Revised Feasibility Study

Ascon Landfill Site
Huntington Beach, California

Submitted to:

Department of Toxic Substances Control
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Cypress, California 90630

Submitted by:

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PROJECT NAVIGATOR, LTD.®

REVISED FEASIBILITY STUDY

Ascon Landfill Site

Huntington Beach, California

THIS DOCUMENT WAS PREPARED UNDER THE DIRECTION AND SUPERVISION OF A QUALIFIED REGISTERED CALIFORNIA PROFESSIONAL ENGINEER

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RFS ABBREVIATIONS AND ACRONYMS

Alt.	Alternative
ARAR	Applicable or Relevant and Appropriate Requirement
ATSDR	Agency for Toxic Substances Disease Registry
BHRA	Baseline Health Risk Assessment
BMP	Best Management Practice
BTEX	benzene, toluene, ethylbenzene, and xylenes
BTU	British Thermal Unit
CAA	Clean Air Act
CALOSHA	California Occupational Safety and Health Act
CAMU	Corrective Action Management Units
CARB	California Air Resources Board
CA-RWQCB	California Regional Water Quality Control Board
CBCEC	California Base Closure Environmental Committee
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHP	Cannery Hamilton Properties, LLC
CND	California/Nevada Development, LLC
COPC	Constituent or Chemical of Potential Concern
CSM	Conceptual Site Model
CSWRCB	California State Water Resources Control Board
CUI	Consolidated undrained triaxial compression
CWA	Clean Water Act
cy	cubic yard
DHS	Department of Health Services
DOGGR	Division of Oil, Gas, and Geothermal Resources

RFS ABBREVIATIONS AND ACRONYMS

DQO	Data Quality Objective
DTSC	Department of Toxic Substances Control
EA	Emergency Action
EFH	Extractable Fuel Hydrocarbons
EIR	Environmental Impact Report
Environ	Environ Corporation, Inc.
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
ESE	Environmental Science and Engineering, Inc.
ETS	Environmental Technology Solutions
EVS	Environmental Visualization System®
FID	Flame Ionization Detector
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FS	Feasibility Study
GAC	Granular Activated Carbon
GARFR	Groundwater Assessment Report of Findings and Recommendations
GC/FID	Gas Chromatography/Flame Ionization Detector
GCL	Geosynthetic Clay Liner
Geosyntec	Geosyntec Consultants
GIS	Geographic Information System
GRA	General Response Action
GRO	Gasoline Range Organics
HDPE	high density polyethylene
HI	Hazard Index
HSAA	California Hazardous Substances Account Act
HWCA	Hazardous Waste Control Act
ISCST3	Industrial Source Complex Short Term, Version 3

RFS ABBREVIATIONS AND ACRONYMS

MCL	Maximum Contaminant Level
MEO	Mineral Estate Owner
mg/l	milligrams per liter
MRL	Minimal Risk Level
MRL	Minimum Risk Levels (ATSDR)
NAPL	Non-Aqueous Phase Liquid
NCP	National Contingency Plan
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
OCSD	Orange County Sanitation District
OCWD	Orange County Water District
OEHHA	Office of Environmental Health Hazard Assessment
OPA	Oil Pollution Act
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
PNL	Project Navigator, Ltd.
ppb	part per billion
PPE	personal protective equipment
ppm	part per million
PRG	Preliminary Remediation Goal
PS3	Pilot Study No. 3 Workplan and fieldwork
psi	pound per square inch
QA/QC	Quality Analysis/Quality Control
RAO	Remedial Action Objective
RAP	Remedial Action Plan
RBC	Risk-Based Concentration
RBSL	Risk-Based Screening Level

RFS ABBREVIATIONS AND ACRONYMS

RCRA	Resource Conservation and Recovery Act
REL	Reference Exposure Level
RFS	Revised Feasibility Study
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
RP	Responsible Party
RWQCB	Regional Water Quality Control Board
SARA	Superfund Amendments and Reauthorization Act
SCAQMD	South Coast Air Quality Management District
SCOC	South Coast Oil Corporation
SDWA	Safe Drinking Water Act
Signal	Signal Mortgage Company
SIT	Slurry Injection Technology
Site	Ascon Landfill Site
STLC	Soluble Threshold Limit Concentration
SVE	Soil Vapor Extraction
SVOC	Semi-Volatile Organic Compound
SWRCB	California State Water Resources Control Board
TCLP	Toxicity Characteristic Leachate Procedure
TDS	Total Dissolved Solids
TEC	Texas Envirochem Group, L.P.
TM1ROF	Technical Memorandum No. 1 Report of Findings
TPH	Total Petroleum Hydrocarbon
TRPH	Total Recoverable Petroleum Hydrocarbon
TSCA	Toxic Substances Control Act
TTLC	Total Threshold Limit Concentration
UCL	Upper Confidence Limit

RFS ABBREVIATIONS AND ACRONYMS

ug/l or µg/l	micrograms per liter
USEPA	United States Environmental Protection Agency
VCA	Voluntary Cleanup Agreement
VFPE	very flexible polyethylene
VOC	Volatile Organic Compound
WMCROF	Waste Material Characterization Report of Findings

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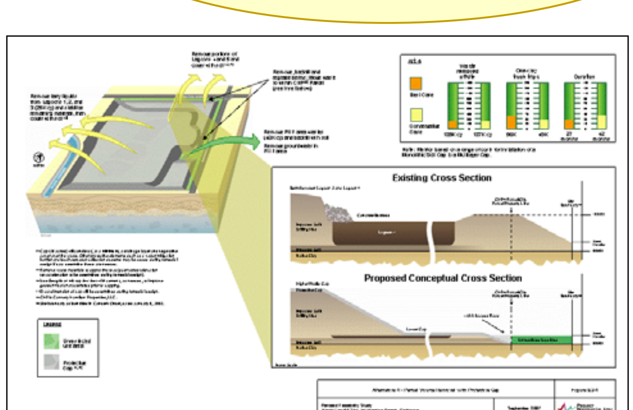
- **Section** — RFS Section
- **Key Step** — Key Sub-Section or Appendix
- **Analysis Result** — Key Analysis Result
- **Other Key Result** — Other Key Result
- ↓ — Analysis Path



Alternative No. 4 Description
1. Remove and dispose Pit F area wastes
2. Remove, treat and/or dispose Pit F groundwater, as needed
3. Remove tarry liquids in Lagoons 1, 2, and 3
4. Remove portions of Lagoons 4 and 5 drilling mud to approximate adjacent street elevation
5. Remove and dispose impacted materials to approximate adjacent street elevation along Hamilton and Magnolia Street
6. Remove and dispose of impacted materials from City parcel
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Revised Feasibility Study
Ascon Landfill Site, Huntington Beach, California | September 2007 | Project Navigator, Ltd.

EXECUTIVE SUMMARY

Introduction

The Revised Feasibility Study was completed due to additional information discovered at the Ascon Landfill Site during implementation of the Environmental Impact Investigation Process launched after the initial site Feasibility Study approval in 2001.

Objectives of the Revised Feasibility Study

The objectives of this Revised Feasibility Study (RFS) are:

1. To assemble remedial alternatives and to evaluate them against the nine criteria of the National Contingency Plan, and
2. To recommend a preferred alternative.

In order to achieve the above objectives, this RFS also:

- Documents field activities undertaken during Pilot Study No. 3,
- Evaluates remedial technologies available to address impacted media at the Site,
- Evaluates and confirms the appropriateness of process options to implement those technologies, and
- Incorporates findings from the Emergency Action conducted in 2005-2006.

Site Description and History

The Ascon Landfill Site (Site) is an approximately 38-acre parcel of land located at the southwestern corner of the intersection of Hamilton Avenue and Magnolia Street in Huntington Beach, California. The Site, as presently configured, contains 5 lagoons (numbered 1 through 5) and 8 pits (A through H). The Site began receiving wastes during approximately 1938, and by the late 1950s nearly the entire Site was covered with ponds/lagoons that received oil field wastes. Disposal of oil field waste ceased in 1972. The Site then received only construction waste and ceased all disposal operations in 1984.

Cannery Hamilton Properties, LLC, purchased the Site in 2003 and is the current surface owner of what the RFS refers to as the Cannery Hamilton parcel. A narrow strip of land along Hamilton Avenue and Magnolia Street is owned by the City of Huntington Beach and is herein called the City parcel.

Descriptions of Pits, Lagoons, and Wastes

Lagoons 1 through 5

Lagoons 1 through 5 contain approximately 85,000 cubic yards of tarry wastes and drilling mud[1]. Lagoons, or ponds, at one time covered most of the Site.

Pit F

Pit F, the only pit visible at the surface today, contains waste described as thick, sticky, black to brown, and odorous. Styrene tars or wastes were reportedly disposed in Pit F. Pit F materials have impacted

[1] The volume is based on the remaining drilling mud and tarry liquids at the Site after the completion of the Emergency Action conducted in 2005 to early 2006, which included removal of over 30,000 cy of drilling mud from Lagoons 4 and 5.

adjacent soils, including saturated soils underneath the clay layer in the pit vicinity. The volume of Pit F contents and impacted adjacent soils is estimated to be approximately 40,000 cubic yards.

Pits A though E, G, H

Other than Pit F, the Site includes seven pits, three near the northwest corner of the Site and 4 near the southeast, reportedly used historically for disposal of oil field waste, chromic acid, and other wastes.

New Information and Evaluations in the RFS

There are many ways in which this RFS improves upon the initial Feasibility Study Report (initial FS)[2], including:

Incorporation of Additional Data Collected

Pilot Study No. 3, conducted in 2004, and studies reported in Technical Memorandum No. 1, conducted in 2002, provided substantial new data and insight into wastes present at the Site. New studies provided approximately 63,000 new data points in addition to the 20,000 documented by the initial FS. The additional studies conducted since the initial FS gathered additional information on the physical and chemical characteristics of the waste materials and on the effect of the Site on surrounding air quality. This RFS uses all presently available data, old and new, to meet its objectives and evaluate remedial alternatives.

Waste Analysis Approach

Although the initial FS analyzed the Constituents of Potential Concern ("COPC") data by geographic areas on the Site, this RFS is focused on the individual waste types. This is because, in many cases, it is more efficient to consolidate similar wastes from different areas of the Site prior to remediation and address each waste type separately. As a result, waste stream analysis, taken in conjunction with geographic analysis (e.g., City or Cannery Hamilton parcels, Pit F area), leads to a more accurate and efficient development of process options and remedial alternatives.

Reevaluation of the Baseline Health Risk Assessment (BHRA) for Soils

Reevaluation of the air pathways for the BHRA for soils was addressed to further refine and accurately estimate potential Site emissions and predicted exposure concentrations at offsite locations. In addition, updates in toxicity values were incorporated into the assessment.

Risk Assessment for Groundwater

This RFS addresses the results of the Risk Assessment for groundwater included in the Groundwater Remedial Investigation (RI) report (Geosyntec, 2007b). Three potential exposure pathways were identified and analyzed in the Risk Assessment.

Development of Risk-Based Concentrations ("RBCs")

RBCs were developed for individual chemicals with the goal that the risk posed by an individual chemical would be at or below the $1x10^{-6}$ cancer risk level, or $1x10^{-5}$ risk level, where appropriate, and below Hazard Index (HI) of 1 for residential, recreational, commercial, and construction land-use scenarios.

The RBCs will be valuable tools in remedy design in that they indicate acceptable residual concentrations of COPCs in soils following remediation (i.e., the RBCs can provide appropriate cleanup levels for

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[2] The initial Feasibility Study Report was authored by Environ Corporation in 2000.

removal actions), provided that the cumulative impacts are acceptable. However, the risk posed by chemicals remaining at the Site following completion of remedial actions can only be accurately determined using final soil or soil gas confirmation data obtained through a post-remediation risk assessment.

Additional Technologies Considered

In addition to the technologies evaluated by the initial FS, this RFS also evaluates the following technologies:

- *Ex Situ* Chemical Oxidation for soils
- Sludge Liquification
- Slurry Injection Technology (SIT) for disposal of waste.

Of these, the first two were evaluated by conducting treatability studies. The last was evaluated only conceptually.

The Process Followed by the RFS

The development of this RFS followed the following steps:

1. Affected media or waste units and their waste types were identified (Section 3).
2. The BHRA was reevaluated and COPCs were identified based upon chemical concentrations and available risk pathways (Section 4).
3. The potential Applicable or Relevant and Appropriate Requirements ("ARARs") and Remedial Action Objectives ("RAOs") were defined (Sections 5 and 6).
4. The risk-based clean-up criteria for the COPCs were determined, and the various waste volumes were estimated (Section 6).
5. Technologies and process options required to remediate the COPCs were identified, and these technologies were screened based upon their effectiveness, implementability, and cost (Section 8).
6. Remediation alternatives were assembled and screened according to the nine NCP criteria, and the alternatives to be retained were compared to each other (Section 9).
7. The preferred remedial alternative for the Site was recommended in Section 10.

Selection of Alternatives

Based on the analysis of the existing and recently collected data at the Site and the screening of various remediation technologies and process options, the following remedial alternatives were identified:

- Alternative 1: No Action
- Alternative 2: Limited Waste Removal
- Alternative 3: Protective Cap
- Alternative 4: Partial Source Removal with Protective Cap
- Alternative 5: Source Removal (with Offsite Disposal and SIT)
- Alternative 6: Source Removal (with Offsite Disposal).

The above alternatives were evaluated using the nine NCP criteria. Based upon this evaluation, the following three alternatives were retained for a comparative evaluation:

- Alternative 3: Protective Cap
- Alternative 4: Partial Source Removal with Protective Cap
- Alternative 6: Source Removal (with Offsite Disposal).

Preferred Alternative

Alternative 4, Partial Source Removal with Protective Cap, is the recommended preferred alternative for the Ascon Landfill Site after screening the six remedial alternatives presented in Section 9 against the nine NCP criteria and performing the comparative evaluation. Knowledge from the Emergency Action conducted in 2005 through early 2006 gave further insight into the Site's existing conditions, the process options retained in this RFS, and ultimately the remedial alternatives identified in Section 9. The Emergency Action confirmed that Alternative 4 is implementable with less potential short-term impacts than remediating the entire Site to unrestricted end use.

The key elements of Alternative 4 are listed below and are further detailed in Sections 9 and 10:

- Removal of Pit F area wastes with offsite disposal and removal and/or treatment of impacted groundwater near Pit F,

- Removal of the tarry liquids in Lagoons 1, 2, and 3,

- Excavation of impacted materials on the City parcel, and backfilling these areas to adjacent street elevation,

- Removal of portions of Lagoons 4 and 5 drilling mud to an appropriate depth determined during remedial design (the cost estimates and waste volumes are based on removal of drilling mud in Lagoons 4 and 5 to adjacent street elevation) by excavation and offsite disposal,

- Excavation of impacted materials to appropriate elevation to be determined during remedial design along an area parallel to Hamilton Avenue and Magnolia Street (the cost estimates and waste volumes are based on removal of impacted materials to adjacent street elevation),

- Construction of a cap over the excavated areas along Hamilton Avenue and Magnolia Street, and

- Construction of a cap over the southwestern portion of the Site. The cap over the Site would be a tiered cap consisting of different elevations in different areas, where the southwestern portion of the cap would be at a higher elevation than the protective cap placed on top of the excavated areas at the north and east sides of the Site. The capped areas may vary in elevation and size depending on the final area and vertical extent of source removal along the east and north sides of the Site to be determined during the remedial design.

Summary of Section 1: Introduction

Site Location Map, *Figure 1.1-1*

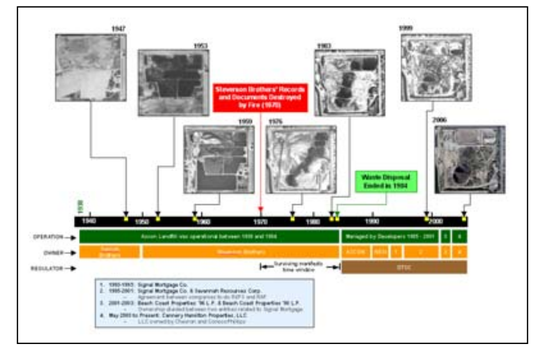
Adjacent Land Use, *Figure 1.2-1*

Site Vicinity and Features Map, *Figure 1.2-2b*

Table 1.3-A. Presence of Site Features through Time

Year	1928	1947	1953	1958	1959	1961	1967	1972	1976	1979	1983	1999	2002	2006
Agricultural field to south	X	X												
Northern former lagoons			X	X	X	X	X	X						
Western oil production				X	X	X	X	?[7]	X	X	X	X	X	X
Eastern oil production		X	X	X	X	X	X	?	X	X	X	X	X	
Southern former lagoon				X	X	X	X	X						
Pit A			X	X	X	X	X	?						
Pit B			X	X	X	X	X	?						
Pit C				X	X		X	?						
Pit D				X	X		X	?						
Pit E				X	X	X	X	?						
Pit F				X	X	X	X	?	X	?	X	X	X	X
Pit G				X	X		X	?	X	?				
Pit H			X	X			X	?						
Flood control channel						X	X	X	X	X	X	X	X	X
Residential to east							X	X	X	X	X	X	X	X
Lagoons 1-5										X[8]	X	X	X	X
Offsite structures (northwest)											X	X	X	X

Presence of Site Features Through Time, *Table 1-A, Section 1.3*



Site History, *Figure 1.4-1*

Site Operations Chronology

1938 – 1984	Site operated as a waste disposal facility.
1938 – 1971	Rotary drilling muds, wastes and waste water brines were the major wastes deposited at the Site.
1957 – 1971	Chromic acid, sulfuric acid, aluminum slag, fuel oils, styrene, and other wastes were disposed on the Site.
1971	All oilfield waste disposal ceased.
1971 – 1984	Inert solid wastes such as abandoned vehicles, asphalt, concrete, metal, soil, and wood were disposed on the Site.
1984	All disposal activities ceased.
1997	Old drums, vehicles, motorcycles, trailers, and piles of cut firewood were found scattered throughout the Site.
1997	RI report and Baseline Health Risk Assessment completed by ESE.
2000	Feasibility Study (initial FS) completed by Environ.
2002 – present	RPs conducted Site assessments under DTSC's oversight.
2003	RPs singed Consent Order. Cannery Hamilton Properties, LLC purchased the Site.

Investigations Conducted Prior to 1997

- **Subsurface Exploration and Monitoring Well Installation at the Proposed Ryan Waste to Energy Plant Site** — Woodward-Clyde Consultants, 1983
- **Final Site Characterization Plan** — Lockman & Associates, 1984
- **Remedial Action/Mitigation Plan** — Bright & Associates, 1985
- **Volume 1 and Appendices A through J, Final Site Characterization Report for Ascon Site** — Radian Corporation, December 1988
- **Final Site Soils Report** — H.V. Lawmaster, 1988
- **Draft Hydrogeological Assessment Report** — ISCO Industries/ITARA Engineers, June 20, 1991
- **Removal Action Plan** — ISCO Industries, October 4, 1991
- **Draft Remedial Investigation Report** — ISCO Industries/ITARA Engineers, May 11, 1992
- **Baseline Health Risk Assessment Report** — Environmental Science & Engineering, Inc., June 9, 1997
- **Remedial Investigation Report** — Environmental Science & Engineering, Inc., June 11, 1997

→ 20,000 Data Points

Investigations Conducted by RPs (2002 onward)

- **Re-Evaluation of Air Pathway Analysis / Revised Air Pathway Risk Assessment** — Geosyntec Consultants 2002
- **Waste Materials Characterization Report of Findings (WMCROF)** — Project Navigator, Ltd., 2002
- **Implementability Assessment Report of Findings (IROF)** — Project Navigator, Ltd., 2002
- **Groundwater Assessment Report of Findings and Recommendations (GARFR)** — Project Navigator, Ltd., 2002
- **Technical Memorandum No. 1 Report of Findings (TM1ROF)** — Project Navigator, Ltd., 2003
- **May 2003 Perimeter Air Sampling Report** — Geosyntec Consultants, 2003
- **Tidal Study and Well Gauging Results Letter Report** — Geosyntec Consultants, 2003
- **Perimeter Air Sampling Report** — Geosyntec Consultants, August 2003
- **Report of Findings, Perimeter Air Sampling Report** — Geosyntec Consultants, 2004
- **Pilot Study No. 3 Waste Characterization, Emissions and Excavation Testing Program Workplan** — Project Navigator, Ltd./Geosyntec Consultants, 2004
- **Supplemental Soil Vapor Investigation** — Geosyntec Consultants, 2006
- **Preliminary Report – Site Material Characterization and Slurry Injection Technology (SIT) Evaluation** — Project Navigator, Ltd., 2004
- **Phase IV Workplan Addendum (Lagoon Sampling Program) to Pilot Study No. 3 Waste Characterization, Emissions and Excavation Testing Program** — Project Navigator, Ltd., 2004
- **Phase V/VI Workplan Addendum (Pits A, B, C, D, E, G, and H, Former Lagoon Areas and Berm Sampling Programs) to Pilot Study No. 3 Waste Characterization, Emissions and Excavation Testing Program** — Project Navigator, Ltd., 2004
- **Phase VIII Workplan Addendum (Pit F Sampling Program) to Pilot Study No. 3 Waste Characterization, Emissions and Excavation Testing Program** — Project Navigator, Ltd., 2004
- **Pit F Offsite Investigation Workplan Addendum to Pilot Study No. 3 Waste Characterization, Emissions and Excavation Testing Program** — Project Navigator, Ltd./Geosyntec Consultants, 2004
- **Pit F Data Package to Pilot Study No. 3 Waste Characterization, Emissions and Excavation Testing Program** — Project Navigator, Ltd., 2004
- **Data Package to Pilot Study No. 3 Waste Characterization, Emissions and Excavation Testing Program** — Project Navigator, Ltd., 2004
- **Phase IX Workplan Addendum (Treatability Testing Program) to Pilot Study No. 3 Waste Characterization, Emissions and Excavation Testing Program** — Project Navigator, Ltd., 2004
- **Pit F Offsite Investigation Addendum Letter Report** — Project Navigator, Ltd./Geosyntec Consultants 2005
- **Five Quarters of Groundwater Monitoring Reports and Groundwater Remedial Investigation** — Geosyntec Consultants, 2007
- **Groundwater Investigation in the Pit F Area** — Geosyntec Consultants, 2006

→ 63,000 Data Points + Emergency Action[1]

This Revised Feasibility Study is based on data collected to date.

Notes:
1. Data from the Emergency Action conducted in 2005-2006 are reported in the Emergency Action Completion Report and Addendum (Project Navigator, Ltd., 2006a,b)

Summary of Section 1: Introduction		Figure 1
Revised Feasibility Study Ascon Landfill Site, Huntington Beach, California	September 2007	Project Navigator, Ltd.

REVISED FEASIBILITY STUDY REPORT
ASCON LANDFILL SITE
HUNTINGTON BEACH, CALIFORNIA

1.0 INTRODUCTION

1.1 Background

The Revised Feasibility Study ("RFS") was completed on behalf of Ascon Landfill Site ("Site") Responsible Parties ("RPs") in conformance with the Imminent and Substantial Endangerment Determination Consent Order 02/03-007 and the Imminent and Substantial Endangerment Determination and Order and Remedial Action Order 02/03-018, both issued by the Department of Toxic Substances Control ("DTSC"). The RFS was completed by Project Navigator, Ltd. ("PNL") with assistance from Geosyntec Consultants ("Geosyntec" or "GeoSyntec") to further identify and evaluate technically feasible and effective remedial action alternatives to protect public health and the environment at the Site. The RFS was prepared as defined by, and in conformance with, the requirements contained in Division 20 of the California Health and Safety Code, and Title 40 of the Code of Federal Regulations.

The RFS reflects additional information and data uncovered during the implementation of the Environmental Impact Investigation Process launched after the initial site Feasibility Study ("initial FS") approval in 2001. The RFS reevaluated remedial action alternatives based on new data and prevailing acceptable practices in the field of hazardous waste remediation.

The initial FS for soil/waste was prepared by ENVIRON International Corporation ("Environ") during the year 2000 under a contract with California/Nevada Development, LLC ("CND"). In November 1995, CND's predecessor, Savannah Resources Corporation had executed an agreement with Signal Mortgage Company ("Signal"), the owner of the property at that time, to prepare a Remedial Investigation/Feasibility Study ("RI/FS") and a Remedial Action Plan ("RAP") in exchange for the option to jointly develop the Site with Signal for residential use. CND entered into a Voluntary Cleanup Agreement ("VCA") with DTSC in May 1996. The VCA required preparation of the RI/FS, RAP, and other associated response action documents, subject to DTSC oversight and approval. CND prepared the draft RI/FS documents for soil/waste, and the documents were approved by DTSC on June 22, 2001. On June 20, 2001, DTSC received a 30-day notice from CND to terminate the VCA; the VCA was terminated on July 20, 2001.

