FINAL REPORT

Ormond Beach Wetland Restoration Site-Wide Soil/Surface Water Investigation

Prepared for:

Aspen Environmental Group
30423 Canwood Street, Suite 215
Agoura Hills, California 91301-4316

Prepared by:

AMEC Earth & Environmental, Inc.
9210 Sky Park Court, Suite 200
San Diego, California 92123

November 2006
PN: 4151001200

FINAL REPORT
ORMOND BEACH WETLAND RESTORATION
GENERAL SITE-WIDE INVESTIGATION
FOR SOIL REUSE OPTIONS

Prepared for:
Aspen Environmental Group
30423 Canwood Street, Suite 215
Agoura Hills, California 91301-4316
Tel: (818) 597-3407
Attn: Susan Walker

Submitted by:
AMEC Earth & Environmental, Inc.
9210 Sky Park Court, Suite 200
San Diego, California 92123
(858) 300-4300

November 2006

Project No. 4151001200

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

AMEC	AMEC Earth & Environmental, Inc.
Aspen	Aspen Environmental Group
ASTM	American Society for Testing and Materials
bgs	below ground surface
CCC	criteria continuous concentration
CMC	criteria maximum concentration
CTR	California Toxics Rule
DDD	Dichloro-diphenyl-dichloroethane
DDE	Dichloro-diphenyl-dichloroethylene
DDT	Dichloro-diphenyl-trichloroethane
EPA	U.S. Environmental Protection Agency
ER-L	effects range-low
ER-M	effects range-median
ft	foot/feet
GPS	global positioning system
HASP	Health and Safety Plan
in	inch/inches
LAR	limited access rig
mg/kg	milligram per kilogram
mg/L	milligram per liter
MLLW	mean lower low water
MWD	Metropolitan Water District
NAVD	North American Vertical Datum
NBS	National Bureau of Standards
NBVC	Naval Base Ventura County
ND	non-detect
OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PEL	probable effects level
QA/QC	quality assurance/quality control
RWQCB	Regional Water Quality Control Board

SAP	Sampling and Analysis Plan
SCC	California State Coastal Conservancy
SU	Salinity Unit
TEL	threshold effects level
TOC	total organic carbon
TPH	total petroleum hydrocarbons
µg/kg	micrograms per kilogram
µg/L	microgram per liter
µm	micrometer
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
WMU	Waste Management Unit

1.0 INTRODUCTION

The California State Coastal Conservancy (SCC) is studying the feasibility of restoring the Ormond Beach Wetlands located in Oxnard, California (Figure 1). A major component of the wetland restoration feasibility study consists of determining the physical and chemical characteristics of the soils and waters within the project area. During an initial phase of the study, AMEC Earth & Environmental, Inc. (AMEC) reviewed numerous documents pertaining to chemical contamination in the soils and sediment in and around the proposed restoration area. The information was summarized in a report titled "Ormond Beach Wetland Restoration Project - Soil Contaminant Review, January 2005" (AMEC 2005). Contained within the report was a list of data gaps pertaining to potential soil and sediment contaminants within the proposed restoration area. Three key data gaps identified were: 1) lack of sediment characterization data in large areas of the site, 2) no samples collected deeper than 5 feet (ft) below ground surface (bgs), and 3) lack of testing for some constituents of concern.

To address the data gaps discussed above, AMEC was contracted by Aspen Environmental Group (Aspen) to conduct general site-wide soil and surface water investigations of the proposed project site. The study involved collection of 30 soil samples and 10 surface water samples positioned throughout the footprint. This report details the sample collection methods employed, and the soil and water chemistry and soil grain size results. The study results are compared to available sediment and water quality ecological effects guidelines to assess the levels of chemical contaminants in the test media. In addition, the physical test results (i.e., grain size) are evaluated to assess their potential for beneficial reuse options (e.g., beach nourishment, habitat enhancement).

The purpose of this site evaluation is to provide a general snapshot of the physical and chemical characteristics of soils and waters within the proposed Ormond Beach Wetland Restoration study area described in the site-specific Sampling and Analysis Plan (SAP) (AMEC 2006). This general assessment is not an exhaustive analysis of each conceivable issue of potential concern. This study has not evaluated/assessed any potential impacts of chemicals contained within the study area on human health and it should not be used for this purpose. The professional opinions in this report are based in part on the interpretation of data from discrete sampling locations that may not represent conditions at unsampled locations.

2.0 SITE HISTORY

The Ormond Beach Wetland Restoration site is located in the City of Oxnard, Ventura County, California. It is situated northwest of Mugu Lagoon and Naval Base Ventura County (NBVC) Point Mugu (Figure 1). The wetland restoration site has several onsite and adjacent former and current uses that could be potential sources of chemical contamination. The site is located adjacent to a former metal recycling facility (currently owned by Alpha and Omega Development, but formerly known as the Halaco Engineering foundry site and slag disposal pile), agricultural fields, an industrial drain, and other agricultural and industrial uses.

w:\sd06\aquatic\ormond_beach\mxd\prj_location.mxd

Date: 06/29/06

Regional Project Location
Ormond Beach Wetland Restoration Project

FIGURE

1

The restoration area consists of these subareas:

- 309 acres north and east of the Alpha and Omega Development slag pile, 277 acres of which was recently acquired by The Nature Conservancy and the SCC from the City of Oxnard / Metropolitan Water District (MWD) (referred to as the former City of Oxnard/MWD Property);
- The 265-acre former Edison Property now owned by the SCC;
- Approximately 340 acres of the Southland Sod Farm (the portion south of McWane Boulevard if this roadway were extended from Edison Drive to Arnold Road);
- The triangular Hueneme Parcel and property between J Street Drain and the northwest boundary of the SCC's 265-acre property, which are owned by the City of Oxnard;
- The Ventura County Game Preserve (approximately 600 acres);
- The approximately 5-acre parcel bounded by Perkins Road/Hueneme Road/Magellan Avenue owned by the City of Oxnard, and the remaining approximately 33 acres that lay north of the railroad tracks and south of Hueneme Road owned by various parties; and
- The Agromin Parcel (approximately 24 acres).

Several drains (e.g., Oxnard Industrial Drain) and drainage ditches (e.g., Oxnard Drainage Ditch #3) that carry stormwater, agricultural runoff, and other wastewaters also traverse the site. These drains and ditches might serve as a source and/or sink for contaminated soils and waters.

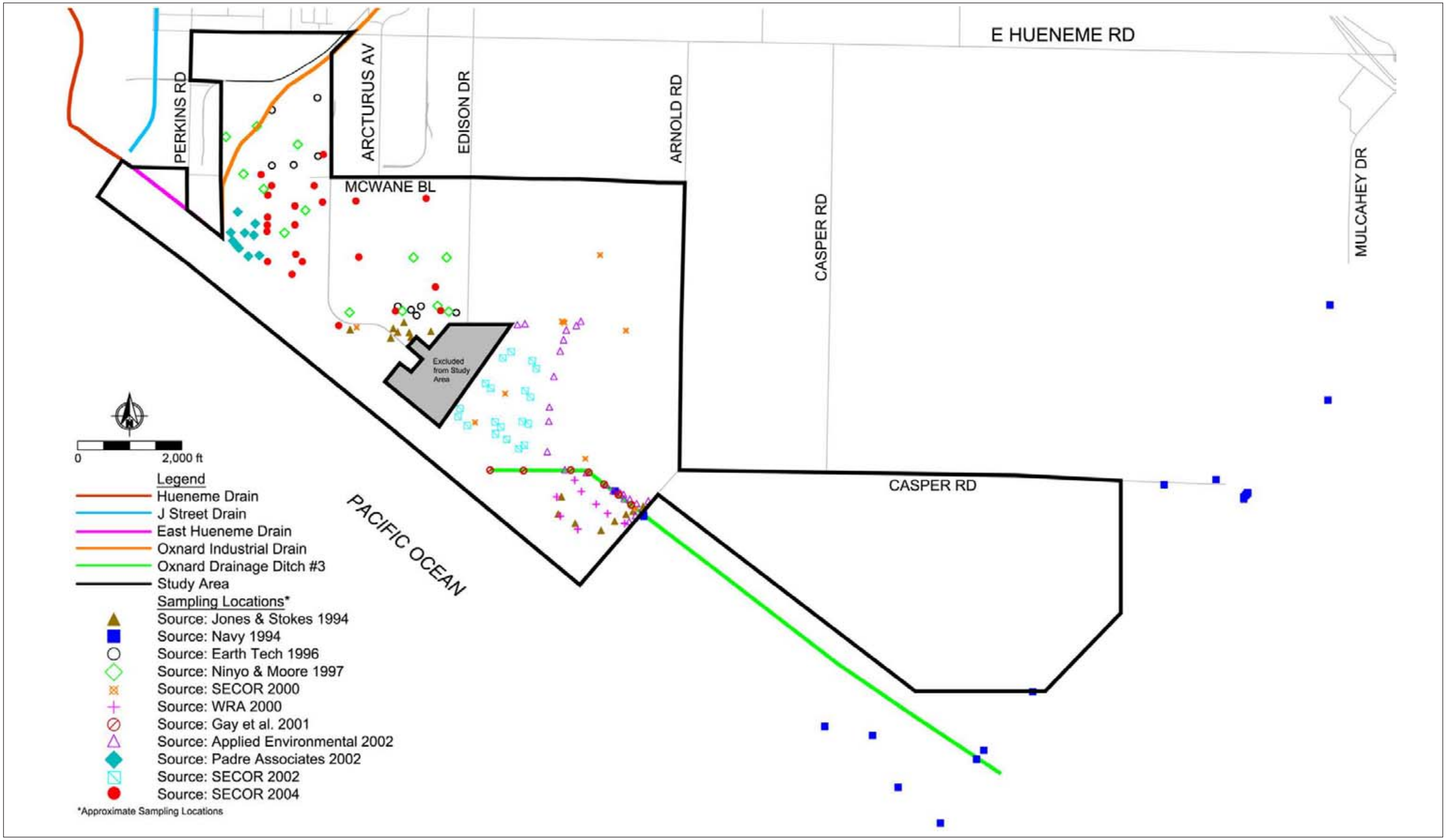
There have been several site contaminant investigations conducted within and adjacent to the proposed wetland restoration site. These studies were performed since the mid-1990s for numerous purposes (e.g., Phase I and II assessments and installation restorations studies). No hazardous waste levels of contaminants were detected in any of the studies. The study sites and sample collection locations from these previous studies are depicted in Figure 2. Figure 3 identifies the approximate locations (based on the study results summarized below) where chemical contaminants were found in elevated concentrations in soil, sediment, or water. Detailed chemical results from some of the historical studies are presented in Appendix A.

