees to control inlet migration; and, flooding of buildings and infrastructure.

Of all the alternatives, Alternative 1 was found to be the most favorable overall. Roughly speaking, when weighting all of the metrics equally, Alternative 1 (Create New Tidal Lagoon) is most favorable 40 percent of the time, Alternative 2 (Restore Seasonally Open Wetland Habitats/Ponds) is most favorable 30 percent of the time, Alternative 3 (Enhance Existing Non-Tidal Wetland Habitats) is most favorable 20 percent of the time, and Alternative 4 (No Project Alternative) is most favorable 10 percent of the time.

Although this Feasibility Study does not presume to choose a preferred alternative (or “proposed project”) for the SCC and its project partners, the following paragraphs outline the overall conclusions of the alternatives evaluation process.

Alternative 1 (Create New Tidal Lagoon). By creating a large, permanently connected tidal lagoon, Alternative 1 would create the largest extent of aquatic and wetland habitat in the project area. This alternative, therefore, maximizes the acreage of high quality habitat and has the highest benefit for listed species and fish species. Because of the large excavation costs needed for the lagoon, Alternative 1 would also be the most expensive alternative.

Inlet closure potential remains a significant source of uncertainty in estimating the excavation requirements for the subtidal lagoon. Reducing the uncertainty of this process may enable reduced lagoon excavation (and costs) by reducing the tidal prism requirements and/or by including active management options for the inlet.

The unconstrained version of Alternative 1 would provide the most benefits to the project area. The most salient benefits of Alternative 1U include:

- ***Hydraulic Design***
  - Provides flexibility to accommodate sea level rise and other uncertainties;
  - Less restrictive for generating tidal prism sufficient to insure inlet stability;
  - Removes concerns about inlet migration that would impact the existing Reliant Power Plant and its outfall;
  - Facilitates connections to existing wetlands and drain mouths; and,
  - Provides space for natural dune system migration in response to sea level rise.
- ***Habitat Creation***
  - Creates wider range of habitat types – subtidal, intertidal, uplands;
  - Creates larger spatial extent of habitat types;
  - Allows for a greater diversity and amount of wildlife utilization;

- Reduces the impact of sea level rise on habitat;
- Likely to provide the best habitat for several federally listed and special status species (such as salt marsh bird's-beak, tidewater goby, and light-footed clapper rail); and,
- Facilitates the establishment of experimental populations of several special status plants due to known tidal conditions during the entire year.

- ***Costs***
  - Reduces the need for flood protection costs in response to sea level rise that would be associated with existing development or new residential development since the created lagoon would accommodate intermittent flooding.

Construction cost savings of Alternative 1C compared to Alternative 1U would be modest[1], but the long term sustainability of salt marsh habitat under Alternative 1C would be limited. The constrained project area would severely restrict the extent of salt marsh habitat and would provide little room for this habitat to transgress in response to future sea level rise.

Alternative 2 (Restore Seasonally Open Wetland Habitats/Ponds). Alternative 2 would create a substantial total wetland area, which would be distributed among a variety of wetland types. Alternative 2 would also maximize the benefit to plant and wildlife species and maximize biodiversity by offering the highest number of habitat type transition zones.

Because of the initial, relatively even distribution between subtidal, intertidal and supertidal habitat area, Alternative 2 would be able to accommodate future sea level rise. Accommodation would be simpler for Alternative 2U, primarily due to the absence of infrastructure. However, infrastructure could be defended against sea level rise if coastal protections, such as levees, are constructed.

Sustaining a portion of Alternative 2's wetlands would rely on groundwater. The quantity and quality of the project area's groundwater needs to be further quantified. Groundwater quantity would affect the grading of the ponds (less quantity would require deeper excavation) and groundwater quality would influence habitat vitality.

Alternative 3 (Enhance Existing Non-Tidal Wetland Habitats). Alternative 3 would only minimally modify the existing hydrology of the project area. Without changes to the surface water configuration, expansion of the project area's existing wetland area would be limited. However, Alternative 3 would be the least costly alternative to implement because it would require the least amount of earthwork. In addition, Alternative 3 would be the best alternative for minimizing edge effects by providing the greatest buffer distance from development along the edge of the wetland restoration area.

The large expanses of coastal prairie created under Alternative 3 would enable accommodation of future sea level rise. For Alternative 3U, additional consideration of sea level rise impacts to infrastructure would be needed.

Project Phasing. Because of its size and tidal prism requirement, the large subtidal lagoon at the center of Alternative 1 would be difficult to build in a phased manner. Alternatives 2 and 3 could be implemented in phases because the components, smaller seasonal ponds or just coastal grassland, are more independent.

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1 Land acquisition costs were not considered in the costing analysis, which would increase the difference in the costs between Alternatives 1U and 1C.

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Table 7-1. Habitat Acreages by Alternative

Habitat	Alternatives						
	Create New Tidal Lagoon[1] (Alternative 1)		Restore Seasonally Open Wetland Habitats/Ponds[1] (Alternative 2)		Enhance Existing Non-Tidal Wetland Habitats[1] (Alternative 3)		No Project Alternative[1] (Alternative 4)
	Unconstrained (Alternative 1U)	Constrained (Alternative 1C)	Unconstrained (Alternative 2U)	Constrained (Alternative 2C)	Unconstrained (Alternative 3U)	Constrained (Alternative 3C)	
Beach and Southern Foredune	127	79	152	90	153	92	86
Backdune	70	50	55	44	85	65	0
Southern Coastal Salt Marsh (Tidal)	437	180	246	78	44	0	0
Southern Coastal Salt Marsh (Non-Tidal)	0	0	190	142	180	153	96
Treatment Wetlands	21	7	25	7	24	8	0
Coastal Grassland	171	50	221	70	222	69	0
Coastal Grassland (Transitional)	162	36	308	127	650	295	0
Seasonal Wetland Depression (Vegetated)	26	0	77	16	151	58	0
Open Water	474	357	119	64	27	5	3
Unvegetated Inter-Tidal	62	35	13	15	0	0	0
Managed Duck Ponds	168	0	168	0	0	0	0
Willow Scrub	38	0	43	5	8	4	0
Brackish Marsh (Non-Tidal)	0	0	46	24	61	25	28
Seasonal Pond / Panne	0	0	93	90	0	0	45
Salt Grass	0	0	0	0	150	0	0
Total Acreage[2]	1,756	794	1,756	772	1,755	774	258[3]

[1] All habitat types are provided as total acreage.

[2] As indicated in Figures 5-1 and 5-2, the property boundaries used to define the unconstrained and constrained alternatives' acreages were prepared for general planning purposes only and were not land surveyed for parcel-specific legal boundaries or acreages. Similarly, the Geographic Information System (GIS) data used to calculate total habitat acreages were not land surveyed for property-specific legal boundaries or acreage. Due to the types of data used and differences in GIS calculation rounding, the total acreages presented in Table 7-1 differ from the total acreage of the unconstrained and constrained "footprints" by 26 acres and four (4) acres, respectively. Assuming total acreage "footprints" of 1,730 acres for the unconstrained alternatives and 770 to 790 for the constrained alternatives, the total habitat acreages presented above may vary by 1.5% (unconstrained) and 0.5% (constrained).

[3] The total "footprint" of Alternative 4 is 540 acres, as shown on Figure 5-10. The remaining acreage (282 acres) associated with Alternative 4 would be comprised of alkali meadows, mixed transitional vegetation, a cultivated sod field (130 acres), developed/industrial uses, non-native grasslands, and coyote brush/eucalyptus and coyote brush/lollipop tree associations.

Table 7-2. Habitat Acreages for the Unconstrained Alternatives Northwest and Southeast of Arnold Road

Habitat	Alternatives					
	Create New Tidal Lagoon[1] (Alternative 1)		Restore Seasonally Open Wetland Habitats/Ponds[1] (Alternative 2)		Enhance Existing Non-Tidal Wetland Habitats[1] (Alternative 3)	
	Northwest of Arnold Road	Southeast of Arnold Road	Northwest of Arnold Road	Southeast of Arnold Road	Northwest of Arnold Road	Southeast of Arnold Road
Beach and Southern Foredune	127	0	152	0	153	0
Backdune	70	0	55	0	85	0
Southern Coastal Salt Marsh (Tidal)	292	145	101	145	0	44
Southern Coastal Salt Marsh (Non-Tidal)	0	0	190	0	180	0
Treatment Wetlands	19	2	23	2	23	1
Coastal Grassland	83	88	133	88	174	48
Coastal Grassland (Transitional)	81	81	227	81	382	268
Seasonal Wetland Depression (Vegetated)	0	2,626	51	26	87	64
Open Water	452	22	97	22	19	8
Unvegetated Inter-Tidal	62	0	13	0	0	0
Managed Duck Ponds	0	168	0	168	0	0
Willow Scrub	2	36	7	36	8	0
Brackish Marsh (Non-Tidal)	0	0	46	0	61	0
Seasonal Pond / Panne	0	0	93	0	0	0
Salt Grass	0	0	0	0	19	131
Total Acreage[2]	1,188	568	1,188	568	1,191	564

[1] All habitat types are provided as total acreage.

[2] As indicated in Figures 5-1 and 5-2, the property boundaries used to define the unconstrained and constrained alternatives' acreages were prepared for general planning purposes only and were not land surveyed for parcel-specific legal boundaries or acreages. Similarly, the Geographic Information System (GIS) data used to calculate total habitat acreages were not land surveyed for property-specific legal boundaries or acreage. Due to the types of data used and differences in GIS calculation rounding, the total acreages presented in Table 7-1 differ from the total acreage of the unconstrained and constrained "footprints" by 26 acres and four (4) acres, respectively. Assuming total acreage "footprints" of 1,730 acres for the unconstrained alternatives and 770 to 790 for the constrained alternatives, the total habitat acreages presented above may vary by 1.5% (unconstrained) and 0.5% (constrained).

Table 7-3. Biological Resources Considerations

Habitat Type	Alternatives: Create New Tidal Lagoon[1] (Alternative 1)		Restore Seasonally Open Wetland Habitats/Ponds[1] (Alternative 2)		Enhance Existing Non-Tidal Wetland Habitats[1] (Alternative 3)		No Project Alternative[1] (Alternative 4)
	Unconstrained (Alternative 1U)	Constrained (Alternative 1C)	Unconstrained (Alternative 2U)	Constrained (Alternative 2C)	Unconstrained (Alternative 3U)	Constrained (Alternative 3C)	
Support Habitats for Special Status Species							
• Salt Marsh Bird's-Beak Habitat (Acreage of Transitional Marsh)	136	54	255	123	637	284	31
• Tidewater Goby Habitat (Acreage Brackish Open Water)	0	0	119	64	27	0	0
• Light-Footed Clapper Rail Habitat (Acreage of Low/High Salt Marsh-breeding; Acreage of Low Salt Marsh/Tidal Habitat-foraging)	499	215	259	93	44	0	0
• Western Snowy Plover Habitat (Acreage of Beach and Dune Habitat–breeding; Acreage of Tidal Habitat-foraging)	259	164	220	149	238	157	86
• California Least Tern Habitat (Acreage of Beach and Dune Habitat–breeding; Acreage of Tidal and Open Water- foraging)	671	486	326	198	265	162	89
• Least Bell's Vireo Habitat (Acreage of Willow Scrub Habitat-breeding/foraging)	38	0	43	5	8	4	0
• Belding's Savannah Sparrow Habitat (Acreage of Southern Coastal Salt Marsh-breeding; Acreage of Southern Coastal Salt Marsh and Adjacent Upland-foraging.	604	264	339	136	360	0	0
• Brown Pelican Habitat (Acreage of Open Water-foraging)	474	357	119	64	27	5	3
➤ Total Acreage	2,681	1,540	1,680	832	1,606	612	209
Support Habitats for Native Species							
• Fish (Acreage of Subtidal Habitat)	474	357	119	64	27	5	0
• Benthic (Acreage of Sub- and Intertidal Habitat)	536	392	132	79	27	5	0
• Salt Marsh Vegetation (Acreage)	437	180	436	220	224	153	96
• Transitional Marsh Vegetation (Acreage)	92	36	211	101	615	269	21
• Salt Grass Community (Acreage)	0	0	0	0	150	0	0
• Salt Panne Community (Acreage)	0	0	93	90	0	0	45
• Seasonal Open Water Community (Acreage)	168	0	261	90	0	0	45
• Seasonal Hypersaline Community (Acreage)	0	0	93	90	0	0	45
• Beach and Foredune Community (Acreage)	127	79	152	90	153	92	86
• Backdune Community (Acreage)	70	50	55	44	85	65	0
• Managed Waterfowl (Acreage of Managed Wetland)	168	0	168	0	0	0	0
➤ Total Acreage	2,072	1,094	1,720	868	1,281	589	338

1 All habitat types are provided as total acreage.

Table 7-4. Alternatives Evaluation Matrix

Evaluation Criteria	Comparative Metric	Alternatives						
		Create New Tidal Lagoon (Alternative 1)		Restore Seasonally Open Wetland Habitats/Ponds (Alternative 2)		Enhance Existing Non-Tidal Wetland Habitats (Alternative 3)		No Project Alternative (Alternative 4)
		Unconstrained (Alternative 1U)	Constrained (Alternative 1C)	Unconstrained (Alternative 2U)	Constrained (Alternative 2C)	Unconstrained (Alternative 3U)	Constrained (Alternative 3C)	
Habitat Restoration								
Maximize Net Restored Aquatic Habitat Value	Best = Total new aquatic habitat created within project site (includes subtidal, intertidal, and non-tidal wetland) (acres)	973 Acres 1st	572 Acres 3rd	707 Acres 2nd	415 Acres 4th	312 Acres 5th	183 Acres 6th	0 Acres 7th
Maximize Benefit to Wildlife Species	Best = Number of habitat types created[1]	12 Habitats (BD, BS, CG, CE, DP, OW, SW, SM, TW, MF, WS, and CH) 5th	9 Habitats (BD, BS, CG, CE, OW, SM, TW, MF, and CH) 6th	16 Habitats (BD, BS, BM, CG, CE, DP, OW, SP, SW, SN, SM, TW, MF, WS, IC, and CH) 1st	15 Habitats (BD, BS, BM, CG, CE, OW, SP, SW, SN, SM, TW, MF, WS, IC, and CH) 2nd	14 Habitats (BD, BS, BM, CG, CE, OW, AM, SW, SN, SM, TW, WS, IC, and CH) 3rd	13 Habitats (BD, BS, BM, CG, CE, OW, SW, SN, TW, WS, and CH) 4th	No new habitat created. There are 9 existing habitats: OW, BS, SP, SN, BM, NG, AM, SF, and MT. 6th
Maximize Benefit to Plant Species	Best = Number of vegetated habitat types created[1]	9 Habitats (Same as above but no OW, UI, or CH) 2nd	9 Habitats (Same as above but no OW, MF, or CH) 2nd	11 Habitats (Same as above but no OW, SP, MF, IC, or CH) 1st	11 Habitats (Same as above but no OW, SP, MF, IC, or CH) 1st	11 Habitats (Same as above but no OW, IC, or CH) 1st	11 Habitats (Same as above but no OW or CH) 1st	11 Habitats (Same as above but no OW, CH, IC, SP, or SF) 1st
Maximize Benefit to Fish Species	Best= Acreage of available subtidal habitat	475 Acres 1st	357 Acres 2nd	119 Acres 3rd	64 Acres 4th	27 Acres 5th	5 Acres 7th	15 Acres 6th
Maximize Benefit to Listed Species	Best = Extent of habitat for selected listed plant and wildlife species that could potentially be supported by the project[2]	1st	4th	2nd	5th	3rd	6th	7th
Maximize Preservation of Higher Quality Habitat	Best = Avoidance/Preservation of highest-quality habitats (percent)	54% 5th	28% 7th	75% 4th	44% 6th	99% 2nd	81% 3rd	100% 1st
Maximize Creation of High Quality Habitat	Best = Acreage of new high quality habitat acreage created (see Section 5 and Section 6 Figures)	1,412 Acres 1st	706 Acres 4th	1,209 Acres 2nd	569 Acres 5th	716 Acres 3rd	403 Acres 6th	0 Acres 7th
Maximize Total High Quality Habitat Preserved and Created	Best = Total acreage of high quality habitat created and preserved minus high quality habitat converted to lower quality habitat	1,394 Acres 1st	697 Acres 3rd	1,190 Acres 2nd	567 Acres 5th	677 Acres 4th	399 Acres 6th	258 Acres 7th
Enhance Wildlife Migration and Plant Dispersal Corridors	Best = Minimize barriers between restored/preserved habitats and maximize connectivity to adjacent existing habitats	No Barriers 1st	3 Barriers (1) Reliant Power Plant (47.41 acres; perimeter is 6,878 linear feet); (2) Agromin Property (19.21 acres; perimeter is 3,879 linear feet); (3) Halaco Site (37.93 acres; perimeter is 5,475 linear feet). The elevated causeway should not be a barrier. 2nd	No Barriers 1st	5 Barriers (1) Reliant Power Plant (47.41 acres; perimeter is 6,878 linear feet); (2) Agromin Property (19.21 acres; perimeter is 3,879 linear feet); (3) Halaco Site (37.93 acres; perimeter is 5,475 linear feet); (4) MWD Exclusion (24.24 acres; perimeter is 4,259 linear feet); (5) Edison Drive (5.67 acres; perimeter is 5,506 linear feet) 3rd	No Barriers 1st	5 Barriers (1) Reliant Power Plant (47.41 acres; perimeter is 6,878 linear feet); (2) Agromin Property (19.21 acres; perimeter is 3,879 linear feet); (3) Halaco Site (37.93 acres; perimeter is 5,475 linear feet); (4) MWD Exclusion (24.24 acres; perimeter is 4,259 linear feet); (5) Edison Drive (5.67 acres; perimeter is 5,506 linear feet) 3rd	5 Barriers (1) Reliant Power Plant (47.41 acres; perimeter is 6,878 linear feet); (2) Agromin Property (19.21 acres; perimeter is 3,879 linear feet); (3) Halaco Site (37.93 acres; perimeter is 5,475 linear feet); (4) MWD Exclusion (24.24 acres; perimeter is 4,259 linear feet); (5) Edison Drive (5.67 acres; perimeter is 5,506 linear feet) 3rd