In June 2001, DTSC notified 16 companies that they had cleanup responsibilities at the Site. Ten of these companies[1], identified at that time as the Cooperating Parties but now referred to as the RPs, entered into a Letter Agreement with DTSC to perform additional data collection and evaluation activities and to complete the soil/waste RAP for the Site based on the preferred remedy identified in the initial FS. In January 2003, nine of the ten RPs entered into an Imminent and Substantial Endangerment Determination and Consent Order, Docket No. I&SE CO 02/03-007, with DTSC to prepare a RI/FS for groundwater, complete the RAP for soil/waste and a RAP for groundwater, prepare California Environmental Quality Act (CEQA) documents (e.g., Environmental Impact Report ["EIR"]) and perform remedial design and implementation of the remedial actions approved in each RAP. In March 2003, the tenth RP, Exxon Mobil Corporation, entered into an Imminent and Substantial Endangerment

[1] The ten RPs are Chevron U.S.A. Inc., Texaco Inc. (Chevron U.S.A Inc. and Texaco Inc. are now combined as Chevron Corp.), Conoco Inc., Phillips Petroleum Company (Conoco Inc. and Phillips Petroleum Company are now combined as ConocoPhillips), ExxonMobil Corp., Shell Oil Company, Atlantic Richfield Company (ARCO), The Dow Chemical Company, TRW (now Northrop Grumman), and Southern California Edison Company. Two of the RPs, Chevron and ConocoPhillips, created a limited liability corporation called Cannery Hamilton Properties, LLC ("CHP") to purchase the Site, and CHP is the current Site owner.

Determination and Order and Remedial Action Order, Docket No. I&SE-RAO 02/03-018, with DTSC to perform the actions identified in I&SE CO 02/03-007 with the other nine RPs. The ten RPs are working together to complete these actions.

During the finalization of the soil/waste RAP and preparations for an EIR (in 2003), it was determined that additional data were needed to complete the EIR process[2]. The DTSC allowed the RPs to supplement the FS for the soil/waste operable unit and evaluate additional remedial alternatives[3]. To address these data gaps and the need for a more complete FS, this RFS was proposed in February 2004 with corresponding fieldwork outlined in the Pilot Study No. 3 Waste Characterization, Emissions, and Excavation Testing Program Workplan (Project Navigator, Ltd., 2004a). As Pilot Study No. 3 was nearly completed, DTSC and the RPs agreed to combine the Groundwater Feasibility Study with this RFS. The groundwater and soil/waste operable units will be combined into one integrated RAP[4]. The Groundwater Remedial Investigation (Geosyntec, 2005b) was submitted as a separate document on March 1, 2005.

Much of the information presented below in Sections 1.2 through 1.6 was excerpted from the initial FS report (Environ, 2000) or the RI report (ESE, 1997b) and updated as appropriate. Feasibility study objectives for this RFS are described in Section 1.7.

1.2 Site Description

The Site is an approximately square parcel of land located at 21641 Magnolia Street in Huntington Beach, California. The Site is located at the southwestern corner of the intersection of Hamilton Avenue and Magnolia Street, approximately ½ mile north of Huntington Beach State Park and the Pacific Ocean (**Figures 1.1-1** and **1.2-1**). The Site is approximately 38 acres in size and is enclosed by a perimeter chain link fence with three 20-foot-wide locked gates and one 4-foot wide gate. The gate at the northwestern corner of the Site provides access from Hamilton Avenue and a second gate provides access from Magnolia Street in the southeastern portion of the Site. A third gate at the southeastern corner of the Site was constructed in 2005 to facilitate waste haul truck exit. A fourth gate, 4-feet wide, was installed in January 2006 midway along Hamilton Avenue for Southern California Edison access to power poles located inside the fenceline along Hamilton Avenue. Hazardous waste and California Proposition 65 signs are posted on the perimeter fence and at the gates.

Specifically, the Site is comprised of two parcels: the CHP parcel and the City parcel. The CHP parcel constitutes all of the Site except for an approximately 30-ft wide margin along the northern edge of the Site against Hamilton Avenue and an approximately 20-ft wide margin along the eastern edge of the Site against Magnolia Street. The RFS refers to these two margin areas collectively as the City parcel. Refer to **Figure 1.2-2a** for a depiction of these areas.

The Site, no longer in operation, consists of five impoundments (referred to as Lagoons 1 through 5), one covered pit (referred to as Pit F), and seven former pits that are no longer visible. The approximate locations of the lagoons and other significant features are presented on **Figure 1.2-2b**.

In May 2003, as part of the Site maintenance and safety program, chain link fencing was installed around Lagoon 3, and bird netting was installed over Lagoons 1 and 2 to keep birds out of the tarry waste and water that seasonally collects within these lagoons. During January 2004, vegetation at the Site was trimmed, trash and debris that had accumulated on the Site were removed, and new chain link fencing was placed around Pit F. In July 2004 safety fencing was placed around Lagoons 4 and 5, and chain link fencing was installed around Lagoons 4 and 5 in March 2006 after the Emergency Action was completed (see below for more information about the Emergency Action). In July 2006, fencing was installed around Lagoons 1 and 2. A small storage shed is located northwest of Pit F.

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[2] Letter from Thomas M. Cota to Ascon RPs, dated December 18, 2003.
[3] Letter from Thomas M. Cota to Ascon RPs, dated January 28, 2004.
[4] Letter from Ning-Wu Chang to Ascon RPs, dated December 29, 2004.

There is an oil production facility consisting of two wells on leased property situated onsite along the western perimeter. This facility is operated by third parties (South Coast Oil Corporation [SCOC], or its successor[5]) and is not owned or operated by CHP or the RPs (refer to Section 1.3 below for more information about ownership of the Site's surface and mineral estate). Until July 2004, equipment remaining on a 2-acre oil production lease existed in the east-central part of the Site. The oil production well (Krik Well No. 80) and associated tank storage were removed during clean-up operations in response to a crude oil release from the well that occurred on March 17, 2004. Krik Well No. 80 was owned and operated by Gregory Miral doing business as the Krik Company under a mineral lease predating CHP ownership of the land. In response to the crude oil release from the well, the U.S. EPA Region IX issued an Order For Removal, Mitigation or Prevention of a Substantial Threat of Oil Discharge, EPA Docket No. OPA 9-2004-0004 to CHP, Miral, and The Krik Company. Although neither Miral nor the Krik Company responded, CHP responded to the order by performing the remedial actions required by the order. Krik Well No. 80 was abandoned by the California Department of Conservation, Division of Oil, Gas & Geothermal Resources on March 27, 2004, and oil production activities ceased at the release site (oil production facilities remain at the western perimeter). The remedial action was completed on April 27, 2004[6], and a Krik Well No. 80 Release Completion Report was submitted to EPA on June 14, 2004.

In July 2005, the RPs commenced an Emergency Action, under DTSC oversight, to strengthen the north berm (along Hamilton Avenue), consisting of removal of some of the drilling mud from the northernmost lagoons (Lagoons 4 and 5) and Site winterization, including installation of a toe drain along the toe of the north berm. Below is a brief history and explanation of the findings that required the Emergency Action.

The Site was built without properly engineered berms when it was constructed in 1938. The 2004-2005 winter brought record-breaking precipitation to Southern California and the Site: the wettest season in the Site's recorded history. The lagoons, including Lagoons 4 and 5 behind the Hamilton berm (north berm), filled with stormwater requiring pumping, treatment, and discharge under permit of approximately 3.8 million gallons of water to Orange County Sanitation District (OCSD) to mitigate the potential of an uncontrolled release of water that had come into contact with drilling mud inside the lagoons. Routine Site inspections during that period revealed the presence of surface cracks in the north berm and potential water seeps from the Site along Hamilton Avenue.

A geotechnical assessment was then performed by the RPs, and it was determined that the north berm was potentially weakened by the record heavy rainfall and, if the Site experienced a similar level of rainfall in the next rainy season beginning in the Fall of 2005, the north berm might potentially be unstable to a factor of safety below accepted standards. The geotechnical assessment concluded that there was a need for prompt, interim action to avoid a potential emergency condition to protect the public and the environment and to minimize the risk to public and private property prior to the 2005-2006 rainy season.

The DTSC reviewed this assessment and agreed that response action at the Site was necessary because there may have been, or could be, an imminent or substantial endangerment to the public health or welfare or to the environment due to the current conditions of the Site and issued an Imminent or Substantial Endangerment Determination letter to the RPs on May 13, 2005[7]. This Determination letter ordered the RPs to take immediate action (Emergency Action) prior to the 2005-2006 rainy season to prevent an emergency due to potential failure of the north berm.

The primary objective of the Emergency Action was to strengthen the north berm by reducing the load on the berm and to mitigate potential seepage along the northern edge of the Site. In the Emergency Action, the following work was performed: removal of a significant portion of the drilling mud in Lagoons 4 and 5, the reshaping of the north berm to reduce the height and flatten the north (outboard) slope, and the installation of an under drain (toe drain) at the toe of the outboard slope of the north berm. The

[5] The operation of the oil production facility may change. However, this property is referred to the South Coast Oil Corporation, or SCOC, property throughout the RFS.
[6] Letter from Robert Wise, Federal On-Scene Coordinator, to CHP, dated April 27, 2004.
[7] Letter from Thomas M. Cota to Ascon RPs, dated May 13, 2005.

excavated drilling mud was to be mixed with soil from the Site to improve its material handling characteristics and transported by end-dump trucks to an approved disposal facility. In addition, a buttress constructed from onsite concrete debris was placed at the toe of the south berm between Lagoons 3 and 4 to support that berm after the removal of drilling mud from Lagoon 4. The Emergency Action was completed in January of 2006 and is documented in the Emergency Action Completion Report (Project Navigator, Ltd., 2006a) and the Emergency Action Completion Report Addendum (Project Navigator, Ltd., 2006b).

1.3 Site Ownership History and Aerial Photography

This section outlines historical ownership of the Site and the results of aerial photograph reviews by Environmental Science and Engineering, Inc. ("ESE") and past investigators. ESE developed the Site history from information presented in the documents listed in Section 1.6 of this RFS report, primarily Radian (Radian, 1988) and ISCO Industries/ITARA Engineers (ISCO, 1992). The following Site history was excerpted from the RI (ESE, 1997b) and updated as appropriate.

The Site was operated as a landfill by the Garrish Brothers from approximately 1938 to 1950 and by the Steverson Bros., Inc. from 1950 until 1984. In 1984, ASCON Properties, Inc. purchased the Site and began negotiations with the DTSC to clean it up as part of a land redevelopment effort. ASCON Properties was unsuccessful in its attempts to remediate and develop the property and filed for bankruptcy in 1989.

NESI Investment Group acquired ownership through a foreclosure sale in July 1990. During 1993, the NESI Investment Group filed bankruptcy, and Signal Mortgage Company acquired the Site in May 1993 through foreclosure. In 1995, Signal Mortgage Company entered into an agreement with a predecessor of CND to work with the DTSC on the RI/FS and RAP under a VCA. However, following completion of the soil/waste RI/FS, CND withdrew from the VCA and had no further involvement with the Site. In 2003, CHP purchased the Site and is the current surface owner.

A limited review of historical aerial photographs of the Site was performed, and the presence of discernable Site features was tabulated from 1928 through 2002 (**Table 1.3-A)**. Corresponding photographs (**Figures 1.3-1a through 1n**) outline the former and current lagoon boundaries and the pit locations for reference, except in **Figures 1.3-1h** and **1.3-1j,** which are oblique views.

Table 1.3-A. Presence of Site Features through Time

Year	1928	1947	1953	1958	1959	1961	1967	1972	1976	1979	1983	1999	2002	2006
Agricultural field to south	X	X												
Northern former lagoons			X	X	X	X	X	X						
Western oil production				X	X	X	X	?[8]	X	X	X	X	X	X
Eastern oil production		X	X	X	X	X	X	?	X	X	X	X	X	
Southern former lagoon				X	X	X	X	X						
Pit A			X	X	X	X	X	?						
Pit B			X	X	X	X	X	?						
Pit C				X	X		X	?						
Pit D				X	X		X	?						
Pit E				X	X	X	X	?						
Pit F				X	X	X	X	?	X	?	X	X	X	X
Pit G				X	X		X	?	X	?				
Pit H			X	X			X	?						
Flood control channel						X	X	X	X	X	X	X	X	X
Residential to east							X	X	X	X	X	X	X	X
Lagoons 1-5										X[9]	X	X	X	X
Offsite structures (northwest)											X	X	X	X

Based on the review of aerial photos, it appears that essentially the entire Site was used at some time for waste disposal. There is evidence that up to eight discrete disposal pits (Pits A through H) existed in the northwestern and southeastern portions of the Site. These pits appear to have been subsequently backfilled with construction debris and fill material, as have the former lagoons.

A separate landfill, called the Cannery Street Disposal Site, was located north of the Site and operated by the County of Orange from 1957 to 1969. Aerial photographs taken in 1961 and 1967, during operation of the landfill, show that the southern extent of the landfill parcel was aligned with the northern extent of the power transmission line right-of-way (**Figure 1.3-2**). This right-of-way, combined with Hamilton Avenue, has apparently created an areal buffer of over 100-ft width between the Ascon Landfill Site and the Cannery Street Disposal Site during all operating phases of both landfills. Monitoring that is overseen by the City of Huntington Beach Fire Department continues for methane in probes at the landfill.

Ownership of the Ascon Landfill Site is divided into separate surface and subsurface mineral estates. The surface estate is currently owned by Cannery Hamilton Properties, LLC, and the subsurface mineral estate is owned by others with title to the oil and gas resources underlying the Site (mineral estate owners or the "MEOs"). By law, surface estate ownership is subordinate to the rights of subsurface owners. MEOs have access to and control over the surface to the extent necessary to initiate and/or maintain development of their mineral rights. The MEOs, through both their ownership of subsurface minerals, as well as oil and gas leases, easements, and surface leases, can affect the surface use of the Site. Therefore, unless effective land use restrictions are imposed on future uses and activities at the Site, any remedy will be subordinate to the rights of the MEOs. Neither the surface owner nor the Ascon RP Group have control over the MEO's exercise of their mineral rights.

DTSC has sent notice letters[10] to these MEOs regarding potential liability as property owners at the Site with cleanup responsibility and has indicated that deed restrictions will be required in the event of selection of a remedy not requiring complete removal of all waste at the Site. The terms of any such

[8] "?" signifies that it is impossible to tell if present from the oblique photograph.
[9] Lagoons 1, 2, and 3 appear as one lagoon in the 1979 aerial photo.
[10] Letter from Thomas M. Cota, dated May 17, 2006.

deed restriction should prohibit all future uses of either the surface or the mineral estate which are incompatible with long term maintenance and stability of the implemented remedy.

1.4 Site Operation

Much of the waste disposed on the Site during its early years came from oil drilling operations and included drilling mud, wastewater brine, and other drilling wastes. Records show that from 1957 to 1971 chromic acid, sulfuric acid, aluminum slag, fuel oils, styrene, and other wastes were also disposed on the Site. From 1971 to 1984, inert solid wastes such as abandoned vehicles, asphalt, concrete, metal, soil, and wood were disposed on the Site. The Site stopped receiving waste commercially in 1984. In 1997, old drums, vehicles, motorcycles, trailers, and piles of cut firewood were found scattered throughout the Site. There was an unauthorized firewood operation on portions of the Site in 1996 and 1997. Discarded vehicles, drum containers, and other debris have been removed from the Site.

Based on aerial photograph interpretation, the wastes contained at the Site were placed directly upon the native soil, and soil was used to form berms resulting in the lagoons and pits. Investigations have shown that the drilling mud and oil-saturated wastes have been found to be present throughout most of the Site, with the exception of the southeastern margin of the property and at the oil production area at the western perimeter. The thickness of the waste varies from a few feet to as much as 20 feet. Soil and construction debris, consisting of wood, brick, concrete, and asphalt were placed over much of the waste material and can be seen around the edges of several of the lagoons. It is estimated that the combined thickness of solid debris and waste materials throughout the Site ranges from about 5 to 25 feet.

A chronology of events at the Ascon Landfill Site, including pit locations and history, is presented in **Tables 1.4-1** and **1.4-2**. These tables identify the major types of wastes that were handled at the Site by year and include some company names associated with specific types of wastes handled at the Site. **Table 1.4-1** identifies when the Site ceased accepting various types of wastes. The majority of the information presented in **Tables 1.4-1** and **1.4-2** and in this section was obtained from reviewing previous reports, viewing aerial photographs, and visiting the Site. Many of the original sources of historical information, such as topographic maps, records, and City documents, used to develop the Site history and layout presented in these reports and in this RFS were not preserved, and therefore some specific activities that occurred and wastes deposited at the Site cannot be definitively established.

As described in Section 1.3, the primary types of waste disposal areas used at the Site were pits and surface impoundments (lagoons). The review of aerial photographs has identified a total of eight pits (Pits A through H). In 1964, the operators of the Site were ordered by Orange County Water Pollution District to cease and desist disposal operations in the waste pits. Subsequent reports document the covering of the waste pits with imported fill material. By the early 1970s, all waste pits were covered except for Pit F.

The Site chronology is depicted along with selected aerial photographs through time in **Figure 1.4-1**.

1.5 Waste Types Disposed at the Site

The total number of waste types disposed at the Site is not known. Past investigators have summarized the documented types of wastes possibly disposed at the Site. Radian (Radian, 1988) reviewed a report by Ecology and Environment, Inc. (July 1983) and concluded that the largest volume of wastes disposed at the Site was drilling mud and oil field wastes. Other wastes that may have been disposed of at the Site include:

- Chromic and sulfuric acids
- Aluminum slag
- Magnesium and potassium chloride

- Corrosive material (acid sludges)
- Mercaptans
- Styrene
- Styrene tars
- “Dion iso-styrene monomer (sic)” (Environ, 2000)
- Polyester resin fractions
- Phenolic wastes
- Synthetic rubber
- Fuel oil (unusable/out of specification)
- Oily wastes
- Construction and other debris (soil, concrete, asphalt, wood, metal, abandoned vehicles, etc.).

1.6 Past Investigations and Reports

Since 1966, there have been numerous investigations conducted at the Site. The primary scope of these investigations was to characterize the surface materials, subsurface wastes, soils, air, soil vapors, background soils, groundwater, and surface water in the Huntington Beach Flood Control Channel (Huntington Beach Channel). The parties performing and the approximate dates of these past investigations are:

• PSI Engineering	June 1966
• Civil Engineers, Inc.	1978 - 1979
• Smith-Emery	July 1979
• California Department of Health Services	October 1980
• California Department of Health Services	March 1981
• Orange County Environmental Management Agency	October 1981
• Ecology and Environment, Inc./USEPA	1982
• Woodward-Clyde/Bechtel Corporation	May 1983
• Ecology and Environment, Inc.	July 1983
• Oil Well Research, Inc.	November 1983
• Lockman & Associates	July 1984
• J.W. Barrington/Truesdale Laboratory	March/April 1985
• Bright and Associates	1985
• Protek Environmental	1985
• E W. Saybolt and Company	August 1985
• South Coast Air Quality Management District	November 1987
• Radian Corporation	December 1988
• H. V. Lawmaster & Co., Inc.	1988
• Wildan Associates	1988
• Earth Technology Corporation	June 1989
• ISCO Industries/ITARA Engineers	1991 - 1992
• California Department of Toxic Substances Control Memorandum	September 1993
• California Department of Toxic Substances Control Memorandum	February 1995
• Environmental Science & Engineering, Inc.	January/Feb. 1996
• Dudek & Associates	July 1996
• Environmental Science & Engineering, Inc.	February/March 1997
• Environmental Science & Engineering, Inc.	June 1997
• J & W Engineering	1999
• Foster Wheeler Environmental Corp.	2000

- Geosyntec 2002 - present
- Project Navigator, Ltd. 2002 - present.

The scope of services for these investigations varied considerably. Some investigations limited their scope to characterization of surface soils or liquids, and other investigations also included the physical and chemical characterization of subsurface materials and groundwater. Key investigations conducted prior to 1997 were summarized and incorporated into the RI and were originally documented in the following reports:

- Woodward-Clyde Consultants, 1983, Subsurface Exploration and Monitoring Well Installation at the Proposed Ryan Waste to Energy Plant Site.
- Lockman & Associates, 1984, Final Site Characterization Plan.
- Bright & Associates, 1985, Remedial Action/Mitigation Plan.
- Radian Corporation, 1988, Volume 1 and Appendices A through J, Final Site Characterization Report for Ascon Site, December.
- H.V. Lawmaster, 1988, Final Site Soils Report
- ISCO industries/ITARA Engineers, 1991, Draft Hydrogeological Assessment Report, June 20.
- ISCO Industries, 1991, Removal Action Plan, October 4.
- ISCO industries/ITARA Engineers, 1992, Draft Remedial Investigation Report, May 11.
- Environmental Science & Engineering, Inc., 1997, Baseline Health Risk Assessment Report, June 9.
- Environmental Science & Engineering, Inc., 1997, Remedial Investigation Report, June 11.

Results from investigations conducted after the RI are summarized in Section 3 of this RFS. These investigations were originally proposed or documented in the following reports:

- Geosyntec, 2002, Re-Evaluation of Air Pathway Analysis/Revised Air Pathway Risk Assessment
- Project Navigator, Ltd., 2002, Waste Materials Characterization Report of Findings (“WMCROF”)
- Project Navigator, Ltd., 2002, Implementability Assessment Report of Findings (“IROF”)
- Project Navigator, Ltd., 2002, Groundwater Assessment Report of Findings and Recommendations (“GARFR”).
- Project Navigator, Ltd., 2003, Technical Memorandum No. 1 Report of Findings (“TM1ROF”)
- Geosyntec, 2003, May 2003 Perimeter Air Sampling Report
- Geosyntec, 2003, Tidal Study and Well Gauging Results Letter Report
- Geosyntec, 2003, August 2003 Perimeter Air Sampling Report
- Geosyntec, 2004, Report of Findings, Perimeter Air Sampling Report
- Project Navigator, Ltd./Geosyntec, 2004, Pilot Study No. 3 Waste Characterization, Emissions and Excavation Testing Program Workplan
- Project Navigator, Ltd., 2004, Preliminary Report – Site Material Characterization and Slurry Injection Technology (SIT) Evaluation
- Project Navigator, Ltd., 2004, Phase IV Workplan Addendum (Lagoon Sampling Program) to Pilot Study No. 3 Waste Characterization, Emissions and Excavation Testing Program
- Project Navigator, Ltd., 2004, Phase V/VI Workplan Addendum (Pits A, B, C, D, E, G, and H, Former Lagoon Areas and Berm Sampling Programs) to Pilot Study No. 3 Waste Characterization, Emissions and Excavation Testing Program
- Project Navigator, Ltd., 2004, Phase VIII Workplan Addendum (Pit F Sampling Program) to Pilot Study No. 3 Waste Characterization, Emissions and Excavation Testing Program
- Project Navigator, Ltd./Geosyntec, 2004, Pit F Offsite Investigation Workplan Addendum to Pilot Study No. 3 Waste Characterization, Emissions and Excavation Testing Program
- Project Navigator, Ltd., 2004, Pit F Data Package to Pilot Study No. 3 Waste Characterization, Emissions and Excavation Testing Program

- Project Navigator, Ltd., 2004, Data Package to Pilot Study No. 3 Waste Characterization, Emissions and Excavation Testing Program
- Project Navigator, Ltd., 2004, Phase IX Workplan Addendum (Treatability Testing Program) to Pilot Study No. 3 Waste Characterization, Emissions and Excavation Testing Program
- Project Navigator, Ltd./Geosyntec, 2005, Pit F Offsite Investigation Addendum Letter Report
- Geosyntec, 2005/2007, Groundwater Remedial Investigation Report
- Geosyntec, Project Navigator, Ltd., 2006, Soil Vapor Technical Memorandum
- Geosyntec, 2006, Supplementary Groundwater Investigation in the Pit F Area Report, July 13, 2006.
- Geosyntec, 2006, Supplemental Soil Vapor Investigation Report

Several of the above investigations focused on potential human health risk. During 1996 and 1997, Environmental Science and Engineering, Inc. ("ESE," known as QST Environmental, Inc., from mid-1997 to mid-1998) performed additional field investigations as part of the completion of the RI. The results of ESE's field investigations and past investigations are presented in the RI report (ESE, 1997b). The chemical data presented in the RI showed that the Site contains detectable concentrations of chemicals in the soil that exceeded the Preliminary Remediation Goals ("PRGs") established by the United States Environmental Protection Agency ("EPA"), Region IX, and exceed the Resource Conservation and Recovery Act ("RCRA") and State of California criteria for classifying materials as hazardous wastes. Using the data compiled in the RI, a Baseline Health Risk Assessment ("BHRA") report was prepared (ESE, 1997a). The BHRA results identified that there were potential risks to human health from the Site. In July 2002, Geosyntec re-evaluated the risk to human health through modifications to the risk assessment and determined that offsite risks to residents and workers were within regulatory acceptable ranges under Federal and State law. These modifications included altering the source terms, revising the model used to estimate flux, and refining the dispersion model. Data acquired during Pilot Study No. 3 and the 2005 Emergency Action (Project Navigator, Ltd., 2006a, 2006b) also indicate that the Site poses no unacceptable risk to neighboring residents (refer to Section 4 and Appendix F).