The major findings of the previous contaminant studies conducted in and adjacent to the Ormond Beach Wetland Restoration site are summarized below. The findings from these previous studies were used to assist in the development of this general site-wide soil and water investigation.

2.1 Previous Site Investigation: Metals

There are two locations within the project boundary where metal contamination may be an issue. This includes areas adjacent to the former Halaco site and the former Edison property.

There appears to be evidence indicating metals from the former Halaco Waste Management Unit (WMU) have migrated into the proposed restoration area in soils and groundwater. This evidence is based upon the following report findings.

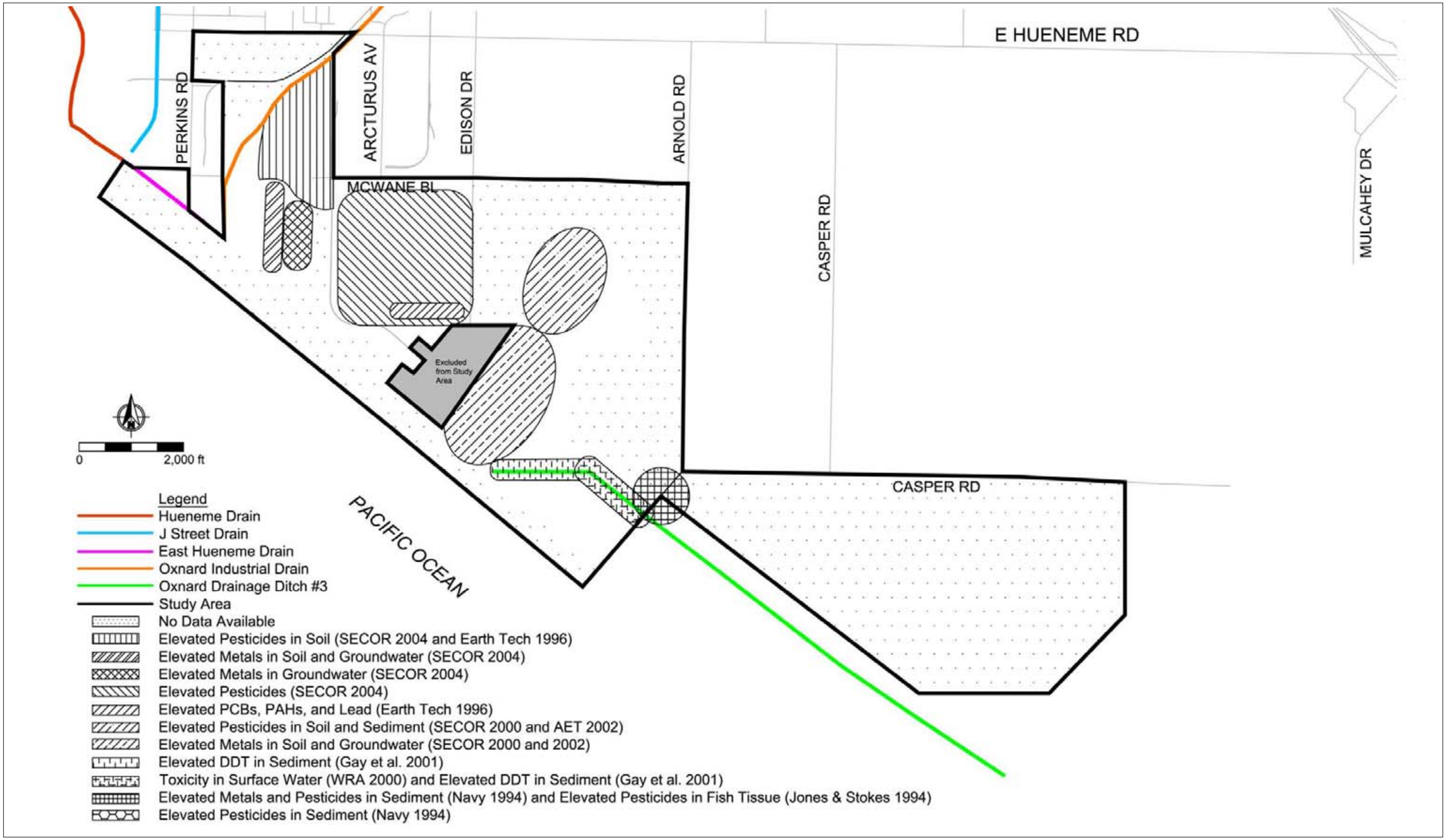


amec

Previous Soil Sample Collection Locations Within or Near the Project Area

FIGURE 2

Graphics/AquaticSciences/OrmondBeach/Ormond2 11_06.fh8



amec

FIGURE 3

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

- Heavy metals within the former City of Oxnard/MWD property are moderately (>effects range low [ERL]) to significantly (>effects range median [ERM]) elevated immediately adjacent to the former Halaco site (SECOR 2004) (note: ERLs and ERMs are discussed in detail in Section 4.2). The U.S. Army Corps of Engineers (USACE) and Regional Water Quality Control Board (RWQCB) will likely require further soil delineation of this area before granting permits.
- Metals in groundwater are elevated (>California Toxics Rule [CTR]) immediately adjacent to the former Halaco site and farther to the east (SECOR 2004). The continued migration of heavy metals in groundwater could have an impact on the success of the wetland restoration project.

To address the level of contamination at and adjacent to the former Halaco site, the Environmental Protection Agency (EPA) Emergency Response and Site Mitigation team began conducting a full investigation of the 40-acre site on 19 June 2006. This includes extensive sampling of the disposal site east of the engineering facility, as well as numerous adjacent areas. The results of the EPA's study will be used to complement the results of this investigation. Results from the EPA's study are estimated to be available in fall 2006.

There may also be residual metal contamination in the groundwater at the former Edison tank farm. The concentrations of metals in the soil at this site are low and the contaminant source has been removed; therefore, no long-term impacts from reuse of the material at this site are expected.

2.2 Previous Site Investigation: Pesticides

Chlorinated pesticides are persistent contaminants that may impact the success of the restoration project if they are exposed to aquatic and/or aquatic-associated organisms (e.g., birds or mammals entering or drinking contaminated water or eating contaminated sediments) and enter the food chain. Previous studies indicate that pesticides may be elevated at several areas within the project boundary. The studies indicate that pesticide levels (particularly Dichloro-diphenyl-trichloroethane [DDT] and metabolites and toxaphene) are significantly elevated (>ERM) in the cultivated land portion (west of Edison Drive and south of McWane Boulevard) of the former City of Oxnard/MWD property and within surface soils of the Southland Sod Farm. In addition, numerous pesticides were found in significantly elevated concentrations in sediment and fish tissue samples collected in Oxnard Drainage Ditch #3.

3.0 METHODS AND MATERIALS

This section discusses the soil and surface water collection program for the current site-wide investigation. Soil and surface water collection, handling, and preservation activities followed the procedures outlined in the site-specific SAP (AMEC 2006).

3.1 Soil Collection

Prior to beginning subsurface exploration activities, a site-specific health and safety plan (HASP) was prepared to cover all AMEC employees and subcontractor personnel, as required by federal and state Occupational Safety and Health Administration (OSHA) regulations. This HASP was reviewed and signed by all AMEC employees and subcontractor personnel prior to beginning work. Underground utilities were located through public services 2 days prior to beginning field work in accordance with California State law. Due to the widespread spacing of the sampling locations, underground utilities also were located using a private utility location subcontractor (EPL, Inc. of Garden Grove, California). These location services were performed on 1 and 5 September, and 11 October 2006. No underground utility lines were identified by EPL that would obstruct the planned boring locations.

Soil boring was performed at 30 locations spread out over the entire study area (Figure 4; Appendix B). The collection sites were pre-placed in areas that: 1) were of interest to Aspen and SCC, 2) would provide adequate coverage of the entire study area, 3) were accessible, and 4) were determined to provide the restoration team with the information needed to move into the next phase of the study. Proposed collection sites were identified in the study SAP. Several of the originally proposed collection sites needed to be moved to new, adjacent locations based on access issues.

Three separate collection events were needed in order to collect all 30 soil samples. Drilling was performed between 5 and 8 September, and on 11 October and 19 October 2006. TestAmerica, Inc., of Anaheim, California, provided the drilling personnel and equipment. Collection sites were located using a hand-held global positioning system (GPS) unit. Once onsite, TestAmerica's drill rig was positioned for sample collection. Soil borings were collected by advancing either a hollow stem auger or hand auger to a pre-determined target sample depth. The target penetration for each soil boring was -6.5 ft North American Vertical Datum (NAVD) 88 (ground surface to -4.5 ft NAVD with a two-foot over-excavation allowance). Table 1 provides a list of the completed borings, date drilled, drilling technique used, borehole diameter, actual depth explored, and collection coordinates (latitude and longitude).