Evaluation Criteria	Comparative Metric	Alternatives						
		Create New Tidal Lagoon (Alternative 1)		Restore Seasonally Open Wetland Habitats/Ponds (Alternative 2)		Enhance Existing Non-Tidal Wetland Habitats (Alternative 3)		No Project Alternative (Alternative 4)
		Unconstrained (Alternative 1U)	Constrained (Alternative 1C)	Unconstrained (Alternative 2U)	Constrained (Alternative 2C)	Unconstrained (Alternative 3U)	Constrained (Alternative 3C)	
Minimize Potential for Colonization by Invasive Species	Best = Acreage of habitat types least impacted by invasive plant species (subtidal, intertidal)[1]	973 Acres 1st	572 Acres 2nd	378 Acres 3rd	157 Acres 4th	71 Acres 5th	5 Acres 6th	3 Acres 7th
Minimize Edge Effects	Best = Maximum buffer distance from development along the edge of the wetland restoration area (feet)	300 Feet 5th	150 Feet 6th	1,300 Feet 3rd	560 Feet 4th	4,000 Feet 1st	2,800 Feet 2nd	-
Greatest Potential for Transition Zone Interaction to Maximize Biodiversity	Best = Greatest number of habitat type transitions (e.g. measure of the boundaries between habitat types)[1]	20 Transitions (CE-SM, SM-TW, TW-CG, TW-CE, TW-MF, TW-OW, OW-MF, OW-SM, CE-CG, OW-BS, BS-BD, BD-SM, CG-SW, SW-CE, CE-DP, WS-CG, WS-CE, CH-SM, DP-SM, SM-MF) 4th	14 Transitions (CE-SM, SM-TW, TW-OW, OW-MF, OW-SM, CE-CG, OW-BS, BS-BD, BD-SM, CG-SW, SW-CE, CH-SM, SM-MF, TW-CG) 6th	35 Transitions (CE-SM, TW-OW, OW-MF, CE-CG, OW-BS, BS-BD, BD-SM, CG-SW, SW-CE, CE-DP, WS-CG, WS-CE, CH-SM, DP-SM, SM-MF, SP-SN, SP-BD, SN-SM, BD-SN, SN-CE, BM-TW, WS-TW, OW-BM, CH-MF, CH-OW, IC-BS, BM-BS, BM-BD, BM-MF, BM-SM, TW-CG, TW-CE, WS-CE, WS-OW, BM-CE) 1st	29 Transitions (CE-SM, TW-OW, OW-MF, CE-CG, OW-BS, BS-BD, BD-SM, CG-SW, SW-CE, CE-DP, WS-CG, WS-CE, CH-SM, DP-SM, SM-MF, SP-SN, SP-BD, BD-SN, SN-CE, WS-TW, OW-BM, IC-BS, BM-MF, BM-SM, TW-CG, TW-CE, WS-CE, WS-OW, BM-CE) 2nd	22 Transitions (CG-CE, CG-WS, CG-TW, WS-OW, WS-BM, WS-TW, TW-OW, TW-BM, TW-CE, BM-SN, BM-BD, OW-BS, BD-SN, SN-CE, CE-SW, CE-AM, AM-SN, AM-SM, SM-CH, SW-CG, BD-BS, WS-CE) 3rd	15 Transitions (CG-CE, WS-BM, WS-TW, TW-OW, TW-BM, TW-CE, BM-SN, OW-BS, BD-SN, SN-CE, CE-SW, CE-AM, SW-CG, BD-BS, WS-OW) 5th	9 Transitions (BM-NG, BM-OW, MT-SN, SN-OW, SN-SP, BS-OW, BS-MT, SP-AM, MT-SP) 7th
Environmental Quality								
Minimize Potential Contaminant Exposure	Best = Lowest disposal volume of potentially contaminated soils (cubic yards [cy^3])	6,071,000 cy^3 5th	4,145,000 cy^3 4th	2,470,000 cy^3 3rd	2,170,000 cy^3 2nd	0 cy^3 1st	0 cy^3 1st	0 cy^3 1st
Maximize Water Quality	Best = Shortest residence time (days) (See also "'Maximize Inlet Resistance to Closure" and Section 6)	0.95 Days 4th	0.90 Days 3rd	0.63 Days 2nd	0.63 Days 2nd	0.53 Days 1st	0.53 Days 1st	0.53 Days 1st*
Maximize Buffering of Degraded Inflows	Best = Largest area of treatment wetlands (acres)	21 Acres 3rd	7 Acres 5th	25 Acres 1st	7 Acres 5th	24 Acres 2nd	8 Acres 4th	0 Acres 6th
Hydrology and Geomorphology								
Maximize Tidal Area	Best = Maximum area under tidal influence (acres)	974 Acres 1st	537 Acres 2nd	379 Acres 3rd	157 Acres 4th	71 Acres 5th	20 Acres 6th	20 Acres 6th
Maximize Tidal Range	Best = Maximum tide range (feet) [% ocean tide range]	4.4 Feet [81%] 1st	3.8 Feet [70%] 2nd	2.5 Feet [46%] 3rd	2.3 Feet [42%] 4th	-	-	-
Minimize Fluvial Flood Hazard	Best = Largest reduction to existing flood stage elevation[3]	1st	2nd	3rd	3rd	4th	4th	4th
Sustainability								
Maximize Inlet Resistance to Closure	Best = Largest tidal prism (acre feet [AF])	2,300 AF 1st	1,700 AF 2nd	410 AF 3rd	370 AF 4th	-	-	-
Minimize Inlet Migration Risk to Infrastructure	Best = Largest distance to infrastructure, largest number of jetties and/or smallest tidal prism[3]	3rd	5th	2nd	4th	1st	1st	1st
Minimize Sea Level Rise Effects to Habitats	Best = Maximize creation of intertidal wetlands[3]	4th	5th	3rd	3rd	1st	2nd	2nd

Evaluation Criteria	Comparative Metric	Alternatives						
		Create New Tidal Lagoon (Alternative 1)		Restore Seasonally Open Wetland Habitats/Ponds (Alternative 2)		Enhance Existing Non-Tidal Wetland Habitats (Alternative 3)		No Project Alternative (Alternative 4)
		Unconstrained (Alternative 1U)	Constrained (Alternative 1C)	Unconstrained (Alternative 2U)	Constrained (Alternative 2C)	Unconstrained (Alternative 3U)	Constrained (Alternative 3C)	
Costs and Construction								
Minimize Construction Costs	Best = Lowest construction cost	$757,130,000 6th	$519,320,000 5th	$292,570,000 4th	$225,620,000 3rd	$40,750,000 2nd	$23,430,000 1st	$0 (N/A)
Maximize Project Cost Effectiveness	Best = Lowest cost per acre ($/acre)	$431,000 5th	$654,000 6th	$167,000 3rd	$292,000 4th	$23,000 1st	$30,000 2nd	$0 (N/A)
Maximize Aquatic Habitat Cost Effectiveness	Best = Lowest cost per net total new aquatic habitat created ($/acre)	$778,000 5th	$908,000 6th	$414,000 3rd	$544,000 4th	$131,000 2nd	$128,000 1st	$0 (N/A)
Minimize Construction Impacts to Existing Habitat and Wildlife	Best = Smallest area impacted during construction (acres)	1,756 5th	794 3rd	1,756 6th	772 1st	1,755 4th	774 2nd	0 (N/A)
Minimize Construction Impacts to Surrounding Land Uses and Built Environment	Best = Lowest construction-related activities (duration and intensity) affecting issues such as transportation, noise and air quality as quantified by smallest total volume of earthwork (cubic yards)	12,108,000 6th	7,536,000 5th	4,361,000 4th	2,938,000 3rd	250,000 2nd	200,000 1st	0 (N/A)

1 Key to Habitat Types

AF	Agricultural Field	CE	Coastal Grassland (Ecotone)	IC	Intermittent Channel	OW	Open Water	SP	Seasonal Pond/Panne
AM	Alkali Meadow/Salt Grass	CH	Channel	MF	Mudflats (Unvegetated Inter-Tidal)	SF	Cultivated Sod Field	SW	Seasonal Wetland Depression (Vegetated)
BD	Backdune	CG	Coastal Grassland	MT	Mixed Transitional	SM	Southern Coastal Salt Marsh (Tidal)	TW	Treatment Wetlands
BM	Brackish Marsh	DI	Developed/Industrial	NG	Non-Native Grassland	SN	Southern Coastal Salt Marsh (Non-Tidal)	WS	Sothern Willow Scrub
BS	Beach & Southern Foredune	DP	Managed Duck Ponds						

2 Evaluation criteria is a quantitative ranking for creating the most habitat for salt marsh bird's beak, tidewater goby, light-footed clapper rail, western snowy plover, California least tern, least bell's vireo, belding's savannah sparrow, and brown pelican. One (1) is most favorable.

3 Criterion is a qualitative ranking, specific to that criterion, rather a quantitative measure. The basis for qualitative rankings is provided in Sections 6 and 7 of the Feasibility Study. First (1st) is most favorable. Each less favorable ranking, i.e. second as opposed to first, represents a significant change in favorability. Since several alternatives may be nearly identical and have the same ranking, the least favorable ranking changes between criteria (e.g., sometimes 1st-4th, sometimes 1st-5th).

8. RECOMMENDATIONS FOR THE PROJECT'S FUTURE STEPS

To facilitate future planning, design and regulatory approval steps for the project, the DIG established a series of short- and long-term recommendations for the SCC's consideration. The recommendations have been grouped according to their subject matter, including biological resources, environmental resources and physical processes, regulatory reviews and approvals, and economics (e.g., project costs and funding sources).

Each recommendation has also been categorized according to the phase of the project within which the results of the recommendation would be needed, or otherwise should be initiated. The first category addresses project design; it includes refinement and optimization of the conceptual alternatives addressed in this Feasibility Study for the purposes of the project's environmental review, and final design and engineering for the alternative that is selected for implementation (e.g., the "approved project"). The second category addresses regulatory processes. This category also has two components. The first addresses needs for preparation of the project's environmental review document and completion of its decision making process. The second speaks to regulatory permit acquisition and approvals, which, for some regulatory agencies, cannot be completed until the project's environmental review process is complete and the project's final design and engineering have been established. The third category addresses project implementation, which includes project construction, management and monitoring.

Realistically, implementation of all of the recommendations provided to the SCC is not considered feasible. Constraints associated with their funding will likely be a limiting factor. Additionally, not all of the recommendations are necessary for the project's implementation. As such, each recommendation has been prioritized for the SCC's consideration; it is noted, however, that as the project progresses additional prioritization of the recommendations may be warranted. The prioritization of the recommendations for this Feasibility Study includes:

- **Critical:** Completion of the recommendation is considered an absolute necessity for project implementation and success;
- **Very High:** Completion of the recommendation is considered extremely important to project implementation and success;
- **High:** Completion of the recommendation is considered important, but if it is not undertaken it would not pose a "fatal flaw" to the project's implementation and success; and,
- **Advantageous:** Completion of the recommendation would benefit some aspect (or aspects) of the project, but it is not necessary for the project's implementation and success.

Short-term recommendations relate to studies and actions that can be initiated within the next one to three years. Long-term recommendations relate to studies and actions that can be initiated during the project's implementation, assuming an estimated 50-year planning horizon. Table 8-1, located at the end of this section, provides a summary of the recommendations.

8.1 SHORT-TERM RECOMMENDATIONS

8.1.1 Biological Resources

Prepare Species-Specific Pre-Restoration Studies

Purpose. These studies are intended to (1) gain a greater understanding of the project area's various biological attributes as well as their relationships to each other, (2) further refine what species-specific restoration techniques and concepts are most likely to succeed, and (3) assist with the development of success criteria at species-specific, habitat-specific and overall ecological scales. For several species it would be ideal to have at least two seasons (e.g., years) of data collection and assessment. Additionally, some surveys must be conducted within a specific timeframe, and their advance planning and completion would help avoid future "critical path" data gaps.

Project Phase. The results of these studies would provide valuable information during refinement and optimization of the conceptual alternatives, as well as during final design and engineering of the approved project. The "baseline" data collected from these studies would also facilitate preparation of the project's environmental review document and its regulatory permit acquisition and approvals process.

Priority. Advantageous to Critical. Some species-specific studies are considered an absolute necessity while others would provide additional scientific knowledge, at both local and regional scales, that would benefit the project but are not considered essential to its success. Prioritization is provided below at a study-specific level. Additional prioritization may be warranted as the project's planning process moves forward.

The following species-specific studies listed have been identified:

- Locate nesting sites for Belding's Savannah Sparrow (*Passerculus sandwichensis beldingi*) versus observed non-nesting use/foraging areas and describe their habitat differences such as tidal versus nontidal, dominant vegetation and density, etc.

  Priority. Critical

- Determine pollinators for Salt Marsh Bird's-Beak (*Cordylanthus maritimus*) and locate breeding habitat for pollinators (e.g., native, solitary ground-nesting bees) and identify habitat characteristics of the project area's sub-population for this species including soil type, salinity, inundation depth/duration, host plant(s), etc.

  Priority. Critical

- Determine which stands of Saltgrass (*Distichlis spicata*) sustain populations of the Wandering Skipper (*Panoquina errans*), a butterfly of special concern. Establishing new sub-populations of this species may depend on the nature of the Saltgrass stands and the availability of nectar plants for the adult Wandering Skippers.

  Priority. High

- Determine the conditions under which Salt Marsh Goldfields (*Lasthenia glabrata ssp. coulteri*) can be sustained within the project area, if additional sub-populations can be established, and if existing populations should be proposed for removal as a result the project's final engineering and design plans.

  Priority. High

- Determine if the project area's dunes support populations of Globose Dune Beetles (*Coelus globosus*), Ciliate Dune Beetles (*Coelus ciliatus*), and Silvery Legless Lizards (*Anniella pulchra pulchra*) and if there are there any threats to the long-term sustainability of their occurrence.

Priority. Advantageous to High

- Determine the distribution of *Juncus acutus* and other plant species along the interface of the project area's dunes and marsh and evaluate the potential dependence of these species on freshwater from the dunes.

  Priority. Advantageous

- Determine if the project area supports three common snails of intertidal salt marshes (*Cerethidea*, *Melampus*, and *Assiminea*) and their habitat preferences. Evaluate if existing subpopulations of these species will be impacted by the project and if they can be translocated successfully to other sites or new sites within the project area. If absent, evaluate if they can they be translocated from another estuary or inoculated through natural processes.

  Priority. High

- If California Hornsnails (*Cerethidea californica*) are present, evaluate if and how they support trematodes. Determine what species of trematodes are present, and as a group, evaluate if they represent a healthy or degraded system.

  Priority. High

- Determine if the project area supports populations of staphylinid beetles and if the project can support these species.

  Priority. Very High

- Monitor populations of New Zealand mudsnails (*Potamopyrgus antipodarum*) in the project area and evaluate methods for its eradication. The species has been observed northwest of the project area and its introduction into the project area could result in significant damage to biological resources.

  Priority. Advantageous

- Sample the small mammal population of the project area to determine which species are present, what habitats they frequent, and if they are prey for raptors, herons, and egrets. Evaluate if any small mammals are not present in the project area, and if there are habitats to support them under existing conditions.

  Priority. Advantageous

In addition to the above, the following experimental studies have been identified:

- Conduct translocation and greenhouse/nursery experiments with Salt Marsh Goldfields and Salt Marsh Bird's Beak to help understand the habitat parameters of these species and evaluate whether the project can successfully accommodate sub-populations. Identify any limitations in dispersal mechanisms and determine if the limitations contribute to the distribution of subpopulations. (Prior to implementation, acquire any applicable regulatory permits or approvals).

  Priority. Critical

- Conduct enhancement/restoration experiments in the wetland transition and upland habitats, including removal of invasive weeds and the planting of native species, to determine the effects of both actions and how the experiments might help guide the design and implementation of project-wide transition and upland buffer creation, enhancement and restoration efforts. (Prior to implementation, acquire any applicable regulatory permits or approvals.)

  Priority. Advantageous to Critical

Prepare Analysis of Environmentally Sensitive Habitat Areas

Purpose. The purpose of this analysis is to identify Environmentally Sensitive Habitat Areas (ESHAs) within the project area to ascertain if implementation of the project would require additional compensation/mitigation per the California Coastal Commission's ESHA Guidelines.

Project Phase. Identifying ESHA's within the project area prior to refinement and optimization of the conceptual alternatives would allow for the avoidance or minimization of ESHA impacts, which, in turn, would reduce possible compensation and mitigation requirements.