1.7 Revised Feasibility Study Objectives and Approach

The objectives of this RFS are:

1) To document field activities undertaken during Pilot Study No. 3,
2) To evaluate remedial technologies available to address affected media at the Site,
3) To evaluate and confirm the appropriateness of process options to implement those technologies,
4) To assemble remedial alternatives and evaluate them against the National Contingency Plan ("NCP") 9 criteria, and
5) To recommend a preferred alternative.

The affected media at the Site are soils and groundwater that are impacted by drilling mud in the former and current lagoons and in the pits, liquid hydrocarbon wastes in Lagoons 1, 2, and 3, tar-like styrene waste in Pit F, and construction debris throughout the Site. This evaluation and screening process has been conducted using criteria specified in the NCP, Title 40 of the Code of Federal Regulations (CFR), Part 300 (40 CFR 300). The guidance prepared by the EPA for use in performing feasibility studies under CERCLA (USEPA, 1988) was also used in the screening process.

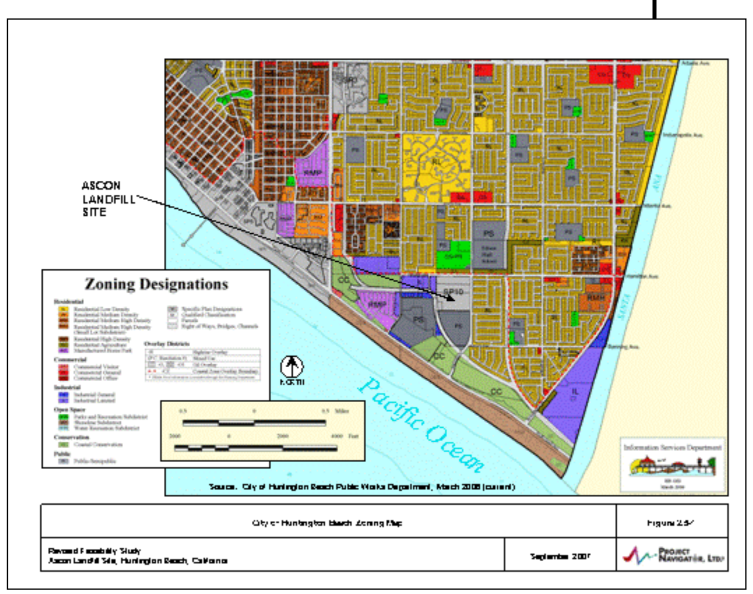
The approach used in this RFS consisted of several steps (**Figure 1.7-1)**. First, Applicable or Relevant and Appropriate Requirements, "ARARs," (see Section 5) and remedial action objectives, "RAOs," (see Section 6) were defined for the Site. Affected media, or waste units, at the Site and their volumes were then defined. This was followed by a review of various technologies and associated process options for addressing the risks posed by the wastes at the Site. Those process options that were judged not to be applicable to the Constituents of Potential Concern ("COPCs") at the Site or to specific Site conditions were eliminated from consideration.

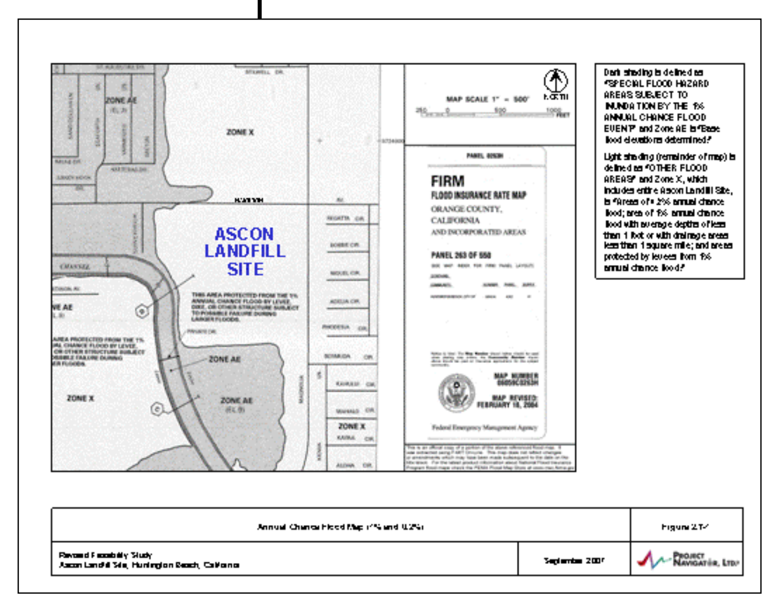
Next, the process options to be considered were screened as to their effectiveness, implementability, and cost. To provide supporting data for the selection of process options, treatability studies and pilot tests were performed on selected process options. The process options that were retained following this screening were assembled into remedial alternatives, which due to this RFS's focus on waste types, consisted of various process options depending on how each waste type was handled as part of any alternative. A detailed evaluation of the potential remedial alternatives was performed using the nine criteria required by the NCP. Finally, based on a comparative analysis of the remedial alternatives, a preferred alternative was recommended for the Site.

The RFS concludes that the preferred remedial alternative for the Site will achieve the remedial action objectives for the Site, comply with ARARs, eliminate or reduce identified risks to acceptable levels, and provide a long-term solution for the Site.

Summary of Section 2: Environmental and Ecological Setting

Topography and Surface Features	Adjacent Land Uses	Natural Resources	General Plan Zoning	Surface Water	Flood Plain Hazard	Climate	Biological Survey	Geology	Hydrogeology
Section 2.2	*Section 2.3*	*Section 2.4*	*Section 2.5*	*Section 2.6*	*Section 2.7*	*Section 2.8*	*Section 2.9*	*Section 2.10*	*Section 2.11*
• Site lies on gently sloping plain • Waste above ground behind 10-20 foot high berms	• Site is surrounded by residential, school, park, fuel storage tanks and light industrial	• Other than oil production, there are no identified significant natural resources	• The Site is zoned under the Magnolia Pacific Specific Plan for residential use • Zoning of surrounding parcels is compatible with existing uses	• Nearby surface water features include the Talbert Marsh, the Santa Ana River, and the Pacific Ocean • The Huntington Beach Flood Control Channel borders the Site and contributes to the groundwater under the Site	• The Site is located in the 0.2% annual chance of flood zone (500-yr flood plain) but not in the 1% annual chance of flood zone (100-yr flood plain)	• Site enjoys morning cloudiness, afternoon sunshine and gentle breezes most of the year • 11.9-in average rainfall	• The Site is highly disturbed • Only sensitive plants are southern tarplant and spiny rush • No sensitive wildlife found	• The Site is located in the Talbert Gap • Beneath the Site are 70 feet of sands with interbedded silt and clay, then 100 feet of sand and gravel with clay layers • The Site is mostly underlain by a clay layer from 2 to 10 feet thick • The clay layer may have significantly impeded infiltration of contaminants into deeper zones and possibly kept groundwater contamination to a minimum	• The Site is located in the pressure area of the Santa Ana River Basin (surface water does not percolate downward) • Groundwater beneath the Site consists of 1) Perched zone, 2) Semiperched Aquifer (SPA), and 3) Talbert Aquifer • Groundwater beneath the Site is significantly impacted from the seawater intrusion, just as all coastal area groundwater





Summary of Section 2: Environmental and Ecological Setting		Figure 2
Revised Feasibility Study Ascon Landfill Site, Huntington Beach, California	September 2007	Project Navigator, Ltd.

2.0 ENVIRONMENTAL AND ECOLOGICAL SETTING

2.1 Introduction

The information presented in this section was excerpted from the RI report (ESE, 1997b) and the initial FS report (Environ, 2000) updated where appropriate. Additional information may be found in the RI and initial FS reports and their respective appendices.

2.2 Topography and Surface Features

The Site is a fenced and primarily vacant property consisting of surface features indicative of its past use as a disposal site. The current locations and configurations of the lagoons and disposal pits, as well as other significant features such as buildings and oil production wells that operate on the Site, are shown on **Figure 1.2-2**.

Piles of construction debris (primarily concrete and asphalt) occur on the surface throughout the Site. There are fences around the perimeters of Pit F, Lagoons 1 – 2, Lagoon 3, Lagoons 4 – 5, and a drum storage area. Structures presently at the Site include a small metal shed adjacent to Pit F, a storage container next to the decontamination pad, and a temporary project office trailer. A concrete pad for equipment decontamination is located southwest of Pit E, and an asphalt pad approximately 200 feet by 200 feet is located west of Lagoons 2 and 3.

The Site is located in a low-lying coastal area that gently slopes to the south/southeast toward the Pacific Ocean. The surface topography of adjacent properties is generally flat with elevations ranging from 5 to 10 feet above mean sea level (MSL) (CDWR, 1967; USGS, 1965). The natural topography of the Site has been disturbed extensively over the years by the operation of the landfill and waste disposal activities described in Section 1.0. An earthen berm, approximately 10 to 20 feet high, has been constructed around much of the Site perimeter to contain surface impoundments and storage areas. Elevation ranges from approximately 5 feet above MSL at the southeastern corner to approximately 25 feet above MSL near the center of the Site. **Figure 2.2-1** presents the topographic contours for the Site at 1-foot intervals in January 2006 (after Emergency Action).

2.3 Adjacent Land Uses

The Site is located in an area of residential, recreational, commercial, and industrial land use (**Figure 1.2-1**). The immediately adjacent land uses identified on **Figure 1.2-1** are:

- North of the Site: Edison Community Park and William Kettler Elementary School
- Northeast of the Site: Edison High School
- East of the Site: Single Family Homes
- South of the Site: Pacific Pipeline Fuel Oil Storage Tanks, Green Belt
- Southwest of the Site: Huntington Beach Flood Control Channel, AES Huntington Beach Power Generation Station (owned by AES Corporation; prior owner was Southern California Edison) Fuel Oil Tanks, light industry
- West of the Site: Light Industry, Oil Production
- Northwest of the Site: Single Family Homes

Other land uses in the vicinity of the Site are recreation areas (parks and Huntington Beach State Park), wetlands (Talbert Marsh), recreational vehicle storage, mobile home trailer park, light industry, and an elementary school (Eader). Approximately 31,000 people live within 1 ½ miles of the Site.

2.4 Natural Resources

Natural resources in the vicinity of the Site consist of beaches and wetlands. Petroleum reserves exist beneath the surface. Previous investigators identified no other significant natural resources. Mineral rights beneath the surface of the Site are owned by other private parties. South Coast Oil Corporation ("SCOC"), or its successor, maintains oil production operations onsite along the western Site perimeter. The RPs do not own, maintain, or have access to the mineral estate beneath Ascon. Refer to Sections 1.2 and 1.3 for additional information regarding mineral estate ownership.

2.5 City of Huntington Beach General Plan Zoning

The area surrounding the Site is generally zoned for industrial, residential, and community facilities (parks, schools) land uses. The City of Huntington Beach General Plan Designations map (City, 2006; see **Figure 2.5-1)** identifies the following zoning designations for the properties surrounding the Site:

- North of the Site: OS-P- Community Facilities: Recreational District (Edison Community Park)
- Northeast of the Site: P (RL)- Educational (Edison High School)
- East of the Site: RL - Low Density Residential
- Southeast of the Site: RL - Low Density Residential
- South of the Site: P - Public (Fuel Oil Tanks)
- Southwest of the Site: P - Public (AES Power Plant)
- West of the Site: I - Light Industrial
- Northwest of the Site: RL – Low Density Residential

The Site is located within an area designated by the City in the "Magnolia Pacific Specific Plan" (Specific Plan 10 of the City of Huntington Beach General Plan [City, 2006]). Any future development of the Site is subject to this plan and other applicable City of Huntington Beach development regulations, unless amended via the public process as required by the municipal zoning code. The plan for the Site was adopted in November 1992 by the City Council and provides for development of the Site as a residential neighborhood with up to 502 units.

In 1993, a development agreement was drafted between the Signal Mortgage Company and the City of Huntington Beach, specifying the entitlement and type of development allowed by Signal Mortgage Company, upon completion of Site cleanup. The development agreement was not executed, and work under this agreement did not occur.

It is possible that the land use zoning of the Site may change in the future, depending on the nature and scope of the remedy for the Site.

2.6 Surface Water

Offsite and onsite occurrence of surface water naturally open to the atmosphere is discussed below.

2.6.1 Offsite Surface Water

The major surface waters in the area of the Site are the Pacific Ocean (½ mile south); Santa Ana River (1 mile east); and the Orange County Flood Control Channel System--Huntington Beach Flood Control Channel (adjacent and southwest). The Huntington Beach Flood Control Channel borders the Site at the southwest corner (**Figures 1.2-1** and **2.7-1**). The channel extends in a northwesterly direction and roughly parallels the coastline. The channel merges with the Talbert Flood Control Channel between Magnolia and Brookhurst Streets. From this point, the merged channel enters the Talbert Marsh Wetlands and flows into the Pacific Ocean.

The Huntington Beach Flood Control Channel was constructed in approximately 1960 with earthen berms and an unlined bottom. The estimated elevation of the top of the berms is 10 feet above MSL and the elevation of the bottom is 1 foot below MSL. Data collected in the 1980s and 1990s suggested that groundwater flow was away from the flood control channel (Radian, 1988 and ESE, 1997b). A tidal study conducted in June 2003 over a ten day period showed that water levels in the flood control channel fluctuated with tides and were approximately 1 ½ to 6 feet above groundwater levels in Site monitoring wells located closest to the channel (Geosyntec, 2003b). Data collected during the tidal study indicate that "losing stream" conditions occur in the channel and that water in the channel discharges to the shallow groundwater beneath the Site. Groundwater contour maps prepared with water level data collected from a total of ten monitoring events between June 2002 and September 2004 confirmed losing stream conditions. Groundwater level data indicate that groundwater flow direction in the southwestern portion of the Site adjacent to the channel is consistently toward the northeast and away from the channel (Geosyntec, 2004b, c, d, 2005a). In summary, groundwater level data collected in the 1980s and 1990s, and more recently in a tidal study and gauging events conducted over the last 2 ½ years, demonstrate that groundwater flows away from the channel and does not discharge into the channel.

Vertical sheet piling was installed along both sides of the channel in spring of 2003 to increase the capacity of the channel. Contour maps of groundwater level elevations after installation of the sheet piling are consistent with maps based on data collected prior to the installation. Section 2.11.1 discusses hydrogeologic conditions in greater detail.

2.6.2 Onsite Surface Water

The Site is topographically higher than the surrounding area. An earthen berm surrounds much of the Site and prevents most surface water from flowing offsite. Within the Site, surface water from rainfall has historically collected in Lagoons 1 through 5. The surface water that collects in the lagoons has been analyzed in the past and is discussed in Section 3.3.1 of this report. The potential for offsite surface water to flow onto the Site is low because the Site elevation ranges from 2 to 20 feet above the surrounding grade.

Seepage from the raised external berm along Hamilton and Magnolia Streets has occurred in the past, following major storm events. This is further discussed in Section 3.3.3 of this report. A Surface Water Management Plan[1] was prepared and submitted to DTSC in January 2004 and has been implemented onsite. The Site applied for coverage under the National Pollutant Discharge Elimination System General Permit No. CAS000001 (General Permit) from the California State Water Resources Control Board for discharge of stormwater associated with industrial activities at the Site in February 2006, after completion of the Emergency Action. A Stormwater Pollution Prevention Plan was prepared in accordance with the General Permit and was implemented and maintained to identify activities and materials that may affect stormwater discharge quality and to identify and implement minimum and Site-specific best management practices to meet water quality standards in the General Permit.

As part of the Emergency Action work completed in January 2006, a toe drain was installed at the foot of the berm along Hamilton Avenue to collect potential stormwater runoff from the berm and any potential future seepage from the berm. The Site was also graded, and swales and detention basins were constructed in fall 2005 to collect stormwater that falls onto the Site that is not collected in the lagoons.

2.7 Flood Plain Hazard

The Site was reported in the initial FS to be located within a defined Flood Hazard Area as indicated on a 100- and 500-Year Flood Map obtained from the City of Huntington Beach, California (Environ, 2000). Improvements in the adjacent Huntington Beach Flood Control Channel, including the reconfiguration of

[1] Project Navigator, Ltd., Surface Water Management Plan, January 27, 2004.

the channel with sheet piling, have resulted in the Site being removed from the 100-year flood plain designation. According to the latest Federal Emergency Management Agency ("FEMA") flood hazard data and maps for the area, the Site lies in FEMA Zone X (500-yeat flood plain[2]), which is a low risk flood area. **Figure 2.7-1** shows a sector of the February 2004 map (Map #06059C0263H) from FEMA (FEMA, 2004).

2.8 Climate

The climate of the Huntington Beach area, like most of southern California, is controlled by the strength and position of a semi-permanent high-pressure cell over the eastern Pacific Ocean. This high-pressure cell creates a repetitive pattern of frequent early morning cloudiness, afternoon sunshine, daytime onshore breezes, and minor temperature fluctuations throughout the year.

As presented in the initial FS (Environ, 2000), complete-year historic climate data are available for 59 years between 1931 and 1995 for the Newport Beach station located at 33° N, 1l7° W at an elevation of 9 feet above MSL (WorldClimate.com, 2005). According to these data, the annual average temperature for the area is 61.2° Fahrenheit (F) with an average monthly high temperature of 68.5° F, occurring in August, and an average monthly low temperature of 55.0° F in January. Rainfall occurs mostly from November through April as generally mid-latitude storms move through the area. An average of approximately 11.9 inches of rain falls each year. Summers are often dry, with the exception of occasional rainfall from thundershowers of tropical origin.

Local meteorological conditions generally conform to the regional pattern of onshore winds during the day, especially in summer, and weak offshore winds at night, especially in winter. The South Coast Air Quality Management District (SCAQMD) catalogues meteorological data from several data collection locations throughout its district.

Wind speed and direction are graphically shown by a wind rose using data collected during Pilot Study No. 3, covering the period from March through June 2004, in **Figure 2.8-1**. The wind rose indicates that the prevailing winds are onshore from the west and southwest with wind speeds averaging 4 to 6 miles per hour. Wind speed and directional data collected during Pilot Study No. 3 were consistent with regional data as reported in the initial FS (see **Figure 2-6** of the initial FS [Appendix A]).

2.9 Biological Survey

Dudek & Associates conducted a biological survey of the Site in July 1996 (Dudek, 1996) and an update in December 2004 (included as Appendix B). Both the original survey and the update concluded that the Site is highly disturbed and does not generally support native plant communities. During the 2004 survey, two native plant communities including baccharis scrub and disturbed coastal salt marsh were found onsite. The dominant vegetation was ornamental and ruderal (weedy).

During the 2004 survey, no sensitive wildlife species were observed onsite. Sensitive plant species were limited to two individuals of spiny rush (California Native Plant Society [CNPS] List 4—"Plant of Limited Distribution") and many individuals of southern tarplant (CNPS List 1B—"Rare or Endangered in California and Elsewhere").

2.10 Geology

The Site is located in the southwestern portion of the Coastal Plain geomorphology of Orange County, which is bordered by the Santa Ana Mountains on the east, the San Joaquin Hills to the southeast, and

[2] Note that former references to "100-year" and "500-year" floods have been revised by FEMA to "1% annual chance" and "0.2% annual chance" floods, respectively.

the Pacific Ocean to the south and west. A line of low hills or mesas and intervening valleys or gaps, associated with the Newport-Inglewood structural zone, are present across the Coastal Plain of Los Angeles and Orange Counties. This structural zone forms the hills, with the inland synclinal trough consisting of thick sequences of permeable and impermeable sediments that form the Orange County Ground Water Basin in this area.

The Site is located within the physiographic feature known as the Talbert or Santa Ana Gap. The Pacific Ocean is approximately ½ mile to the south; the Huntington Beach Mesa is approximately 1 ¼ miles to the northwest; the Santa Ana River and Newport Mesa are approximately 1 ¼ miles to the east. The Site is also within the northwest-trending Newport-Inglewood Fault Zone, immediately north of the "South Branch." Movement along the fault zone has resulted in complex stratigraphy in Pleistocene age or older sediments (CDWR, 1967).

The Santa Ana Gap was formed during the Pleistocene age sea-level retreat when the ancestral Santa Ana River eroded the uplifted mesas. At the end of the last ice age, the sea level rose and the gap was filled with approximately 170 feet of mixed alluvial and coastal sediments. These Holocene age sediments consist of two units: an upper unit approximately 70 feet thick that consists of clay and silt with interbedded sands and peat beds, and a lower unit approximately 100 feet thick that consists of sand and gravel. These two Holocene age units are believed to be present at the Site beneath the waste material, soil, and construction debris. These Holocene sediments unconformably overlie faulted marine and alluvial sediments of the Lower Pleistocene San Pedro Formation (CDWR, 1967).

The upper Holocene unit described above makes up the unconsolidated sediments immediately underlying the Site. The sediments are described by previous investigators as being composed of an upper silty-clay layer that ranges from 2 to 10 feet thick and a lower water-bearing sand unit (Radian, 1988). With the possible exception of the very western portion of the Site and the area east of Lagoons 1 and 2, the upper silty-clay layer was noted in nearly all of the borings drilled throughout the Site and, to some extent, may have significantly impeded the infiltration of contaminants into deeper zones. Cross sections prepared by Radian (Radian, 1988) illustrate that the silty-clay layer is thinner (less than 2 feet) beneath the southern one-third of the Site and thicker (greater than 10 feet) beneath the northern two-thirds of the Site.

2.11 Hydrogeology

As presented in the Water Quality Control Plan for the Santa Ana River Basin prepared by the California Water Quality Control Board ("CA-RWQCB") - Santa Ana Region, the Site is within the pressure area of the Orange County Ground Water Basin (CA-RWQCB, 1995). Typically, near-surface fine-grained sediments prevent water from percolating downward to producing aquifers (San Pedro Formation) in the pressure area. In the Site vicinity, shallow groundwater is found in one of two units: (1) clays, silts, and sands designated as the Semiperched Aquifer located within the upper unit of Holocene alluvium; and (2) sands and gravels of the lower Holocene alluvium, which is termed the Talbert Aquifer. Groundwater in the Semiperched Aquifer has been degraded regionally by high concentrations of total dissolved solids and nitrates and, therefore, is not produced for any beneficial use. The California-RWQCB's beneficial use designations for groundwater in the Site area include municipal and domestic supply, agricultural supply, industrial service supply, and industrial process supply (see Section 2.11.2).

Based on published USGS regional cross-sections, the top of the Talbert Aquifer is approximately 80 to 90 feet below ground surface, and the bottom is approximately 200 feet below ground surface in the area of the Site (USGS, 1959). The Talbert Aquifer appears to be deeper beneath the Site than further inland. Beneath the Talbert Aquifer is the water bearing zones of the Pleistocene age San Pedro Formation.

The Semiperched Aquifer has never been considered and important source of groundwater in the Orange County Groundwater Basin. The Talbert Aquifer, though, was historically considered an important groundwater source in the vicinity of the Site. However, groundwater production wells in the Talbert Gap area (i.e., vicinity of the Site) have been abandoned due to seawater intrusion. Under conditions of little inland groundwater production from wells, groundwater in the Talbert Aquifer and likely the Semiperched Aquifer has a seaward flow direction, which is southward. However, when inland groundwater production increased within the Talbert Aquifer and connected deeper aquifers, groundwater potentiometric heads dropped below sea level, producing a northward groundwater flow direction and saltwater intrusion through much of the Talbert Gap, including the Site vicinity (USGS, 1959).