An AMEC field geologist performed drilling oversight and core logging during the drilling operation. Soil cores were extruded from the sample barrel and placed on plastic sheeting for examination. At each site, the continuous soil core was evaluated from the ground surface to the target collection depth. Observations were recorded on field boring log forms (Appendix C). Observations included classification of the soils according to the Unified Soil Classification System (USCS), the depths of soil samples collected for laboratory analysis or archival purposes, and other relevant visual and/or olfactory observations. No field or head space screening of the soils was performed and no groundwater samples were collected. Following the core logging process, photographs of each soil core were taken (Appendix D).

Following the core logging process and photographs, subsamples were taken for physical and chemical analysis. This procedure involved collecting four separate types of samples:

1. A sample composite was prepared by taking an approximate 1-in subsample at 1-ft intervals from the ground surface to the bottom of the core. This sample was analyzed for grain size and chemical contaminants.

2. Three discrete samples were taken that consisted of approximately a 6-in segment from the top, middle, and bottom of the core. These samples have been archived if future analysis is deemed necessary.

amec

Soil and Surface Water Sampling Locations
Ormond Beach Wetland Restoration Project

FIGURE
4

Table 1. Detail of Completed Borings

Drilling Date	Boring Location	Drilling Method	Borehole Diameter (in.)	Total Depth (ft bgs)	Latitude (decimal degrees)	Longitude (decimal degrees)
9/8/06	C1	HSA	8	13	34.11813855	-119.12776
9/8/06	C2	HSA	8	15	34.11921144	-119.1332693
9/8/06	C3	HSA	8	13	34.12320793	-119.1312093
9/8/06	C4	HSA	8	13	34.12252128	-119.1388375
9/8/06	C5	HSA	8	15	34.11867499	-119.1457684
9/7/06	C6	HSA	8	21	34.13998783	-119.1574253
10/11/06	C7	HSA/LAR	6	14.5	34.13192219	-119.1570948
9/8/06	C8	HSA	8	13	34.12201703	-119.1489441
9/7/06	C9	HSA	8	15	34.1362381	-119.162162
10/11/06	C10	HSA/LAR	6	14.5	34.12962557	-119.1571793
9/7/06	C11	hand auger[1]	4	3	34.13629711	-119.1772146
9/7/06	C12	HSA	8	17	34.13833022	-119.1776759
9/8/06	C13	HSA	8	17	34.14035261	-119.1844834
9/7/06	C14	HSA	8	18	34.14042234	-119.1795052
10/11/06	C15	HSA/LAR	6	15	34.14291123	-119.1819347
9/8/06	C16	hand auger	4	5	34.14040089	-119.1880561
9/6/06	C17	HSA	8	19	34.14353371	-119.1756053
9/6/06	C18	HSA	8	20	34.1402185	-119.1766728
10/11/06	C19	hand auger	4	5	34.14508192	-119.1784127
9/6/06	C20	HSA	8	20	34.13957477	-119.1717697
9/7/06	C21	HSA	8	17	34.13800299	-119.1760612
9/6/06	C22	HSA	8	17	34.13824439	-119.1717107
9/7/06	C23	hand auger	4	8	34.1394943	-119.177853
9/6/06	C24	hand auger	4	6	34.13364172	-119.1718126
9/6/06	C25	HSA	8	16	34.13446248	-119.1729445
9/6/06	C26	HSA	8	16	34.13305163	-119.1747362
10/19/06	C27	HSA/LAR	6	14.5	34.12869464	-119.1637471
10/19/06	C28	HSA/LAR	6	14.5	34.13000533	-119.1627136
9/7/06	C29	HSA	8	14.5	34.1250962	-119.158187
9/8/06	C30	HSA	8	14	34.12748873	-119.1654826

Notes:

HSA = Hollow stem auger, 8-inch outside diameter with continuous split barrel sampling at 5-foot intervals

HSA/LAR = Limited access hollow stem auger, 6-inch outside diameter with continuous split barrel sampling at 1.5-foot intervals

in. = inches

ft. = feet

bgs = below ground surface

[1] Borings advanced using a hand auger were completed by TestAmerica, Inc.

Soil samples for chemical analysis were dispensed to certified clean, 8-ounce glass jars with Teflon liners. Samples for grain size analysis were placed in polyethylene bags. All samples were held on ice until delivery to the chemistry laboratory. Appropriate chain-of-custody procedures were followed during the collection, handling, and transportation of samples. Samples were transported to the laboratory by either field personnel or laboratory courier.

The California-accredited laboratory, Calscience Environmental Laboratory of Garden Grove, California, conducted all chemical analyses according to EPA-approved methods. Test methods and detection limits were outlined in the SAP. Grain size analyses were performed by PTS Laboratory of Santa Fe Springs, California (under subcontract to Calscience), using the laser method.

3.1.1 Borehole Abandonment Procedures

All 30 soil borings were immediately abandoned following sample collection. Each soil boring was abandoned in accordance with County of Ventura requirements per Well Permit No. 6413 (Appendix E). Generally speaking, these requirements included permanent abandonment of the soil boring by plugging the borehole with bentonite chips. The bentonite chips were placed in each hole using a free-fall method. The chips were poured into each borehole slowly to ensure that a seal was formed along the length of the hole. In most cases, groundwater had risen to nearly 5 ft bgs in each of the boreholes, such that no additional hydration of the bentonite chips was necessary. For the two boreholes (C-17 and C-19) where groundwater was not encountered while drilling, potable water was added to the holes after placement of the bentonite chips. Native soil from the surrounding area around each borehole was placed in the top 1 to 2 ft. Per county requirements, a Registered Inspector's Water Well Seal Record form was completed for each of the 30 borings and submitted to the county (Appendix F).

3.1.2 Derived Waste Procedures

As required in the well boring permits, all soil cuttings and decontamination fluids generated during the drilling program were containerized in 55-gallon drums, properly labeled, sealed, and left in the vicinity of the soil boring locations at each of the properties that comprise the site. The soil and water samples were deemed non-hazardous waste by Belshire Environmental Services, Inc., a state-certified waste-handling firm located in lake Forest, California. The soil cuttings were removed from the site by Belshire Environmental and taken to TPST Technologies, Inc. for ultimate disposal. The decontamination fluids were also removed from the site by Belshire Environmental and taken to DeMenno Kerdoon for ultimate disposal.

3.2 Surface Water Collection

A total of 10 surface water samples were collected on 10 August 2006 by AMEC scientists. The water samples were collected by directly submerging a sample bottle below the water's surface. Bottles were immediately placed in iced coolers for holding while they were transported to the laboratory for analysis. Calscience Environmental Laboratory also conducted the analytical analyses on the surface water samples. The geographical locations of the surface water samples are depicted on Figure 4. Photographs of the surface water collection sites are contained in Appendix D. The 10 collection sites are identified below.

1. Site SW-1: Bubbling Springs/Hueneme Drain
2. Site SW-2: J Street Drain
3. Site SW-3: Game Preserve Channel
4. Site SW-4: East Hueneme Drain
5. Site SW-5: Oxnard Industrial Drain - South
6. Site SW-6: Train Track – Adjacent Channel
7. Site SW-7: TNC/SCC Agricultural Channel
8. Site SW-8: Game Preserve Duck Pond
9. Site SW-9: Oxnard Industrial Drain - North
10. Site SW-10: Oxnard Drainage Ditch #3

4.0 RESULTS

4.1 Physical Results

Physical results are summarized in Tables 2 (grain size) and 3 (total organic carbon and percent solids). The laboratory data report is contained in Appendix G. The grain size results indicate that the soils beneath the study area are generally fine-grained and primarily consist of a mixture of fine sand, silt, and clay in varying proportions. The largest grain size observed was medium sand; gravels generally were not encountered (with the exception of pebble-sized grains in Sites C-7 and C-10 beneath the Southland Sod Farm property). Soils also were generally loose and very moist to completely saturated within the upper 10 feet. A well-sorted, gray fine sand layer was encountered across the study area in 21 out of the 30 soil borings at depths ranging from 4 to 18 ft bgs.

In borings where the well-sorted sand layer was encountered, the sand extended to the total depth of the boring, with the exception of Site C-10 where the sand layer appeared to end at the depth of the boring (14.5 ft bgs). Therefore, the thickness of the well-sorted sand layer is unknown. This is based upon the fact that it did not occur in all of the borings, and that its base may have been encountered in Site C-10. Based on these observations, this layer could be laterally and vertically discontinuous. In the soil boring at Site C-9, the thickest section of the well-sorted sand was encountered from 4.5 to 15 ft bgs, when compared to other borings.

Table 2. Grain Size Results Summary

Size Fraction	Site C1	Site C2	Site C3	Site C4	Site C5	Site C6
Gravel (%)	0	0	0	0	0	0
Sand – Coarse (%)	0	0	0	0	0	0
Sand – Medium (%)	0	0	0	0	0	0
Sand – Fine (%)	8.63	12.95	3.52	0.01	2.02	9.76
Total Sand	8.63	12.95	3.52	0.01	2.02	9.76
Silt (%)	66.15	59.6	71.22	55.83	70.32	62.8
Clay (%)	25.23	27.45	25.26	44.16	27.67	27.44
Silt & Clay (%)	91.37	87.05	96.48	99.99	97.98	90.24
Size Fraction	**Site C7**	**Site C8B**	**Site C8T**	**Site C9**	**Site C10**	**Site C11**
Gravel (%)	0	0	0	0	0	0
Sand – Coarse (%)	0	0	0	0	0	0
Sand – Medium (%)	34.53	52.63	0	0	0	0
Sand – Fine (%)	59.54	40.5	13.15	26.9	0	23.71
Total Sand	94.07	93.13	13.15	26.9	0	23.71
Silt (%)	4.22	5.02	63.23	52.37	68	60.03
Clay (%)	1.71	1.85	23.62	20.74	32	16.26
Silt & Clay (%)	5.93	6.87	86.85	73.1	100	76.29
Size Fraction	**Site C12**	**Site C13**	**Site C14**	**Site C15**	**Site C16**	**Site C17**
Gravel (%)	0	0	0	0	0	0
Sand – Coarse (%)	0	0	0	0	0	0
Sand – Medium (%)	0	38.13	0	0	9.18	0
Sand – Fine (%)	23.6	33.71	0.5	0	35.97	13.58
Total Sand	23.6	71.84	0.5	0	45.15	13.58
Silt (%)	59.23	21.01	63.39	68.55	39.91	67.99
Clay (%)	17.17	7.14	36.11	31.45	14.94	18.43
Silt & Clay (%)	76.4	28.15	99.5	100	54.84	86.42