Priority. High

Prepare Essential Fish Habitat Analysis

Purpose. The purpose of this analysis is to identify existing Essential Fish Habitat (EFH) within the project area. The analysis should include a determination as to whether tidewater gobies are restricted to the J-Street and Hueneme Drain area or if they also occur along the Oxnard Industrial Channel. It is recommended that the analysis include a monitoring program to evaluate the salinity of the J Street lagoon to ascertain the viability of those project alternatives that include tidewater goby habitat.

Project Phase. Preparing the EFH analysis prior to refinement and optimization of the conceptual alternatives would allow for the avoidance or minimization of EFH impacts and additionally provide the opportunity to further assess the viability of creating new tidewater goby habitat.

Priority. Critical. Completing the EFH analysis early would support and advance all future phases of the project.

8.1.2 Environmental Resources and Physical Processes

Prepare Ecological Gaps Analysis

Purpose. The purpose of this analysis it to identify gaps in the regional ecological functions of the project area to maximize opportunities that support weak or missing functions.

Project Phase. Identifying gaps in the region's ecological functions prior to refinement and optimization of the project's conceptual alternatives would ultimately maximize the project's environmental benefits at both local and regional scales. The results of the analysis would also be useful during preparation of the project's environmental review document by providing additional information in support of the project's stated objectives, as required by both CEQA and NEPA.

Priority. High

Complete Cross-Sections

Purpose. The purpose of completing two-dimensional cross-sections of each of the project's conceptual alternatives is to provide a means of evaluating their relatedness in terms of habitat types, topography, sea level, hydrology and other environmental factors.

Project Phase. Completion of the cross-sections should be done prior to refinement and optimization of the project's conceptual alternatives to ensure their long-term success and sustainability.

Priority. Critical

Complete a Regional Littoral Sediment Budget Analysis

Purpose. The results of a sediment budget analysis from Port Hueneme to Point Mugu would improve current predictions for inlet resistance to closure, thereby increasing the level of confidence in creating sustainable habitats for some of the project's alternatives.

Project Phase. The results of the sediment budget analysis prior to refinement and optimization of the project's conceptual alternatives are considered a key aspect of the project's future steps and imperative for completion of the approved project's final engineering and design plans.

Priority: Critical if Alternative 1 is chosen as the proposed project; High for the remaining alternatives.

Complete Nearshore Wave Monitoring

Purpose. The purpose of this monitoring program is to assess local nearshore wave patterns to further refine and improve predictions for inlet stability and resistance to closure, which would improve the degree of confidence in developing long-term, viable wetland habitats. It is suggested that the Coastal Data Information Program (CDIP) be contacted for possible collaboration opportunities.

Project Phase. The monitoring program should be implemented well in advance of the refinement and optimization phase of the project's conceptual alternatives to ensure that the resulting data is considered for long-term sustainability. Data collected from the monitoring program is also considered essential for the approved project's final engineering and design plans.

Priority. Critical if Alternative 1 is chosen as the proposed project; High for the remaining alternatives.

Complete Morphological Modeling of Inlet

Purpose. The purpose of the morphological modeling for those conceptual alternatives that involve an inlet, in terms of location, migration, ebb and flood shoals bathymetry, and influence on their respective lagoon's tidal range, would help refine decisions related to the need for, and geometry of, jetties. The modeling would also assist with the development of site grading plans and infrastructure protection requirements.

Project Phase. Completion of the modeling should be done prior to refinement and optimization of the project's conceptual alternatives to ensure their long-term viability.

Priority. Critical

Prepare Agricultural Drainage Study

Purpose. The purpose of this Study is to assess the project area's agricultural drainage connectivity, discharge and conveyance capacity. The Study should include assessment of subsurface drains and limiting culvert capacity of the duck club property to ensure that the water supply needed for the project is sufficient.

Project Phase. The Study should be prepared prior to refinement and optimization of the project's conceptual alternatives as it would be highly instrumental in identifying any alternative that may be infeasible.

Priority. Critical

Prepare Sea Level Rise and Coastal Flood Inundation Study

Purpose. The purpose of this Study is to predict changes to the project area's coastline in response to anticipated sea level rise and assess the project area's coastal flood inundation zones as they relate to sea level rise. The results of the Study would be useful for land acquisition strategies, as well as establishment of final engineering and design plans as well as grading plans. The Study may additionally be used to further refine all of the alternatives that are truly viable and thus carried forward for detailed analysis in the project's environmental review document.

Project Phase. The Study should be completed either prior to or during refinement and optimization of the project's conceptual alternatives.

Priority. Critical

Prepare a Groundwater Study

Purpose. The purpose of the Groundwater Study is to assess the hydraulic conductivity and groundwater flow rates in project area's semi-perched surface aquifer and examine the connectivity between semi-perched and deep aquifers of the project area to assess potential salinity intrusion. Identification of the potential location of seeps and springs fed from shallow groundwater sources for each alternative also is important for potential establishment of brackish marsh habitat and nontidal palustrine marshes on the margins of estuary.

Project Phase. The Study should be prepared prior to preparation of the project's environmental review document as its results would be instrumental in identifying excavation requirements, particularly as related to the current conceptual plans for Alternative 2.

Priority. Critical

Prepare a Subsidence Feasibility Analysis

Purpose. The purpose of this analysis is to assess of the feasibility and costs of pumping groundwater to cause managed subsidence of the project area to reduce the need for excavation and provide a water source for the project. If this analysis concludes that managed subsidence is a viable option for one or more alternatives, it would likely lessen project implementation costs due to reduced excavation costs.

Project Phase. Should the SCC wish to pursue to feasibility of managed subsidence this Study should be prepared prior to or during refinement and optimization of the project's conceptual alternatives and before preparation of the project's environmental review document.

Priority. Critical

Complete Water Quality Monitoring and Sampling Program

Purpose. The purpose of this program is to ensure that the quality of the water sources required for the long-term sustainability of the project is adequate. The program should include a wide range of sampling locations and be undertaken over multiple seasons.

Project Phase. The program should be initiated prior to or during refinement and optimization of the project's conceptual alternatives and completed prior to final engineering and design of the approved project.

Priority. Critical

Prepare an Ecological Risk Analysis

Purpose. The purpose of this analysis is to further evaluate the historic and existing contaminant sources within and surrounding the project area to determine: (1) the volume of excavated soil that could be re-used on-site versus the volume of excavated soil that would need to be transported and disposed of off-site; and, (2) the potential effects of these contaminant sources on the habitats created. The archived soil samples that were collected during the project's Site-Wide Soil/Surface Water Investigation are recommended for this analysis. A program for cooperative data sharing with the USEPA could also be pursued to facilitate this analysis. The recommendations of the Site-Wide Soil/Surface Water Investigation should be integrated into the analysis.

Project Phase. The analysis should be completed prior to or during refinement and optimization of the project's conceptual alternatives.

Priority. Critical

Integrate Public Access and Recreation Plans into Project Design Plans

Purpose. The purpose of this process is to integrate the "Access Vision Plan" into the conceptual alternatives that have been developed for the project. The process would require careful consideration of the project's habitat restoration goals and objectives versus public access and use and the restrictions that may be necessary for habitat protection.

Project Phase. The integration process should be completed during refinement and optimization of the project's conceptual alternatives.

Priority. Critical

8.1.3 Regulatory Processes

Identify Proposed Project

Purpose. The purpose of this recommendation is to establish which alternative the SCC wishes to pursue as the "proposed project" for completion of the environmental review and decision making process. To facilitate identification of the type of environmental review document to be prepared and to guide the document's impact analysis, this process should additionally include a determination as to whether the project's implementation will be phased.

Project Phase. The proposed project must be identified prior to preparation of the project's environmental review document.

Priority. Critical

Identify and Coordinate with the Federal Lead Agency

Purpose. It is currently anticipated that a joint CEQA/NEPA environmental review document would need to be prepared for the project and that the USACE, Los Angeles District, would act as the federal Lead Agency. The purpose of this recommendation is to verify that the project's environmental review requires consideration under NEPA and that the USACE will act at the federal Lead Agency.

Project Phase. Verification of NEPA compliance and identification of the federal Lead Agency must be completed prior to preparation of the project's environmental review document. Coordination with USACE should be initiated as soon as the SCC identifies the proposed project.

Priority. Critical

Initiate Public and Involvement and Participation Program

Purpose. The purpose of this program is to facilitate the public's understanding, acceptance and support of the project. This program would also assist with the early resolution of possible issues of concern and controversy that could hinder the project's environmental review process.

Project Phase. This program should be initiated prior to the "formal" start of the project's environmental review process (e.g., publication of a Notice of Intent/Notice of Preparation) so that the public, local stakeholders and affected agencies are provided with the opportunity to comment on the project and its alternatives.

Priority. Very High

Initiate Informal Agency Consultations

Purpose. The purpose of initiating informal agency consultations is to facilitate the project's regulatory permit acquisition process and ensure that agency concerns are appropriately addressed in the project's environmental review document.

Project Phase. The informal agency consultations should be initiated prior to preparation of the project's environmental review document.

Priority. Very High

Complete Formal Wetland Delineation

Purpose. The purpose of completing a formal wetland delineation of the project area is to support regulatory permitting with federal agencies including the USACE and USFWS and State agencies including the CDFG and CCC. Completion of the delineation would additionally facilitate completion of the biological and water resources analyses of the project's environmental review document. Because the CCC and CDFG criteria for delineating wetlands within the Coastal Zone generally includes more wetland habitat than the USACE three-parameter approach, and because outside the limit of the Coastal Zone the CDFG's approach would likely include more wetland habitat than the USACE approach, it will be important to conduct more than one delineation for the entire set of properties that make up the final project area. It will also be important determine the differences among the regulatory boundaries for the federal and State agencies. The USFWS approach would generally be consistent with the State's approaches rather than the USACE approach.

Project Phase. The wetland delineation should be completed prior to preparation of the project's environmental review document.

Priority. Critical

Complete Cultural Resources Phase I or Phase II Investigation

Purpose. The purpose of this investigation, as warranted, is to ascertain if significant cultural resources would be affected by project implementation so that a Section 106 consultation process with the SHPO can be initiated as soon as possible. Establishing the need for a Section 106 consultation is key because there are no regulatory time limits for its completion, and several agencies, including the USACE will not issue their permits and approval until the Section 106 SHPO consultation is complete.

Project Phase. The investigation should be completed either prior to or during preparation of the project's environmental review document.

Priority. Very High

Complete Environmental Review and Permit Acquisition Processes

Purpose. The purpose of this recommendation is to ensure that all regulatory review processes and approvals are complete prior to project implementation.

Project Phase. The environmental review and decision making process must precede the regulatory permit acquisition and approval process. Some regulatory permits and approval may not be issued until final engineering and design of the approved project are complete.

Priority. Critical

Prepare Wetland Restoration Management and Monitoring Plan

Purpose. The purpose of the Wetland Restoration Management and Monitoring Plan (Management and Monitoring Plan) is to guide all future phases of the project once the proposed project has been established. The Management and Monitoring Plan should be flexible, interdisciplinary, programmatic and adaptive to ensure that ecosystem functions and social and economic values are sustained. The Management and Monitoring Plan should also include additional monitoring and management activities that such as watershed and water quality monitoring, habitat-specific sustainability success criteria and sea level rise monitoring.

Project Phase. A Draft Management and Monitoring Plan should be relatively well established prior to preparation of the project's environmental review document. A Final Management and Monitoring Plan may be required by some regulatory agencies prior to issuance of permits and approvals, and must be complete prior to project implementation.

Priority. Critical

8.1.4 Economics

Complete Cost Feasibility Analysis

Purpose. The purpose of this analysis is to complete a detailed cost feasibility analysis of the project's refined and optimized alternatives to determine if any of them are too costly to pursue. Although the project's environmental review document cannot dismiss alternatives solely on the basis of economic constraints, a detailed cost analysis would assist with the "paring down" of those alternatives that were considered but ultimately considered infeasible. The analysis would also provide valuable information for the SCC's future pursuit of potential funding sources.

Project Phase. The analysis should be completed prior to preparation of the project's environmental review document.

Priority. Critical

Assess Funding Potential Under the USACE In-Lieu Fee Program

Purpose. The purpose of this assessment is to ascertain if the project is a candidate for funding under the USACE in-lieu fee program per the "Mitigation Rule" published April 10, 2008.

Project Phase. The assessment should be completed prior to or during preparation of the project's environmental review document.

Priority. Very High

Complete Carbon Sequestering Analysis

Purpose. The purpose of this analysis is to estimate and compare carbon sequestration potential of the project's refined and optimized alternatives. Under the right conditions, tidal marsh vegetation can extract and sequester carbon dioxide, a climate-changing greenhouse gas, from the atmosphere. Partial project funding may be available from the sale of carbon credits for carbon sequestered as a result of project implementation.

Project Phase. The analysis should be prepared following refinement and optimization of the project's conceptual alternatives. The analysis could be integrated into the scope of the project's environmental review document.

Priority. High

8.2 LONG-TERM RECOMMENDATIONS

8.2.1 Biological Resources

Develop and Implement Seed Collection Program

Purpose. The purpose of this recommendation is to develop a program for on-site seed collection and the propagation of plant materials for long-term use within the project area. Implementation of the program would help maintain local genotype and may be the only viable method of providing the required plantings necessary for full restoration. Implementation of the program is considered key to the project's long-term viability. It will be important to understand the viability of seed for each species collected, because some species will have short periods of viability and cannot be stored for long periods. Additionally, some species are likely to have dormancies mechanisms, which will have to be understood to be able to initiate germination.

Project Phase. The program should be initiate soon after the approved project has been established and all properties for project implementation have been secured.

Priority. Very High

8.2.2 Environmental Resources and Physical Processes

Implement and Evaluate Wetland Restoration Management and Monitoring Plan

Purpose. Implementation of the Wetland Restoration Management and Monitoring Plan (Management and Monitoring Plan) will be the primary mechanism for the project's short- and long-term success. Evaluation and revision to the Management and Monitoring Plan should be completed at routine intervals to achieve a long-term management strategy that is flexible and adaptive to resource/issue-specific site conditions as they evolve.

Project Phase. Implement as first task of any pre-construction activities. Evaluate and revise every five years or as warranted by project site conditions.

Priority. Critical

8.2.3 Regulatory Processes

Develop and Implement Permit Compliance Plan

Purpose. The purpose of the Permit Compliance Plan (Compliance Plan) is to ensure that all of the conditions of the project's regulatory permits and approvals are implemented. The Compliance Plan should categorize the conditions into pre-construction, construction and project implementation phases as well as by resource/issue-area. The Compliance Plan should additionally identify any reports that may need to be prepared for agency review and the required submittal timing of these reports.

Project Phase. Development of the Compliance Plan's organization and structure should begin during the project's regulatory permit acquisition process and completed immediately upon receipt of all of the project's regulatory permits and approvals. The duration of the Compliance Plan's implementation would be contingent upon the stipulations of each of the project's agency-specific permits or approvals.

Priority. Very High

8.2.4 Economics

Develop Long-Term Funding Program

Purpose. The purpose of this program is to develop and implement a strategy that would ensure a funding source (or sources) for the project's long-term management and monitoring. The program should be flexible and allow for regular evaluation to address changing economic conditions and new funding opportunities that will evolve with time. The goal of the program should be to secure project funding in perpetuity.

Project Phase. The program should be developed and implemented as soon as the approved project is established and the properties necessary for its implementation are secured.

Priority. Critical

Table 8-1. Summary of Short- and Long-Term Recommendations

Recommendation	Project Phase	Priority
Short-Term Recommendations		
Biological Resources		
Prepare Species-Specific Pre-Restoration Studies	Prior to refinement and optimization of the conceptual alternatives	Critical to Advantageous[1]
Prepare Analysis of Environmentally Sensitive Habitat Areas	Prior to refinement and optimization of the conceptual alternatives	High
Prepare Essential Fish Habitat Analysis	Prior to refinement and optimization of the conceptual alternatives	Critical
Environmental Resources and Physical Processes		
Prepare Ecological Gaps Analysis	Prior to refinement and optimization of the conceptual alternatives	High
Complete Cross-Sections	Prior to refinement and optimization of the conceptual alternatives	Critical
Complete a Regional Littoral Sediment Budget Analysis	Prior to refinement and optimization of the conceptual alternatives	Critical to High[2]
Complete Nearshore Wave Monitoring	Prior to refinement and optimization of the conceptual alternatives	Critical to High[2]
Complete Morphological Modeling of Inlet	Prior to refinement and optimization of the conceptual alternatives	Critical
Prepare Agricultural Drainage Study	Prior to refinement and optimization of the conceptual alternatives	Critical
Prepare Sea Level Rise and Coastal Flood Inundation Study	Prior to or during refinement and optimization of the project's conceptual alternatives	Critical
Prepare a Groundwater Study	Prior to preparation of the project's environmental review document	Critical
Prepare a Subsidence Feasibility Analysis	Prior to or during refinement and optimization of the project's conceptual alternatives	Critical
Complete Water Quality Monitoring and Sampling Program	Initiated prior to or during refinement and optimization of the project's conceptual alternatives	Critical
Prepare an Ecological Risk Analysis	Prior to or during refinement and optimization of the project's conceptual alternatives	Critical
Integrate Public Access and Recreation Plans into Project Design Plans	During refinement and optimization of the project's conceptual alternatives	Critical
Regulatory Processes		
Identify Proposed Project	Prior to preparation of the project's environmental review document	Critical
Identify and Coordinate with the Federal Lead Agency	Prior to preparation of the project's environmental review document	Critical
Initiate Public and Involvement and Participation Program	Prior to preparation of the project's environmental review document	Very High
Initiate Informal Agency Consultations	Prior to preparation of the project's environmental review document	Very High
Complete Formal Wetland Delineation	Prior to preparation of the project's environmental review document	Critical
Complete Cultural Resources Phase I or Phase II Investigation	Prior to preparation of the project's environmental review document	Very High
Complete Environmental Review and Permit Acquisition Processes	Initiate during the preparation of the project's environmental review document	Critical
Prepare Wetland Restoration Management and Monitoring Plan	Complete Draft Plan prior to preparation of the project's environmental review document	Critical

Recommendation	Project Phase	Priority
Economics		
Complete Cost Feasibility Analysis	Prior to preparation of the project's environmental review document	Critical
Assess Funding Potential Under the USACE In-Lieu Fee Program	Prior to or during preparation of the project's environmental review document	Very High
Complete Carbon Sequestering Analysis	During (as part of) preparation of the project's environmental review document	High
Long-Term Recommendations		
Biological Resources		
Develop and Implement Seed Collection Program	Initiate soon after the approved project has been identified and all properties for project implementation have been secured.	Very High
Environmental Resources and Physical Processes		
Implement Wetland Restoration Management and Monitoring Plan	Implement as first task of any pre-construction activities. Evaluate and revise every five years or as warranted by project site conditions	Critical
Regulatory Processes		
Develop and Implement Permit Compliance Plan	Development of the Plan's organization and structure should begin during the project's regulatory permit acquisition process and completed immediately upon receipt of all of the project's regulatory permits and approvals	Very High
Economics		
Develop Long-Term Funding Program	The program should be developed and implemented as soon as the approved project is established and the properties necessary for its implementation are secured	Critical

[1] Prioritization is study-specific. Please refer to Section 8.1.1 (Short-Term Recommendations, Biological Resources) for the priority of each study.