As a result of the saltwater intrusion, groundwater in the basin beneath the Huntington Beach region, including groundwater beneath the Site, has been significantly degraded. An injection barrier system, known as the Talbert Water Injection Barrier, was installed as a measure to control the degradation of the drinking water in the basin.

The Site is approximately 3 miles south (seaward) of the Talbert Water Injection Barrier. The barrier is a line of wells installed across the Santa Ana Gap in 1976 for injection of recycled potable water. The water is injected at up to 15 million gallons per day along Ellis Avenue to form a seaward piezometric gradient or barrier to prevent the further intrusion of seawater into fresh water aquifers that is caused by excessive pumping (overdrafting) of the groundwater basin further inland. To maintain a seaward piezometric gradient at the barrier under severe overdraft conditions, seven extraction wells were placed between the Talbert Water Injection Barrier and the ocean to create a hydraulic trough. When needed, brackish groundwater can be withdrawn at rates up to 1,000 gallons per minute from these extraction wells and discharged into the flood control channels (Herndon, 1992; McGillicuddy, 1993). However, available evidence indicates that the injection barrier and associated injection wells have not significantly affected groundwater flow at the Site since 1988 (Geosyntec, 2005b).

In September 1988 and March 1997, groundwater elevations along the eastern perimeter of the Site were measured at 3.09 feet and 2.14 feet below MSL, respectively, in Well AW-2 (located in the southeastern corner of the Site; **Figure 2.11-1**) and at 2.98 feet and 0.32 feet below MSL, respectively, in Well MW-4 (located at the northeastern corner). Groundwater elevations in MW-4 during the January 1996 gauging event were recorded at 2.67 feet below MSL. A comparison of recent monitoring data (**Table 2.11-1**) shows groundwater elevations have generally remained the same. From June 2002 to December 2004, water levels in Well AW-2 ranged 1.82 to 3.30 feet below MSL, and water levels in Well MW-4 ranged from 2.33 to 3.79 feet below MSL.

2.11.1 Local Hydrogeology

As discussed in Section 2.11, the Site is located in the Santa Ana Pressure Ground Water Sub-basin of the East Coastal Plain Hydrologic Sub-area (CA-RWQCB, 1995). Shallow groundwater is found in three zones or aquifers beneath the Site: the Perched Zone, the Semiperched, and the Talbert. Each of these units is discussed below.

Perched Zone. Recent investigations by Project Navigator, Ltd. (2003) at the Site delineated several zones of perched liquid in the east and southwest portions of the Site. The perched liquid was encountered between approximately 5 to 14 feet elevation (NAVD88) within the waste zone and fill zones and above the native soils (Table 5-1). The liquid was interpreted to be a mixture of rainwater and old pit liquids that were ponded on top of fine-grained waste and fill materials. Observations made during recent trenching investigations conducted as part of the RFS investigations (Pilot Study No. 3) indicated that liquids above the water table occur in thin sandy layers and produced relatively little liquid in the open trenches that intersected known perched liquid areas and depths. The water bearing materials in the perched zone were demonstrated to be discontinuous and of limited extent.

Semiperched Aquifer. The Semiperched Aquifer beneath the Site generally consists of sand with some interbedded silt and clay and extends from approximately 10 to 30 feet below ground surface (bgs) to a depth of approximately 80 to 90 feet bgs. The bottom portion of the Semiperched Aquifer appears to be mostly sand material. Several investigations (Radian, 1988; ESE, 1997b; Geosyntec, 2007b) identified a clay layer of varying thickness from 2 to 10 feet that overlies the water-bearing sand unit of the Semiperched Aquifer. The clay layer is thickest in the northern two-thirds of the Site and thinner in the southern one-third of the Site (ESE, 1997b). The presence of the clay layer impedes the downward migration of waste materials. However, due to the reported depth of some of the lagoons, it is possible, but not verified, that waste materials may be in contact with groundwater in some lagoon areas of the Site. Waste materials associated with Pit F appear to be in contact with groundwater in the vicinity of Pit F (see Section 3.2.1.2).

Groundwater flow in the Semiperched Aquifer appears to be controlled to some degree by: (1) operation of the Talbert Water Injection Barrier, as discussed in Section 2.11, and (2) the adjacent Huntington Beach Flood Control Channel. As stated in Section 2.6.1, the Huntington Beach Flood Control Channel constitutes a losing stream and contributes to groundwater under the Site.

Recent groundwater monitoring data collected between June 2002 and December 2006 are generally consistent and indicate that groundwater flows across the Site in a generally northerly direction with a northeastern to eastern component in the southern portions of the Site (see **Figure 2.11-1** for June 2004). In the western portion of the Site, groundwater flows to the northeast away from the Huntington Beach Flood Control Channel. The hydraulic gradient under the Site is very flat (generally less than 0.003 foot per foot during June 2004).

Prior to the excessive pumping of inland aquifers (which began in the 1960s) and the operation of the Talbert Water Injection Barrier in 1976, the groundwater gradient in the Semiperched Aquifer was probably to the south towards the Pacific Ocean or southwest towards the Huntington Beach Flood Control Channel.

Talbert Aquifer. The Talbert Aquifer is a sequence of sandy water-bearing zones separated by clay layers. The Talbert Aquifer is present immediately beneath the Semiperched Aquifer. Based on USGS regional cross-section (Figure 5-3), the top of the Talbert Aquifer occurs at approximately 80 to 90 feet below the Site surface. Based on this interpretation, Site borings have not intersected the Talbert Aquifer. The Talbert Aquifer is an intercalated sequence of three sandy water-bearing zones separated by clay layers beneath the Site. The first zone is found immediately beneath the Semiperched Aquifer at a depth of approximately 20 to 30 feet below the native ground surface and extends to approximately 60 feet (30 to 40 feet thick). The second zone is found from approximately 80 to 105 feet, and the third zone is found from approximately 125 to 190 feet (Radian, 1988; CDWR, 1967).

The Orange County Water District ("OCWD") maintains three groundwater monitoring wells located within 1 mile of the Site. These wells are screened in the Talbert Aquifer. The OCWD wells were installed to monitor water elevations and chemical concentrations to check for salt water intrusion. The initial FS reported the presence of a groundwater production well, GWRC-HBF4, located 0.25 miles west of the Site on Newland Avenue. OCWD records now indicate that this well was destroyed on November 9, 2001 (OCWD, 2004, included as Appendix C). Well construction and water elevation data are presented below in **Table 2.11-A**. The information obtained from the OCWD is included in Appendix A of the initial FS (Appendix A of RFS).

Table 2.11-A. OCWD Well Construction and Water Elevation Data

Well Number	Well Owner	Distance from Site	Date Drilled	Total Well Depth	Screened Interval	Depth to Water (ft)	Water Elevation (ft MSL)
OCWD-MI	OCWD	1.0 mi NE	11/1/67	115	75-110	4.75	-0.56
OCWD-M2	OCWD	0.5 mi NNW	9/1/67	155	85-150	9.86	0.65
OCWD-M28	OCWD	0.5 mi E	7/1/69	155	80-145	1.16	0.91

Notes:
Water level information collected by the OCWD on March 5 and 6, 1997.

Using water level data from the three OCWD wells, the calculated groundwater flow direction in the Talbert Aquifer is to the northeast (compass bearing N52E). This flow direction is consistent with the flow component in the Semiperched Aquifer (**Figure 2.11-1**).

2.11.2 Groundwater Quality and Potential Uses

The groundwater quality and potential uses of each of the two uppermost aquifers beneath the Site are discussed in this section.

According to the Water Quality Control Plan (CA-RWQCB, I995), groundwater in the East Coastal Plain Hydrologic Subarea (which includes the Site) has the following designated beneficial uses: Municipal and domestic supply, agricultural supply, industrial service supply, and industrial process supply. The Talbert Aquifer is utilized as a drinking water source in other areas of the basin. However, according to Orange County Water District (personal communication, 2003), there is no groundwater production of any kind (drinking water, agricultural, industrial) within three miles of the Site. This is due to the fact that groundwater in the vicinity of the Site is severely degraded by seawater intrusion.

The Water Board has established water quality objectives (**Table 2.11-B)** for the Santa Ana Pressure Groundwater Sub-basin (Table 4-1 of CA-RWQCB, 1995, and Attachment to Resolution No. R8-2004-0001).

Table 2.11-B. Santa Ana Pressure Groundwater Sub-basin Water Quality Objectives (mg/l)

TDS	Hardness	Sodium	Chloride	Nitrates	Sulfates
580	240	45	55	3.4	100

Groundwater quality in the Semiperched Aquifer has been regionally degraded by high concentrations of total dissolved solids (TDS) and nitrates (ESE, 1997b and Geosyntec, 2005b). Presently, the Semiperched Aquifer is not used for any beneficial purposes in the vicinity of the Site. Because of its shallow nature and poor water quality resulting from saltwater intrusion, it is doubtful that the Semiperched Aquifer would have any beneficial use in the future. Based on groundwater data collected in March and April 2004 (Geosyntec, 2005b), TDS concentrations in the shallow groundwater beneath the Site ranged from approximately 4,500 mg/l to 26,000 mg/l. The TDS is comprised mostly of dissolved sodium and chloride indicating seawater intrusion.

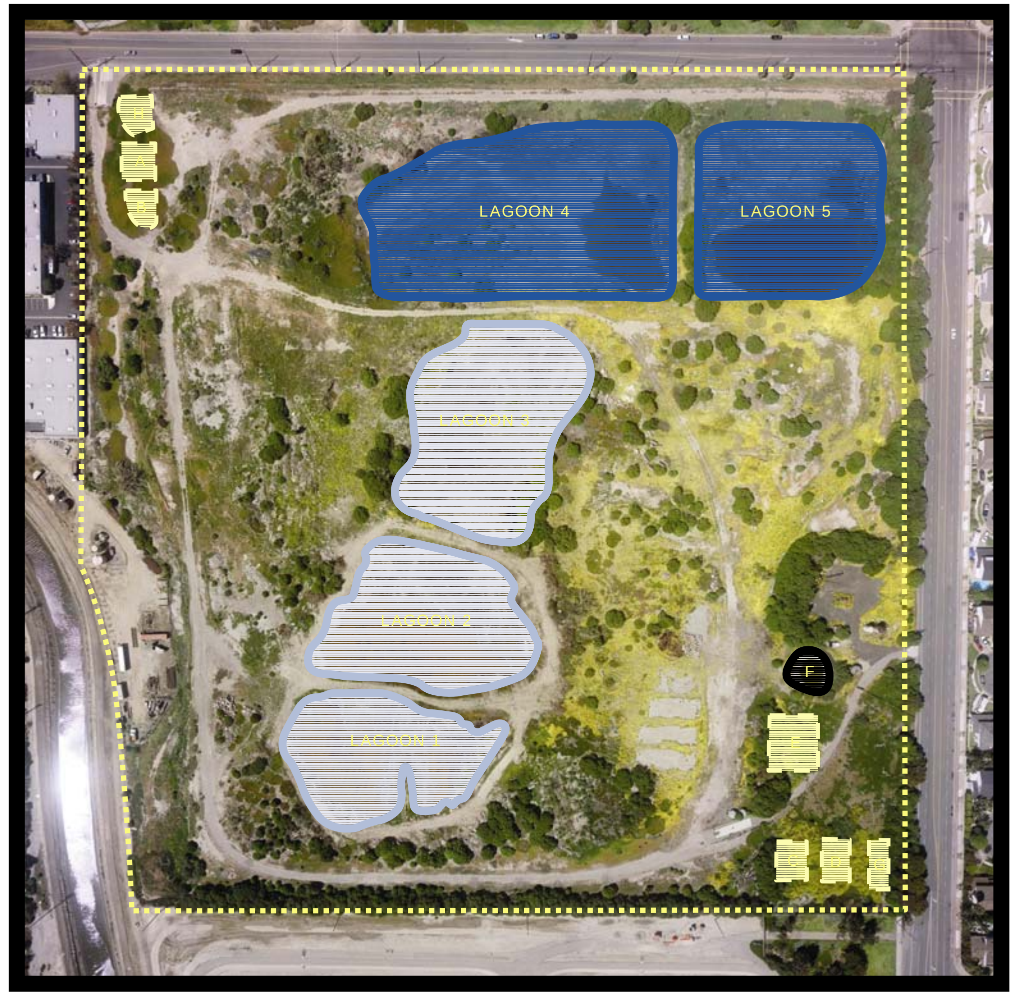
As discussed above, groundwater quality in the Talbert Aquifer in the vicinity of the Site has been significantly degraded by salt water intrusion and does not meet the water quality objectives listed in the above table. Salt water intrusion has compromised groundwater quality in the Talbert Aquifer since at least 1963 according to the CDWR (CDWR, 1967). The USGS reported significant deterioration of groundwater quality in the site area occurring from 1930 to 1945 (USGS, 1959). Chloride concentrations in the uppermost water-bearing zone of the Talbert Aquifer ranged from 100 to 500 mg/l. Deeper zones in the Talbert Aquifer had chloride concentrations in excess of 500 mg/l (CDWR, 1967).

By design, the Talbert Water Injection Barrier has sacrificed water quality south of Ellis Avenue (approximately 3 miles north of the Site) in efforts to preserve the larger groundwater resources located inland. The Site is located between the coast and the injection barrier and over groundwater with poor water quality. Current groundwater quality in both the Semiperched Aquifer and Talbert Aquifers beneath the Site do not qualify as drinking water resources as defined by State Water Resources Control Board (CSWRCB) Resolution No. 88-63 due to the elevated TDS and chloride concentrations (CSWRCB, 1988). Even so, the CA-RWQCB has designated beneficial uses other than municipal supply; therefore, remedial efforts at the Site will include the protection of groundwater as an objective.

Summary of Section 3: Summary of Remedial Investigation and Post-RI Studies

Media	Analyte Group	New Studies
Solid Wastes	• VOCs, SVOCs / PAHs • Pesticides / PCBs • Metals, TPH, pH • Ignitability • Reactivity with Water • TCLP, STLC (As Needed)	*Technical Memorandum No. 1 Report of Findings* **Project Navigator, Ltd.**, February 21, 2003 *Pilot Study No. 3 RFS Appendix D and Section 3* **Project Navigator, Ltd.**, March 2005
Groundwater	• VOCs, SVOCs / PAHs • Pesticides / PCBs • Metals, TPH, pH • Emerging Compounds • TDS, Major Anions • Major Cations	*Groundwater Assessment Report of Findings and Recommendations* **Project Navigator, Ltd.**, August 30, 2002 *Groundwater Remedial Investigation* **Geosyntec**, June 14, 2007
Air	• VOCs, SVOCs • TO-15 • Petroleum Hydrocarbons • Odor, Sulfur Compounds • Petroleum Hydrocarbons • Ambient Perimeter Air • Perimeter Air During Pilot Study No. 3 • Perimeter Air during Emergency Action	*Re-Evaluation of Air Pathway Revised Air Pathway Risk Assessment* **GeoSyntec**, July 12, 2002 *Report of Findings Perimeter Air Sampling Program* **GeoSyntec**, February 23, 2004 *Emergency Action Completion Report & Addendum* **Project Navigator, Ltd.**, March 3, July 7, 2006

Site Features



N

Sections	Investigation or Waste Stream	Key Findings
Solid Wastes (Section 3.2)	Tarry Liquids Lagoons 1, 2, and 3	Liquids can be mixed with soil, excavated and disposed offsite or fluidized and pumped for offsite recycling
	Pit F Area Wastes	Can be excavated and disposed offsite, likely as hazardous waste
	Lagoons 4 and 5	If removed, the waste materials may need to be disposed as California-hazardous waste
	Pits A, B, C, D, E, G & H	Recent sampling shows the pit wastes are similar to other site materials
	Highly Liquid Drilling Muds	If removed, the waste materials may need to be disposed as California-hazardous waste
	Drilling Muds	If removed, the waste materials may need to be disposed as California-hazardous waste
	Impacted Soils	If removed, the impacted soils may need to be disposed as California-hazardous waste because of elevated TPH levels or soluble lead
	Minimally Impacted Soils / Fill	If disturbed by proposed remedy, testing will be required to recycle onsite
	Impacted Native Clay	If removed, impacted clay may be able to be disposed as non- hazardous material (testing will be required for confirmation)
Liquid Materials (Section 3.3)	NAPL-Like Liquids	Appear to be similar to the highly liquid drilling muds, present above the clay
	Groundwater Near Pit F	Limited in extent, will be managed during source removal at Pit F
	Groundwater Near Lagoon 1	Appears to be limited in extent, can be left under cap
	Deep Groundwater	Not impacted by the presence of waste materials on the Site
	Groundwater / Huntington Beach Flood Control Channel	The flow in the channel actually recharges the groundwater beneath the Site, water from the Site does not flow into the channel
	Tidal Fluctuations in Groundwater	The flow in the channel is affected by tides, but the influences do not impact groundwater flow under the Site
Air (Section 3.4, Appendix F)	Perimeter Ambient Air Studies	The Ascon Landfill Site in current condition does not pose a risk
	Perimeter Air Sampling During Pilot Study No. 3 and Emergency Action	The monitoring with waste disturbance confirmed that the Site does not pose a risk to local residents, but odors will be a challenge
	Soil Vapor and Surface Emissions Studies	Soil vapor does not pose unacceptable risk for commercial. Surface emissions are near background.
	Downhole Flux Sampling	Provided sufficient data to evaluate various excavation approaches
	Surface Flux Sampling and Suppressant Testing	Provided sufficient data to identify acceptable performance for specific products
	Odor and Emissions Findings	Can be controlled with foams and suppressants; Needs to be further evaluated during final design (sprung structures may be needed for odor control)

Summary of Section 3: Summary of RI and Post-RI Studies		**Figure 3**
Revised Feasibility Study Ascon Landfill Site, Huntington Beach, California	September 2007	Project Navigator, Ltd.

3.0 SUMMARY OF REMEDIAL INVESTIGATION & POST-RI STUDIES

3.1 Introduction

The 1997 Remedial Investigation (RI) Report (ESE, 1997b) presented the scope of work and results from Site characterization investigations that occurred prior to 1997, and provided additional data. Materials were collected and analyzed from soil, sediment, and wastes from the eight pits, five current lagoons, former lagoon areas, perimeter berm, offsite background locations, and berm seeps. Soil vapor and groundwater samples (onsite and offsite) were also sampled and analyzed.

Since completion of the RI report, several additional evaluations and investigations have been conducted as shown below:

- Re-Evaluation of Air Pathway Analysis, Revised Air Pathway Risk Assessment, Geosyntec, July 12, 2002 (Geosyntec, 2002a).
- Groundwater Assessment Report of Findings and Recommendations ("GARFR"), Project Navigator, Ltd., August 30, 2002 (Project Navigator, Ltd., 2002b).
- Ambient Air Quality Evaluation Report, Geosyntec, September 13, 2002 (Geosyntec, 2002b).
- Technical Memorandum No. 1 Report of Findings ("TM1" or "TM1ROF"), Project Navigator, Ltd., February 21, 2003 (Project Navigator, Ltd., 2003). See **Figure 3.1-1** for sample locations.
- Report of Findings Perimeter Air Sampling Program, Geosyntec, February 23, 2004 (Geosyntec, 2004a).
- Pilot Study No. 3 and Addenda for Phases IV, V/VI, VIII, and IX (Project Navigator, Ltd., 2004a, 2004c, 2004d, 2004e, 2004f). **Figure 3.1-1** identifies the sampling locations from Pilot Study No. 3 fieldwork.
- First through Fourth Quarter Groundwater Monitoring Reports, Geosyntec (Geosyntec, 2004b-d, 2005a).
- December 2006 Groundwater Monitoring Report, (Geosyntec, 2007a).
- Groundwater Remedial Investigation Report, Geosyntec, February 28, 2005 (Geosyntec, 2005b, 2007b).
- Emergency Action berm stabilization per the Final Emergency Action Workplan, Project Navigator, Ltd., Geosyntec, July 6, 2005 (Project Navigator, Ltd., 2005d). During the Emergency Action, many soil samples were collected for waste profiling (for disposal purposes). Documentation in Emergency Action Completion Report and Emergency Action Completion Report Addendum (Project Navigator, Ltd., 2006a, b).

Figure 3.1-1 shows the locations of soil sampling locations from investigations to date, including Pilot Study No. 3. Appendix A presents the text and tables from the initial FS that summarize the RI data. Data from groundwater monitoring events, including the GARFR and four sampling events during 2004, are summarized in the Groundwater RI (Geosyntec, 2005b).

Pilot Study No. 3 consisted of nine phases of fieldwork conducted during March through early December of 2004 (**Table 3.1-A)**. The objectives and corresponding fieldwork of each Phase are discussed in Appendix D.

Table 3.1-A. Investigation Phases of Pilot Study No. 3	
Phase I	Small auger assessment of Former Lagoon Areas
Phase II	Bucket auger assessment of Former Lagoon Areas
Phase III	Trenching in Former Lagoon Areas

Table 3.1-A. Investigation Phases of Pilot Study No. 3	
Phase IV	Sampling lagoons
Phase V	Sampling Pits A, B, C, D, E, G, and H
Phase VI	Geotechnical assessment (deep borings)
Phase VII	Further lagoon studies -- Eliminated
Phase VIII	Sampling Pit F and Pit F area
Phase VIII Addendum	Pit F offsite investigation
Phase IX	Treatability testing

The main objectives of Pilot Study No. 3 were "to collect data to provide better classification of waste materials (hazardous vs. non-hazardous) and to collect data on the nature, magnitude, and possible rates of odor and chemical emissions that may be generated by the buried waste materials at the Site when excavated and handled" (Project Navigator, Ltd., 2004a). Data collection efforts prior to Pilot Study No. 3 focused on the identification of specific chemical compounds in discrete samples from different geographic areas of the Site. Although these data were useful for the 1997 RI and baseline risk assessment, additional data were required to further develop a range of remedial alternatives and to evaluate various waste handling and disposal options.

Pilot Study No. 3 therefore consisted of waste sampling using composite methods to create samples that are more representative of characterization samples to be taken during a removal action, air sampling during invasive activities, and emissions assessment from freshly-exposed wastes. Pilot Study No. 3 also included emission control agent testing to identify effective means to mitigate emissions during excavation and subsequent waste handling. Soils and waste materials at the Site were tested to determine if any materials would be potentially classified as hazardous waste under either California or Federal law. In general, the analytical tests used in the material characterization are listed in **Table D-2** of **Appendix D**.

As a result of theTM1ROF and Pilot Study No. 3, a significant volume of additional data has been collected since completion of the 1997 RI Report. These data are presented and discussed as follows:

- Section 3.2 summarizes the initial RI (soils and solid material) and the findings of these additional soil and waste investigations. Section 3.2 also includes a statistical analysis to forecast waste classification using the RI, TM1ROF, and Pilot Study No. 3 soil and waste data (see Section 3.2.3).
- Section 3.3 summarizes findings concerning groundwater (GARFR and 2005 Groundwater RI) and other liquids including seeps and surface water as reported in the initial FS and Surface Water Management Activities Letter Report and Addendum[1].
- Section 3.4 summarizes findings concerning ambient or perimeter air.
- Appendix D contains documentation for field activities conducted during Pilot Study No. 3.
- Tabular summaries of soil/waste data from combined soil/waste investigations (RI, TM1ROF, Pilot Study No. 3) are found in Appendix E.
- Additional data and analyses concerning potential emissions (e.g., downhole flux assessment, emissions control agent testing, and dispersion modeling) are found in Appendix F.
- Appendix G contains perimeter air data collected during Pilot Study No. 3.

[1] Data regarding 2005 surface water are reported under separate cover (Surface Water Management Activities Letter Report and Addendum, March and April 2005).

3.1.1 Analytical Database

The analytical data presented in the RI were compiled into a comprehensive database that consisted of about 20,000 individual entries. Data were prepared by manual entry from available hard copies and electronically from any available files. Since the initial database was compiled, it has continued to be updated with entries from additional studies (TM1ROF and Pilot Study No. 3), bringing the total number of entries to approximately 83,000. The current number of entries in the database, not including geotechnical data, is listed in **Table 3.1-B** below by study and data type.