Shaded 'Total Sand' values indicate a sand percentage of ≥60%

Table 2. Grain Size Results Summary (Continued)

Size Fraction	Site 18	Site C18B	Site C18T	Site C19	Site C20	Site C21
Gravel (%)	0	0	0	0	0	0
Sand – Coarse (%)	0	0	0	0	0	0
Sand – Medium (%)	0	23.51	0	0	0	0
Sand – Fine (%)	13.47	67.85	2.52	37.36	14.5	0.04
Total Sand	13.47	91.36	2.52	37.36	14.5	0.04
Silt (%)	63.36	5.9	63.36	48.2	52.57	58.33
Clay (%)	23.17	2.73	34.12	14.44	32.92	41.62
Silt & Clay (%)	86.53	8.63	97.48	62.64	85.5	99.96

Size Fraction	Site C22	Site C23	Site C24	Site C25	Site C26	Site C27
Gravel (%)	0	0	0	0	0	3.79
Sand – Coarse (%)	0	0	0	0	0	2.51
Sand – Medium (%)	1.1	0	0	64.67	16.63	19.96
Sand – Fine (%)	33.51	2.41	28.49	19.42	46.63	54.61
Total Sand	34.61	2.41	28.49	84.09	63.26	77.08
Silt (%)	45.7	70.69	55.64	11.24	26.36	0
Clay (%)	19.69	26.89	15.87	4.67	10.37	0
Silt & Clay (%)	65.39	97.59	71.51	15.91	36.73	19.12

Size Fraction	Site C28	Site C29	Site C30
Gravel (%)	0	0	0
Sand – Coarse (%)	0	0	0
Sand – Medium (%)	15.48	11.89	0
Sand – Fine (%)	43.28	52.08	61.82
Total Sand	58.76	63.97	61.82
Silt (%)	27.3	28.21	28.44
Clay (%)	13.94	7.82	9.73
Silt & Clay (%)	41.24	36.03	38.18

Shaded 'Total Sand' values indicate a sand percentage of ≥60%

Table 3. Soil Physical Results Summary

Constituent (All Values are in Dry Weight)	Site C1 Comp	Site C2 Comp	Site C3 Comp	Site 4 Comp	Site C5 Comp	Site C6 Comp
Total Organic Carbon (TOC) (mg/kg)	3500	9300	4300	7900	6400	4900
Total Solids (%)	80.2	68.5	80.6	74.6	73.4	75.0
Constituent (All Values are in Dry Weight)	**Site C7 Comp**	**Site C8 Comp**	**Site C9 Comp**	**Site C10 Comp**	**Site C11 Comp**	**Site C12 Comp**
Total Organic Carbon (TOC) (mg/kg)	3100	3900	6600	4800	6800	4800
Total Solids (%)	86.0	78.5	78.7	80.6	81.0	75.0
Constituent (All Values are in Dry Weight)	**Site C13 Comp**	**Site C14 Comp**	**Site C15 Comp**	**Site C16 Comp**	**Site C17 Comp**	**Site C18 Comp**
Total Organic Carbon (TOC) (mg/kg)	4300	6400	4100	7100	8200	5300
Total Solids (%)	79.2	79.2	86.1	94.1	79.4	81.6
Constituent (All Values are in Dry Weight)	**Site C19 Comp**	**Site C20 Comp**	**Site C21 Comp**	**Site C22 Comp**	**Site C23 Comp**	**Site C24 Comp**
Total Organic Carbon (TOC) (mg/kg)	6900	6700	5800	7100	6200	5800
Total Solids (%)	88.6	78.1	76.0	78.8	79.5	86.1
Constituent (All Values are in Dry Weight)	**Site C25 Comp**	**Site C26 Comp**	**Site C27 Comp**	**Site C28 Comp**	**Site C29 Comp**	**Site C30 Comp**
Total Organic Carbon (TOC) (mg/kg)	6400	4900	2400	4000	3900	4300
Total Solids (%)	74.7	77.9	85.4	76.9	81.1	80.8

TOC – total organic carbon
mg/kg – milligram per kilogram

4.2 Soil Chemistry Results

Soil chemistry results are summarized in Tables 4 through 6. The laboratory data reports are contained in Appendix H. For the most part, the soil samples throughout the study area were free of chemical contaminants, with several exceptions.

At this early stage in the wetland restoration feasibility study, it is unknown where excavated soils might be placed. Comparing the study results to the marine and freshwater guidelines described below is helpful in predicting if toxic effects might occur as a result of the future unconfined aquatic disposal of the study site soil.

For comparison purposes, the soil chemistry results listed in Tables 4 through 6 are compared to applicable marine and freshwater sediment quality guidelines. The marine guidelines, ERLs and ERMs, are used to form a general opinion as to whether the chemical levels found in marine sediments are likely to have adverse impacts on sensitive organisms (Buchman 1999). These guidelines were derived by compiling empirical study data. The ERL is defined as the lower tenth percentile concentration of the available sediment toxicity data compiled. The ERM is the median concentration of the compilation of toxic samples. The freshwater threshold effects level (TEL) and probable effects level (PEL) were derived in a similar manner to the marine sediment guidelines; however, the TEL represents the geometric mean of the 15^{th} percentile concentration of the toxic effects data set. The PEL is the geometric mean of the 50 percent of impacted, toxic samples. Essentially, toxic effects are rarely expected to occur at concentrations less that the ERL or TEL, while toxic effects are likely to occur at concentrations above the ERM or PEL.

4.2.1 Metals

For the most part, metal levels were well below TEL/PEL and ERL/ERM guideline levels. Cadmium exceeded the TEL (0.596 mg/kg) for freshwater sediment at Sites C-4, C-19, C-20, and C-25. Arsenic exceeded the TEL (5.9 mg/kg) for freshwater sediment and the ERL (8.2 mg/kg) for marine sediment at Site C-3 (Table 4).

4.2.2 Petroleum Hydrocarbons

Total petroleum hydrocarbons (TPH) were non-detect (ND) at all locations with the exceptions of Sites C-16, C-17, C-19, C-24, C-27, and C-28. These sites had TPH concentrations ranging from 9 to 80 mg/kg (Table 5).

4.2.3 Pesticides

Measured concentrations of total DDT and derivatives (sum of DDT + DDE [dichloro-diphenyl-dichloroethylene] + DDD [dichloro-diphenyl-dichloroethane]) ranged from ND to 370 µg/kg. Elevated levels (above both marine ERMs and freshwater PELs) of total DDT and derivatives were found at Sites C-7, C-10, C-14, C-16, C-17, C-18, C-19, C-22, and C-24 (Table 6). These sites are, for most part, spread out over the entire study area (with the exception of the Ventura County Game Preserve).

Table 4. Soil Chemistry Results – Metals

																ERL (mg/kg)	ERM (mg/kg)	TEL (mg/kg)	PEL (mg/kg)
Analyte (mg/kg-dry wt.)	**Site C1 Comp**	**Site C2 Comp**	**Site C3 Comp**	**Site C4 Comp**	**Site C5 Comp**	**Site C6 Comp**	**Site C7 Comp**	**Site C8 Comp**	**Site C9 Comp**	**Site C10 Comp**	**Site C11 Comp**	**Site C12 Comp**	**Site C13 Comp**	**Site C14 Comp**	**Site C15 Comp**	**(Marine Sediment)**		**(Freshwater Sediment)**	
Antimony	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-	-
Arsenic	2.50	3.20	**8.56**	3.54	3.67	2.60	1.87	2.52	2.20	2.35	2.08	2.86	2.04	3.29	3.30	8.2	70	5.9	17
Barium	53.3	73.4	51.3	80.1	76.8	68.8	43.0	57.7	54.5	69.5	55.0	68.5	51.0	61.3	95.7	-	-	-	-
Cadmium	0.161	0.474	0.424	**0.772**	0.444	0.353	0.294	0.337	0.365	0.530	0.354	0.483	0.490	0.408	0.580	1.2	9.6	0.596	3.53
Chromium	8.05	12.8	7.25	12.3	12.0	8.69	4.58	8.41	6.49	8.71	6.09	9.76	5.44	7.35	11.3	81	370	37.3	90
Copper	7.17	17.9	5.98	12.3	10.7	9.20	4.72	7.65	6.10	8.60	6.91	12.3	5.60	7.28	11.6	34	270	35.7	197
Lead	6.05	10.5	4.93	12.2	16.5	7.50	2.46	6.80	5.13	3.71	8.51	9.89	4.54	6.91	4.93	46.7	218	35	91.3
Nickel	8.55	13.6	7.89	14.1	13.4	9.98	6.68	9.75	7.42	10.8	7.20	11.1	7.13	8.82	15.0	20.9	51.6	18	35.9
Selenium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-	-
Silver	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	3.7	-	-
Zinc	24.1	38.3	20.6	38.8	37.5	31.6	20.4	26.2	22.2	32.4	22.9	35.1	21.8	25.6	43.9	150	410	123.1	315
Aluminum	4540	6890	3900	6690	6810	5240	3020	4700	4050	4980	3790	5700	3390	4300	6820	-	-	-	-
Magnesium	3840	5410	2900	4860	6270	3650	1950	4600	2870	3620	3360	4220	2390	3130	4950	-	-	-	-
Manganese	233	231	108	211	272	194	139	140	160	242	138	172	120	151	344	-	-	-	-
Mercury	ND	ND	ND	0.0339	ND	ND	ND	ND	ND	ND	ND	0.0272	ND	ND	0.0363	0.15	0.71	0.174	0.486