[2] Critical if Alternative 1 is chosen as the proposed project; High for the remaining alternatives.

9. LIST OF ACRONYMS

Acronym	Meaning
ACHP	Advisory Council on Historic Preservation
AET	Apparent Effects Threshold (dry weight)
AF	Acre Feet
AFY	Acre Feet Per Year
AWTP	Advanced Water Treatment Plant
BA	Biological Assessment
BMPs	Best Management Practices
BO	Biological Opinion
CAA	(Federal and California) Clean Air Act
CARB	California Air Resources Board
CCC	California Coastal Commission
CDFG	California Department of Fish and Game
CDIP	Coastal Data Information Program
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CMWD	Calleguas Municipal Water District
CNPS	California Native Plant Society
CWA	Clean Water Act
DDD	Dichloro-Diphenyl-Dichloroethane
DDE	Dichloro-Diphenyl-Dichloroethylene
DDT	Dichloro-Diphenyl-Trichloroethane
DIG	Design Integration Group
DPR	(California) Department of Parks and Recreation
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ERL	Effects Range-Low (dry weight)
ERM	Effects Range-Median (dry weight)
ESA	(Federal) Endangered Species Act
ESHA	Environmentally Sensitive Habitat Area
FEMA	Federal Emergency Management Agency
Ft^3/s	Cubic Feet Per Second
GIS	Geographic Information System
GREAT Program	Groundwater Recovery Enhancement and Treatment Program
LARWQCB	Los Angeles Regional Water Quality Control Board
MGD	Million Gallons per Day

Acronym	Meaning
Mg/kg	Milligram per kilogram
MHHW	Mean Higher High Water
MHW	Mean High Water
MLLW	Mean Lower Low Water
MOA	Memorandum of Agreement
MRCA	Mountains Recreation Conservation Authority
MTL	Mean Tide Line
MWD	Metropolitan Water District of Southern California
NAVD88	North American Vertical Datum of 1988
NBVC	Naval Base Ventura County (Point Mugu)
NEPA	National Environmental Policy Act
NMFS	National Marines Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRPH	National Register of Historic Places
NWR	National Wildlife Refuge
OBTF	Ormond Beach Task Force
ODD #3	Oxnard Drainage Ditch Number 3
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated Biphenyl
PEL	Probable Effects Level
PTP	Pumping Trough Pipeline
SAA	Streambed Alteration Agreement
SCC	(California) State Coastal Conservancy
SCE	Southern California Edison
SHPO	State Historic Preservation Officer
SLERA	Screening Level Environmental Risk Assessment
SMMC	Santa Monica Mountains Conservancy
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TEL	Threshold Effect Level
THPO	Tribal Historic Preservation Officer
TNC	The Nature Conservancy
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture

Acronym	Meaning
USFWS	United States Fish and Wildlife Service
UWCD	United Water Conservation District
VCAPCD	Ventura County Air Pollution Control District
VCGP	Ventura County Game Preserve
VCWPD	Ventura County Watershed Protection District
VOC	Volatile Organic Compound
WQC	Water Quality Certification
WWTP	Waste Water Treatment Plant

10. LIST OF PREPARERS AND REVIEWERS

Preparation of this Feasibility Study has been a collaborative effort that has involved numerous public, private and non-profit parties. Discussions with these parties will continue to be a vital part for the final Ormond Beach Wetland Restoration effort's implementation. The SCC gratefully acknowledges and appreciates all parties that have been involved to date.

For the purposes of this Feasibility Study's preparation, the parties listed in Table 10-1 are noted.

Table 10-1. List Preparers and Reviewers

Name	Association & Role
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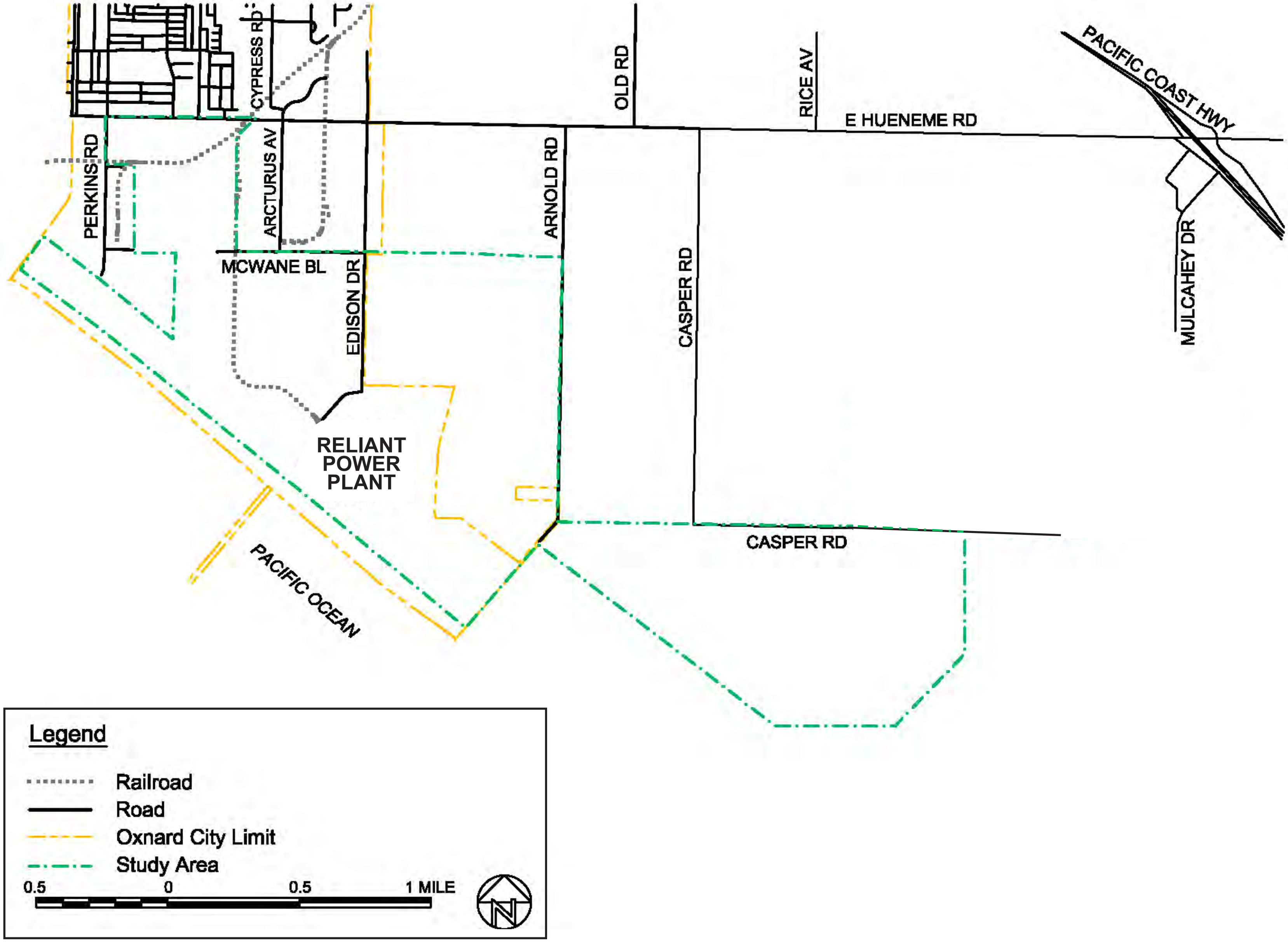
Appendix A.
Infrastructure Maps

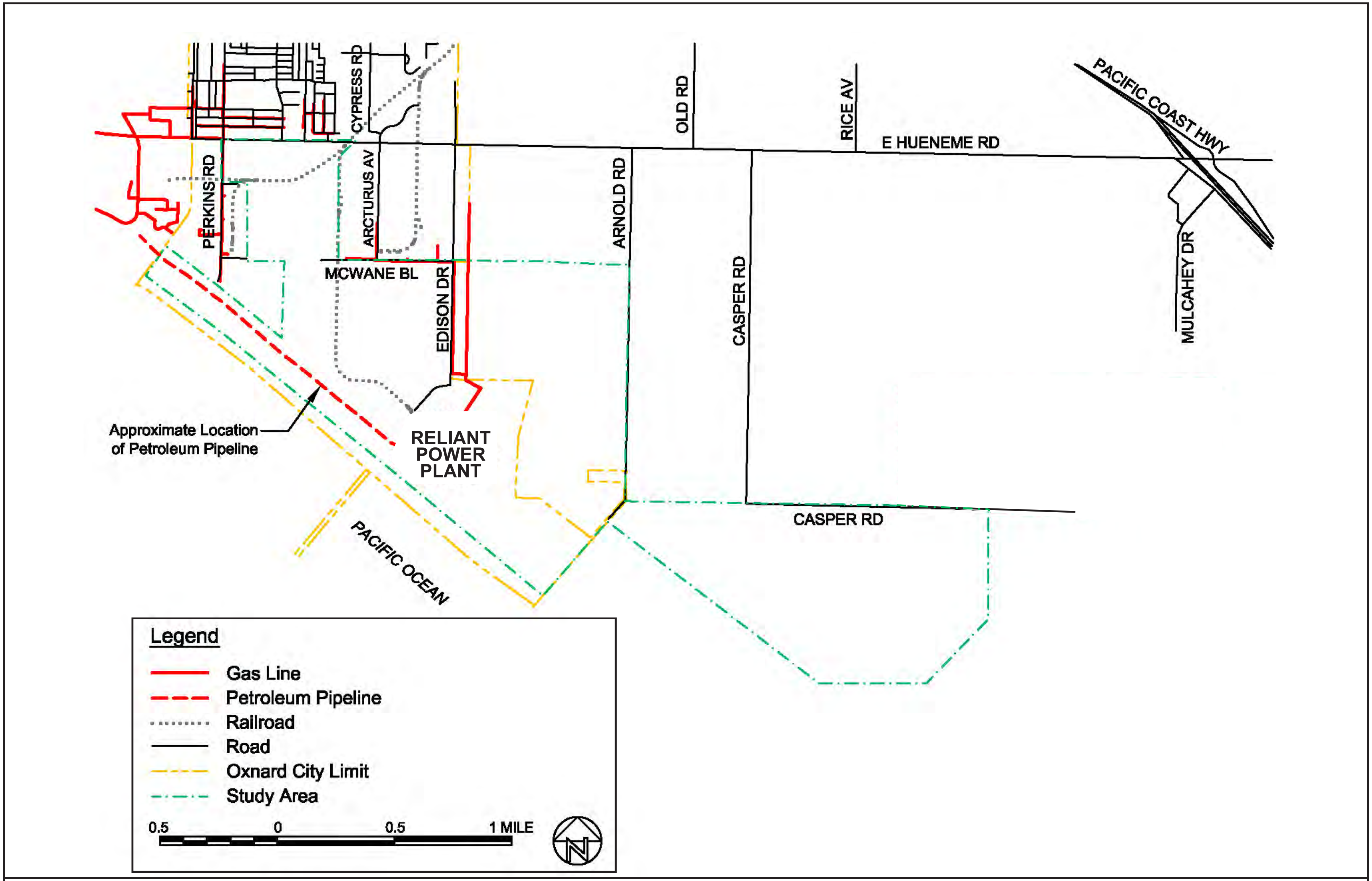


Aspen Environmental Group

Source: Everest International Consultants, 2004.

Figure A-1

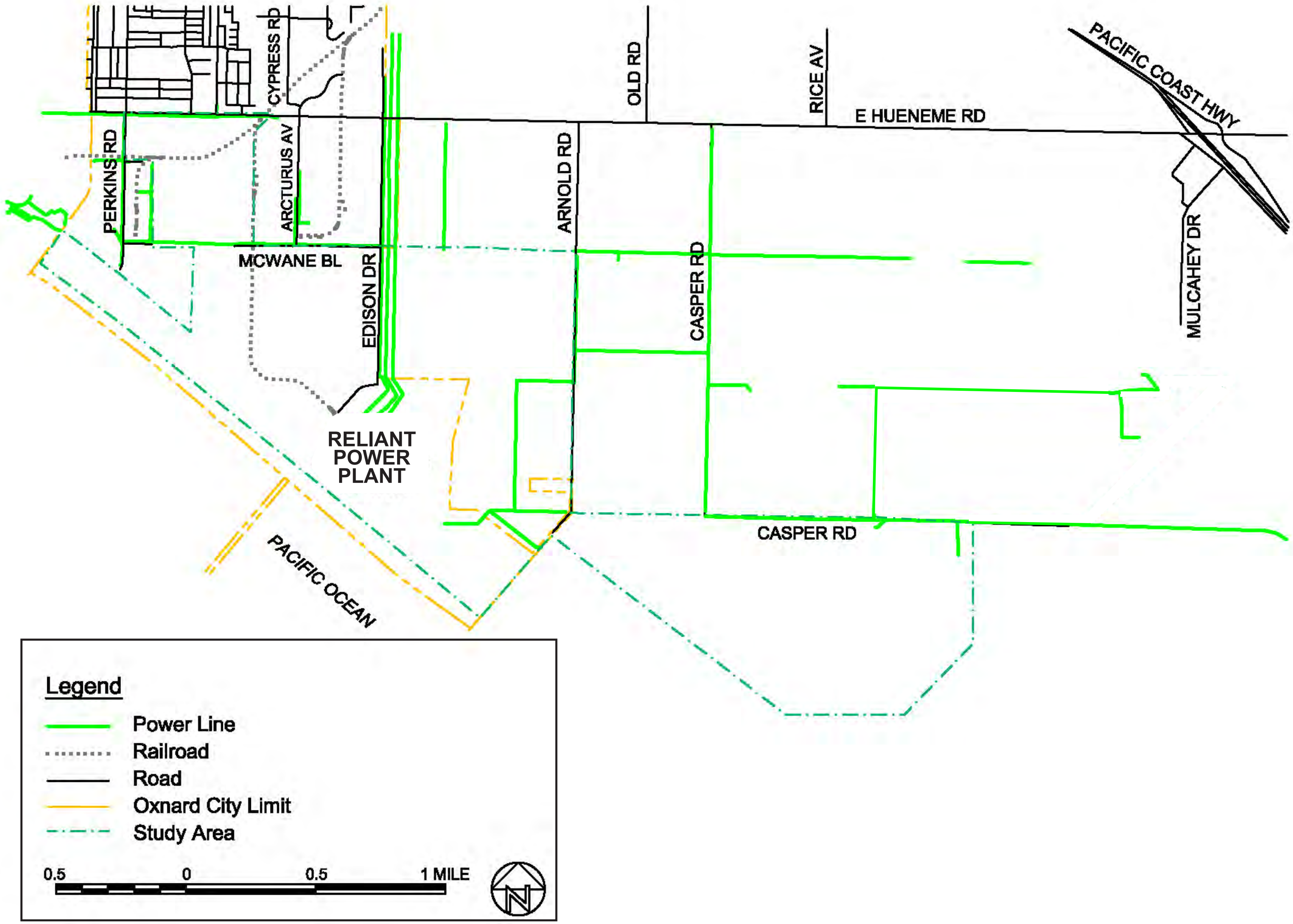
Existing Roads and Railroads



Source: Everest International Consultants, 2004.