Table 3.1-B. Database Components and Metrics

Investigation	RI	TM1ROF	Pilot Study No. 3	Total
Soil Data	14,300	5,600	16,700	36,600
STLC Data	0	170	135	305
TCLP Data	124	34	77	235
Soil Gas Data	385	0	670	1,055
Flux Data	48	0	9,500	9,548
Air Monitoring Data	0	7,900	4,400	12,300
Groundwater Data	5,000	1,500[2]	16,650[3]	23,150
Number of Data Entries	~19,900	~15,200	~48,100	~83,200

3.1.2 Waste Types and Media

For the purposes of this report, the data collected during Pilot Study No. 3 and the data presented in the TM1ROF and RI have been combined, organized, and evaluated by waste types based on the physical and chemical characteristics of each wastes present at the Site. The potential wastes identified and described in detail in Section 3.2.3 include:

1. Minimally impacted fill soils and debris, including construction debris that has been minimally impacted by contact with contaminant-bearing soils.
2. Impacted soils (including fill sands and silts, and impacted construction debris).
3. Highly liquid drilling mud, which are characterized by relatively low strength and are generally noted as being saturated with oil/liquid. This waste includes materials in Lagoons 4 and 5 and is also presumed to represent materials present beneath tarry oils in Lagoons 1, 2, and 3.
4. Drilling mud of higher strength that are typically mixed with coarser-grained drill cuttings and typically not noted as being "saturated."
5. Tarry lagoon liquids, which are tarry oils estimated to include the upper few feet of materials contained in Lagoons 1, 2, and 3.
6. Styrene-impacted materials associated with Pit F.

Four other materials not considered wastes, but addressed in the RFS, are groundwater (Section 3.3.4), soil gas (Sections 3.4.1 and 3.4.2), perimeter air (Section 3.4.3), and non-aqueous phase liquids ("NAPL") found in groundwater monitoring wells (Section 3.3.5).

[2] Groundwater data reported in GARFR (PNL, 2002b).
[3] Groundwater data collected during four 2004 sampling events and one 2006 sampling event as documented in the Groundwater RI (Geosyntec, 2005b, 2007b) and corresponding quarterly reports.

The specific wastes and waste locations discussed in Section 3 are grouped into corresponding media of interest for the purpose of the feasibility study. However, for the feasibility study, solid waste found within the City parcel is considered separately from solid waste in the Cannery Hamilton Properties, LLC ("CHP") parcel because separate ownership of these parcels may dictate or enable different remedial considerations. The media of interest groupings are designed to focus on geographical location (e.g., City parcel, Pit F area) in addition to physical properties. The media of interest and grouped corresponding waste types at the Site are further discussed in Section 8 and are:

Media	Waste Type
Groundwater	• Groundwater • Non-Aqueous Phase Liquids (NAPL)
Tarry Liquids	• Tarry Liquids in Lagoons 1, 2, and 3
Soil/Solid Waste (CHP and City parcels)	• Highly Liquid Drilling mud in Lagoons 4 and 5 • Highly Liquid Drilling mud (Non-Pit and Non-Lagoon Areas) • Drilling mud (higher strength/lower moisture) • Impacted Soils • Pits A, B, C, D, E, G, and H Areas • Minimally-Impacted Fill Materials • Native Soils
Pit F Waste and Pit F-Impacted Soils	• Pit F Area

Sub-sections of Section 3 are organized by general medium and include findings regarding:

- Impacted Solid Materials (Section 3.2)
- Impacted Liquids (Section 3.3), including groundwater, and
- Impacted Air (Section 3.4)

Where applicable within these three sub-sections, the soil/waste analyses are focused on each of the specific waste types identified above. This manner of presentation is in contrast to that of the initial FS, which discussed results based solely on the geographic location of sample locations (e.g., lagoons, pits, berms, etc.).

3.2 Impacted Solid Materials

This section describes the physical and chemical characteristics of the impacted solid materials present at the Site. Site features and summarized findings of pre- and post- Pilot Study No. 3 investigations related to impacted solid materials are presented. Findings from geotechnical investigations are summarized, and anticipated hazardous waste characteristics are identified.

3.2.1 Site Feature Descriptions and Findings

This section describes features or areas of the Site, including waste pits, lagoons, former lagoon area, and berms, and discusses findings from the specified report regarding the same.

3.2.1.1 Waste Pits (other than Pit F)

Soil, waste, and water samples were collected by previous investigators from the eight disposal pits, designated as Pits A through H. The existence of the seven pits other than Pit F has been established through the use of aerial photographs and topographic maps because they are no longer visible. These pits were backfilled with construction debris and other fill material.

The pits are of relatively limited areal extent, each less than 100 feet on a side. Pits A, B, and H are located in the northwestern corner of the Site; Pits C, D, E, F and G are located in the southeastern corner of the Site (**Figure 1.2-2)**.

Pits A and B are reported to have been used for disposal of oily wastes, and Pits C and D are reported to have been used for disposal of chromic and sulfuric acids. Reportedly, oily wastes containing styrene were placed in Pit E. Styrene tar and synthetic rubber wastes were reportedly disposed of in Pit F. The types of wastes disposed of in Pits G and H are not known (**Table 1.4-2**) (Radian, 1988).

The contaminated soil and waste materials found in the pits are composed of compounds generally consistent with the disposal records, with the exception that chromic and sulfuric acids were not confirmed to be major constituents of Pits C and D (see RI findings below). Many of the hydrocarbon compounds that were detected (straight- and branch-chain alkanes, alkenes, and aromatics) appear to be typical of those found in petroleum exploration and production operations. Analytical results from the samples collected in Pits A through H are presented in Section 3.2.3.

Significant findings from the RI (ESE, 1997b) related to the waste pits (other than Pit F) include:

- Pits A, B, and H, located at the northwestern corner of the Site, contain approximately 5,200 cubic yards (cy) of waste material. Pits C, D, and G in the southeastern corner of the Site contain approximately 1,000 cy of waste material. Pit E contains approximately 2,200 cy. Pit F contains approximately 1,700 cy of waste material (Radian, 1988).

- The wastes contained in Pits A through H contain Total Petroleum Hydrocarbons ("TPH"), benzene, toluene, ethylbenzene, and xylenes ("BTEX"), and other Volatile Organic Compounds ("VOCs") and Semi-Volatile Organic Compounds ("SVOCs").

- Pits C and D do not exhibit the anomalous pH values that would confirm the reported historical dumping of chromic and sulfuric acid wastes. Moreover, two samples from Pit C were each analyzed for hexavalent and total chromium. No hexavalent chromium was detected in either sample, and total chromium concentrations were less than 24 mg/Kg.

Significant findings from Pilot Study No. 3 relating to the waste pits (other than Pit F) include:

<u>Pit A:</u> Located in the northwestern corner of the Site, Pit A is covered by fill and concrete debris to a depth of approximately 14 feet below ground surface (bgs). Hydrocarbon-impacted material was observed between 14 and 25 feet bgs consisting of dark colored soil, clay, and silt with hydrocarbon odor. Native silty sand was encountered at 25 feet bgs. Samples were collected at depths ranging from 16 to 23.5 feet bgs, corresponding to the zone of impacted materials. Headspace results for intervals in borehole PA-1 (**Table D-4** of Appendix D) show elevated photoionization detector ("PID") levels beginning at 15 feet bgs and extending to 23 feet bgs, with readings ranging between 195 and 885 ppm.

<u>Pit B:</u> Located in the northwestern corner of the Site adjacent to Pit A, Pit B is covered by fill consisting of coarse sand and gravel to a depth of approximately 21.5 feet bgs. Hydrocarbon-impacted material was observed between 21.5 and 25 feet bgs consisting of greenish black to dark greenish gray silt and sand with hydrocarbon odor. Native silty sand was encountered at 26 feet bgs. Headspace results for intervals in borehole PB-1 show elevated PID levels beginning at 20 feet bgs. Elevated PID readings associated with the impacted zone range between 607 and 1,653 ppm within the interval of 21 to 25 feet bgs.

<u>Pit C:</u> Located in the southeastern corner of the Site, Pit C is covered by fill material to a depth of approximately 9 feet bgs. Impacted clay with a slight hydrocarbon odor was detected at 9 feet bgs in the estimated center of the Pit. Thickness of impacted material was observed to be 1 foot thick. The impacted zone is underlain by native silt and sand at 10 feet bgs, which also appeared to be slightly impacted as evidenced by a slight hydrocarbon odor. VOCs were not detected in the PID headspace samples.

Pit D: Located in the southeastern corner of the Site, Pit D is covered with fill material to a depth of 11 feet bgs in the center. Black asphalt material was noted at a depth of 8 feet with some fine gravel and concrete debris. Native silty sand was encountered at 11 feet bgs. No hydrocarbon-impacted material was encountered, and PID headspace sample readings ranged up to 27 ppm.

Pit E: Located in the southeastern corner of the Site directly south of Pit F, Pit E is covered with silt and fine-grained sandy fill material to a depth of 15 feet bgs. Clayey silt and silty clay with slight hydrocarbon odor was encountered at 9 feet bgs and appears to be fill. Native clay could not be distinguished from the fill material in the borehole. Native sand was encountered at 15 feet bgs. Native sand was impacted, with the highest PID reading (163 ppm) in the borehole at 15.5 feet bgs.

Two borings were drilled in the area demarcated as Pit E during the Phase I portion of Pilot Study No. 3, PNL-10 and PNL-10a (see **Figure 3.1-1**). These borings were drilled to 16.5 feet bgs and did not contain waste material.

During Phase VIII, one step-out boring for Pit F, PNL-F31, was installed in the Pit E area (see **Figure 3.1-1)**. Slight hydrocarbon impacts were noted in this borehole in native clay and underlying sand (15 to 25 feet bgs).

Pit G: Located in the southeastern corner of the Site, adjacent to Pit D, Pit G is covered with silty fill material to a depth of 8 feet bgs. A thin lens of native clay material was encountered from 8 to 8.5 feet bgs in one location, with no clay in an adjacent location. No hydrocarbon-impacted material was observed in the boreholes through Pit G. PID readings ranged from 0 to 12 ppm.

Pit H: Located in the northwestern corner of the Site, Pit H is covered by fill consisting of silty sand with asphalt fragments noted at 4.5 feet bgs. Hydrocarbon-impacted material was observed between 6 and 11.5 feet bgs consisting of dark greenish gray oil-saturated clay with hydrocarbon odor. Native sandy silt was encountered at 11.5 feet bgs. Headspace results for intervals in borehole PH-1 show elevated PID levels beginning at 3 feet bgs, extending to 12 feet bgs, and ranging between 58 and 392 ppm.

3.2.1.2 Pit F

Pit F, previously referred to as the "Styrene Pit," is located on the east side of the Site and is the only pit visible on the surface. The pit consists of a circular bermed area approximately 50 feet in diameter enclosed by a chain-link fence and covered with multiple synthetic plastic liners. The berms around the pit consist of soil and oil-impacted material apparently borrowed from other areas around the Site.

Pit F is reported by ESE (ESE, 1997b) to be filled with a thick, dark brown to black, viscous, and extremely sticky material with great elasticity. Previous investigators reported that Pit F is the source of a strong, sharp, metallic/organic odor. However, ESE sampled the surface material from this pit in January 1996 and reported that odors were not noted during sampling (ESE, 1997b). By July of 1996, the cover installed by Radian had deteriorated somewhat, and neighbors complained of odors. A temporary visqueen cover was placed over the cracked area of the old cover. The visqueen was replaced with a reinforced polypropylene cover in June 1997. Two additional high density polyethylene liners were installed in March - April 2004. This liner extends approximately 15 feet beyond the toe of the berm.

In 2002 a boring, P-10, was drilled in the area of Pit F during the TM1ROF fieldwork (Project Navigator, Ltd., 2003) (refer to **Figure 3.1-1** for boring location). P-10 was drilled approximately 25 feet northeast of the outer edge of the pit and was designed to assess the shallow subsurface conditions of the groundwater adjacent to the pit area. A light-tan, highly viscous material with a sharp chemical odor was detected in the borehole, and a piezometer subsequently was installed at the location to monitor conditions in the subsurface.

Investigation of the pit contents in 2004 during Pilot Study No. 3 revealed that the pit contains a dark brown, extremely sticky and viscous liquid with a sharp chemical odor: observations that are consistent with the prior investigations. The liquid is present to a depth of approximately 5 feet below the liner as measured on the west side of the pit. Underlying the liquid wastes is a pit bottom that is characterized by a hard white clay-like material containing numerous rubbery stringers and partings. The thickness of the white clay-like bottom was not determined.

Angled borings designed to assess the material below the pit bottom showed wet silty sand impacted by an odorous stringy yellow material similar to the Pit F liquid, but which is much less sticky. The thickness and stringy character of the impacted zone diminishes with distance away from the pit. The thickness of impacted material ranges from less than 1-foot in thickness at the distant end of the plume to approximately 15 feet thick directly adjacent to the pit (**Figure 3.2-1**).

Significant findings from Pilot Study No. 3 (Phase VIII) investigation of Pit F include:

- The physical characteristics of liquids in the pit are similar to that described by previous investigators for the Site.

- Pit F-impacted material consisting of a light-tan, highly viscous, adhesive liquid with a sharp chemical odor was observed in 16 borings; PNL-F1, PNL-F3, PNL-F4, PNL-F6, PNL-F7, PNL-P10, PNL-11, PNL-F11, PNL-F12, PNL-F18, PNL-F19, PNL-F21, PNL-F22, PNL-F25, PNL-F28, and PNL-F29 (**Figure 3.2-1**). Impacted material was detected in borings as far as 100 feet laterally from the pit to the east, north, and south.

- Material from the pit appears to have migrated in the subsurface through a layer of coarse and medium grained sands directly on top of the semi-perched aquifer.

- The footprint of impacted material in the subsurface near Pit F extends beyond the footprint of the pit area with an areal extent of approximately 1.1 acres.

3.2.1.3 Pit F Offsite Investigation

Previous investigations at the Site, including soil and downhole vapor flux investigations as part of Pilot Study No. 3 (see Appendix F), showed that potential impacts from Pit F materials in the subsurface had not been investigated in the eastern direction toward Magnolia Street. The Pit F offsite investigation was therefore completed to assess soils and soil gas near and outside of the eastern fence line of the Site and to measure contaminant flux, if any, at the ground surface. The investigation included assessment of soils, soil gas, and surface flux along Magnolia just outside the fence line. The assessment is documented in the Pit F Offsite Investigation Addendum Letter Report submitted to DTSC on January 31, 2005 (Project Navigator, Ltd., 2005a).

Conclusions from the Pilot Study No. 3 Pit F offsite investigation include:

- Analyses for VOCs and SVOCs were below detection limits in all offsite soil samples.
- Analyses for VOCs in soil gas at 3-feet bgs showed multiple volatile compounds at low concentrations.
- VOC and sulfur compound analyses of surface flux collected just offsite generally showed that Pit F has not impacted offsite air. No compound related to Pit F materials was found in the surface flux. Most compounds encountered could be attributed to oil and gas operations conducted onsite or to the petroleum release from the Krik Well #80 that occurred on March 17, 2004.

3.2.1.4 Current Lagoons

The aerial photographs (see also Section 1.3) show that most of the Site was covered by lagoons, or ponds (see 1958 Site aerial map, **Figure 1.3-d**). Over the years, the lagoons were divided and enclosed by berms, and in-filling with oilfield wastes created the current configuration of five lagoons at the Site. The lagoons were used mainly for disposal of oil and other production wastes. They were subsequently partially filled in with concrete, wood, and other construction debris. Currently, the lagoons contain exploration and production wastes, impacted soils, and debris.

In 1996, ESE collected samples from each of the five lagoons using an excavator at depths of 4 to 5 feet to obtain additional data on the physical characteristics of the liquid and solid materials present there. Samples were collected from the excavator bucket and submitted to Core Laboratories for analysis for the following physical properties: percent volume determination of water, sediment and oil by centrifuge; specific gravity; grain size distribution; viscosity; and heating value. The results of these analyses, and further details on this investigation, are documented in Section 3.2.2.

A summary of the findings from the RI (ESE, 1997b) is presented below.

- Of the five current lagoons, Lagoon 1 is the smallest, with dimensions of approximately 200 by 300 feet. Lagoon 4 is the largest, measuring approximately 300 by 500 feet. The current lagoons cover approximately 30 percent of the Site area.

- The lagoons contain varying percentages of soil by volume, with the highest proportion in Lagoons 4 and 5. In terms of grain size, the soil from all five lagoons has been found to be primarily in the silt range.

- Lagoons 1 and 2 contain the highest oily liquid content.

- Based on observations of the lagoon materials, it appears that it would be feasible to remove the materials by excavation.

- A simulated distillation of hydrocarbons from several lagoon samples showed that 1) the hydrocarbon ranges span the ranges of gasoline, diesel, and waste oils, and 2) the ranges of hydrocarbons were consistent between the different lagoons (**Figure 3.2-2**).

- Based on some of the analytes detected in the lagoon samples, wastes other than those from petroleum production may have been dumped in the lagoons.

Following are the major findings from Phase IV of Pilot Study No. 3, the lagoon sampling program:

- No free liquids were observed. Samples excavated from Lagoons 1 and 3 contained predominately heavy, highly viscous tar and drilling mud. Samples from Lagoon 2 contained a thicker tar and less mud/clay but more soil material (including silt and gravel). Samples from Lagoons 4 and 5 contained mostly tar/silt/clay (drilling mud).

- The degree to which lagoon materials flowed into the trenches limited the depths to which materials could be observed/sampled in all five lagoons.

- Excavation to the top of the native alluvium material was possible at two locations, one on the southeast side of Lagoon 4 (sample PNL-L4A) and the south side of Lagoon 5 (sample PNL-L5B). At these locations, relatively higher strength, solid-like materials were present. Refusal was encountered at all other locations. In Lagoons 1 through 3, refusal depths ranged from 4 to 10 feet bgs.

- PID/FID readings from the excavated lagoon materials were highest in Lagoon 4 (readings up to 200 ppm) and below 100 ppm in all other sample locations. Sulfur and hydrocarbon odors were observed during the testing.

- Chemical constituents detected in the lagoon tar/soil samples include petroleum hydrocarbons, VOCs, and metals. Lead, barium, arsenic, and chromium were the metals detected in significant concentrations. The samples also contained DDT and PCBs.

- Odor levels above background (SCAQMD[4] Level I) were noted on one occasion at the northern Site perimeter (AA-02) air monitoring station (see **Figure 3.1-1** for station locations), which was downwind from the lagoons being disturbed. Section 3.4.2.2 further discusses results from perimeter air monitoring during Pilot Study No. 3.

- Surface Flux Testing was conducted on each lagoon sample using two emissions control agents. Rusmar® foam was the most effective agent for controlling emissions and odors based on PID/FID results (76% and 94% reduction, respectively), Jerome hydrogen sulfide analyzer readings (91%), and laboratory odor flux measurements (dynamic dilution olfactometry, 84%). These results were in agreement with speciation results for TO-15 and TO-3 SUMMA canister samples. However, speciation odor results showed very little reduction in concentrations of reduced sulfur compounds via control agent addition. Further details on the Phase IV surface flux testing are discussed in Appendix F.

- VOCs detected in the surface flux measurements were primarily BTEX or derivative compounds. Reduced sulfur (odor) compounds detected included hydrogen sulfide, carbon disulfide, carbonyl sulfide, and thiophenes (few samples).

- Physical properties tests were performed on samples of tarry waste/mud collected from Lagoons 1, 2 (both samples), and 3 (one sample only) by Conti Testing Laboratories Inc. (Bethel Park, Pennsylvania). The samples were tested for proximate and ultimate fuel analyses[5], pour point by ASTM D-97, viscosity vs. temperature (Brookfield test), and specific gravity by ASTM D-71. Pour (melting) point temperatures of the material in the lagoons ranged from 90 to 150^{o}F, and specific gravities between 1.1 and 1.3. Heat value is about 13,000 BTU/lb for Lagoons 1 and 2 (3 of 4 samples) and 5,000 BTU/lb for Lagoon 3, showing that Lagoon 1 and 2 tars have considerable (unblended) fuel value. Viscosity versus temperature tests showed material viscosity decreases considerably upon heating.

- Geotechnical analyses were also performed on samples PNL-L4B and PNL-L5A, which included moisture content, bulk density, and one-dimensional consolidation. Unconfined compression tests were attempted but could not be run due to lack of cohesive strength in the material. The results, discussed in greater detail in Section 3.2.2, show that the material in these samples (which was primarily low strength drilling mud) had a high liquid content and was very compressible.

- The EPA 8015 extractable hydrocarbon distribution for samples from Lagoons 1, 2, 3, and 5 (one sample) was prepared by Del Mar Analytical Inc. at the request of Project Navigator, Ltd. The percentage distribution (**Table 3.2-1**) shows that hydrocarbons are distributed throughout the middle and higher ranges. This compares with **Figure 3.2-2** from prior studies.

[4] Southern California Air Quality Management District (SCAQMD) uses a rating system to describe odor intensity. See **Table D-6** of **Appendix D** for description of odor intensity levels.
[5] These analyses, which include BTU value and elemental composition, would be required to evaluate acceptance of waste for a potential coal waste blending receiver (Colmac Resources). Analytical methods include ASTM D3174, -3175, -3176, -4239, and -5373.

3.2.1.5 Former Lagoon Areas

Aerial photographs of the Site indicate that at various times most of the Site was covered by one or more large lagoons. For that reason, most of the area of the Site that is not a pit, lagoon, or perimeter berm is designated as part of the former lagoon area. Samples were collected from the soil surface and subsurface to assess the impacts from the former lagoons and to locate any unidentified potential areas of more concentrated chemical constituents. Additional sampling was performed by Project Navigator, Ltd. during the TM1ROF program in 2002 (Project Navigator, Ltd., 2003). Additional data were generated by Project Navigator, Ltd. in 2004 during Pilot Study No. 3 for this RFS. Details regarding the investigations completed prior to the TM1ROF for former lagoon areas are presented in the RI report (ESE, 1997b). The analytical results, conclusions, and significant findings are discussed below.

The significant findings regarding the former lagoon areas as presented in the RI (ESE, 1997b) include:

- Based on a comparison of TPH concentrations, the former lagoon areas are impacted to a lesser extent than the pits or current lagoons.

- The following analytes were found in the former lagoon areas at significant levels: benzene, PCB-1260, arsenic, beryllium, lead, and thallium.

Significant findings presented in the TM1ROF (Project Navigator, Ltd., 2003) regarding the former lagoon areas include:

In the TM No. 1 program, 26 geoprobe borings and 10 piezometer wells were drilled in the former lagoon areas (**Figure 3.1-1**). Sampling from the TM No. 1 program was targeted at identifying free phase liquids within the former lagoon areas of the Site. This program added definition to the fill, waste, and liquid levels and groundwater conditions within the Site. During this program, a zone of perched liquid was identified within and on top of the waste in the east and southwest areas of the Site corresponding with areas of fill and construction debris. Black, separate-phase hydrocarbon was initially detected in four monitoring wells installed in this program. Chemical analyses were performed on soil and waste samples for VOCs, SVOCs, TPH, metals, and Soluble Threshold Limit Concentration ("STLC") metals and Toxicity Characteristic Leachate Procedure ("TCLP") metals. These results are tabulated in **Table E-2** and **Table E-3** of **Appendix E** along with similar data from Pilot Study No. 3. Summary statistics from the combined data sets are presented in Section 3.2.3.

VOCs (EPA Method 8260B) were detected in all boreholes in the TM No.1 program. The highest VOC concentrations were detected in drilling mud in the northwest portion of the Site at boring P-3 with naphthalene reported at 67,000 ug/kg. SVOCs (EPA Method 8270C) were detected in seven borings. The highest SVOC concentrations were detected also in boring P-3 with 2-methylnapthalene, naphthalene, and phenanthrene reported at 46,000, 45,000, and 27,000 ug/kg, respectively. TPH by method 8015M was detected in 27 borings in the former lagoon areas. The highest detected level of TPH (Volatile Fuel Hydrocarbons) of 2,000 mg/kg was found in boring GP-16 on the east side of the Site. STLC metals were analyzed for nine borings in the former lagoon areas under TM No. 1 program. Metals exceeding California soluble threshold limit values were detected in five borings. STLC exceedences were noted for chromium (borings P-2 and P-3), arsenic (boring P-3), and lead (borings P-3, P-5, P-7, and P-8).