																ERL (mg/kg)	ERM (mg/kg)	TEL (mg/kg)	PEL (mg/kg)
Analyte (mg/kg-dry wt.)	**Site C16 Comp**	**Site C17 Comp**	**Site C18 Comp**	**Site C19 Comp**	**Site C20 Comp**	**Site C21 Comp**	**Site C22 Comp**	**Site C23 Comp**	**Site C24 Comp**	**Site C25 Comp**	**Site C26 Comp**	**Site C27 Comp**	**Site C28 Comp**	**Site C29 Comp**	**Site C30 Comp**	**(Marine Sediment)**		**(Freshwater Sediment)**	
Antimony	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-	-
Arsenic	2.53	2.47	2.43	3.22	2.45	3.02	2.74	2.75	3.02	3.43	2.59	3.18	1.75	1.89	1.96	8.2	70	5.9	17
Barium	124	62.7	57.1	87.3	70.0	70.9	59.9	61.7	156	62.5	50.4	65.5	72.5	50.2	45.1	-	-	-	-
Cadmium	0.495	0.415	0.347	**0.650**	**0.675**	0.475	0.416	0.445	0.344	**0.866**	0.399	0.337	0.443	0.243	0.338	1.2	9.6	0.596	3.53
Chromium	8.65	7.84	7.35	10.7	9.22	9.55	8.44	8.93	8.91	8.83	7.48	9.46	9.59	4.99	7.02	81	370	37.3	90
Copper	28.4	7.90	7.15	10.7	9.34	9.03	9.14	8.91	11.3	8.96	7.67	9.72	7.59	5.22	7.00	34	270	35.7	197
Lead	30.3	7.45	6.51	5.68	10.4	8.80	7.27	9.65	20.9	7.67	5.97	2.92	3.23	4.55	5.76	46.7	218	35	91.3
Nickel	8.53	8.82	8.25	13.3	10.6	10.3	9.35	9.92	8.90	10.1	8.46	10.7	9.85	6.48	8.51	20.9	51.6	18	35.9
Selenium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.625	ND	ND	ND	-	-	-	-
Silver	0.175	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	3.7	-	-
Zinc	77.2	26.4	27.4	42.3	32.6	32.0	28.5	30.6	42.0	30.1	23.6	30.0	29.3	20.0	22.7	150	410	123.1	315
Aluminum	4130	4650	4220	6390	5650	5670	4900	5290	4300	5240	4340	5400	4670	3260	3790	-	-	-	-
Magnesium	3620	3010	2900	4710	4330	4180	3270	4160	3160	3520	2740	3820	2890	2270	2530	-	-	-	-
Manganese	279	139	138	239	189	180	188	204	119	177	126	205	170	131	138	-	-	-	-
Mercury	0.0237	ND	ND	0.0293	0.0312	0.0277	ND	ND	0.0859	0.0283	ND	ND	ND	0.0385	ND	0.15	0.71	0.174	0.486

ND = Non-detect at reporting limit
Comp = composite
mg/kg = milligram per kilogram
Bold values exceed ERL and/or TEL
Bold and boxed values exceed ERM and/or PEL
- = no guideline available

Table 5. Soil Chemistry Results – Total Petroleum Hydrocarbons (C7-C44)

Carbon Number (mg/kg-dry wt.)	Site C1 Comp	Site C2 Comp	Site C3 Comp	Site C4 Comp	Site C5 Comp	Site C6 Comp	Site C7 Comp	Site C8 Comp	Site C9 Comp	Site C10 Comp	Site C11 Comp	Site C12 Comp
C7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C9-C10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C11-C12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C13-C14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C15-C16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C17-C18	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C19-C20	ND	ND	ND	0.26	ND	ND	ND	ND	ND	ND	ND	ND
C21-C22	ND	ND	ND	1.4	ND	ND	ND	ND	ND	ND	ND	ND
C23-C24	ND	ND	ND	0.18	ND	ND	ND	ND	ND	ND	ND	ND
C25-C28	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C29-C32	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C33-C36	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C37-C40	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C41-C44	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C7-C44 Total	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

mg/kg = milligram per kilogram
ND = Non-detect

Table 5. Soil Chemistry Results – Total Petroleum Hydrocarbons (C7-C44) (Continued)

Carbon Number (mg/kg-dry wt.)	Site C13 Comp	Site C14 Comp	Site C15 Comp	Site C16 Comp	Site C17 Comp	Site C18 Comp	Site C19 Comp	Site C20 Comp	Site C21 Comp	Site C22 Comp	Site C23 Comp	Site C24 Comp
C7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C9-C10	ND	ND	ND	0.16	ND	ND	ND	ND	ND	ND	ND	ND
C11-C12	ND	ND	ND	0.75	ND	ND	0.44	ND	ND	ND	ND	ND
C13-C14	ND	ND	ND	1.3	0.012	ND	1.4	ND	ND	ND	ND	0.26
C15-C16	ND	ND	ND	3.4	0.38	ND	2.8	ND	ND	ND	ND	1.5
C17-C18	ND	ND	ND	2.0	0.57	ND	2.4	ND	ND	ND	ND	2.0
C19-C20	ND	ND	ND	3.1	1.1	ND	4.0	ND	ND	ND	ND	2.4
C21-C22	ND	ND	ND	4.1	1.8	ND	5.4	ND	ND	ND	ND	3.6
C23-C24	ND	ND	ND	11	3.8	ND	18	ND	ND	ND	ND	3.7
C25-C28	ND	ND	ND	15	5.4	ND	17	ND	ND	ND	ND	11
C29-C32	ND	ND	ND	13	1.5	ND	11	ND	ND	ND	ND	9.0
C33-C36	ND	ND	ND	12	1.4	ND	9.5	ND	ND	ND	ND	6.6
C37-C40	ND	ND	ND	5.1	0.28	ND	4.5	ND	ND	ND	ND	5.2
C41-C44	ND	ND	ND	5.4	ND	ND	4.4	ND	ND	ND	ND	3.4
C7-C44 Total	ND	ND	ND	75	16	ND	80	ND	ND	ND	ND	49

Table 5. Soil Chemistry Results – Total Petroleum Hydrocarbons (C7-C44) (Continued)

Carbon Number (mg/kg-dry wt.)	Site C25 Comp	Site C26 Comp	Site C27 Comp	Site C28 Comp	Site C29 Comp	Site C30 Comp
C7	ND	ND	ND	ND	ND	ND
C8	ND	ND	ND	ND	ND	ND
C9-C10	ND	ND	ND	ND	ND	ND
C11-C12	ND	ND	ND	ND	ND	ND
C13-C14	ND	ND	ND	ND	ND	ND
C15-C16	ND	ND	ND	ND	ND	ND
C17-C18	ND	ND	0.060	0.035	ND	ND
C19-C20	0.37	ND	0.47	0.10	ND	ND
C21-C22	0.94	ND	0.71	0.40	ND	ND
C23-C24	0.16	ND	1.3	0.61	ND	ND
C25-C28	ND	ND	2.7	22	ND	ND
C29-C32	ND	ND	3.5	ND	ND	ND
C33-C36	ND	ND	3.6	1.7	ND	ND
C37-C40	ND	ND	2.0	1.0	ND	ND
C41-C44	ND	ND	1.9	2.1	ND	ND
C7-C44 Total	ND	ND	16	9.0	ND	ND

Table 6. Soil Chemistry Results – PCBs and Pesticides

							ERL	ERM	TEL	PEL
Analyte (µg/kg-dry wt.)	**Site C1 Comp**	**Site C2 Comp**	**Site C3 Comp**	**Site C4 Comp**	**Site C5 Comp**	**Site C6 Comp**	**(Marine Sediment)**		**(Freshwater Sediment)**	
Total PCBs	ND	ND	ND	ND	ND	ND	22.7	180	34.1	277
p,p-DDD	ND	ND	ND	ND	ND	**2.5**	2	20	3.54	8.51
p,p-DDE	ND	ND	ND	**5.9**	ND	**19**	2.2	27	1.42	6.75
p,p-DDT	ND	ND	ND	**2**	ND	**5.7**	1	7	-	-
Total DDTs	ND	ND	ND	**7.9**	ND	**27.2**	1.58	46.1	6.98	4,450
Toxaphene	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA
Dieldrin	ND	ND	ND	ND	ND	ND	0.02	8	2.85	6.67
Chlordane	ND	ND	ND	ND	ND	ND	0.5	6	4.5	8.9
							ERL	**ERM**	**TEL**	**PEL**
Analyte (µg/kg-dry wt.)	**Site C7 Comp**	**Site C8 Comp**	**Site C9 Comp**	**Site C10 Comp**	**Site C11 Comp**	**Site C12 Comp**	**(Marine Sediment)**		**(Freshwater Sediment)**	
Total PCBs	ND	ND	ND	ND	ND	ND	22.7	180	34.1	277
p,p-DDD	**4.5**	ND	**5**	**21.8**	ND	ND	2	20	3.54	8.51
p,p-DDE	**47**	ND	**12**	**95**	**17**	**4.2**	2.2	27	1.42	6.75
p,p-DDT	**91**	ND	**4.7**	**104**	**6.3**	ND	1	7	-	-
Total DDTs	**142.5**	ND	**21.7**	**220.8**	**23.3**	**4.2**	1.58	46.1	6.98	4,450
Toxaphene	390	ND	79	360	ND	ND	-	-	-	-
Dieldrin	**12**	ND	ND	ND	ND	ND	0.02	8	2.85	6.67
Chlordane	**55**	ND	ND	**67**	ND	ND	0.5	6	4.5	8.9

ND = Non-detect at reporting limit
Comp = composite
p,p = both 2,4 and 4, 4 compounds combined
µg/kg = microgram per kilogram

Bold values exceed ERL and/or TEL
Bold and boxed values exceed ERM and/or PEL
- = no guideline available