Figure A-2

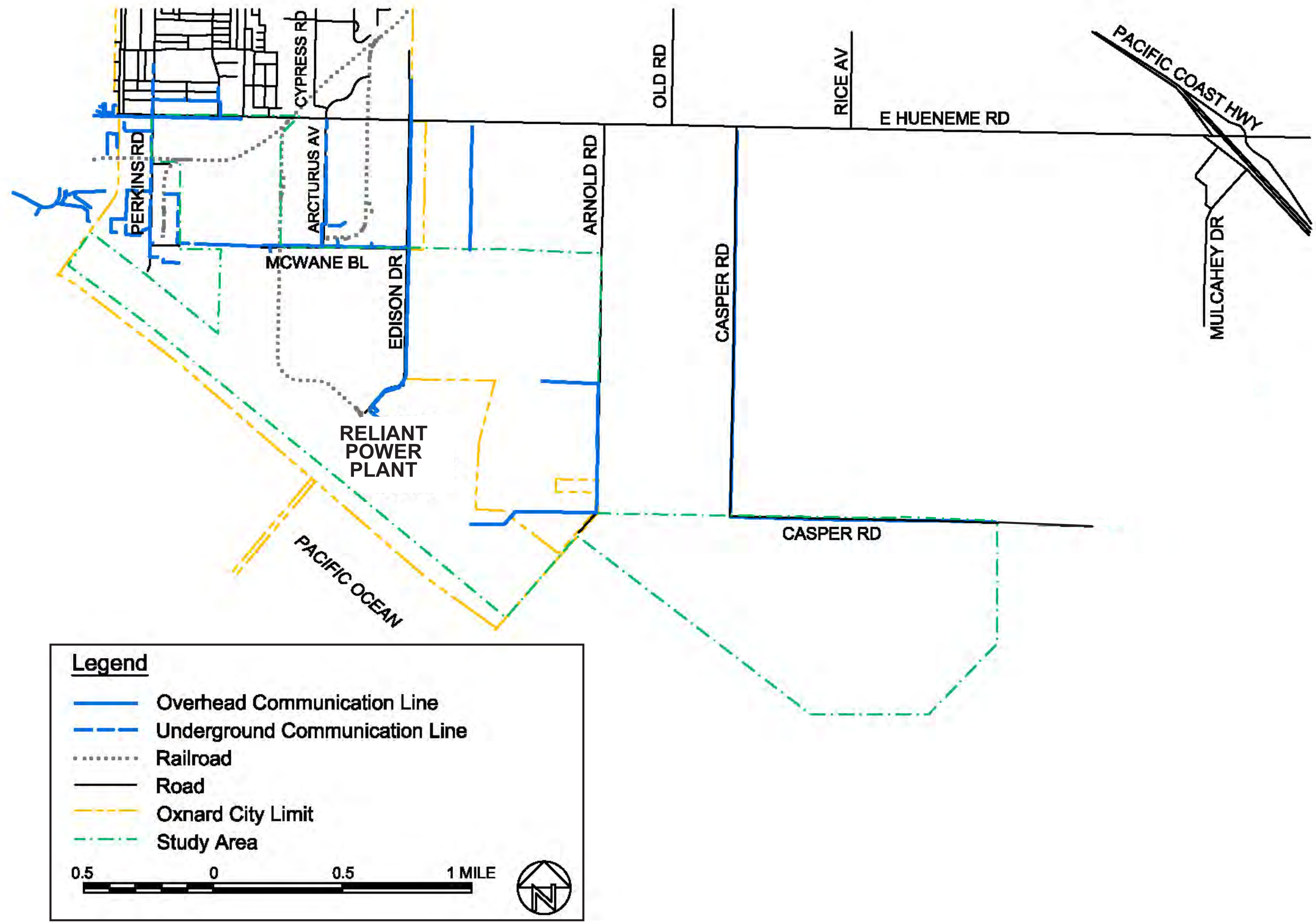
Existing Gas and Petroleum Pipelines



Source: Everest International Consultants, 2004.

Figure A-3

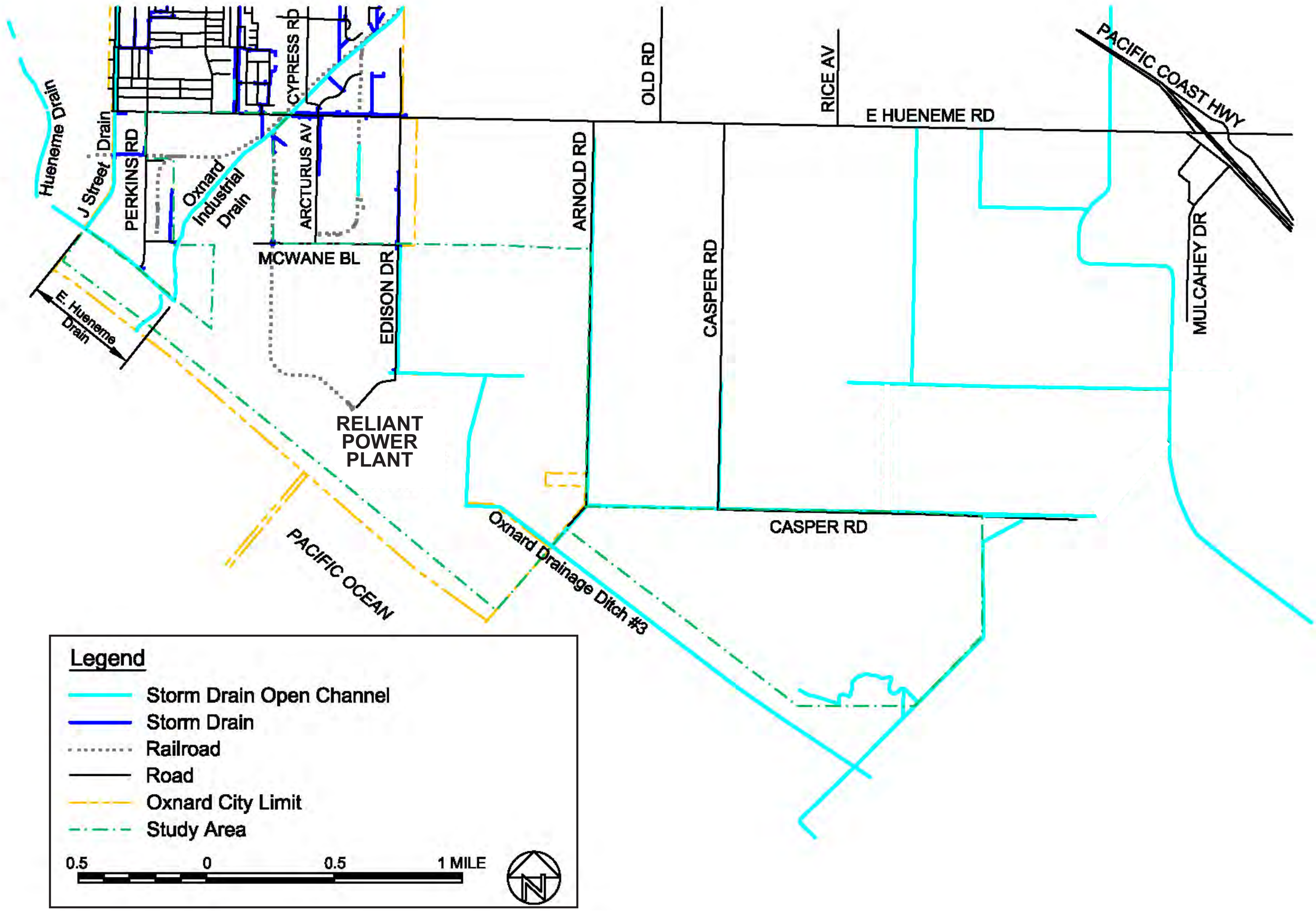
Existing Power Lines



Source: Everest International Consultants, 2004.

Figure A-4

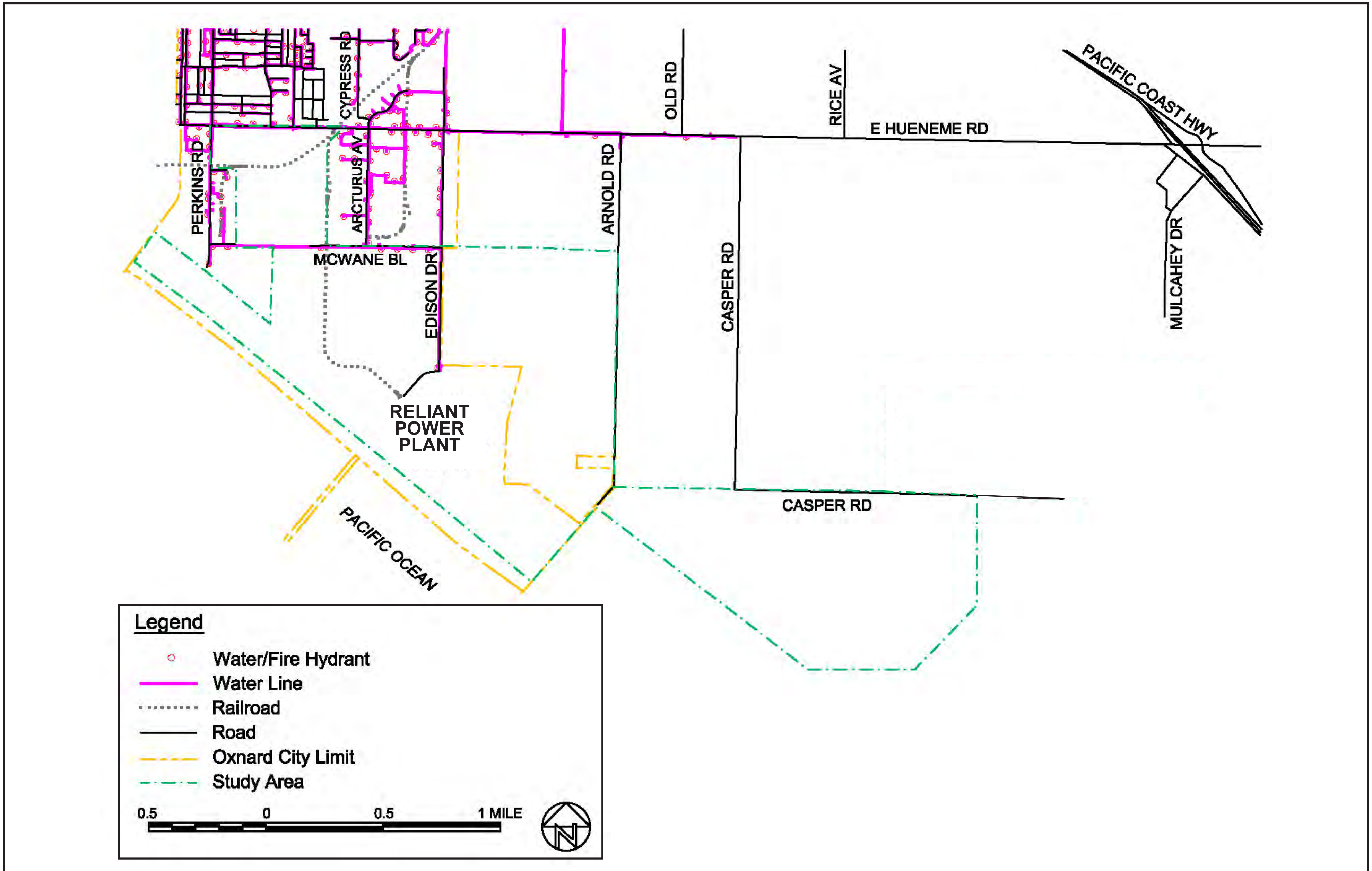
Existing Communication Lines



Source: Everest International Consultants, 2004.

Figure A-5

Existing Storm Drains and Open Channels

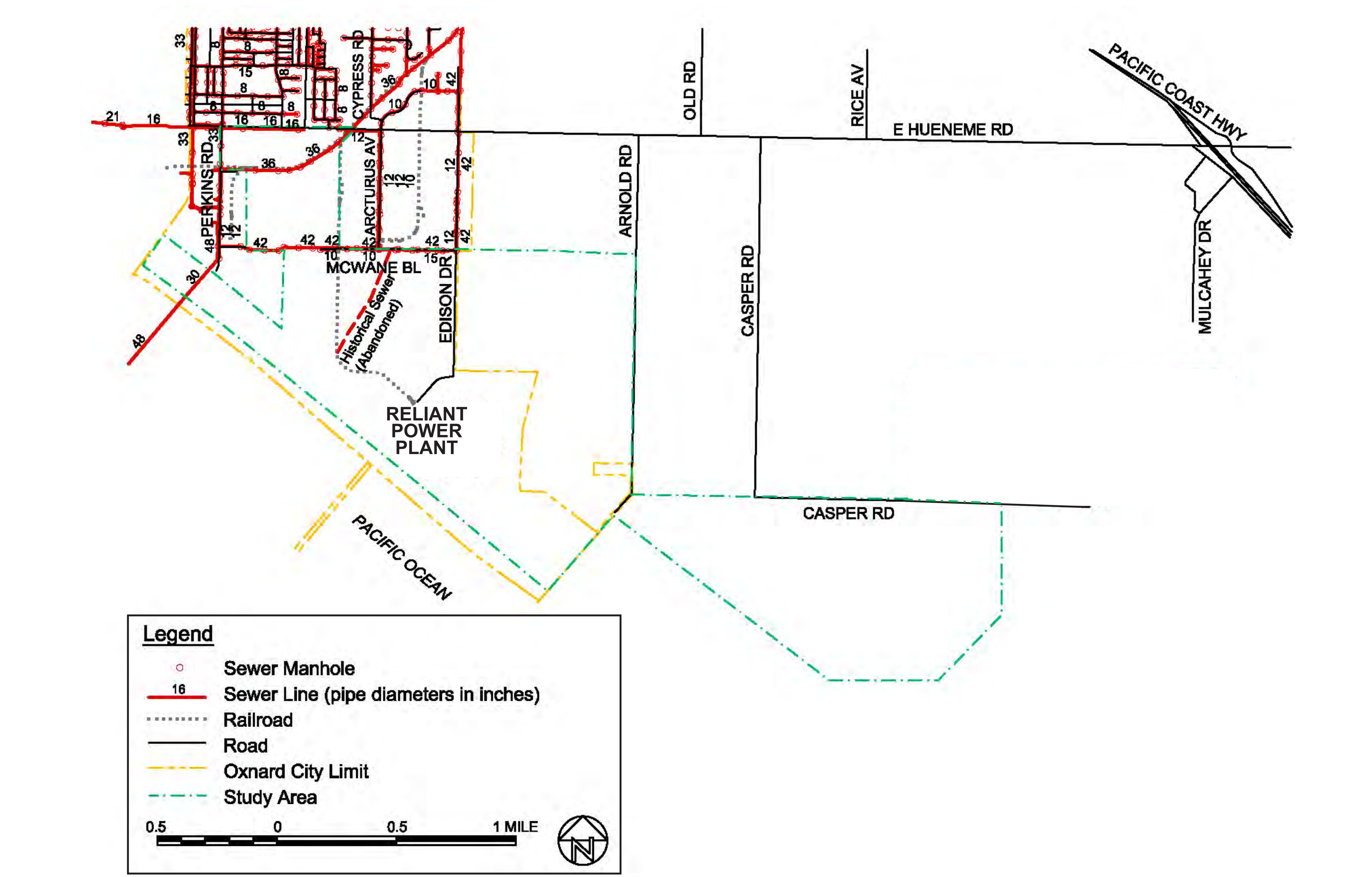


Aspen Environmental Group

Source: Everest International Consultants, 2004.

Figure A-6

Existing Water Facilities



Source: Everest International Consultants, 2004.

Figure A-7

Existing Sewer Facilities

Appendix B.

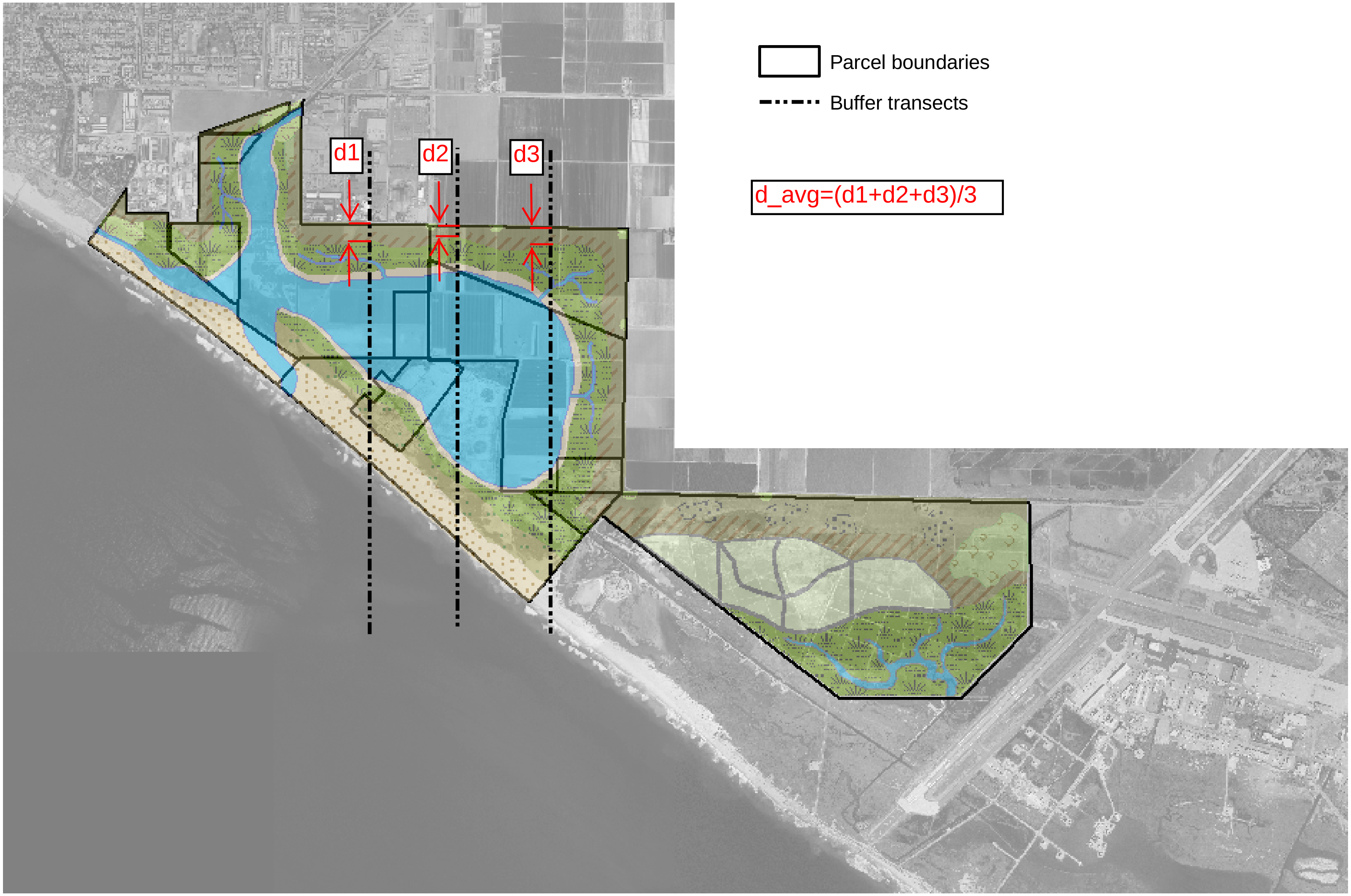
Technical Information
For
Hydrologic, Hydraulic and
Geomorphological Analysis

B. 1 Buffer Area Between Wetlands and the Project's Boundaries

To quantify the extent of buffer between wetlands habitat and the project's boundaries, three transect lines were overlaid on the project area, as shown in Figure B-1 for the unconstrained project area and in Figure B-2 for the constrained project area. The distance along each of these transects between the project boundary and the wetland boundary was measured for each alternative and then averaged. An example of this statistic is shown in Figure B-1 for Alternative 1. The transect buffer distances as well as the average for all alternatives are presented in Table B-1.