Notable geologic findings in the TM No. 1 program showed indications of a zone of perched liquid within and on top of oily drilling waste and within the fill material on the eastern and southern portions of the Site. The estimated extent of perched liquids at the time of the TM No. 1 program is shown in **Figure 3.2-3**. The extent of perched liquids in the former lagoons areas was further evaluated during Pilot Study No. 3 Phases I, II, III, and VI, and was determined to not be of significant quantities, and thus to not pose a significant problem for excavation.

Following are findings from the Phase II field investigation of Pilot Study No. 3 regarding the former lagoon areas:

- Bucket auger refusal was encountered in PNL-BA3, PNL-BA6, PNL-BA7, PNL-BA8, and PNL-BA13 due to subsurface concrete. Refusal was remedied by utilizing a backhoe to remove the concrete debris.

- VOC readings greater than 1,000 ppm from PID/FID headspace analyses were detected in borings PNL-BA1, PNL-BA3, PNL-BA8, and PNL-BA11, with all elevated readings associated with impacted soil or waste. The highest stockpile PID/FID readings were detected from PNL-BA8 and PNL-BA13 cuttings.

- Chemical constituents detected in stockpile soil samples included petroleum hydrocarbons, VOCs, SVOCs, and metals. Total Recoverable Petroleum Hydrocarbon ("TRPH") concentrations were in the range of 0.2% to 7.3%. VOCs detected were primarily BTEX compounds in the low ppm range. Barium and lead were the metals detected in the highest concentrations. Waste statistics for fill, impacted soil, and drilling mud are presented in Section 3.2.3.

- With the surface flux chamber, seven emissions control agents[6] were first tested on waste from the highest emitting boring (PNL-BA8), with the best control agent from that test used on samples from the other borings. Rusmar surfactant foam (applied as a 2- to 3-inch layer, in a ratio of 1:6.5 pure product to water) was the most effective agent in controlling odors and emissions for waste material from PNL-BA8 and the other borings. VOC emissions were controlled at an average rate of 65% to 80% (based on field FID and PID measurements, respectively) and odors were reduced at an average of about 70% (from olfactory analyses). Rusmar was also the optimally performing agent based on the speciated hydrocarbon (TO-15 analysis) data. Further discussion on the Phase II emission control agent testing is provided in Appendix F.

- Compounds detected in soil gas (from surface flux testing) included hydrocarbons and VOCs (BTEX, styrene, carbon disulfide) generally at low ppm levels. Emission control agent application did not appear to reduce VOC concentrations significantly, but did control hydrocarbons to varying degrees.

A radiological survey was conducted during Phase III of Pilot Study No. 3, the finding of which is described as follows:

Background radiation levels on the Site range between 10 and 18 microRoentgen per hour. Offsite background radiation levels (see **Figures 3.2-4a** – **3.2-4e** for location of background readings) range between 8 and 13 microRoentgen per hour. Radiation levels on stockpiles ranged between 12 and 18 microRoentgen per hour on contact (**Figures 3.2-4a** – **3.2-4e**). The highest observed readings were recorded at PNL-TP3 (18 microRoentgen per hour). The observed radiation levels show no consistent pattern with regard to material type. The variation in readings on soil piles is attributed to normal background level fluctuations from varying soil matrices and geometric effects from irregular shaped piles. All radiation levels observed are well below any state or federal regulatory limit for external exposure.

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[6] These included proprietary liquid surfactants such as Biosolve®, Microblaze®, Alabaster CS1®, and Petroclean®, as well as tap water and a latex foam product manufactured by Rusmar®.

3.2.1.6 Perimeter Berm

An earthen berm, 10 to 20 feet high, was constructed in the past around the northern and eastern perimeter of the Site to contain the pits and lagoons. The perimeter berm is covered over much of its outer surface with vegetation[7].

The height of the perimeter berm relative to the land surface outside and within the Site varies. The berm is the highest in the northeastern portion of the Site, along Hamilton Avenue and Magnolia Street, after the elevation of the north berm was reduced to approximately 15 feet MSL during the Emergency Action conducted between July 2005 through January 2006. The perimeter berm is lower along the south side of the Site. There is virtually no berm in the southeast corner of the Site and along most of the western side of the Site.

To continue a convention used in the RI report, it has been assumed that the perimeter berm extends from the northwest corner of the Site clockwise around the Site to the southwest corner. Details regarding the previous investigations completed for the perimeter berm were presented in the RI report (ESE, 1997b). The relevant analytical findings were also summarized in the initial FS Tables in Appendix A of this RFS.

Because the materials within the perimeter berms, like all other Site materials, are within the wastes categorized and discussed in this RFS (see Section 3.2.3), specific sampling and analyses of the berm areas was not performed during Pilot Study No. 3. However, information gathered during excavation and grading of the north berm under the Emergency Action in 2005 through early 2006 showed that the north berm contains a significant amount of drilling mud (up to approximately 75% of the berm contents).

3.2.1.7 Construction Debris

It is apparent from an inspection of the Site that large quantities of construction debris, such as concrete rubble, wood, and other construction wastes, were disposed at the Site. Some of the previous investigations included inspections of the surface and subsurface to assess the type and estimate the volumes of the construction debris present. Details regarding the previous investigations of construction debris were presented in the RI report (ESE, 1997b).

In January 1996, four test pits (ESE-TESTPIT-1 through 4), each approximately 5 feet square by 15 feet deep, were excavated (**Figure 3.1-1**). The materials removed from the test pits were visually examined and are described below:

- Test Pit No. 1 (ESE-TESTPIT-1) was mostly oil-stained soil with some unstained soil, wood debris, bricks, and plastic wrap. No concrete rubble was observed.
- Test Pit No. 2 (ESE-TESTPIT-2) contained approximately 25 to 35 percent concrete and asphalt rubble, and the remainder consisted of oil-stained soil, unstained soil, and brick. Generally, clean soil was found from the surface to a depth of 5 feet bgs.
- Test Pit No. 3 (ESE-TESTPIT-3) contained approximately 10 to 15 percent concrete and asphalt rubble and the rest consisted of oil-stained soil, unstained soil, steel, and PVC pipe. The top 5 feet was primarily clean soil.
- Test Pit No. 4 (ESE-TESTPIT-4) contained clayey soil with slight oil staining. Petroleum hydrocarbon odors increased with depth. There was no construction debris observed in this pit.

In 2004, an assessment of the construction debris was performed to better understand the handling characteristics of the material. In the Phase III program discussed above, five trenches (PNL-TP01, -TP03, -TP05, -TP06, and –TP07) were found to have construction debris present. Concrete and construction debris were easily removed from trenches with excavators and did not appear to pose a

[7] The north berm was hydroseeded with natural drought resistant vegetation seed in October of 2005 during the Emergency Action.

handling problem with the equipment used for trenching. Wood and other debris were relatively small in size and did not appear to be a problem for excavation. Heavy construction debris and concrete tended to undercut and slough when excavated, limiting the slope of excavations to under 1:1 (Horizontal to Vertical).

Materials encountered at the surface and subsurface at the Site include broken concrete, large diameter concrete pipe, asphalt, brick, metal, plastic, wood, wire, ceramic tile, roofing material, wallboard, and miscellaneous debris. Large concrete slabs, which appear to be from building and highway foundations, were distributed irregularly over the Site. Blocks up to 7 feet long and 4 feet thick were encountered at the surface in the southeastern portion of the Site, east of Lagoons 1, 2, and 3. Large blocks of concrete were also encountered west of Lagoon 3. Construction debris and concrete occur within and near the road areas and also bound the perimeter of Lagoons 1, 2, and 3. Reinforcing bar and metal conduit were distributed widely at the surface and in the subsurface.

Concrete and construction debris in the subsurface tended to be concentrated on the east side of the Site where large volumes of debris were placed to fill in the former lagoon areas. Aerial photographs from 1976 show former lagoon areas being filled with rubble piles on the south and west portions of the Site. By 1983 the construction debris and fill covered the former lagoon areas, and the Site took on its current configuration. From the period of 1983 through the present, little or no additional construction debris or fill was disposed on the Site.

Subsequent to Pilot Study No. 3, much of the concrete debris located on the surface throughout the Site was collected, broken, and used as a concrete buttress in the southern side of Lagoon 4, to support the berm between Lagoons 3 and 4 after the removal of drilling mud from Lagoon 4 under the Emergency Action in 2005. The remainder of broken concrete from the Emergency Action work remains on the Site's surface in the northwestern portion of the Site.

3.2.1.8 Background Soil Sampling

In 1988, one background soil sample was collected from a grassy area in Edison Community Park, approximately 800 feet north of Hamilton Avenue and 600 feet east of the residential area and sports complex. The sample was collected from a depth of 3 feet bgs and was analyzed for TPH and priority pollutant metals. At the request of DTSC, in February 1997 seven additional background soil samples were obtained. The samples were collected along the north side of Hamilton Avenue and the east and west sides of Magnolia Street from depths of 5.5 to 8 feet bgs. The samples were analyzed for TPH and metals. Details regarding the investigation completed for background are presented in the RI report (ESE, 1997b). A tabular summary of statistics for the analytical data for the background soil samples is presented in **Table 3-25** of the initial FS, Appendix A. Concentrations above residential preliminary remediation goals ("PRGs"; USEPA, 2004) for arsenic were found in all eight background samples, and an elevated concentration of beryllium was found in one of the eight samples collected. In summary, background, offsite, concentrations for arsenic and beryllium exceed residential PRGs.

3.2.2 Geotechnical Investigations

Extensive sampling has been performed to ascertain the physical properties of fill and native material at the Site. Samples have been collected in each of the five lagoons and former lagoon areas, beginning with 1996 investigations performed by ESE and reported in the RI (ESE, 1997b) and with recent borings installed by Project Navigator, Ltd. during Pilot Study No. 3. These studies were performed to determine the feasibility of placing construction equipment at various portions of the Site and excavation of the more liquid wastes[8].

[8] Pumpability was also assessed for the more liquid wastes.

In January 1996, in order to obtain additional data on the physical characteristics of the liquid and solid materials present in the lagoons, ESE collected samples from two locations in each of the five lagoons using a track-mounted excavator. In nine of the ten locations, samples were collected at two depths: one at approximately 4 to 5 feet and another at the interface between the lagoon material and the underlying native soil. The physical characteristics of the samples were recorded, and samples were collected from the excavator bucket for laboratory analysis. In general, Lagoons 1 and 2 contained materials with the highest liquid content, particularly from the western portions of the lagoons, which was an oily/tarry substance that flowed out of the excavator bucket, and Lagoons 4 and 5 contained the highest concentrations of solids. ESE found that, based on observations of the lagoon materials, it appeared that it might be feasible to remove the materials by excavation.

A total of 18 samples were submitted to Core Laboratories, a state-certified physical testing laboratory, for the following analyses: percent volume determination of water; sediment and oil by centrifuge; specific gravity; grain size distribution; viscosity; and heating value. **Table 3.2-2** presents a summary of the testing results from the ESE lagoon samples. Following is a summary of significant findings of the RI regarding geotechnical issues:

- The results of the grain size distribution indicate the materials are primarily in the silt range. The sediment was found to be 54 to 95 percent fine-grained material.

- The centrifuge method was successful in separating water from the other materials but not in determining accurate sediment-oil volumes (oil was only detected in one sample, which belied the physical appearance and chemical characteristics of the samples). It appears the method was unable to separate the oil from the fine-grained sediment, and therefore underestimated the oil percent volumes.

- Viscosity values could not be obtained from any of the nine lagoon samples, even at increasing temperatures, due to the extremely high solid content of the samples.

Additional details from this study, including laboratory analytical reports and chain-of-custody forms for the geotechnical samples, are presented in the RI Report (ESE, 1997b).

During the TM No. 1 Program field activities, twenty-five direct-push (Geoprobe®) borings were cored and ten piezometers were installed within the Site boundaries (**Figure 3.1-1**). Geotechnical samples were collected to evaluate the physical condition of the fill and waste at the Site. The drilling program involved collection of the following types of samples:

- In the borings for the piezometers, split spoon samples were collected and standard penetration tests ("SPT") were performed continuously or at 5-foot intervals. SPT testing was performed in accordance with ASTM D1486.

- Acetate sleeves from continuous coring of Geoprobe borings were submitted for laboratory chemical analyses only.

- Recovered samples were visually classified using the Unified Soil Classification System ("USCS") (ASTM D2488).

Collection of Shelby tube samples was precluded by the amount of concrete, debris, and loose material encountered in the borings. Thus, samples were collected with split spoon samplers to ensure that a sufficient amount of recoverable material was obtained. Split spoon samples were submitted to the Ninyo and Moore (Irvine, California) geotechnical laboratory for the following laboratory tests (on selected samples):

- Particle Size Distribution (ASTM D 422), including sieve and hydrometer analyses
- Atterberg Limits (ASTM D 4318)

- In-place moisture content and density (ASTM D 2216 and D 2937, respectively)
- Hydraulic conductivity (ASTM D 5084)
- Maximum dry density and optimum moisture content (ASTM D 1557) (2 samples)
- Unconfined compression (ASTM D 2166)
- Consolidated undrained triaxial compression ("CUI") (ASTM D 4767) (4 samples)

Hydraulic conductivity, density, and compression tests were performed to estimate permeability, bearing capacity, and effective strength parameters. The sieve and hydrometer analyses and Atterberg Limits tests were performed for laboratory soil classification. A summary of the geotechnical analyses performed during TM No. 1 Program is presented in **Table 2-2** in **Appendix I**.

Following is a summary of the major findings from the TM No. 1 Program geotechnical investigation, excerpted from a 2003 report prepared by Parsons for the TM1ROF (Appendix I). Parsons identified three soil strata of geologic interest at the Site: Stratum I – Fill Soil; Stratum II – Waste & Impacted Fill Material; and Stratum III – Native Material. A summary of subsurface conditions from the TM1ROF is shown in **Table E-1** in the Parsons Report in Appendix I.

Stratum I:

- Heterogeneous fill material comprised mostly of silty sand and sandy silt, with varying amounts of gravel, clay and construction debris (such as concrete, asphalt, and brick).
- Thickness ranged from 2 feet at the southwestern portion of the Site to 20 feet in the central area.
- SPT values ranged from 10 to 81 blows per foot.
- Sieve analysis and Atterberg Limits tests generally indicate the soil is coarse grained with non-existent to low plasticity.
- Permeability of material is low to moderate.
- In-place density values were all below the estimated maximum dry density.

Stratum II:

- Drilling mud, oily soil waste, and other oil or hydrocarbon-impacted material. Varying amounts of construction debris were also encountered.
- The drilling mud exhibits the behavior of low-to high-plasticity clay.
- This stratum was encountered across the Site, at a thickness ranging from 3 feet at the southwestern portion of the Site to 26.5 feet in the northwest portion of the Site.
- SPT values ranged from 2 to 35 blows per foot (with higher values in a few borings, P-4 and P-10), with the lowest readings in the drilling mud.
- Sieve analyses and Atterberg limits testing indicated the material is generally fine grained with moderate to high plasticity.
- Material permeability is very low.
- Material effective shear stress and friction angle is relatively low.
- Additional bearing capacity and differential settlement analyses are recommended if short-term loading is planned to occur directly on Stratum II.

Stratum III:

- Native material, comprised predominantly of silt with varying amounts of sand and clay, underlain by sand (varying in silt content).
- Stratum III was encountered in most (9 of 10) of the piezometers and slightly over half of (14 of 25) the Geoprobes.
- The observed extent of Stratum III was greater than 10 feet in four of the nine piezometers and in two of the Geoprobes.

- SPT values ranged from 8 to 40 blows per foot, with higher values in two of the piezometers.
- Geotechnical testing was not conducted.

A copy of the Parsons report, boring logs, and analytical reports from the TM No. 1 geotechnical borings are presented in Appendix I.

Additional studies performed by Dr. Edward Kavazanjian at the request of the RPs showed that the results of the CUI tests appeared to be representative of disturbed samples and also that the tests were conducted without allowing sufficient time for complete consolidation. This resulted in underestimated results of un-drained shear strength for these samples.

Tables showing the geotechnical results for the Phase VI investigations of Pilot Study No. 3 are presented in **Table 3.2-3a** and **Table 3.2-3b** and in Appendix J (PTS laboratory report).

The relevant geotechnical findings from Phase VI of Pilot Study No. 3 are presented below:

1. The USCS classifications for drilling mud and native clay are both fat (high plasticity) clay.

2. Native soil underlying clay is coarse grained silty sand.

3. Moisture content (by weight) of native material (sand/clay) ranged from 22 to 51 percent, averaging about 28 percent. Bulk density averaged about 1.45 g/cc. Drilling mud was found to have much higher moisture content, particularly in Lagoons 4 and 5, and lower bulk densities.

4. Hydraulic conductivity of both the native clay and drilling mud are in the 1 to 10^{-7} cm/sec range, which is in the expected range for these types of materials.

5. The consolidation tests show that the drilling mud is particularly compressible, with about 10% to 25% permanent settlement expected to occur after placement of a load, such as reconsolidated fill in a cap (the drilling mud in Lagoons 4 and 5 is softer, with permanent settlement ranging from 20 to 40%). Following consolidation, the moisture content and void ratio of the material decreased and the density of the material increased, reflecting a release of pore fluids from the materials. The consolidated material had 100% pore volume saturation.

6. CUI (ASTM D 4767) could not be run due to entrained oil oozing from drilling mud with load application. This oil contaminated the pressure transducers of the testing equipment. Unconsolidated undrained shear (ASTM D 2850) was substituted for the CUI method.

7. The unconsolidated undrained shear tests show low shear strengths for the compressible waste and native silty materials, but the samples appear to have been subject to excessive disturbance.

8. The unconfined compression test results were found to be in the same range as the unconsolidated undrained shear results described above. The unconsolidated undrained shear results, being slightly more conservative and more complete, were used to estimate shear strength values of the compressible waste and native clay in stability analyses performed Dr. Ed Kavazanjian as shown below.

9. Blow counts are shown on **Figure 3.2-5**.

Stability/Settlement Analyses

Stability and settlement evaluations of the drilling mud and underlying native clay and sand were also performed by Dr. Ed Kavazanjian. Dr. Kavazanjian's evaluation memorandum is presented in Appendix

K. Dr. Kavazanjian evaluated two different scenarios associated with placing specified amounts of waste and cap material on top of existing ground at the Site. The quantities of waste/cap material evaluated were based on potential capping scenarios developed for the detailed evaluation in Section 9.0. The general findings of this evaluation are as follows:

1. Consolidation Tests – Settlement Analysis

    a. Settlement analyses were performed using the soil profiles for borings PNL-21, -23, and -28 (see **Figure 3.1-1** for boring locations) and the associated consolidation test results on samples recovered from each boring.

    b. Coefficients of consolidation and a compression index were calculated for the compressible waste and native clay in each of these borings, and were found to be representative of compressible, low permeability materials (ranging from a low plasticity silt to a high plasticity clay). The coefficient of consolidation values ranged from 200 to 250 ft^2/year for the compressible waste in PNL-23 and 2 to 6 ft^2/year for the underlying native clay and compressible waste in PNL-21.

    c. The total settlement depends on the amount of additional fill added. The estimated settlement is significantly greater at PNL-21 and PNL-23 than PNL-28 due to the relatively small amount of compressible material at PNL-28. The total settlement calculated for PNL-21 and PNL-23 was 10.8 and 8.9 inches respectively, while the total settlement calculated for PNL-28 was 1.7 inches. The values listed above are a conservative scenario assuming a 5-foot soil cover is placed on existing grade. Total settlement values were also calculated for the above three borings for a scenario of placing a 5-foot soil cap on the Site after excavation of waste material down to street elevation. This scenario provided total settlement values of 1.6, 2.2, and 1.3 inches for PNL-21, PNL-23, and PNL-28. Total settlement values were also calculated for different loading scenarios on top of a soil cap at the Site to account for potential structures placed on top of a cap (refer to Appendix K for these values). PNL-28 is located in the southwest corner of the Site (see **Figure 3.1-1**), whereas PNL-21 and PNL-23 are located in the northern part of the Site.

    d. The estimated time for 99% consolidation of clay was calculated to be 60 years for PNL-21, 11 years for PNL-23, and greater than one month for PNL-28. The above timeframes are based on placement of a 5-foot soil cover on existing grade. Time for 99% consolidation of clay was also calculated for the same three borings for a scenario of placing a 5-foot soil cap on the Site after excavation of waste material down to street elevation. This scenario provided times for 99% consolidation of clay of 1.5 years for both PNL-21 and PNL-23, and greater than one month for PNL-28. Time for 99% consolidation of clay was also calculated for different loading scenarios on top of a soil cap at the Site to account for potential structures placed on top of a cap (refer to Appendix K for these values).

2. Stability Tests

    a. The native sand underlying the silty clay layer appears to be a marine terrace deposit that is not susceptible to liquefaction

    b. The analyses were hindered by relatively poor definition of the shear strength of the compressible waste and native materials. Samples from previous investigations and current samples appear to have been subjected to excessive sample disturbance.

    c. **Figure 3.2-6** shows a cross section of the cap showing the parameters (e.g., material densities and strengths) used in the tests.

d. Factor of safety values were calculated for different capping scenarios, to include long-term stability analyses results, short-term stability analyses results for unconsolidated Lagoon 4 waste and consolidated waste strength. These values are provided in Appendix K.

In summary, three strata have been identified at the Site that range in thickness and material heterogeneity. These strata are: heterogeneous fill, hydrocarbon impacted materials such as drilling mud, and native material (primarily sandy silt and clay). These materials have distinct physical characteristics (e.g., strength, moisture content, and permeability) that have been analyzed in various Site investigations conducted from 1996 through Pilot Study No. 3. Dr. Edward Kavazanjian has reviewed the geotechnical data from the Site investigations and conducted stability and settlement analyses of the drilling mud and underlying native material. Dr. Kavazanjian found that the magnitude and rate of consolidation due to the high compressibility of drilling mud was variable across the Site, and concluded that the native sand underlying the silty clay layer does not appear to present a significant liquefaction potential. Soil properties and profiles should be confirmed for the remedial design of the selected remedial alternative for the Site.

3.2.3 Summary Evaluation of Chemical Characteristics for Potential Solid Wastes

The initial FS (Environ, 2000) evaluated waste materials based primarily on geographic location on the Site, such as current lagoons, former lagoon areas, waste pits, berms, and so forth. A different evaluation of materials is presented in this RFS and is based on the physical and chemical properties of the materials, in addition to consideration of the geographic location. The objective of dividing the Site materials into waste types is based on the premise that, regardless of the selected remedy, it is the physical and chemical properties of the materials that will largely determine how the material can be managed.

A review of all available borings logs from the Site was conducted for the purpose of identifying and locating specific potential wastes that would be encountered during remediation. The specific wastes identified by their general physical properties and analyzed herein with respect to their chemical properties are:

1. Minimally impacted fill soils and debris, including construction debris that has been minimally impacted by contact with contaminant-bearing soils.
2. Impacted soils (including fill sands and silts, and contaminant-impacted construction debris).
3. Highly liquid drilling mud, which are characterized by relatively low strength (penetration test blow-counts of 3 blows per 6-inch interval or less) and are generally noted as being saturated with oil/liquid. This includes materials in Lagoons 4 and 5, and is also presumed to represent materials present beneath tarry oils in Lagoons 1, 2, and 3.
4. Drilling mud of higher strength (blow counts greater than 3 per 6-inch interval) that are typically mixed with coarser-grained drill cuttings and typically not noted as being "saturated."
5. Tarry lagoon liquids, which are tarry oils estimated to include the upper few feet of materials contained in Lagoons 1, 2, and 3.
6. Styrene-impacted materials associated with Pit F.

Location-specific delineation of materials is maintained where it may provide useful information for the development and implementation of alternative remedies. Location-specific descriptions of chemical properties are maintained for Pit F, other former pit areas (Pits A, B, C, D, E, G, and H) and existing Lagoons 1 through 5. The former pits were retained as distinct areas, aside from their physical and chemical characteristics because of previous reports that specific wastes were disposed in these areas, which may include listed wastes or other wastes that may require separate handling during any removal/disposal action.

This section provides detailed descriptions of potential waste characteristics for all soil data collected at the Site. The data used to determine the characteristics of potential wastes include 1997 RI, TM1ROF, and Pilot Study No. 3 data. Only chemical constituents with results that potentially exceeded California- or RCRA-hazardous waste limits are discussed. Non-detect results were assumed to be present at one-half the undiluted detection limit for the purposes of these preliminary waste classifications. Assessment or evaluation of the risks to the environment or human health that chemical constituents in the wastes may pose is not covered in this discussion, and the statistical methods applied for the purpose of the waste evaluation are not intended to be used for risk-determination purposes.