Table 6. Soil Chemistry Results – PCBs and Pesticides (Continued)

Analyte (µg/kg-dry wt.)	Site C13 Comp	Site C14 Comp	Site C15 Comp	Site C16 Comp	Site C17 Comp	Site C18 Comp	ERL (Marine Sediment)	ERM (Marine Sediment)	TEL (Freshwater Sediment)	PEL (Freshwater Sediment)
Total PCBs	ND	ND	ND	ND	ND	ND	22.7	180	34.1	277
p,p-DDD	ND	**9.7**	ND	**12**	**3.9**	**6.8**	2	20	3.54	8.51
p,p-DDE	3.2	**33**	**1.7**	**110**	**48**	**74**	2.2	27	1.42	6.75
p,p-DDT	ND	**5.3**	ND	**126**	**19.7**	**34**	1	7	-	-
Total DDTs	3.2	**48**	ND	**248**	**71.6**	**114.8**	1.58	46.1	6.98	4,450
Toxaphene	ND	63	ND	780	110	130	-	-	-	-
Dieldrin	ND	ND	ND	ND	ND	ND	0.02	8	2.85	6.67
Chlordane	ND	ND	ND	ND	ND	ND	0.5	6	4.5	8.9

Analyte (µg/kg-dry wt.)	Site C19 Comp	Site C20 Comp	Site C21 Comp	Site C22 Comp	Site C23 Comp	Site C24 Comp	ERL (Marine Sediment)	ERM (Marine Sediment)	TEL (Freshwater Sediment)	PEL (Freshwater Sediment)
Total PCBs	ND	ND	ND	ND	ND	ND	22.7	180	34.1	277
p,p-DDD	ND	ND	ND	**22.8**	ND	**72**	2	20	3.54	8.51
p,p-DDE	**87.3**	**7.9**	**12**	**170**	**16**	**110**	2.2	27	1.42	6.75
p,p-DDT	**33**	**6**	**5.7**	**177**	**5.6**	**8.1**	1	7	-	-
Total DDTs	**120.3**	**13.9**	**17.7**	**369.8**	**21.6**	**190.1**	1.58	46.1	6.98	4,450
Toxaphene	240	ND	56	1000	ND	310	-	-	-	-
Dieldrin	ND	ND	ND	ND	ND	ND	0.02	8	2.85	6.67
Chlordane	ND	ND	ND	ND	ND	ND	0.5	6	4.5	8.9

Table 6. Soil Chemistry Results – PCBs and Pesticides (Continued)

							ERL	ERM	TEL	PEL
Analyte (µg/kg-dry wt.)	**Site C25 Comp**	**Site C26 Comp**	**Site C27 Comp**	**Site C28 Comp**	**Site C29 Comp**	**Site C30 Comp**	**(Marine Sediment)**		**(Freshwater Sediment)**	
Total PCBs	ND	ND	ND	ND	ND	ND	22.7	180	34.1	277
p,p-DDD	ND	**2**	ND	ND	1.7	ND	2	20	3.54	8.51
p,p-DDE	**18**	**6.6**	ND	ND	**6.1**	**3.2**	2.2	27	1.42	6.75
p,p-DDT	**15.3**	**2.8**	ND	ND	ND	ND	1	7	-	-
Total DDTs	**33.3**	**11.4**	ND	ND	**7.8**	**3.2**	1.58	46.1	6.98	4,450
Toxaphene	78	ND	ND	ND	ND	ND	-	-	-	-
Dieldrin	ND	ND	ND	ND	ND	ND	0.02	8	2.85	6.67
Chlordane	ND	ND	ND	ND	ND	ND	0.5	6	4.5	8.9

The insecticide toxaphene was detected in 12 of the 30 soil samples tested (at Sites C-7, C-9, C-10, C-14, C-16, C-17, C-18, C-19, C-21, C-22, C-24, and C-25) at concentrations ranging from ND to 1,000 µg/kg (in Site 22 soil). There are no sediment effects guidelines for toxaphene to compare the results too.

Chlordane was detected in two samples, Sites C-7 and C-10, at concentrations of 55 and 67 µg/kg, respectively. Dieldrin was detected in only one sample, Site C-7, at a concentration of 12 µg/kg. These levels of chlordane and dieldrin are above aquatic sediment effects guidelines (Table 6).

It should be noted that the pesticide results summarized above are based upon the testing of core composites. Consequently, the pesticide levels at each site are likely biased low.

4.3 Surface Water Chemistry Results

Surface water chemistry results are summarized in Tables 7 through 10. The laboratory data reports are contained in Appendix I.

For comparison purposes, the surface water chemistry results summarized in Table 8 are compared to applicable ambient water quality criteria listed in the California Toxics Rule (CTR) (EPA 2000). The criteria are referred to as criteria continuous concentrations (CCCs) and criteria maximum concentrations (CMCs). The CCC levels are protective of chronic effects on sensitive organisms, while the CMC is protective of acute effects. Both marine and freshwater ambient water criteria are listed in Table 8. The freshwater criteria are hardness dependent: the freshwater criteria listed in Table 8 assume a hardness of 100 mg/L.

Most surface water metal levels were well below ambient water criteria (with two exceptions). Copper was found in elevated concentrations at Sites SW-5, SW-6 and SW-7 with concentrations of 5.37, 10.3, and 6.76 µg/L, respectively. Zinc was found to exceed the CMC acute level of both freshwater and marine water at Site SW-4 (129 µg/L).

Site SW-3 was the only highly saline station with a salinity value of 31 salinity unit [SU]. The other nine sites had salinity values ranging from 0.84 to 4.3 SU (which is considered to be brackish water) (Table 7).

In regards to pesticides, the water samples were all ND for DDT and derivatives, organophosphorous pesticides, and PCBs. TPH testing for the carbon range of C7-C44 showed that most locations were ND, with the exception of Sites SW-3 and SW-6 which had results of 560 and 1200 µg/L, respectively.

Table 7. Surface Water Chemistry Results – General Chemistry

Constituent	Site SW1	Site SW2	Site SW3	Site SW4	Site SW5	Site SW6	Site SW7	Site SW8	Site SW9	Site SW10
Total Hardness (mg/L)	1000	1200	6700	1300	1100	2100	480	1600	1100	1700
Specific Conductance (µmhos/cm)	3900	6000	45000	5200	3500	6900	1200	4700	3000	4400
Total Phosphorus (mg/L)	1.1	0.74	0.40	0.24	0.50	3.8	2.6	0.49	0.68	0.67
Nitrate (as N) (mg/L)	ND	ND	ND	0.52	3.8	ND	0.67	35	5.0	47
Salinity (SU)	2.3	3.7	31	3.2	1.9	4.3	0.84	2.7	1.6	2.4
Total Alkalinity (as CaCO3) (mg/L)	360	290	170	100	180	230	200	290	190	290
Total Kjeldahl Nitrogen (mg/L)	ND	ND	ND	ND	ND	3.5	ND	ND	ND	ND
Ammonia (as N) (mg/L)	ND	ND	ND	ND	ND	0.70	ND	ND	ND	ND

mg/L = milligram per liter
N = nitrogen
SU = salinity unit
CaCO3 = calcium carbonate
µmhos/cm = micromhos per centimeter
ND = non-detect

Table 8. Surface Water Chemistry Results – Metals

Constituent (µg/L)	Site SW1	Site SW2	Site SW3	Site SW4	Site SW5	Site SW6	Site SW7	Site SW8	Site SW9	Site SW10	Marine		Freshwater	
											CMC "Acute"	CCC "Chronic"	CMC "Acute"	CCC "Chronic"
Arsenic	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	69	36	340	150
Barium	60.4	64.2	57.3	27.2	59.9	109	47.8	50.3	28.1	45.4	-	-	-	-
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	42	9.3	4.3	2.2
Chromium	6.0	6.58	14.6	6.35	5.62	11.4	8.09	6.76	5	7.46	1100	50	550	180
Copper	ND	ND	ND	ND	**5.37**	**10.3**	**6.76**	ND	ND	ND	4.8	3.1	13	9.0
Lead	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	210	8.1	65	2.5
Nickel	ND	ND	ND	ND	ND	12.9	ND	ND	ND	8.05	74	8.2	470	52
Selenium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	290	71	-	5.0
Silver	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.9	-	3.4	-
Zinc	20	ND	ND	**129**	20.4	31.1	22.7	19.6	46.7	33.4	90	81	120	120
Aluminum	187	106	242	ND	149	2020	2000	121	ND	548	-	-	-	-
Iron	1130	648	235	106	103	3410	3400	137	ND	912	-	-	-	-
Magnesium	116000	170000	1430000	183000	132000	320000	40900	210000	124000	166000	-	-	-	-
Manganese	353	329	340	112	92.4	418	96.2	9.92	70.2	223	-	-	-	-
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	-	-	-	-

Freshwater metal numbers are hardness-dependent values with 25 mg/L as minimum & 400 mg/L as maximum calcium carbonate; Freshwater CMC and CCC criteria in this table assume a hardness of 100 mg/L.