Table B-1. Buffer transect distance between wetlands and project boundaries

Alternative	West transect (ft)	Center transect (ft)	East transect (ft)	Average (ft)
Alternative 1U	324	256	306	295
Alternative 1C	50	128	256	145
Alternative 2U	1033	1194	1631	1286
Alternative 2C	764	446	482	564
Alternative 3U	2707	3930	5430	4022
Alternative 3C	2559	2943	3045	2849



Note: The property boundaries depicted in this figure are for general planning purposes only. They have not been surveyed and may not coincide exactly with parcel-specific legal boundaries.

Feet
0 2,000 4,000 8,000

figure B-1

Ormond Beach Wetland Restoration

Transects for Buffer Analysis, Unconstrained

PWA Ref# - 1738

PWA

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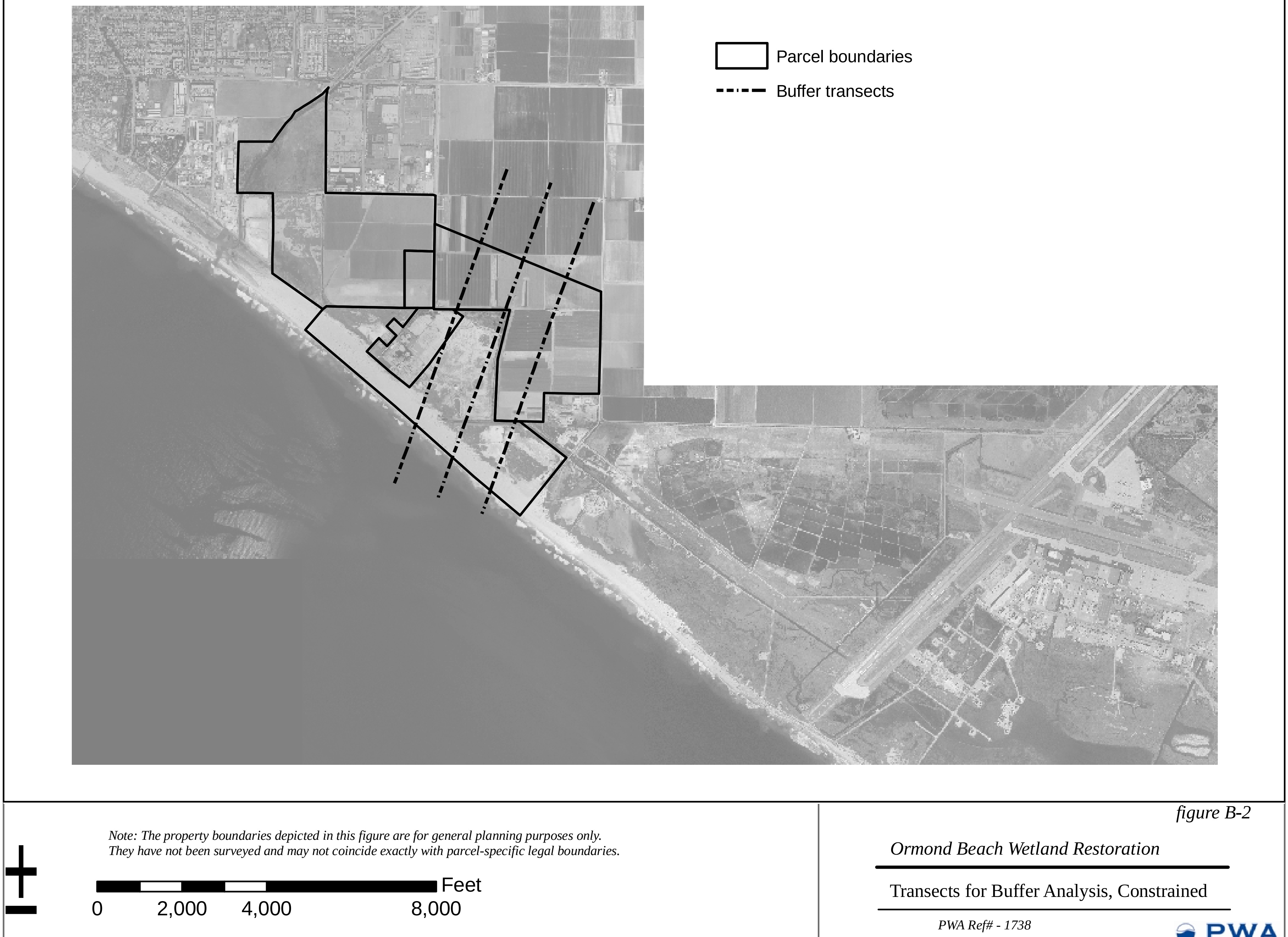

Note: The property boundaries depicted in this figure are for general planning purposes only. They have not been surveyed and may not coincide exactly with parcel-specific legal boundaries.

figure B-2

Ormond Beach Wetland Restoration

Transects for Buffer Analysis, Constrained

PWA Ref# - 1738

PWA

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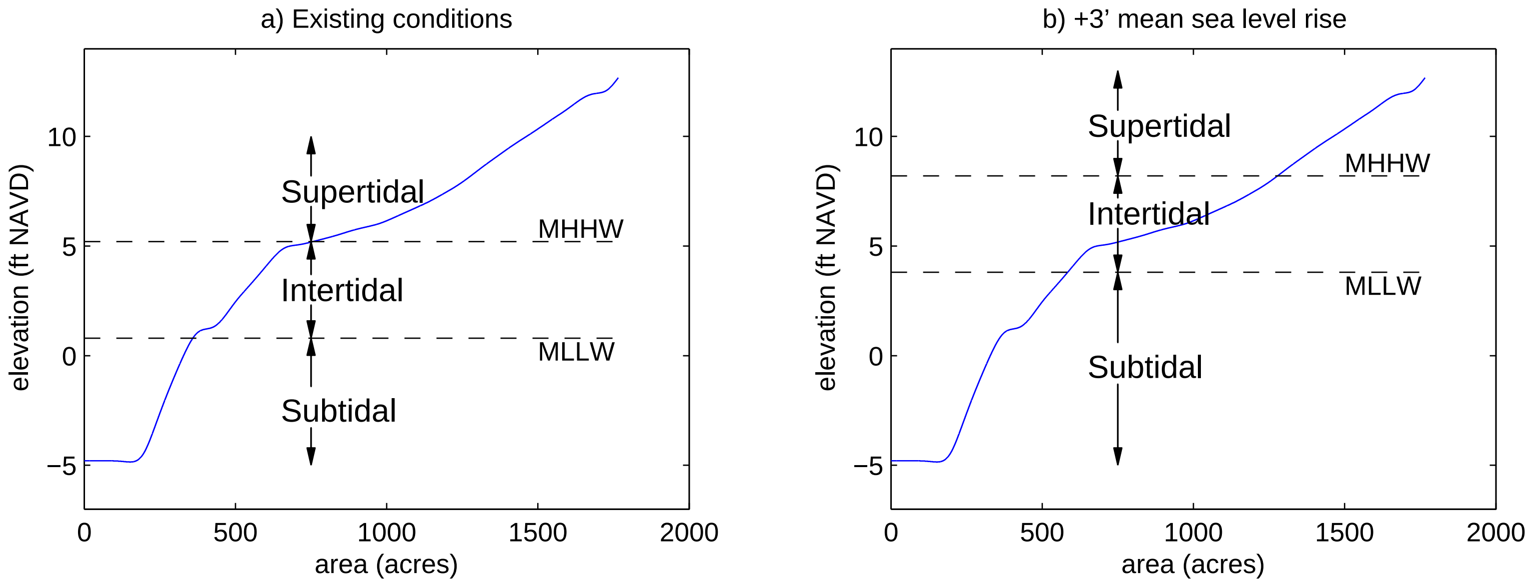
B. 2 Habitat Response to Sea Level Rise

A preliminary estimate of habitat response to three feet of sea level was conducted by partitioning the proposed grading surfaces into three elevation-based areas for existing mean sea level and mean sea level plus three feet. The three areas are subtidal, intertidal and supertidal. The boundary between subtidal and intertidal was set equal to MLLW; the boundary between intertidal and supertidal was set equal to MHHW. The areas were estimated from the hypsometry curves calculated for each alternative. (See Sections 6.1.2.1 and B. 4 for a description of tidal elevations and hypsometric curves.) An example of the existing scenario and three feet of sea level rise scenario for Alternative 1U is shown in Figure B-3. Area estimates for all alternatives are shown in Table B-2.

Table B-2. Alternative habitat predictions (in acres)

	Existing conditions			+3' mean sea level rise			Percent change		
Alternative	Subtidal	Intertidal	Supertidal	Subtidal	Intertidal	Supertidal	Subtidal	Intertidal	Supertidal
Alternative 1U	357	397	1012	584	694	488	13%	17%	-30%
Alternative 1C	288	173	334	420	189	186	17%	2%	-19%
Alternative 2U	61	268	1437	420	640	706	20%	21%	-41%
Alternative 2C	48	187	540	259	218	298	27%	4%	-31%
Alternative 3U	0	79	1686	157	775	834	9%	39%	-48%
Alternative 3C	0	0	775	0	295	479	0%	38%	-38%



Source: See Section 6

Figure *B-3*
Ormond Beach Wetlands Restoration

Alternative 1U Habitat Areas

PWA Ref# 1738

PWA

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B. 3 Tidal elevations and range

The input and resulting calculated parameters using Keuglegan (1967) are provided in Table B-3, along with the sources used to select the parameters. The coefficient of repletion, K, is calculated from the following equation from Keuglegan (1967):

$$K = \frac{TA_{avg}}{2\pi A_b}\sqrt{\frac{2g}{a_0\left[k_{en} + k_{ex} + \frac{fL}{4R}\right]}}$$

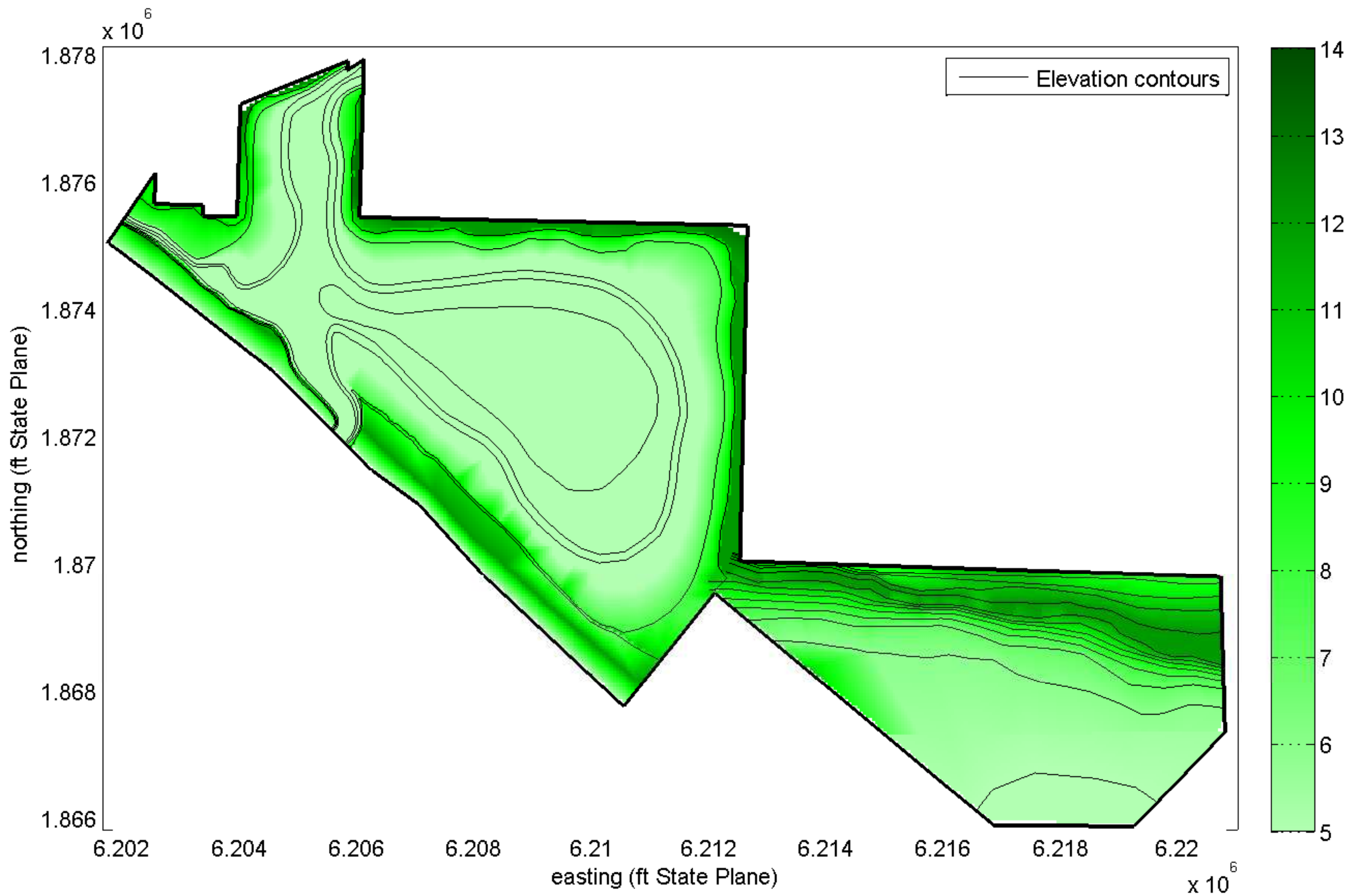
Table B-3. Parameters for Keuglegan (1967) estimate of tidal range

Input Parameter	units	Alt. 1U	Alt. 1C	Alt. 2U	Alt. 2C	Source
Tidal period (T)	hr	12.4	12.4	12.4	12.4	M_2 tidal period
Inlet width (W)	ft	337	283	149	137	Jarrett (1976)
Inlet depth (D)	ft	5.1	4.3	2.3	2.1	Jarrett (1976)
Average channel cross-section area (A_{avg})	ft^2	1719	1217	343	288	W*D
Surface area of bay (A_b)	ft^2	2.5E+07	2.1E+07	6.5E+06	5.7E+06	Alternative designs, Section 5
Ocean tide amplitude (a_0)	ft	2.61	2.61	2.61	2.61	NOAA Santa Monica (station ID 9410840)
Entrance loss coefficient (k_{en})	-	0.1	0.1	0.1	0.1	Keulegan (1967)
Exit loss coefficient (k_{ex})	-	1	1	1	1	Keulegan (1967)
Manning's n	-	0.03	0.03	0.03	0.03	U.S. Army Corps (2002) CEM
Darcy-Weisbach friction factor (f)	$ft^{1/3}$	0.061	0.065	0.080	0.082	U.S. Army Corps (2002) CEM
Inlet length (L)	ft	2000	2000	2200	2200	Alternative designs, Section 5
Hydraulic radius (R)	ft	5.0	4.2	2.2	2.0	A/(W+2D)
Calculated Parameter	**units**	**Alt. 1U**	**Alt. 1C**	**Alt. 2U**	**Alt. 2C**	**Source**
Coefficient of repletion (K)	-	0.90	0.70	0.41	0.37	Keulegan (1967)
% reduction between ocean and bay (a_b/a_0)	-	0.81	0.70	0.46	0.42	Keulegan (1967)
Bay tidal range (a_b)	ft	4.4	3.8	2.5	2.3	(% reduction) * $2a_0$
MHHW	ft	5.2	5.2	5.2	5.2	NOAA Santa Monica (station ID 9410840)
MTL	ft	3.0	3.3	4.0	4.1	MHHW-a_b
MLLW	ft	0.8	1.4	2.7	2.9	MHHW-$2a_b$

B. 4 Hypsometry, Tidal Volume and Tidal Prism

For each alternative, a hypsometric curve was generated in several steps. First, the appropriate elevation was assigned to the each alternative's key habitat boundaries by combining the tidal range estimates for each alternative with the habitat elevation assumptions described in Section 6.1.1.1. The habitat boundaries were then converted into a set of contour lines, as shown in Figure B-4. These contour lines served as the basis for interpolation to create an approximation of the alternatives' ground bathymetric surface in three dimensions (Figure B-4). The linear interpolation was conducted over the entire project area, using grid cells with a 50 meters (167 feet) spatial resolution. Finally, the interpolated bathymetric surface was sorted according to the grid cells' elevation and related to the cumulative area to estimate the hypsometry (Figure B-5).