Soil analyses resulted in categorization of all materials at the Site into the following waste types:

- Tarry Liquids in Lagoons 1, 2, and 3 (**Table 3.2-4**)
- Highly Liquid Drilling mud in Lagoons 4 and 5 (**Table 3.2-5**)
- Highly Liquid Drilling mud (Non-Pit and Non-Lagoon Areas) (**Table 3.2-6**)
- Drilling mud (higher strength/lower moisture) (**Table 3.2-7**)
- Impacted Soils (including composite and unspecified soil sample results) (**Table 3.2-8**)
- Pits A, B, C, D, E, G, and H Areas (**Table 3.2-9**)
- Pit F Area (**Table 3.2-10**)
- Minimally-Impacted Fill Materials (**Table 3.2-11**)
- Native Soils (**Table 3.2-12**)

Additionally, STLC and TCLP data are summarized by potential waste type in **Tables 3.2-13** and **3.2-14**, respectively. Results for Pilot Study No. 3 ignitability and pH analyses for various wastes types are presented in **Table 3.2-15**.

Analytical results are compared to applicable regulatory limits for total concentration, potential leachability, and analytically determined leachability. Although maximum detected contaminant concentrations are compared to regulatory limits, statistically determined upper confidence limits ("UCLs"), which are defined as the mean concentration plus 95-percent confidence interval, are acceptable as generally representative of the waste type for the purpose of assessing potential waste type classifications. Waste type classifications presented below are preliminary, and are based on currently available data. Additional waste classification sampling and analysis (including STLC and TCLP analyses) will be performed during implementation of any remedial activity to verify the waste types classifications presented in this section.

If the UCL for total soil concentrations of an analyte in a waste exceeds the Total Threshold Limit Concentration ("TTLC"), the waste is generally classified as a California-Hazardous waste. STLC and TCLP analyses are used to determine the potential leachability of contaminants in simulated landfill conditions. STLC and TCLP analyses are performed by placing a mass of soil sample in an acidic solution of either 10-times (STLC) or 20-times (TCLP) the mass of the soil sample. The leached solution is analyzed for the resulting contaminant concentration. Therefore, if the regulatory limit for leachability of a contaminant is 5 mg/L and the analytical method results in dilution of the sample mass by 10-times, the original sample would need to contain 50 mg/kg of the contaminant to potentially leach 5 mg/L of the contaminant, if all of the contaminant were to leach from the sample. Similar to comparisons to TTLC limits, STLC and TCLP results are compared to the UCL of each waste data set to determine the regulatory classification of the waste stream.

Figures depicting the estimated areal extent and thickness of the occurrence of each of the potential wastes discussed below (Sections 3.2.3.1 through 3.2.3.9) are summarized on **Figures 3.2-7** through **3.2-14** (respectively). **Figure 3.2-15** depicts sampling locations in native soils.

3.2.3.1 Tarry Liquids in Lagoons 1, 2, and 3

Arsenic: The maximum concentration of arsenic detected in this waste (100 mg/kg) exceeds 10-times the STLC (50 mg/kg). However, the 95-percent UCL concentration for arsenic is 38.6 mg/kg. STLC results for arsenic in this waste (**Table 3.2-13**) do not exceed the threshold for California-hazardous waste.

Barium: The maximum concentration of barium detected in this waste (5000 mg/kg) and the 95-percent UCL concentration (1122 mg/kg) exceed the 10-times the STLC (1000 mg/kg) and maximum concentration exceeds the 20-times the TCLP level (2000 mg/kg). STLC and TCLP results for barium (**Tables 3.2-13** and **3.2-14**, respectively) do not exceed the thresholds for California- or RCRA-hazardous wastes.

Cadmium: The maximum concentration of cadmium detected in this waste (78.0 mg/kg) and the 95-percent UCL concentration (11.8 mg/kg) exceed the 10-times the STLC (10 mg/kg) and the maximum concentration exceeds the 20-times the Toxicity Characteristic Leaching Procedure (TCLP) level (20 mg/kg). STLC and TCLP analyses for cadmium were not performed for this waste. Therefore, based on the 95-percent UCL concentration exceeding 10-times the STLC level, additional testing may be required for STLC-cadmium during implementation of the selected remedial alternative to determine if this waste is potentially a California-hazardous waste.

Chromium (total): The maximum concentration of total chromium detected in this waste (300 mg/kg) and the 95-percent UCL concentration (109 mg/kg) both exceed 10-times STLC (50 mg/kg) and 20-times TCLP (100 mg/kg) levels. STLC-total chromium has a maximum concentration of 5.4 mg/L, and a 95-percent UCL concentration of 4.0 mg/L. TCLP analyses of total chromium have a maximum concentration of 5.1 mg/L, and a 95-percent UCL concentration of 1.13 mg/L. The 95-percent UCL concentrations for both STLC and TCLP chromium are both less than the 5 mg/L limit for both tests; therefore, chromium concentrations are below California- and RCRA-hazardous concentrations for this waste.

Lead: The maximum concentration of lead detected in this waste (1,800 mg/kg) exceeds the TTLC of 1,000 mg/kg, the 10-times the STLC (50 mg/kg) and 20-times the TCLP (100 mg/kg). The 95-percent UCL concentration for lead is 491 mg/kg, which exceeds 10-times STLC and 20-times TCLP levels, but does not exceed the TTLC. TCLP results for lead (**Table 3.2-14**) for this waste do not exceed the thresholds for RCRA-hazardous wastes. STLC results for lead of 6.1 mg/L (95-percent UCL concentration) exceeded the 5 mg/L limit (**Table 3.2-13**). Therefore, this waste may be classified as California-hazardous waste.

The table below summarizes the waste classification anticipated for the Lagoons 1, 2, and 3 tarry liquids.

Table 3.2-A. Tarry Liquids in Lagoons 1, 2, and 3

Analyte	STLC 95% UCL (mg/L)	Soil Total 95% UCL (mg/kg)	Exceed California-Hazardous Waste (STLC) Limit (mg/L)[2]?
Arsenic	1.3	38.6	No (5)
Barium	30.3	1,122	No (100)
Cadmium	NA[1]	11.8	Potential[3] (1)
Chromium	4.0	109	No (5)
Lead	6.1	490	Yes (5)

1. NA – Not Analyzed
2. STLC limits are shown in parenthesis in mg/L for each respective contaminant in the right-most column.
3. Potential – Soil total concentration exceeds 10-times STLC limit. No STLC data are available for this waste; therefore, no conclusive waste classification determination is presented.

3.2.3.2 Highly Liquid Drilling mud in Lagoons 4 and 5

Barium: The maximum concentration of barium detected in this waste (2,600 mg/kg) exceeds 10-times the STLC (1,000 mg/kg) and 20-times the (TCLP) (2,000 mg/kg). However, the 95-percent UCL concentration for barium is 692 mg/kg. STLC and TCLP results for barium do not exceed the thresholds for California- or RCRA-hazardous wastes.

Cadmium: The maximum concentration of cadmium detected in this waste (23.0 mg/kg) exceeds 10-times the STLC (10 mg/kg) and 20-times the TCLP (20 mg/kg). However, the 95-percent UCL concentration for cadmium is 4.3 mg/kg. STLC and TCLP results for cadmium in this waste do not exceed the thresholds for California- or RCRA-hazardous wastes.

Chromium (total): The maximum concentration of total chromium detected in this waste is 190 mg/kg, exceeding both the 10-times STLC (50 mg/kg) and 20-times TCLP (100 mg/kg) levels. The 95-percent UCL concentration of 85.3 mg/kg total chromium is above the 10-times STLC but below the 20-times TCLP levels. STLC and TCLP analyses of total chromium in this waste do not exceed the thresholds for California- or RCRA-hazardous wastes.

Lead: The maximum concentration of lead detected in this waste (1,200 mg/kg) exceeds the TTLC of 1,000 mg/kg, the 10-times the STLC (50 mg/kg) and 20-times the TCLP (100 mg/kg). The 95-percent UCL concentration for lead is 371 mg/kg, which does not exceed the TTLC. STLC-lead analyses for this waste are below the 5 mg/L limit. The 95-percent UCL concentration for TCLP-lead in this waste (19.2 mg/L; **Table 3.2-14**) exceeds the threshold for RCRA-hazardous wastes of 5 mg/L. However, of the 8 samples analyzed for TCLP lead from this waste, lead was detected in only one sample, at a concentration of 58 mg/L (sample L2-2-2.5 in Lagoon 4). A copy of the laboratory report detailing this high TCLP-lead result could not be identified, and due to the age of the data, this result could not be verified by the laboratory. Prior to Site remediation, additional sampling in the vicinity of the sample (L4-2-2.5) may demonstrate this single data point to be anomalous. If so, drilling mud in Lagoons 4 and 5 may not be classified as RCRA-hazardous waste. Data from the Emergency Action in 2005 resulted in two California-hazardous concentrations from samples of material from this waste (both from Lagoon 4): 5,000 mg/kg TTLC result and 44 mg/L STLC result. Therefore, this waste could be considered California-hazardous due to lead. Further testing would be required during implementation of the remedial alternative to verify the classification of this waste.

1,2-Dichloroethane: The maximum concentration of 1,2-dichloroethane in Lagoons 4 and 5 is 10.0 mg/kg. This is equal to the 20-times TCLP level (10 mg/kg) for this analyte. However, the 95-percent UCL concentration for 1,2-dichloroethane in Lagoons 4 and 5 is 2.21 mg/kg, below 20-times the TCLP level. No STLC level has been established for this compound.

The table below summarizes the waste classification anticipated for the Lagoons 4 and 5 highly liquid drilling mud. Although no data are available for wastes beneath the tarry liquids in Lagoons 1, 2 and 3, it is likely, based on interpretation of Site aerial photographs, that wastes beneath the oily liquids are similar to the drilling mud encountered in Lagoons 4 and 5.

Table 3.2-B. Highly Liquid Drilling mud in Lagoons 4 and 5

Analyte	STLC 95% UCL (mg/L)	Soil Total 95% UCL (mg/kg)	Exceed California-Hazardous Waste (STLC) Limit (mg/L)[2]?
Barium	16.3	692	No (100)
Cadmium	NA[1]	4.3	No (1)
Chromium	3.8	85.3	No (5)
Lead	1.4	371	No (5)
1,2-DCA	NA	2.21	NE[3]

1. NA – Not Analyzed
2. STLC limits are shown in parenthesis in mg/L for each respective contaminant in the right-most column.
3. NE – Not established

3.2.3.3 Highly Liquid Drilling mud (non-Pit and non-Lagoon Areas)

For the highly liquid drilling mud (drilling mud with relatively low strength characteristics), no compounds from total-soils analyses were detected in concentrations exceeding TTLC, 10-times STLC, or 20-times TCLP level concentrations (**Table 3.2-6**). Because only a limited number of samples from this waste were analyzed for total metals in soil, 95% UCL concentrations of total metals are not presented. STLC-metals analyses (**Table 3.2-13**) were performed on several soil samples from this waste that are not paired with total-soils metal analyses. TCLP-metals analytical results for this waste did not detected any TCLP-metals in excess of the TCLP limits for RCRA-hazardous wastes (**Table 3.2-14**).

Arsenic: The maximum STLC-arsenic concentration detected in this waste is 7.9 mg/L, which exceeds the 5 mg/L limit. However, because the 95-percent UCL concentration of STLC-arsenic is 4.03 mg/L, it is anticipated that STLC-arsenic concentrations will not result in this waste being classified as California-hazardous.

Chromium (total): The maximum STLC-chromium (total) concentration detected in this waste is 8.3 mg/L, which exceeds the 5 mg/L limit. However, because the 95-percent UCL concentration of STLC-chromium (total) is 4.5 mg/L, it is anticipated that STLC-chromium concentrations may not result in this waste being classified as California-hazardous.

Lead: The maximum STLC-lead concentration detected in this waste is 16 mg/L, exceeding the 5 mg/L limit. The 95-percent UCL concentration of STLC-lead is 11.7 mg/L; therefore, this waste may potentially be classified as a California-hazardous waste due to STLC-lead concentrations.

Table 3.2-C. Highly Liquid Drilling mud (non-pit and non-lagoon areas)

Analyte	STLC 95% UCL (mg/L)	Soil Total Maximum (mg/kg)	Exceed California-Hazardous Waste (STLC) Limit (mg/L)[1]?
Arsenic	3.7	3.1	No (5)
Chromium	4.5	27	No (5)
Lead	10.8	22	Yes (5)

1. STLC limits are shown in parenthesis in mg/L for each respective contaminant in the rightmost column.

3.2.3.4 Drilling mud (Non-Pit and Non-Lagoon Areas)

Arsenic: The maximum concentration of arsenic detected in this waste (140 mg/kg) exceeds 10-times the STLC (50 mg/kg). However, the 95-percent UCL concentration for arsenic is 29.7 mg/kg. STLC and TCLP results for arsenic in this waste do not exceed the threshold for California-hazardous or RCRA-hazardous waste.

Barium: The maximum concentration of barium detected in this waste (2,300 mg/kg) exceeds 10-times the STLC (1,000 mg/kg) and 20-times the TCLP (2,000 mg/kg). However, the 95-percent UCL concentration for barium is 883 mg/kg. STLC and TCLP results for barium do not exceed the thresholds for California- or RCRA-hazardous wastes.

Chromium (total): The maximum concentration of total chromium in this waste is 56 mg/kg, which exceeds the 10-times STLC (50 mg/kg). However, the 95-percent UCL concentration of 29.8 mg/kg total chromium is below 10-times STLC level. STLC and TCLP analyses of total chromium in this waste do not exceed the thresholds for California- or RCRA-hazardous wastes.

Lead: The maximum concentration of lead detected in this waste (320 mg/kg) exceeds the 10-times the STLC (50 mg/kg) and 20-times the TCLP (100 mg/kg). The 95-percent UCL concentration for lead is 115 mg/kg. TCLP results for lead (**Table 3.2-14**) do not exceed the threshold for RCRA-hazardous wastes.

STLC results for lead of 8.5 mg/L (95-percent UCL concentration) in drilling mud exceed the 5 mg/L STLC-lead limit (**Table 3.2-13**). Therefore, impacted soils at the Site may potentially be classified as California-hazardous waste due to the elevated STLC-lead concentrations.

Mercury: The maximum TCLP-mercury result for the drilling mud waste is 0.22 mg/L, slightly exceeding the 0.20 mg/L limit. However, the average concentration of TCLP-mercury for this waste is 0.11 mg/L (less than the 20-times TCLP level). Additionally, the maximum mercury concentration in this waste is 0.32 mg/kg, which is less than the 10-times STLC (2 mg/kg) and 20-times TCLP (4 mg/kg) levels. STLC-mercury results for this waste are non-detect. Therefore, based on available TCLP- and STLC-mercury data, this waste would not be classified as a RCRA- or California-hazardous waste.

Table 3.2-D. Drilling mud (non-pit and non-lagoon areas)

Analyte	STLC 95% UCL (mg/L)	Soil Total 95% UCL (mg/kg)	Exceed California-Hazardous Waste (STLC) Limit (mg/L)[1]?
Arsenic	2.3	29.7	No (5)
Barium	22.3	883	No (100)
Chromium	2.3	29.8	No (5)
Lead	8.5	115	Yes (5)
Mercury	Not detected	0.15	No (NE)[2]

1. STLC limits are shown in parenthesis in mg/L for each respective contaminant in the rightmost column.
2. NE- Not Established

3.2.3.5 Impacted Soil, Composite Soil, and Unspecified Soil Samples

Arsenic: The maximum concentration of arsenic detected in this waste (78 mg/kg) exceeds 10-times the STLC (50 mg/kg). However, the 95-percent UCL concentration for arsenic is 16 mg/kg. STLC results for arsenic do not exceed the threshold for California-hazardous waste.

Barium: The maximum concentration of barium detected in this waste (3,100 mg/kg) exceeds 10-times the STLC (1,000 mg/kg) and 20-times the TCLP (2,000 mg/kg). However, the 95-percent UCL concentration for barium is 829 mg/kg. STLC and TCLP results for barium do not exceed the thresholds for California- or RCRA-hazardous wastes.

Cadmium: The maximum concentration of cadmium detected in this waste (12 mg/kg) exceeds 10-times the STLC (10 mg/kg). However, the 95-percent UCL concentration for barium is 1.0 mg/kg. STLC results for cadmium do not exceed the thresholds for California-hazardous wastes.

Chromium (total): The maximum concentration of total chromium detected in this waste (180 mg/kg), exceeds both the 10-times STLC (50 mg/kg) and 20-times TCLP (100 mg/kg) levels. However, the 95-percent UCL concentration of 41.5 mg/kg total chromium is below both of these levels. STLC and TCLP analyses of total chromium in this waste do not exceed the thresholds for California- or RCRA-hazardous wastes.

Lead: The maximum concentration of lead detected in this waste (2,560 mg/kg) exceeded the TTLC of 1,000 mg/kg, the 10-times the STLC (50 mg/kg) and 20-times the TCLP (100 mg/kg). The 95-percent UCL concentration for lead is 219 mg/kg, which does not exceed the TTLC. TCLP results for lead do not exceed the threshold for RCRA-hazardous waste. STLC results for lead of 14.6 mg/L (95-percent UCL concentration) in soil composite samples exceed the 5 mg/L limit (**Table 3.2-13**). Therefore, impacted soils at the Site may potentially be classified as California-hazardous waste.

Mercury: The maximum concentration of mercury detected in this waste (37 mg/kg) exceeds the TTLC of 20 mg/kg, the 10-times the STLC (2 mg/kg) and 20-times the TCLP (4 mg/kg). The 95-percent UCL concentration for mercury is 2.30 mg/kg, which does not exceed either the TTLC or 20-times TCLP, but does exceed 10-times the mercury STLC. TCLP results for mercury (**Table 3.2-14**) were non-detect; however, STLC analyses for mercury were not performed for this waste. Impacted soils at the Site may therefore potentially be classified as California-hazardous waste due to mercury, although the 95-percent UCL concentration of mercury may be considered non-representative due to a single analytical result of 37 mg/kg (a sample analyzed from boring AW-1). The next-highest result for mercury detected in impacted soils was only 1.9 mg/kg. Additional waste characterization sampling and analysis will be required during a removal action for this waste, including STLC-mercury analyses.

Selenium: The maximum concentration of selenium detected in this waste (28 mg/kg) exceeds 10-times the STLC (10 mg/kg) and 20-times the TCLP level (20 mg/kg). However, the 95-percent UCL concentration for selenium is 2.79 mg/kg, which is below both the 10-times STLC and 20-times TCLP level concentrations. STLC analysis for selenium was not performed for this waste, and TCLP results for selenium do not exceed the threshold for RCRA-hazardous wastes.

Table 3.2-E. Impacted Soils, Composite Soils, and Unspecified Soils Samples

Analyte	STLC 95% UCL (mg/L)	Soil Total 95% UCL (mg/kg)	Exceed California-Hazardous Waste (STLC) Limit (mg/L)[4]?
Arsenic	1.4[1]	16	No (5)
Barium	24.9	829	No (100)
Cadmium	0.15[2]	1.0	No (1)
Chromium	3.0	41.5	No (5)
Lead	12.5	219	Yes (5)
Mercury	NA[3]	2.3	Potentially[5] (0.2)
Selenium	NA	2.79	No (1)

1. Average value only; insufficient data for determination of 95% UCL concentration
2. Single analytical result
3. NA – Not Analyzed
4. STLC limits are shown in parenthesis in mg/L for each respective contaminant in the rightmost column.
5. Potential – Soil total concentration exceeds 10-times STLC limit. No STLC data are available for this waste; therefore, no conclusive waste classification determination is presented.

3.2.3.6 Pits A, B, C, D, E, G, and H

Chromium (total): The maximum concentration of total chromium from this waste is 600 mg/kg, which exceeds both the 10-times STLC (50 mg/kg) and 20-times TCLP (100 mg/kg) levels. The 95-percent UCL concentration of 57.6 mg/kg total chromium is below the 20-times TCLP level and exceeds the 10-times STLC for total chromium. STLC and TCLP analyses were not performed on soils from this waste. Therefore, based on 95% UCL concentration for total chromium, this waste is potentially California-hazardous due to chromium.

Copper: The maximum concentration of copper detected in this waste is 1,300 mg/kg, which exceeds the 10-times STLC (250 mg/kg). The 95-percent UCL concentration is 109 mg/kg (below the 10-times STLC level); therefore, this waste is not likely to be classified as a California-hazardous waste due to copper concentrations. STLC-copper analyses were not performed for this waste, and no TCLP limit for copper exists.

Lead: The maximum concentration of lead detected in this waste (640 mg/kg) exceeds the 10-times the STLC (50 mg/kg) and 20-times the TCLP (100 mg/kg). The 95-percent UCL concentration for lead is 53.8 mg/kg, which exceeds the 10-times STLC limit, but is less than the 20-times TCLP limit. Therefore, this waste is potentially a California-hazardous waste. STLC and TCLP analyses were not performed on soils from this waste, and specific determination of waste classification for these wastes will require additional sampling and analysis during a removal action.

Selenium: The maximum concentration of selenium detected in this waste is 75 mg/kg, which exceeds both the 10-times STLC (10 mg/kg) and 20-times TCLP (20 mg/kg) levels. However, the 95-percent UCL concentration of selenium in this waste is 4.74 mg/kg, below both the 10-times STLC and 20-times TCLP levels. No samples from this waste were analyzed for STLC-selenium or TCLP-selenium.

Table 3.2-F. Pits A, B, C, D, E, G, and H

Analyte	STLC 95% UCL (mg/L)	Soil Total 95% UCL (mg/kg)	Exceed California-Hazardous Waste (STLC) Limit (mg/L)[2]?
Chromium	NA[1]	57.6	Potential[3] (5)
Copper	NA	109	No (25)
Lead	NA	53.8	Potential (5)
Selenium	NA	4.74	No (1)

1. NA – Not Analyzed
2. STLC limits are shown in parenthesis in mg/L for each respective contaminant in the rightmost column.
3. Potential – Soil total concentration exceeds 10-times STLC limit. No STLC data are available for this waste; therefore, no conclusive waste classification determination is presented.

3.2.3.7 Pit F

Beryllium: The maximum concentration of beryllium detected in the Pit F area is 99 mg/kg, which exceeds the 10-times STLC level of 7.5 mg/kg. The 95-percent UCL concentration of beryllium in this waste is 9.61 mg/kg, which is also in excess of the 10-times STLC level. Analysis of STLC-beryllium in this waste is non-detect (**Table 3.2-13**).

Lead: The maximum concentration of lead detected in this waste is 94 mg/kg, which exceeds the 10-times STLC level (50 mg/kg), but is below the 20-times TCLP level (100 mg/kg). The 95-percent UCL concentration for lead is 13.1 mg/kg. STLC-lead is non-detect in this waste.

Thallium: The maximum concentration of thallium detected in this waste (100 mg/kg) exceeds 10-times the STLC (70 mg/kg). The 95-percent UCL concentration for thallium is 9.64 mg/kg. STLC-thallium is non-detect in this waste.

Heptachlor Epoxide: The maximum concentration of heptachlor epoxide in the Pit F area is 0.67 mg/kg, which is above the 20-times TCLP level of 0.2 mg/kg. The 95-percent UCL concentration of heptachlor epoxide in this waste is 0.096 mg/kg [less than the 20-times TCLP level (0.16 mg/kg), and 10-times the STLC limit (4.7 mg/kg)]. No STLC or TCLP analyses were performed for this compound.

Benzene: The maximum concentration of benzene in the Pit F area is 24 mg/kg, which is above the 20-times TCLP level (10 mg/kg). The 95-percent UCL concentration of benzene is 2.98 mg/kg (less than the 20-times TCLP level). No TCLP analyses were performed for this waste. However, based on the 95% UCL concentration, this waste does not appear to be RCRA-hazardous waste based on benzene concentrations. No STLC levels have been established for benzene.