ND = Non Detect within reporting limits

µg/L = microgram per liter

CCC = criteria continuous concentration

CMC = criteria maximum concentration

\- = no CTR criteria established

Bold values exceed either marine or freshwater criteria

Table 9. Surface Water Chemistry Results – TPH (C7-C44)

Carbon Number (µg/L)	Site SW1	Site SW2	Site SW3	Site SW4	Site SW5	Site SW6	Site SW7	Site SW8	Site SW9	Site SW10
C7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
C8	ND	ND	ND	ND	ND	17	ND	ND	ND	ND
C9-C10	ND	ND	ND	ND	ND	3.8	ND	ND	ND	ND
C11-C12	ND	ND	6.5	ND	0.067	30	ND	ND	2.3	ND
C13-C14	ND	ND	11	ND	11	60	ND	ND	9.0	ND
C15-C16	9.1	ND	12	3.1	12	78	ND	ND	ND	ND
C17-C18	19	2.2	31	13	15	120	ND	1.0	ND	4.6
C19-C20	33	9.1	62	31	33	170	14	78	7.6	10
C21-C22	59	9.7	49	23	36	120	15	8.6	7.6	12
C23-C24	30	4.8	39	28	46	130	13	5.2	6.9	10
C25-C28	87	16	96	72	97	140	36	12	4.0	7.1
C29-C32	63	25	110	59	72	170	38	20	16	18
C33-C36	42	17	100	33	33	130	29	11	12	13
C37-C40	17	8.9	16	11	13	15	29	18	14	9.6
C41-C44	9.3	6.7	20	2.7	2.4	11	12	10	8.3	2.8
C7-C44 Total	ND	ND	560	ND	ND	1200	ND	ND	ND	ND

µg/L = microgram per liter
ND = non-detect

Table 10. Surface Water Chemistry Results – PCBs and Pesticides

Constituent (µg/L)	Site SW1	Site SW2	Site SW3	Site SW4	Site SW5	Site SW6	Site SW7	Site SW8	Site SW9	Site SW10
Total PCBs	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total DDTs	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diazinon	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorvos	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Disulfoton	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethoprop	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Merphos	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methyl Parathion	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mevinphos	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Naled	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phorate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ronnel	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fenthion	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorpyrifos	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloronate	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tokuthion	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Azinphos Methyl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Coumaphos	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Demeton-o	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Demeton-s	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Stirophos	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fensulfothion	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bolstar	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

µg/L = microgram per liter
ND = non-detect

5.0 DISCUSSION

The purpose of this study is to provide a general site-wide assessment of the soil and surface water within the Ormond Beach Wetland Restoration site boundary. The assessment involved characterizing soil grain size and chemical contamination as well as surface water chemistry. This study was prompted by the fact that previous studies conducted within the project footprint did not provide adequate information to make informed decisions regarding soils or surface water. While this study is more focused, it is not a definitive evaluation of the restoration site. Based upon the results contained in this report, additional focused studies will likely be deemed necessary as the restoration project proceeds in to more advanced stages (e.g., environmental review in accordance with CEQA and NEPA).

This investigation involved assessment in large areas that previously had been unstudied, including: the Ventura County Game Preserve; the triangular 'Hueneme Parcel' owned by the City of Oxnard west of where Perkins Road dead ends; the City of Oxnard's property bounded by Hueneme Road and Perkins Road (the site of an advanced water purification facility, which is currently under construction); and portions of Southland Sod Farm. In addition to expanding the lateral dataset into unstudied area, this study involved collection of soil samples to depths previously unsampled (i.e., -6.5 ft NAVD), and testing of chemical constituents omitted from prior sampling and testing programs.

5.1 Soil Reuse Options

A key question for every wetland restoration project is where to dispose of and/or beneficially reuse excavated soils. Beneficial reuse options for excavated soils include beach nourishment, nearshore placement for littoral cell replenishment, river berm or levee construction, upland fill for contouring or revegetation, and structural fill. The preferred option for many coastal restoration projects is beach nourishment. This option provides a cost-effective method of disposing of excavated soils, while also providing a much needed benefit to eroding southern California beaches.

General guidelines for the suitability of dredged or excavated material for beach nourishment include:

- Physically compatible material meeting Clean Water Act §230.60 criteria (see below); or,
- Physically compatible material with contamination levels equal to or less than beach materials found at the nourishment site; or,
- Chemically compatible material that passes Tier III testing and does not exceed contamination levels acceptable for ecological and human receptor exposure.

Clean Water Act §230.60(a), in part, states that the dredged or fill material will most likely to be free from chemical, biological, or other pollutants where it is composed primarily of sand, gravel, or other naturally occurring inert material. Grain size results dictate whether the sediment qualifies to be used for nearshore or onshore beach nourishment. In general, sediment to be used for on-beach nourishment purposes should be greater than 80 percent sand and greater than 0.075 mm. In addition, it should be similar to the material already present at the proposed receiver beach. For nearshore placement (>30 ft deep), the percentage of sand needed would be less than 80 percent. For this study, 60 percent was chosen as a level at which nearshore placement might be considered (this is not based upon any regulatory criteria or guidance).

The sites with greater than 60 percent sand are identified on Table 2 and in Figure 5. This includes Sites C-7 (94.07 percent), C-13 (71.84 percent), C-25 (84.09 percent), C-26 (63.26 percent), C-27 (77.08 percent), C-29 (63.97 percent), and C-30 (61.82 percent). It should be noted that these samples represent top-to-bottom core composites. There are also likely to be lenses of sand found within distinct strata at the various boring locations. For the most part however, when sand was observed in the samples not listed above, it was typically found near the bottom of the core (15-20 ft bgs). Grain size sub-samples were taken within two of the sandy bottom portions, and their percent sand was high (91 percent at C18B and 93 percent at C8B). These results indicate that disposal alternatives in addition to beach placement will likely need to be pursued.

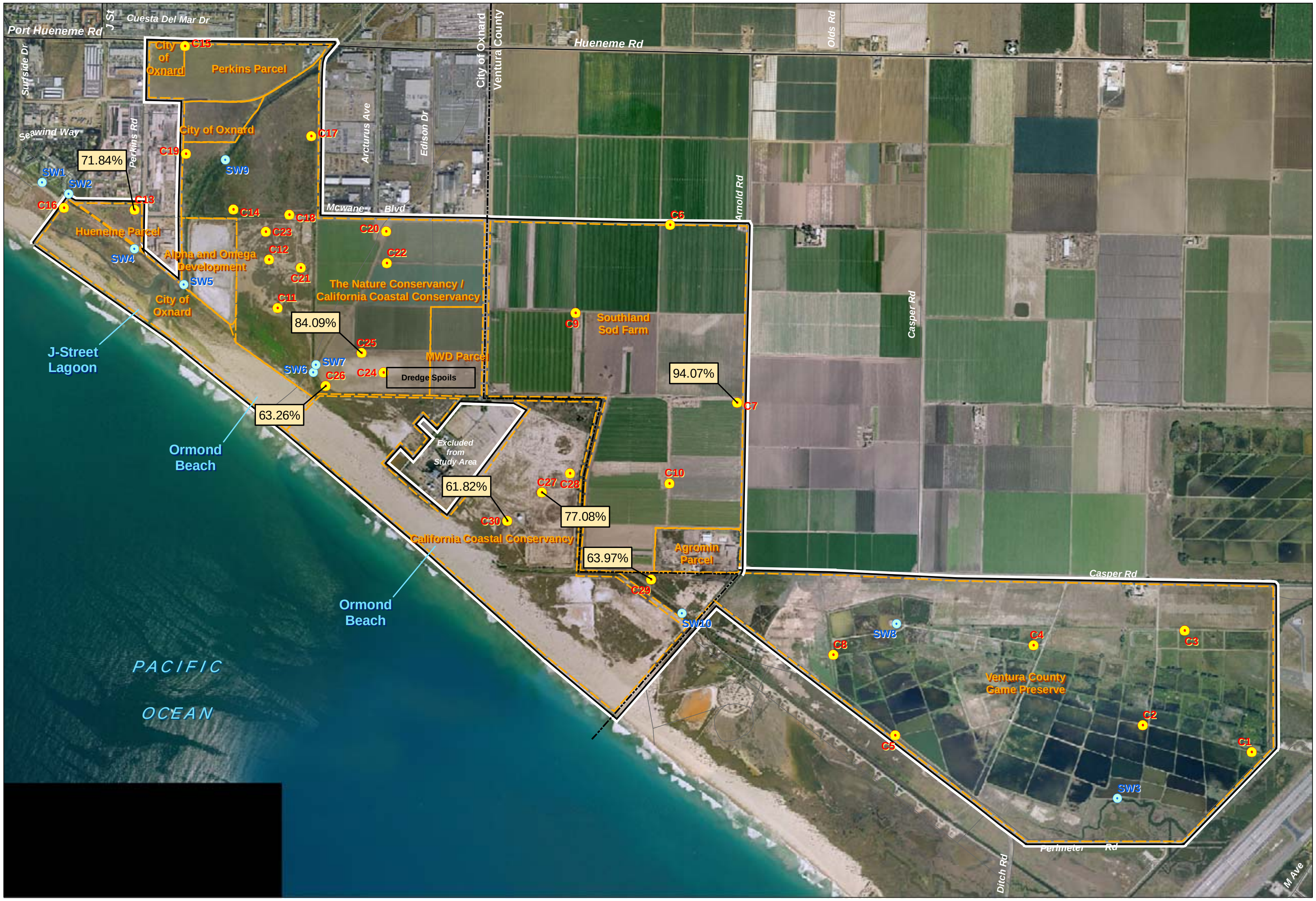
General guidelines for the suitability of dredged or excavated material for use as fill material to construct levees, create uplands habitat, and provides wetlands cover include:

- For levees - physically compatible material that contains a relatively low amount of organic material and soil with low cohesion (e.g., cobbles, pebbles, gravel, and sand). Some levels of contamination might be acceptable for levee core material that will be isolated from the surrounding environment.
- For upland habitat and wetlands cover - physically compatible material that contains a relatively low amount of organic material and soil with low cohesion (e.g., cobbles, pebbles, gravel, and sand). Some levels of contamination might be acceptable for material that is covered and, hence, isolated from the surrounding environment. The cover material that is exposed to the surrounding environment would have to be relatively clean of contaminants such that the potential for harm to human and ecological receptors is within acceptable limits. In addition, the physical and chemical characteristics of the material should be sufficient to allow for successful establishment of the target vegetation (e.g., coastal sage scrub in the upland areas and pickleweed in the high coastal salt marsh areas).