The elevation versus depth relationship expressed by a hypsometric curve can be integrated to estimate the volume between two specified elevations. When the specified elevations are selected according to the lagoon tidal ranges described above, the resulting volumes can be related to tidal function. For example, integrating between MHHW and the lowest elevation provides an estimate of the diurnal tidal volume, the volume which is filled with tidal flow at least once per day (Figure B-5, left panel). Similarly, the diurnal tidal prism, the average quantity of water which enters and exits the lagoon during the larger of a day's two tides, can be estimated by integrating between MHHW and MLLW (Figure B-5, right panel).



Source: See Section 6

Figure B-4
Ormond Beach Wetlands Restoration

Alternative 1U Bathymetry

PWA Ref# 1738

PWA

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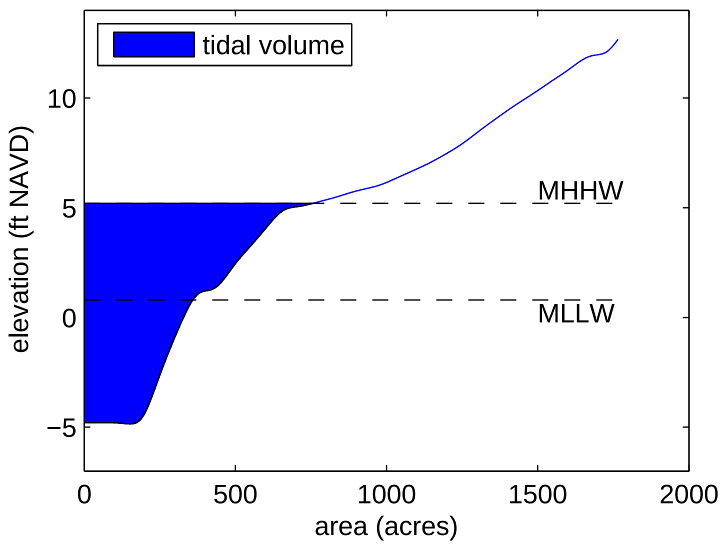

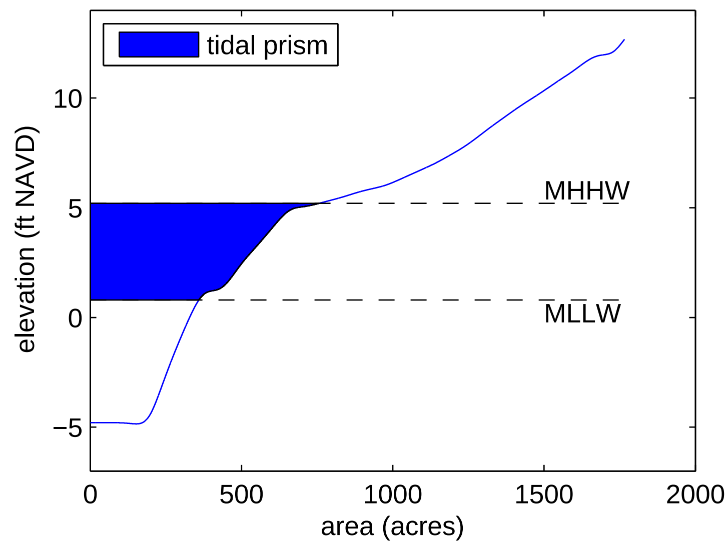

Source: See Section 6

Figure *B-5*
Ormond Beach Wetlands Restoration

Alternative 1U Hypsometry, Tidal Volume, and Tidal Prism

PWA Ref# 1738

PWA

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B. 5 Inlet Closure Stability

The Channel Equilibrium Area software (Seabergh and Kraus, 1997) was used to conduct the Escoffier analysis for the restoration alternatives. This software tool requires several input parameters to represent the characteristics of the ocean, bay, and inlet channel. The values of these parameters were selected from several sources. Table B-4 provides a summary of the parameters for the four alternatives that propose an enlarged permanent or seasonal lagoon.

Table B-4. Parameters used for Escoffier analysis of inlet closure stability

Input Parameter	units	Alt. 1U	Alt. 1C	Alt. 2U	Alt. 2C	Source
Tidal period (T)	hr	12.4	12.4	12.4	12.4	M_2 tidal period
Inlet channel width (W)	ft	337	283	149	137	Jarrett (1976)
Average channel cross-section area (A_{avg})	ft^2	1719	1217	343	288	W*D
Surface area of bay (A_b)	ft^2	2.5E+07	2.1E+07	6.5E+06	5.7E+06	Alternative designs, Section 5
Ocean tide amplitude (a_0)	ft	2.61	2.61	2.61	2.61	NOAA Santa Monica (station ID 9410840)
Entrance loss coefficient (k_{en})	-	0.1	0.1	0.1	0.1	Keulegan (1967)
Exit loss coefficient (k_{ex})	-	1	1	1	1	Keulegan (1967)
Manning's n	-	0.03	0.03	0.03	0.03	U.S. Army Corps (2002) CEM
Inlet channel length (L)	ft	2000	2000	2200	2200	Alternative designs, Section 5
Hydraulic radius (R)	ft	5.0	4.2	2.2	2.0	A/(W+2D)

Appendix C.
Construction Cost Details

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 1U: Create Lagoon, Unconstrained

1.00 YARD SETUP, MOB AND DEMOB
1.01 Mobilization and Demobilization

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Mobilization/Demobilization	1	ls	$31,168,570.00	$31,168,570

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Mob/Demob costs based on 6% of total construction cost.

1.01	**Mobilization and Demobilization** **SUBTOTAL:**	**$31,168,570**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 1U: Create Lagoon, Unconstrained

2.00 EARTHWORK, SITE ACCESS AND PREPARATION
2.01 Northwest Area

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Clear and grub	1,183	ac	$3,000.00	$3,549,000
2	Temporary haul/access routes	12,000	lf	$40.00	$480,000
3	Hydraulic dredge (excavate, haul, and dispose on beach)	2,207,000	cy	$8.00	$17,656,000
4	Cut (excavate, haul, and dispose off-site as landfill daily cover)	6,071,000	cy	$54.50	$330,869,500
5	Stockpile and dewater excavated material	3,035,500	cy	$10.80	$32,783,400
6	Remove existing road	98,280	sf	$1.88	$185,248
7	Remove existing railroad	9,900	lf	$24.04	$237,998
8	Upland grading	78	ac	$6,450.00	$499,875
	Overexcavation				
9	Cut (excavate, haul, and dispose/stockpile on-site)	2,759,300	cy	$9.60	$26,489,280
10	Hydraulic dredge (excavate, haul, and dispose on beach)	2,759,300	cy	$8.00	$22,074,400
11	Stockpile and dewater excavated material	2,759,300	cy	$10.80	$29,800,440
12	Fill and grade material on-site	2,759,300	cy	$4.86	$13,410,198
13	Berm to block Oxnard Drainage Ditch 3	1	ls	$50,000.00	$50,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Assume 20% of net cut in Northwest Area would be sand and suitable for beach disposal.
3. Assume Northwest Area would be overexcavated to hold 25% of net cut. The overexcavation would be done in area where sand is present and displaced material would be disposed on beach.
4. Assume 55% of net cut in Northwest Area to be disposed in landfill as daily cover.
5. Upland grading includes grading for coastal prairie.
6. Assume 50% of excavated material for land fill requires dewatering.
7. Does not include Halaco site clean-up. Assume Halaco site to be cleaned up and materials removed by others.
8. Assume Reliant Power Station Facility to be demolished by others.

2.01 **Northwest Area**	**SUBTOTAL:**	**$478,085,339**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 1U: Create Lagoon, Unconstrained

2.00 EARTHWORK, SITE ACCESS AND PREPARATION
2.02 Southeast Area

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Clear and grub	575	ac	$3,000.00	$1,725,000
2	Temporary haul/access routes	5,600	lf	$40.00	$224,000
3	Cut (excavate, haul, and dispose/stockpile on-site)	854,000	cy	$9.60	$8,198,400
4	Hydraulic dredge (excavate, haul, and dispose on beach)	217,000	cy	$8.00	$1,736,000
5	Fill and grade material on-site	793,550	cy	$4.86	$3,856,653
6	Upland grading	165	ac	$6,450.00	$1,064,250
7	Berm for duck pond	6,000	lf	$300.00	$1,800,000
8	Geotextile	20,000	sy	$2.83	$56,610

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Assume 100% of net cut in Southeast Area would be sand and suitable for beach disposal.
3. Upland grading includes grading for coastal prairie and wetland depression.

2.02	**Southeast Area**	**SUBTOTAL:**	**$18,660,913**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 1U: Create Lagoon, Unconstrained

3.00 UTILITIES
3.01 Utility & Service Protection, Relocation or Removal

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Remove underground gas utilities	7,600	lf	$26.59	$202,118
2	Remove underground petroleum utilities	7,000	lf	$30.00	$210,000
3	Remove underground and overhead power utilities	23,000	lf	$30.00	$690,000
4	Remove telephone utilities	10,500	lf	$12.00	$126,000
5	Remove underground water utilities	5,700	lf	$15.00	$85,500
6	Remove underground sewer utilities	5,000	lf	$18.00	$90,000
7	Protect and/or relocate misc. utilities (nominal)	1	ls	$50,000.00	$50,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.

3.01	**Utility & Service Protection, Relocation or Removal** **SUBTOTAL:**	**$1,453,618**

Alternative 1U: Create Lagoon, Unconstrained

4.00 HYDRAULIC IMPROVEMENTS
4.01 Miscellaneous Hydraulic Improvements

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Pumping to duck pond	1	ls	$80,000.00	$80,000
2	Inlet Jetty	1	ls	###########	$2,500,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Inlet Jetty cost is an allowance only.
3. Pumping cost is construction cost only. Does not include operating costs.

4.01	**Miscellaneous Hydraulic Improvements**	**SUBTOTAL:**	**$2,580,000**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 1U: Create Lagoon, Unconstrained

5.00 MISCELLANEOUS STRUCTURES AND FACILTIES
5.01 Miscellaneous Structures and Recreational Facilities

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Visitor Center	1	ls	$800,000.00	$800,000
2	Viewing platform	5,000	sf	$90.00	$450,000
3	Public parking	100,000	sf	$4.12	$412,000
4	Pedestrian trail	26,400	lf	$30.00	$792,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.

5.01	**Miscellaneous Structures and Recreational Facilities**	**SUBTOTAL:**	**$2,454,000**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 1U: Create Lagoon, Unconstrained

6.00 HABITAT
6.01 Revegetation

Item #	Item	Description	Quantity	Unit	Unit Price	TOTAL
1	809	Coastal praire and seasonal wetland depression	359	ac	$10,000.00	$3,590,000
2	810	Willow scrub	38	ac	$48,600.00	$1,846,800
3	813	Treatment wetlands	21	ac	$15,000.00	$315,000
4	814	Coastal salt marsh	402	ac	$35,000.00	$14,080,500
5	812	Backdune	70	ac	$0.00	$0.00

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Costs include temporary irrigation during planting.
3. Assume 90% of total area of coastal salt marsh needs new planting.

6.01		**Revegetation**	**SUBTOTAL:**	**$16,242,300**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 1C: Create Lagoon, Constrained

1.00 YARD SETUP, MOB AND DEMOB
1.01 Mobilization and Demobilization

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Mobilization/Demobilization	1	ls	$21,379,060.00	$21,379,060

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Mob/Demob costs based on 6% of total construction cost.

1.01 Mobilization and Demobilization	**SUBTOTAL:**	**$21,379,060**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 1C: Create Lagoon, Constrained

2.00 EARTHWORK, SITE ACCESS AND PREPARATION
2.01 Northwest Area

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Clear and grub	795	ac	$3,000.00	$2,385,000
2	Temporary haul/access routes	12,000	lf	$40.00	$480,000
3	Hydraulic dredge (excavate, haul, and dispose on beach)	1,507,000	cy	$8.00	$12,056,000
4	Cut (excavate, haul, and dispose off-site as landfill daily cover)	4,145,000	cy	$54.50	$225,902,500
5	Stockpile and dewater excavated material	2,072,500	cy	$10.80	$22,383,000
6	Remove existing road	98,280	sf	$1.88	$185,248
7	Remove existing railroad	9,900	lf	$24.04	$237,998
8	Upland grading	30	ac	$6,450.00	$193,500
9	Overexcavation				
10	Cut (excavate, haul, and dispose/stockpile on-site)	1,884,000	cy	$9.60	$18,086,400
	Hydraulic dredge (excavate, haul, and dispose on beach)	1,884,000	cy	$8.00	$15,072,000
11	Stockpile and dewater excavated material	1,884,000	cy	$10.80	$20,347,200
12	Fill and grade material on-site	1,884,000	cy	$4.86	$9,156,240
13	Berm to block Oxnard Drainage Ditch 3	1	ls	$50,000.00	$50,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Assume 20% of net cut in Northwest Area would be sand and suitable for beach disposal.
3. Assume Northwest Area would be overexcavated to hold 25% of net cut. The overexcavation would be done in area where sand is present and displaced material would be disposed on beach.
4. Assume 55% of net cut in Northwest Area to be disposed in landfill as landcover.
5. Upland grading includes grading for coastal prairie.
6. Assume 50% of excavated material for land fill and on-site fill requires dewatering.

2.01	**Northwest Area**	**SUBTOTAL:**	**$326,535,086**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 1C: Create Lagoon, Constrained

3.00 UTILITIES
3.01 Utility & Service Protection, Relocation or Removal

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Remove underground gas utilities	7,600	lf	$26.59	$202,118
2	Remove underground petroleum utilities	7,000	lf	$30.00	$210,000
3	Remove underground and overhead power utilities	23,000	lf	$30.00	$690,000
4	Remove telephone utilities	10,500	lf	$12.00	$126,000
5	Remove underground water utilities	5,700	lf	$15.00	$85,500
6	Remove underground sewer utilities	5,000	lf	$18.00	$90,000
7	Protect and/or relocate misc. utilities (nominal)	1	ls	$50,000.00	$50,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.

3.01	**Utility & Service Protection, Relocation or Removal**	**SUBTOTAL:**	**$1,453,618**

Alternative 1C: Create Lagoon, Constrained

4.00 HYDRAULIC IMPROVEMENTS
4.01 Miscellaneous Hydraulic Improvements

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Inlet Jetty	1	ls	###########	$2,500,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Inlet Jetty cost is an allowance only.

4.01	**Miscellaneous Hydraulic Improvements**	**SUBTOTAL:**	**$2,500,000**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 1C: Create Lagoon, Constrained

5.00 MISCELLANEOUS STRUCTURES AND FACILTIES
5.01 Miscellaneous Structures and Recreational Facilities

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Visitor Center	1	ls	$800,000.00	$800,000
2	Viewing platform	5,000	sf	$90.00	$450,000
3	Public parking	100,000	sf	$4.12	$412,000
4	Pedestrian trail	26,400	lf	$30.00	$792,000
5	Elevated causeway	88,000	sf	$200.00	$17,600,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.

5.01	**Miscellaneous Structures and Recreational Facilities**	**SUBTOTAL:**	**$20,054,000**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 1C: Create Lagoon, Constrained

6.00 HABITAT
6.01 Revegetation

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Coastal praire and seasonal wetland depression	86	ac	$10,000.00	$860,000
2	Treatment wetlands	7	ac	$15,000.00	$105,000
3	Coastal salt marsh	162	ac	$35,000.00	$5,670,000
4	Backdune	50	ac	$0.00	$0.00

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Costs include temporary irrigation during planting.
3. Assume 90% of total area of coastal salt marsh needs new planting.

6.01 Revegetation	**SUBTOTAL:**	**$5,775,000**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 2U: Restore Seasonal Ponds, Unconstrained

1.00 YARD SETUP, MOB AND DEMOB
1.01 Mobilization and Demobilization

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Mobilization/Demobilization	1	ls	$15,760,920.00	$15,760,920

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Mob/Demob costs based on 8% of total construction cost.

1.01	**Mobilization and Demobilization**	**SUBTOTAL:**	**$15,760,920**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 2U: Restore Seasonal Ponds, Unconstrained

2.00 EARTHWORK, SITE ACCESS AND PREPARATION
2.01 Northwest Area

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Clear and grub	1,184	ac	$3,000.00	$3,552,000
2	Temporary haul/access routes	12,000	lf	$40.00	$480,000
3	Hydraulic dredge (excavate, haul, and dispose on beach)	658,000	cy	$8.00	$5,264,000
4	Cut (excavate, haul, and dispose off-site as landfill daily cover)	2,470,000	cy	$54.50	$134,615,000
5	Stockpile and dewater excavated material	1,235,000	cy	$10.80	$13,338,000
6	Remove existing road	98,280	sf	$1.88	$185,248
7	Remove existing railroad	9,900	lf	$24.04	$237,998
8	Upland grading	40	ac	$6,450.00	$258,000
9	Berm to block Oxnard Drainage Ditch 3	1	ls	$50,000.00	$50,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Assume 20% of net cut in Northwest Area would be sand and suitable for beach disposal.
3. Assume 80% of net cut in Northwest Area to be disposed in landfill as landcover.
4. Upland grading includes grading for coastal prairie.
5. Assume 50% of excavated material for land fill and on-site fill requires dewatering.
6. Does not include Halaco site clean-up. Assume Halaco site to be cleaned up and materials removed by others.
7. Assume Reliant Power Station Facility to be demolished by others.

2.01	**Northwest Area** **SUBTOTAL:**	**$157,980,246**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 2U: Restore Seasonal Ponds, Unconstrained

2.00 EARTHWORK, SITE ACCESS AND PREPARATION
2.02 Southeast Area

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Clear and grub	575	ac	$3,000.00	$1,725,000
2	Temporary haul/access routes	5,600	lf	$40.00	$224,000
3	Cut (excavate, haul, and dispose/stockpile on-site)	854,000	cy	$9.60	$8,198,400
4	Hydraulic dredge (excavate, haul, and dispose on beach)	217,000	cy	$8.00	$1,736,000
5	Fill and grade material on-site	793,550	cy	$4.86	$3,856,653
6	Upland grading	165	ac	$6,450.00	$1,064,250
7	Berm for duck pond	6,000	lf	$300.00	$1,800,000
8	Geotextile	20,000	sy	$2.83	$56,610

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Assume 100% of net cut in Southeast Area would be sand and suitable for beach disposal.
3. Upland grading includes grading for coastal prairie and wetland depression.

2.02	**Southeast Area**	**SUBTOTAL:**	**$18,660,913**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 2U: Restore Seasonal Ponds, Unconstrained

3.00 UTILITIES
3.01 Utility & Service Protection, Relocation or Removal

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Remove underground gas utilities	7,600	lf	$26.59	$202,118
2	Remove underground petroleum utilities	7,000	lf	$30.00	$210,000
3	Remove underground and overhead power utilities	23,000	lf	$30.00	$690,000
4	Remove telephone utilities	10,500	lf	$12.00	$126,000
5	Remove underground water utilities	5,700	lf	$15.00	$85,500
6	Remove underground sewer utilities	5,000	lf	$18.00	$90,000
7	Protect and/or relocate misc. utilities (nominal)	1	ls	$50,000.00	$50,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.

3.01 Utility & Service Protection, Relocation or Removal	**SUBTOTAL:**	**$1,453,618**

Alternative 2U: Restore Seasonal Ponds, Unconstrained

4.00 HYDRAULIC IMPROVEMENTS
4.01 Miscellaneous Hydraulic Improvements

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Pumping to duck pond	1	ls	$80,000.00	$80,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Pumping cost is construction cost only. Does not include operating costs.

4.01	**Miscellaneous Hydraulic Improvements**	**SUBTOTAL:**	**$80,000**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 2U: Restore Seasonal Ponds, Unconstrained

5.00 MISCELLANEOUS STRUCTURES AND FACILTIES
5.01 Miscellaneous Structures and Recreational Facilities

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Visitor Center	1	ls	$800,000.00	$800,000
2	Viewing platform	5,000	sf	$90.00	$450,000
3	Public parking	100,000	sf	$4.12	$412,000
4	Pedestrian trail	26,400	lf	$30.00	$792,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.

5.01	**Miscellaneous Structures and Recreational Facilities** **SUBTOTAL:**	**$2,454,000**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 2U: Restore Seasonal Ponds, Unconstrained

6.00 HABITAT
6.01 Revegetation

Item #	Item	Description	Quantity	Unit	Unit Price	TOTAL
1	809	Coastal praire and seasonal wetland depression	608	ac	$10,000.00	$6,080,000
2	810	Willow scrub	43	ac	$48,600.00	$2,089,800
3	813	Treatment wetlands	25	ac	$15,000.00	$375,000
4	814	Coastal salt marsh	392	ac	$35,000.00	$13,734,000
5	812	Backdune	55	ac	$0.00	$0.00
6	811	Brackish marsh	9	ac	$20,000.00	$184,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Costs include temporary irrigation during planting.
3. Assume 90% of total area of coastal salt marsh needs new planting.
4. Assume 20% of total area of brackish marsh needs new planting.

6.01	Revegetation	SUBTOTAL:	$16,382,800

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 2C: Restore Seasonal Ponds, Constrained

1.00 YARD SETUP, MOB AND DEMOB
1.01 Mobilization and Demobilization

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Mobilization/Demobilization	1	ls	$12,154,500.00	$12,154,500

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Mob/Demob costs based on 8% of total construction cost.

1.01 Mobilization and Demobilization	**SUBTOTAL:**	**$12,154,500**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 2C: Restore Seasonal Ponds, Constrained

2.00 EARTHWORK, SITE ACCESS AND PREPARATION
2.01 Northwest Area

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Clear and grub	772	ac	$3,000.00	$2,316,000
2	Temporary haul/access routes	12,000	lf	$40.00	$480,000
3	Hydraulic dredge (excavate, haul, and dispose on beach)	588,000	cy	$8.00	$4,704,000
4	Cut (excavate, haul, and dispose off-site as landfill daily cover)	2,170,000	cy	$54.50	$118,265,000
5	Stockpile and dewater excavated material	1,085,000	cy	$10.80	$11,718,000
6	Remove existing road	98,280	sf	$1.88	$185,248
7	Remove existing railroad	9,900	lf	$24.04	$237,998
8	Upland grading	30	ac	$6,450.00	$193,500
9	Berm to block Oxnard Drainage Ditch 3	1	ls	$50,000.00	$50,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Assume 20% of net cut in Northwest Area would be sand and suitable for beach disposal.
3. Assume 80% of net cut in Northwest Area to be disposed in landfill as landcover.
4. Upland grading includes grading for coastal prairie.
5. Assume 50% of excavated material for land fill and on-site fill requires dewatering.

2.01 Northwest Area SUBTOTAL: $138,149,746

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 2C: Restore Seasonal Ponds, Constrained

3.00 UTILITIES
3.01 Utility & Service Protection, Relocation or Removal

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Remove underground gas utilities	7,600	lf	$26.59	$202,118
2	Remove underground petroleum utilities	7,000	lf	$30.00	$210,000
3	Remove underground and overhead power utilities	23,000	lf	$30.00	$690,000
4	Remove telephone utilities	10,500	lf	$12.00	$126,000
5	Remove underground water utilities	5,700	lf	$15.00	$85,500
6	Remove underground sewer utilities	5,000	lf	$18.00	$90,000
7	Protect and/or relocate misc. utilities (nominal)	1	ls	$50,000.00	$50,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.

3.01 Utility & Service Protection, Relocation or Removal SUBTOTAL: $1,453,618

Alternative 2C: Restore Seasonal Ponds, Constrained

4.00 HYDRAULIC IMPROVEMENTS
4.01 Miscellaneous Hydraulic Improvements

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Inlet Jetty	1	ls	$2,500,000.00	$2,500,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.

4.01	**Miscellaneous Hydraulic Improvements**	**SUBTOTAL:**	**$2,500,000**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 2C: Restore Seasonal Ponds, Constrained

5.00 MISCELLANEOUS STRUCTURES AND FACILTIES
5.01 Miscellaneous Structures and Recreational Facilities

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Visitor Center	1	ls	$800,000.00	$800,000
2	Viewing platform	5,000	sf	$90.00	$450,000
3	Public parking	100,000	sf	$4.12	$412,000
4	Pedestrian trail	26,400	lf	$30.00	$792,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.

5.01	**Miscellaneous Structures and Recreational Facilities**	**SUBTOTAL:**	**$2,454,000**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 2C: Restore Seasonal Ponds, Constrained

6.00 HABITAT
6.01 Revegetation

Item #	Item	Description	Quantity	Unit	Unit Price	TOTAL
1	809	Coastal praire and seasonal wetland depression	86	ac	$10,000.00	$860,000
2	810	Willow scrub	5	ac	$48,600.00	$243,000
3	813	Treatment wetlands	7	ac	$15,000.00	$105,000
4	814	Coastal salt marsh	198	ac	$35,000.00	$6,930,000
5	812	Backdune	44	ac	$0.00	$0.00
6	811	Brackish marsh	5	ac	$20,000.00	$96,000

Notes:

1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Costs include temporary irrigation during planting.
3. Assume 90% of total area of coastal salt marsh needs new planting.
4. Assume 20% of total area of brackish marsh needs new planting.

6.01	**Revegetation**	**SUBTOTAL:**	**$7,374,000**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 3U: Enhance Existing Conditions, Unconstrained

1.00 YARD SETUP, MOB AND DEMOB
1.01 Mobilization and Demobilization

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Mobilization/Demobilization	1	ls	$2,693,890.00	$2,693,890

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Mob/Demob costs based on 10% of total construction cost.

1.01	**Mobilization and Demobilization**	**SUBTOTAL:**	**$2,693,890**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 3U: Enhance Existing Conditions, Unconstrained

2.00 EARTHWORK, SITE ACCESS AND PREPARATION
2.01 Northwest Area

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Clear and grub	1,182	ac	$3,000.00	$3,546,000
2	Temporary haul/access routes	6,000	lf	$40.00	$240,000
3	Remove existing road	98,280	sf	$1.88	$185,248
4	Remove existing railroad	9,900	lf	$24.04	$237,998
5	Upland grading	1,190	ac	$6,450.00	$7,675,500
6	Berm to block Oxnard Drainage Ditch 3	1	ls	$50,000.00	$50,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Assume grading of entire area to be done by scrapers.
3. Assume excavation is above ground water elevation and dewatering of excavated material is not necessary.
4. Does not include Halaco site clean-up. Assume Halaco site to be cleaned up and materials removed by others.
5. Assume Reliant Power Station Facility to be demolished by others.

2.01 **Northwest Area**	**SUBTOTAL:**	**$11,934,746**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 3U: Enhance Existing Conditions, Unconstrained

2.00 EARTHWORK, SITE ACCESS AND PREPARATION
2.02 Southeast Area

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Clear and grub	575	ac	$3,000.00	$1,725,000
2	Upland grading	575	ac	$6,450.00	$3,708,750

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Upland grading includes grading for coastal prairie and wetland depression.
3. Assume grading of entire area to be done by scrapers.

2.02	**Southeast Area**	**SUBTOTAL:**	**$5,433,750**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 3U: Enhance Existing Conditions, Unconstrained

3.00 UTILITIES
3.01 Utility & Service Protection, Relocation or Removal

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Remove underground gas utilities	7,600	lf	$26.59	$202,118
2	Remove underground petroleum utilities	7,000	lf	$30.00	$210,000
3	Remove underground and overhead power utilities	23,000	lf	$30.00	$690,000
4	Remove telephone utilities	10,500	lf	$12.00	$126,000
5	Remove underground water utilities	5,700	lf	$15.00	$85,500
6	Remove underground sewer utilities	5,000	lf	$18.00	$90,000
7	Protect and/or relocate misc. utilities (nominal)	1	ls	$50,000.00	$50,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.

3.01 Utility & Service Protection, Relocation or Removal SUBTOTAL: $1,453,618

Alternative 3U: Enhance Existing Conditions, Unconstrained

4.00 HYDRAULIC IMPROVEMENTS
4.01 Miscellaneous Hydraulic Improvements

Item #	Description	Quantity	Unit	Unit Price	TOTAL
	No hydraulic improvements.				

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.

4.01	**Miscellaneous Hydraulic Improvements**	**SUBTOTAL:**	

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 3U: Enhance Existing Conditions, Unconstrained

5.00 MISCELLANEOUS STRUCTURES AND FACILTIES
5.01 Miscellaneous Structures and Recreational Facilities

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Visitor Center	1	ls	$800,000.00	$800,000
2	Viewing platform	5,000	sf	$90.00	$450,000
3	Public parking	100,000	sf	$4.12	$412,000
4	Pedestrian trail	26,400	lf	$30.00	$792,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.

5.01	**Miscellaneous Structures and Recreational Facilities**	**SUBTOTAL:**	**$2,454,000**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 3U: Enhance Existing Conditions, Unconstrained

6.00 HABITAT
6.01 Revegetation

Item #	Item	Description	Quantity	Unit	Unit Price	TOTAL
1	809	Coastal praire and seasonal wetland depression	1,024	ac	$10,000.00	$10,240,000
2	810	Willow scrub	8	ac	$48,600.00	$388,800
3	813	Treatment wetlands	24	ac	$15,000.00	$360,000
4	814	Coastal salt marsh	112	ac	$35,000.00	$3,920,000
5	812	Backdune	85	ac	$0.00	$0.00
6	811	Brackish marsh	12	ac	$20,000.00	$244,000
7	815	Salt grass	75	ac	$10,000.00	$750,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Costs include temporary irrigation during planting.
3. Assume 50% of total area of coastal salt marsh needs new planting.
4. Assume 20% of total area of brackish marsh needs new planting.
5. Assume 50% of total area of salt grass needs new planting.

6.01	**Revegetation**	**SUBTOTAL:**	**$5,662,800**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 3C: Enhance Existing Conditions, Constrained

1.00 YARD SETUP, MOB AND DEMOB
1.01 Mobilization and Demobilization

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Mobilization/Demobilization	1	ls	$1,548,800.00	$1,548,800

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Mob/Demob costs based on 10% of total construction cost.

1.01	**Mobilization and Demobilization**	**SUBTOTAL:**	**$1,548,800**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 3C: Enhance Existing Conditions, Constrained

2.00 EARTHWORK, SITE ACCESS AND PREPARATION
2.01 Northwest Area

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Clear and grub	775	ac	$3,000.00	$2,325,000
2	Temporary haul/access routes	6,000	lf	$40.00	$240,000
3	Remove existing road	98,280	sf	$1.88	$185,248
4	Remove existing railroad	9,900	lf	$24.04	$237,998
5	Upland grading	845	ac	$6,450.00	$5,450,250
6	Berm to block Oxnard Drainage Ditch 3	1	ls	$50,000.00	$50,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Assume grading of entire area to be done by scrapers.
3. Assume excavation is above ground water elevation and dewatering of excavated material is not necessary.

2.01 Northwest Area	**SUBTOTAL:**	**$8,488,496**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 3C: Enhance Existing Conditions, Constrained

3.00 UTILITIES
3.01 Utility & Service Protection and Relocation

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Remove underground gas utilities	7,600	lf	$26.59	$202,118
2	Remove underground petroleum utilities	7,000	lf	$30.00	$210,000
3	Remove underground and overhead power utilities	23,000	lf	$30.00	$690,000
4	Remove telephone utilities	10,500	lf	$12.00	$126,000
5	Remove underground water utilities	5,700	lf	$15.00	$85,500
6	Remove underground sewer utilities	5,000	lf	$18.00	$90,000
7	Protect and/or relocate misc. utilities (nominal)	1	ls	$50,000.00	$50,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.

3.01 Utility & Service Protection and Relocation	**SUBTOTAL:**	**$1,453,618**

Alternative 3C: Enhance Existing Conditions, Constrained

4.00 HYDRAULIC IMPROVEMENTS
4.01 Miscellaneous Hydraulic Improvements

Item #	Description	Quantity	Unit	Unit Price	TOTAL
	No hydraulic improvements.				

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.

4.01	**Miscellaneous Hydraulic Improvements**	**SUBTOTAL:**	

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 3C: Enhance Existing Conditions, Constrained

5.00 MISCELLANEOUS STRUCTURES AND FACILTIES
5.01 Miscellaneous Recreational Facilities and Structures

Item #	Description	Quantity	Unit	Unit Price	TOTAL
1	Visitor Center	1	ls	$800,000.00	$800,000
2	Viewing platform	5,000	sf	$90.00	$450,000
3	Public parking	100,000	sf	$4.12	$412,000
4	Pedestrian trail	26,400	lf	$30.00	$792,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.

5.01	**Miscellaneous Recreational Facilities and Structures**	**SUBTOTAL:**	**$2,454,000**

Ormond Beach Wetland Restoration Feasibility Plan
Alternative 3C: Enhance Existing Conditions, Constrained

6.00 HABITAT
6.01 Revegetation

Item #	Item	Description	Quantity	Unit	Unit Price	TOTAL
1	809	Coastal praire and seasonal wetland depression	422	ac	$10,000.00	$4,220,000
2	810	Willow scrub	4	ac	$48,600.00	$194,400
3	813	Treatment wetlands	8	ac	$15,000.00	$120,000
4	814	Coastal salt marsh	77	ac	$35,000.00	$2,677,500
5	812	Backdune	65	ac	$0.00	$0.00
6	811	Brackish marsh	5	ac	$20,000.00	$100,000

Notes:
1. Unit costs are in-place costs and include contractor's overhead and profit.
2. Costs include temporary irrigation during planting.
3. Assume 50% of total area of coastal salt marsh needs new planting.
4. Assume 20% of total area of brackish marsh needs new planting.
5. Assume 50% of total area of salt grass needs new planting.

6.01	Revegetation	SUBTOTAL:	$3,091,900