5.2 Soil Chemistry

The soil chemical analyses indicate that the study area is essentially free of metal and organic (e.g., petroleum hydrocarbons, PCB) chemical contamination, with the exception of the total DDT. Detectable levels of the pesticides total DDT and toxaphene were found throughout the study site. A geographical depiction of the total DDT results is presented in Figure 6. The total organochlorine pesticide levels observed in the study area may affect the reuse options that are pursued. 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. In addition, the pesticide results reported in this study report are based upon the testing of core composites. Consequently, the pesticide levels at each site are likely biased low.

Additional analysis of these results, as well as further testing, may be necessary when specific soil reuse options are being evaluated.



Legend

- Soil Core Sample Locations
- Surface Water Sample Locations
- City/County Boundary

Road Classification

- Freeway
- Major Road
- Local Road

Project Data

- Study Area Boundary
- Parcels of Interest

Map Notes

Data Source:
Sampling Locations - AMEC
Study Area Boundary - AMEC
Parcel of Interest (approximate)- Aspen, AMEC
Imagery - Aspen Environmental
Roads - ESRI StreetMap

Projection
State Plane, California 405, NAD 83, Feet

Date: 11/08/2006 dfk
Path: w:martin/sd06/aquatic /ormond_beach/mxd/ fig5_grainsize.mxd

N

1 inch equals 1,500 feet

0 750 1,500 3,000
Feet

amec

Sites with Greater than 60 Percent Sand
Ormond Beach Wetland Restoration Project

FIGURE

5

Legend

- Soil Core Sample Locations
- Surface Water Sample Locations
- City/County Boundary

Road Classification

- Freeway
- Major Road
- Local Road

Project Data

- Study Area Boundary
- Parcels of Interest

Map Notes

Data Source:
Sampling Locations - AMEC
Study Area Boundary - AMEC
Parcel of Interest (approximate)- Aspen, AMEC
Imagery - Aspen Environmental
Roads - ESRI StreetMap

Projection
State Plane, California 405, NAD 83, Feet

Date: 11/09/2006 dfk
Path: w:martin/sd06/aquatic/ormond_beach /mxd/fig6_organics.mxd

N

1 inch equals 1,500 feet

0 750 1,500 3,000

Feet

amec

Total DDT Values at Soil Sample Locations
Ormond Beach Wetland Restoration Project

FIGURE

6

5.3 Surface Water Chemistry

Surface water chemistry concentrations were low and typical of what is commonly found in surface runoff associated drainages. Copper (three stations) and zinc (one station) were found slightly above ambient water 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 soil samples over much of the study area.

6.0 RECOMMENDATIONS

This section provides two recommendations that might be considered as logical “next steps” for the soil reuse evaluation portion of the Ormond Beach Wetland Restoration Project.

1. Based upon the composite organochlorine pesticides results presented in this report, it is recommended that the archive samples be analyzed (top, middle, and bottom core samples) to determine the actual organochlorine pesticide levels closer to the ground surface, as well as with depth in the sediment column. It should be determined at what depth soil pesticide levels reach or approach non-detect. This information will be invaluable in determining the volume of pesticide-containing soils that will need to be removed from the project area with possible agricultural reuse.

2. Due to the elevated levels of organochlorine pesticides in the study area, it would be useful to analyze for other types of pesticides (e.g., organophosphorous, pyrethroid), and possibly herbicides in the sample archives. It may be useful to discuss recent pesticide use practices with farmers or the local agricultural extension agency to help identify the analytes to be tested.

7.0 LIMITATIONS

This report and recommendations are provided for the sole use of Aspen Environmental Group, Inc. and the California Coastal Conservancy for the sole purposes outlined therein, and for the site under study. These documents may not be relied upon by any third party without the prior written agreement of AMEC.

AMEC services have been performed in accordance with the normal and reasonable standard of care exercised by similar professionals performing services under similar conditions and geographic locations. Except for our stated standard of care, no other warranties or guarantees are offered as part of AMEC’s contracted services.

The findings contained herein are relevant to the dates of AMEC's site visits and should not be relied upon to represent conditions at later dates. In the event that changes in the nature, usage or layout of the property or nearby properties are made, the conclusions and recommendations contained in this report may not be valid. If additional information becomes available, it should be provided to AMEC so that the original conclusions and recommendations can be modified as necessary.

The purpose of an environmental site assessment is to reasonably evaluate the potential for adverse impact from past practices at a given property or neighboring properties. In performing an environmental site assessment, it is understood that a balance must be struck between a reasonable inquiry into the environmental issues and an exhaustive analysis of each conceivable issue of potential concern. The professional opinions in this report are based in part on the interpretation of data from discrete sampling locations that may not represent conditions at unsampled locations.

Finally, it should be noted that no subsurface exploration can be thorough enough to exclude the possible presence of contaminants at a given site. In cases where contaminants have not been discovered through exploration, this should not be construed as a guarantee that contaminants do not exist. At a given site, environmental conditions may exist that cannot be identified by visual observation. Where sample collection and testing have been performed, AMEC's professional opinions are based in part on the interpretation of data from discrete sampling locations that may not represent conditions at unsampled locations.

The findings contained herein are relevant to the dates of the AMEC Site visit and should not be relied upon to represent conditions later. In the event that changes in the nature, usage, or layout of the property or nearby properties are made, the conclusions and recommendations contained in this report may not be valid. If additional information becomes available, it should be provided to AMEC so the original conclusions and recommendations can be modified as necessary.

The boring logs and related information included in this report are indicators of subsurface conditions only at the specific locations and times noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions that, in the opinion of AMEC, exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling location.

The analyses and recommendations contained in this report are based on data obtained from subsurface exploration. The methods used indicate subsurface conditions only at the specific locations where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Samples cannot be relied on to accurately reflect the strata variations that usually exist between sampling locations. In addition, soil samples tested in this study were composites prepared by combining multiple samples taken from various depths in the soil column. These results do not represent the exact chemical concentration at a discreet depth in the soil column tested.

The recommendations presented in this report are based upon a limited number of subsurface samples obtained from widely spaced sampling locations. The samples may not fully indicate the nature and extent of the variations that actually exist between sampling locations.

8.0 REFERENCES

AMEC 2005. Ormond Beach Wetland Restoration Project - Soil Contaminant Review, January.

AMEC 2006. Final Draft, Ormond Beach Wetland Restoration, Site-Wide Soil/Surface Water Investigation, Sampling and Analysis Plan. Prepared for Aspen Environmental Group. July.

Applied Environmental Technologies, Inc. 2002. Report of a Limited Sediment Assessment of a Portion of the Oxnard Drainage District Ditch, Edison Drive to the North Side of Arnold Road, Oxnard, California. February 19.

Buchanan, M.F., 1999. NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Seattle, WA, Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration, 12 pages.

Earth Tech. 1996. Phase I Environmental Site Assessment Report, Former Western LNG Terminal/Baldwin Homes Property, Oxnard, California. December.

Environmental Protection Agency (EPA) 2000. Water Quality Standards; Establishment of Numeric Criteria for Toxic Pollutants for the State of California; Rule (20 CFE Part 131). May 18.

Gay, D., C. Gibson, J. Gress, F. Kaminsky, M. Schulz, and K. Siegler. 2001. Analysis of Contaminants and Potential Effects at the South Ormond Beach Wetland Restoration Site, Ventura County, California. Group Master's Thesis. University of California, Santa Barbara. June.

Jones & Stokes. 1994. Final Report, South Ormond Beach Wetland Restoration and Management Plan. November. (only Section 2 was reviewed).

Los Angeles Regional Water Quality Control Board. 2003. Characterization of Wastes in Waste Management Unit – Halaco Engineering Co., Oxnard, California (File No. 70-24). Letter from Dennis Dickerson, Executive Officer. September 26.

Lowney Associates. 2001. Geotechnical Investigation, Oxnard Plain Brine Pipeline Phase 1 and 2. November 27.

Lowney Associates. 2002. Supplemental Geotechnical Exploration, Oxnard Plain Brine Two Trenchless Segments. December 10.

Ninyo & Moore. 1997. Phase II Environmental Site Assessment, Baldwin Builders (Ormond Beach) Property, Oxnard, California. January 10.

Padre Associates. 2002. Report of Findings, Characterization/Waste Sampling of Waste Management Unit, Halaco Engineering Co. Facility, Located at 6200 Perkins Road, Oxnard, Ventura County, California. Prepared for Halaco Engineering Company. November.

SECOR. 2000a. Review of Environmental Documents, SCE Tank Farm and Excess Land, Ormond Beach, Oxnard, California. May.

SECOR. 2000b. Soil, Surface Water, and Groundwater Sampling for Due Diligence, SCE Tank Farm and Excess Land, Ormond Beach, Oxnard, California. July.

SECOR. 2002a. Soil and Groundwater Sampling for Due Diligence, SCE's Former Tank Farm and Associated Area, Ormond Beach, Oxnard, California. May.

SECOR. 2002b. Risk Evaluation, Proposed Wetlands Creation Project, SCE Ormond Beach Facility, Oxnard, California. May.

SECOR. 2004. Phase 2 Environmental Site Assessment Report, Ormond Beach, Metropolitan Water District/City of Oxnard Property, McWane Boulevard, Oxnard, California. September.

Southern California Edison. 2001. Final Remediation Report. Station Fuels Oil Facilities, Tank Farm Decommissioning, Ormond Beach Generation Station, Oxnard, California. August 31.

URS. 2004a. Technical Work Plan, Additional Site Characterization Investigations, for the Halaco Engineering Facility, Oxnard, California. Prepared for Halaco Engineering Company. April.

URS. 2004b. Technical Work Plan, Supplemental, Waste Management Unit Characterization. Prepared for Halaco Engineering Company. May.

URS. 2004c. Technical Report, Conceptual Closure Plan, Waste Management Unit, for the Halaco Engineering Facility, Oxnard, California. Prepared for Halaco Engineering Company. August.

Wetlands Research Associates. 2000. South Ormond Beach Wetlands Soil and Water Study. July 20*.*