Table 3.2-G. Pit F			
Analyte	**STLC (mg/L)**	**Soil Total 95% UCL (mg/kg)**	**Exceed California-Hazardous Waste (STLC) Limit (mg/L)[3]?**
Beryllium	ND[1]	9.61	No (0.75)
Lead	ND	13.1	No (5)
Thallium	ND	9.64	No (7)
Heptachlor Epoxide	NA[2]	0.096	No (0.47)
Benzene	NA	2.98	NE[4]

1. ND – Not Detected
2. NA – Not Analyzed
3. STLC limits are shown in parenthesis in mg/L for each respective contaminant in the right-most column.
4. NE- Not Established

Ignitability: Results from ignitability analyses performed during Pilot Study No. 3 (**Table 3.2-15**) indicate that waste materials within Pit F may be considered RCRA-hazardous due to ignitability (flash point at temperatures less than 140°F).

3.2.3.8 Minimally-Impacted Fill Materials

Chromium (total): The maximum concentration of total chromium from this waste is 120 mg/kg, exceeding both the 10-times STLC (50 mg/kg) and 20-times TCLP (100 mg/kg) levels. The 95-percent UCL concentration of 40.9 mg/kg total chromium is below both of these criteria. TCLP analysis for total chromium in fill soils is non-detect.

Lead: The maximum concentration of lead detected in this waste (1,800 mg/kg) exceeds the TTLC of 1,000 mg/kg, the 10-times the STLC (50 mg/kg) and 20-times the TCLP (100 mg/kg). The 95-percent UCL concentration for lead is 292 mg/kg, which does not exceed the TTLC. TCLP analysis for lead in fill soils (**Table 3.2-14**) is non-detect. STLC-lead analysis was not performed for this waste, except during the Emergency Action conducted in 2005. The maximum detection of 1,800 mg/kg lead was in sample DOHS-767, which was collected near the intersection of Magnolia Street and Hamilton Avenue, adjacent to, but outside of the Site boundary and, therefore, may not be representative of Site soils in that area or fill materials at the Site in general. Data from the Emergency Action in 2005 resulted in several California-hazardous concentrations from material in this waste: a maximum of 2,100 mg/kg TTLC and a maximum of 110 mg/L STLC. Therefore, this waste may be considered California-hazardous due to lead. Further testing would be required during implementation of the remedial alternative to verify classification of this waste.

3.2.3.9 Native Soils

Lead: The maximum concentration of lead detected in this waste is 180 mg/kg, which exceeds the 10-times STLC (50 mg/kg) and the 20-times TCLP (100 mg/kg). The 95-percent UCL concentration for lead is 26.8 mg/kg, below both the 10-times STLC and 20-times TCLP levels. TCLP-lead is non-detect in this waste. No samples were analyzed for STLC-lead from native soils. It may be anticipated that native soils in direct contact with impacted soils, drilling mud, or other contaminated wastes from the Site, may be locally impacted with contaminants similar to those encountered in the adjacent wastes.

3.2.3.10 Summary of Potential Waste Characteristics

Analyses of the chemical contaminant characteristics of the potential waste types from the Site result in the following conclusions.

- A significant volume of wastes present at the Site, including the tarry liquids in Lagoons 1, 2, and 3, the non-pit/non-lagoon highly liquid drilling mud, the higher strength/lower moisture drilling mud, and impacted soils, may potentially be considered California-hazardous waste, primarily due to STLC-lead concentrations in excess of 5 mg/L.

- Material in Lagoons 4 and 5 evidenced a RCRA-hazardous waste characteristic due to TCLP-lead reported in a single sample from Lagoon 4. However, additional testing of this waste during a removal action may demonstrate that the single sample result was anomalous. Results from the 2005 Emergency Action demonstrated that this waste could be classified as California-hazardous.

- Material from the vicinity of Pits A, B, C, D, E, G, and H may potentially be considered RCRA-hazardous wastes due to the materials reportedly disposed in these areas; however, data collected to date is insufficient to characterize these materials as potentially RCRA- or California-hazardous. Material disposed in these pits was reportedly, based on descriptions of wastes, potentially classified as hazardous, but chemical data collected during Phase V of Pilot Study No. 3 does not support this classification.

- Similarly, impacted material in the vicinity of Pit F has not been definitively identified as RCRA- or California-hazardous based on the chemical constituents. However, liquid materials within the upper portion of Pit F have been determined to have ignitable characteristics, and therefore are potentially RCRA-hazardous waste.

- Fill materials, consisting primarily of soils and concrete construction debris, are non-hazardous, based on chemical characteristics prior to the Emergency Action conducted in 2005. Data from the 2005 Emergency Action show that this waste (fill materials) will likely be classified as California-hazardous due to Lead.

- Native soils, while locally impacted when in direct contact with overlying wastes (primarily in the vicinity of the Pits), are non-hazardous, based on chemical characteristics.

Leachable (TCLP and/or STLC) lead is the primary contaminant exhibiting characteristics of California-hazardous (or, for Lagoon 4, potentially RCRA-hazardous) waste with respect to the 95-percent UCL concentrations of contaminants in the potential wastes described above. Analytical results for STLC-lead and TCLP-lead (not including data from the 2005 Emergency Action) are presented by potential waste on the following figures:

- **Figure 3.2-16** (Lagoons 1, 2, and 3);
- **Figure 3.2-17** (Lagoons 4 and 5);
- **Figure 3.2-18** (Highly-Liquid Drilling mud, non-pit/non-lagoon);
- **Figure 3.2-19** (Drilling mud); and
- **Figure 3.2-20** (Impacted Soils).

3.3 Impacted Liquid Materials

This section summarizes the chemical characteristics of the impacted liquids at or near the Site. These liquids include:

- Surface Water (ponded within the Lagoons)

- Huntington Beach Flood Control Channel Water
- Seeps
- Groundwater
- Non-Aqueous Phase Liquids (NAPL).

Information presented below regarding the surface water and seeps is from the initial FS (Environ, 2000). Information regarding the channel water, groundwater, and NAPL is from the 2005 Groundwater RI (Geosyntec, 2005b, 2007b).

3.3.1 Surface Water Sampling

Surface water samples were collected from Lagoons 1, 4, and 5 in 1997 and from all Lagoons in 2005. For the 1997 sampling, the maximum detections of the six analytes found in elevated concentrations include benzene (500 ug/l), methylene chloride (99 ug/l), antimony (500 ug/l), arsenic (370 ug/l), lead (69 ug/l), and thallium (500 ug/L). Summary statistics for 1997 data from the lagoon surface water are found in **Table 3-19** of **Appendix A**.

Samples of surface water from the Lagoons were collected and analyzed in February 2005 following weeks of high precipitation that resulted in emergency surface water removal from the Site. The results of these analyses are reported in the “March 2005 Surface Water Management Activities Letter Report” (Project Navigator, Ltd., 2005b) and subsequent addendum (Project Navigator, Ltd., 2005c). The chemicals of potential concern in the surface water samples collected in 2005 and their maximum detected concentration were: Oil and Grease (15 mg/l), Total Organic Halides (0.110 mg/l), and arsenic (200 ug/l).

Samples of ponded water collected offsite during the 2004-2005 rainy season from the Site’s northern perimeter along Hamilton Avenue and the Site’s southeastern corner is discussed below in Section 3.3.3. Samples of surface water ponded north of the Site’s perimeter along Hamilton Avenue and the Site’s southeastern area were also collected on September 20, 2005. The results of these analyses were given to DTSC in September of 2005[9]. The results showed that these samples were similar to typical urban runoff, with low detections of phenol and acetone just over the detection limits.

3.3.2 Huntington Beach Flood Control Channel

In the Groundwater RI (Geosyntec, 2005b) it was concluded that the Huntington Beach Flood Control Channel that runs adjacent to the southwest corner of the Site behaves as a “losing stream” in that it contributes water to groundwater beneath the Site. This was concluded after analysis of a tidal study (Geosyntec, 2003b) and groundwater flow directions at the Site. Because water from the flood control channel is contributing to groundwater under the Site, the channel was sampled during the fourth quarter of 2004 and tested for general minerals and metals.

Comparison of salt and metal concentration in channel water to those in seawater (**Table 3.3-1**) show elevated levels of selenium (89 mg/l compared to 0.21 mg/l in seawater), barium (19 mg/l compared to 2.1 ug/l in seawater), and copper (9 mg/l compared to 0.52 ug/l in seawater). The Groundwater RI concluded that the selenium in the channel water is a likely source of elevated selenium concentration in groundwater at the Site (see Section 3.3.4). Selenium and TDS concentration are generally highest in groundwater in the western portion of the Site near the channel, providing additional evidence that the channel is contributing to groundwater beneath the Site.

[9] Hard copy of laboratory reports were given to Greg Holmes at a meeting conducted at the Site on September 20, 2005.

3.3.3 Seeps

Historical Site operations have caused the Site to be topographically higher than the surrounding area. Because water accumulates in the lagoons during periods of heavy rainfall, there have been occasions during past rainy seasons when water has been reported to have discharged from the Site as seeps.

Details regarding the investigations completed for seeps prior to 1997 are presented in the RI report (ESE, 1997b). Summary statistics for the analytical data for water samples from the seeps are presented in **Table 3-26** of **Appendix A**. The areas, sample locations, analytes, results, and depths are listed in **Table 3-27** of **Appendix A**.

Runoff and/or seepage from the perimeter berm contained four metals. The DTSC stated in its February 1995 memorandum that seepage water was a concern to the public because it came from a disposal site (DTSC, 1995). At that time, the DTSC recommended that any seepage be controlled by construction of a sand bag berm.

The 1997/1998 winter rainy season was characterized by unusually frequent and occasionally very heavy rainfall. In March 1998, water seepage began at the Hamilton Avenue gate and along the northern berm, and water accumulated in the street. Water samples were collected on April 3, 1998, and analyzed for TRPH, pesticides, PCBs, VOCs, SVOCs, California Title 22 metals, pH, chlorides, and organic lead. The results of the analyses were presented in the RI. By early May 1998, the seepage had ceased.

Ponded water has been observed more recently following very high total rainfall in 2004-2005, particularly during January and February of 2005. Ponded water just offsite from the Site's northern perimeter along Hamilton Avenue and the Site's southeastern corner was sampled and analyzed (samples were collected on January 21, February 11, and February 24, 2005). The results of these analyses were reported through email communication to DTSC in February and March of 2005[10]. The results showed that these samples were similar to typical urban runoff.

3.3.4 Groundwater

A Groundwater Remedial Investigation (Groundwater RI) was conducted at the Site by Geosyntec and reported in 2005 (Geosyntec, 2005b), with Revision 1 in 2007 (Geosyntec, 2007b). Information used to assess the Site groundwater conditions was collected during past investigations, beginning in the 1980s, and continuing to 2006 as part of the Groundwater RI. Data used in the risk analysis were limited to those collected during the 2002 sampling events (GARFR, Project Navigator, Ltd., 2003) and the 2004 and 2006 sampling events (Geosyntec 2004b, 2004c, 2004d, 2005a, 2007a), which were considered most representative of present Site conditions and that used reliable quality control measures. The groundwater investigation included the gauging of groundwater levels and NAPL, a groundwater/surface water interaction study (tidal study), installation of five new monitoring wells, completion of five quarterly groundwater sampling events, and a NAPL sampling event. The results of the recent groundwater sampling conducted at the Site (2002 through 2006) indicate the following:

- Groundwater beneath the Site has been degraded as the result of seawater intrusion. This is evidenced by both high salinity and by the hydrogeologic conditions present at the Site (see Section 2.11.2). The shallow groundwater contains very high TDS concentrations consisting mainly of dissolved sodium and chloride. TDS concentrations were measured up to 26,000 milligrams per liter (mg/l), which is approximately 80% of typical concentrations in seawater. State Maximum Contaminant Levels (MCLs) for drinking water for chloride, sulfate, and TDS are significantly exceeded across the Site. **Table 3.3-2** contains results of general mineral analyses of selected wells at the Site.

[10] Emails from Tamara Zeier to Christine Chiu, dated February 7, 2005, and March 18, 2005.

- The lateral and vertical extent of dissolved phase contaminants (mostly fuel hydrocarbon contamination) is limited in the shallow groundwater. VOCs were generally detected at low levels (i.e., below 10 ug/l) in onsite wells. The detection of VOC concentrations above 10 ug/l was localized and occurred in three onsite wells AW-5, B-4A/B-4, and B-7. VOCs detected at higher concentrations included 1,2,4-trimethylbenzene, benzene, ethylbenzene, sec-butylbenzene, isopropylbenzene, naphthalene, m,p-xylene, and o-xylene. VOCs have not been detected in any offsite wells (MW-16 through MW-19), with the exception of chloromethane, which was detected at a low concentration (2.5 ug/l) in MW-19, located southeast of the Site. VOCs were not detected in monitoring well MW-20, which is completed in the lower portion of the SPA. VOC detections in groundwater from 2002 through 2006 samplings are listed in **Tables 3.3-3** and shown in **Figure 3.3-1**.

- Comparison of California MCLs with VOC concentrations detected in the shallow groundwater beneath the Site indicates that two VOCs were detected above California MCLs: benzene and 1,4-dichlorobenzene (**Table 3.3-3**). Benzene was detected above the MCL in well MW-9 during the third quarter of 2004 and in monitoring well B-4/B-4A during all six sampling events conducted from 2002 to 2006. The compound 1,4-dichlorobenzene was detected slightly above the MCL during one sampling event in monitoring well NMW-1.

- SVOCs were detected in two onsite monitoring wells: B-4A/B-4 and B-7. The SVOCs 2,4-dimethylphenol and 2-methylphenol were detected in B-4A/B-4 at concentrations up to 1500 ug/l and 2100 ug/l, respectively. Benzoic acid was detected once in B-7 at a concentration of 20 ug/l during the second quarter 2004 sampling event. SVOC detections in groundwater from 2002 through 2006 samplings are listed in **Tables 3.3-4** and shown in **Figure 3.3-1**.

- Generally, with the exception of barium and selenium, dissolved metal concentrations in the shallow groundwater were not significantly elevated. Barium concentrations were detected at elevated levels in the deep monitoring well MW-20 (concentrations ranged between 1,700 ug/l to 2,000 ug/l during the four quarters of 2004, which is above the 1,000 ug/l MCL for barium). Elevated barium concentrations were not detected in any other well located on the Site. The high barium concentration in MW-20 is likely to be unrelated to Site wastes and is likely representative of deeper groundwater quality, given the lower concentrations present in the shallower monitoring locations. Elevated selenium concentrations (up to 140 ug/l) were detected across the Site and are above the selenium MCL of 50 ug/l in 17 of 23 of the wells sampled during at least one of the sampling rounds. The highest selenium concentrations were detected in the western portion of the Site. The most likely explanation is that the source of the selenium in groundwater is seawater recharge from the Huntington Beach Flood Control Channel (see Section 3.3.2).

- Antimony and arsenic have also been detected slightly above their respective MCLs in a few Site monitoring wells. The detection of concentrations above the MCLs in these wells are inconsistent (i.e., not reproducible) and appear to be relatively localized. Antimony was detected a concentrations (11 ug/L or 12 ug/L) slightly above the MCL in three monitoring wells (AW-2, B-4, and MW-4) in the June 2002 monitoring event. Antimony was not detected above the MCL in these wells or any other well in the subsequent five monitoring events completed at the Site. Arsenic was detected above the MCL in three monitoring well locations. Arsenic was detected at a concentration of 16 ug/l and 11 ug/L in B-4A in June 2004 and December 2006, respectively, at a concentration of 26 ug/L in GP-24 in June 2004, and at a concentration of 11 ug/L in MW-13 in December 2004. These detections are not considered to be related to Site wastes. Detections of metals are listed in **Table 3.3-5**.

- The emergent chemical compounds 1,4-dioxane, N-nitrosodimethylamine (NDMA), perchlorate, and chromium VI were analyzed for in selected samples as summarized in **Table 3.3-6**. Results indicate 1,4-dioxane was detected in five wells (AW-4A, B-4A, B-7, GP-1, and MW-13) located on the Site at relatively low concentrations (0.61 ug/l to 3.5 ug/l). NDMA was detected at a very low concentration (0.0021 ug/l) in a sample collected from MW-17 in the first quarter of 2004 but was neither detected at any other location nor was it detected in MW-17 in the second quarter of 2004. Chromium VI and perchlorate were not detected in any groundwater samples collected at the Site. Emergent compound results are shown in **Figure 3.3-1**.

- Total Petroleum Hydrocarbon (TPH by EPA Method 8015M) was detected in only one of sixteen wells tested for TPH during the 2002 sampling event. TPH was detected in B-6 at a relatively low concentration: 0.65 mg/l. These results are found in **Table 3.3-7**.

The results of the groundwater sampling, as summarized above, indicate that the lateral and vertical extent of dissolved phase contaminants in groundwater is limited. The detection of relatively elevated VOC concentrations on the Site is limited to three monitoring wells: AW-5, B-4A/B-4, and B-7. SVOCs have been detected in two wells on the Site: B-4A and B-7. In addition, no significant concentrations of VOCs were detected in offsite wells. The limited extent of the groundwater contamination together with the fact that wastes have been present on the Site for a long period of time (up to 65 years) indicates that waste is effectively isolated from groundwater and that contaminant transport is being significantly impeded.

The relatively small amount of dissolved phase contamination is likely attributable to a combination of factors including: (1) the aquitard-like influence of the clay/silt layer that extends across the Site; (2) the confined or semi-confined nature of the groundwater occurring beneath the Site; and (3) the likely occurrence of some contaminant attenuation in the groundwater. The limited vertical extent of dissolved phase contamination, as indicated by the lack of contamination in MW-20, is likely the result of the upward vertical gradient in the Semiperched Aquifer beneath the Site.

Summaries of groundwater results from historical sampling (prior to 2002) are presented in Appendix L. These data were not used in the risk characterization for groundwater at the Site because of insufficient or undocumented quality assurance and quality control measures during sampling and analysis. Also, the historical data are not representative of present groundwater conditions.

3.3.5 Non-Aqueous Phase Liquids (NAPL)

NAPL was monitored for depth and thickness of occurrence and sampled during the December 2004 groundwater sampling event by Geosyntec. Results are documented in the Fourth Quarter 2004 Groundwater Monitoring Report (Geosyntec, 2005a) and the Groundwater RI (Geosyntec, 2005b, 2007b). Following is a summary of findings regarding NAPL at the Site:

- NAPL occurs throughout the Site in monitoring wells completed in both the perched zone and the SPA. Measurable NAPL was detected in 18 of 59 locations at the Site, including six perched wells, during the December 2004 groundwater sampling event. Trace amounts of NAPL were observed in an additional four locations (**Figure 3.3-2**).

- Analyses of four NAPL samples from piezometers P-1, P-5, P-6, and P-8 indicate that the overall composition of the NAPL is comprised of several hydrocarbon fractions including gasoline-range hydrocarbons, diesel, crude oil, and a kerosene-like fraction. Hydrocarbon ranges with their corresponding weight percentages for each sample are listed in **Table 3.3-8**. Physical analyses of the NAPL indicate that the product mixture is relatively viscous and immobile, consistent with field observations. Viscosity at three temperatures is reported in **Table 3.3-9**, and interfacial and surface tension against air and tap water are reported in **Table 3.3-10**. Metal and VOC concentrations are found in **Table 3.3-11** and **Table 3.3-12**, respectively. **Table 3.3-11** also lists pH results of the NAPL samples. NAPL laboratory reports are found in Appendix I of the Groundwater RI (Geosyntec 2005b, 2007b).

- Although NAPL was detected or observed in 16 wells considered completed in the SPA, analysis of boring logs indicates that NAPL in the Site subsurface generally occurs above or in the top portions of the fine-grained clay/silt layer, and not in the Semiperched Aquifer. Exceptions are the Pit F area, the area in the middle portion of the Site directly east of Lagoon 1 and Lagoon 2 (well P-6) where the clay/silt layer may be thinned, and in the area of well P-9 where the clay/silt layer may be thinned. The occurrence of NAPL in many of the monitoring wells completed in the SPA is likely to be the artifact of well construction, and that NAPL has migrated through the well annulus and then to the groundwater surface in the Site monitoring wells. NAPL in one well, B-2, a well destroyed during the Emergency Action, was likely to be present due to seepage into the casing during well construction.

- The lateral and vertical extent of NAPL is limited to the Site area. The lack of NAPL in offsite wells is likely attributable to a combination of factors including the presence of the fine-grained clay/silt layer discussed previously, very shallow groundwater gradients, and NAPL's relatively low mobility.

3.3.6 Soil Gas Influence

It is undetermined whether soil gas concentrations are contributing to soil or to groundwater contamination. A post-remediation soil vapor investigation will be conducted to determine if any remaining chemicals or waste constituents are contributing to Site contamination. The soil vapor investigation subsequent to the removal of contaminated soil and waste will start at 10 feet bgs. Wherever the depth to groundwater is within the 10 feet bgs level, the collected groundwater data will be used to estimate the contribution. Data collected shall be screened against the soil gas California Human Health Screening Levels (CHHSLs) as developed by the California Environmental Protection Agency (Cal/EPA) Office of Environmental Health Hazard Assessment (OEHHA).

3.4 Impacted Air

This section includes summaries of evaluations and findings regarding:

- Previous Air and Vapor Investigations
- 2006 Soil Vapor Investigation and Surface Emissions Survey
- Perimeter Air Monitoring Data
- Perimeter Air Monitoring During Pilot Study No. 3
- Relevant Background Air Data.

The following sections describe the findings of previous investigations as well as the results from air monitoring during Pilot Study No. 3. Downhole flux testing and emission control agent testing performed during Pilot Study No. 3 are documented in Appendix F. Dispersion modeling of the emissions results is also presented in Appendix F.

3.4.1 Previous Air and Vapor Investigations

Soil vapor and air investigations were performed in 1988 and 1997. The reported purpose of these investigations was to determine if detectable volatile components were impacting offsite receptors or might impact onsite workers during Site remediation. Details regarding the investigations for soil vapor and air were presented in the 1997 RI report (ESE, 1997b) and were briefly summarized in the initial FS. The soil gas data were included in **Tables 3-28** and **3-29** of the initial FS (Appendix A). The investigators concluded that methane and TPH were the only detectable VOCs migrating offsite (Environ, 2000).

3.4.2 2006 Supplemental Soil Vapor Investigation and Surface Emissions Survey

A soil vapor survey was conducted on July 2006 to address the data gaps identified in the Soil Vapor Technical Memorandum (Project Navigator, Ltd./Geosyntec, 2006a) and documented in the Supplemental Soil Vapor Investigation Report (Geosyntec, 2006c). The specific objectives were (1) to assess the presence and concentrations of chemicals of concern in soil vapor along the northwestern perimeter of the Site and evaluate potential vapor intrusion into nearby commercial structures and (2) to assess surface emissions across the Site and evaluate these emissions with respect to background emissions from non-impacted, off-site soils.

The soil vapor samples were collected at seven locations (SGP-01 through SGP-07) along the northwest border of the Site. Soil vapor collection points were installed at a depth of 5 feet bgs at each boring location, and an additional point was installed at 10 feet bgs at SGP-03.

The concentrations of the compounds detected in the soil vapor samples were compared to risk-based screening levels (RBSLs) for the vapor intrusion pathway. The RBSLs were calculated using the DTSC version of the Johnson and Ettinger model (2005) assuming default commercial exposure assumptions and a target risk of 10^{-5} and a target hazard quotient of 1. The detected concentrations did not exceed the RBSLs calculated for commercial exposures.

The surface emissions survey was conducted to assess VOC emissions from the Site and in general accordance with SCAQMD Rule 1150.1 Attachment A, Instantaneous Landfill Surface Monitoring. During the surface emissions survey, the Site was walked using a 25-ft grid pattern, and FID measurements were recorded. Upgradient and background concentrations ranged from 1.2 ppm to 1.6 ppm, and the highest Site surface concentration was 2.5 ppm. **Figure 3.4-1** presents a map of the survey data.

3.4.3 Perimeter Air Monitoring

Ambient air quality at the Site was evaluated through multiple rounds of perimeter air sampling conducted between August 2002 and December 2003 during periods of Site inactivity. In addition, perimeter air monitoring consisting of real time measurements and sample collection was conducted during field activities performed for Pilot Study No. 3 investigations and the 2005 Emergency Action. A summary of these perimeter air sampling and monitoring activities is provided in the following sections.

3.4.3.1 Perimeter Air Monitoring Prior to Pilot Study No. 3

Ambient air quality at the perimeter of the Site was evaluated prior to conducting Pilot Study No. 3 field investigation activities through the collection of composite ambient air samples. Several ambient air sampling events were conducted between August 2002 and December 2003. For each event, SUMMA canister samples collected from perimeter locations around the Site were analyzed for VOCs by EPA method TO-15. Wind speed and direction data were also collected with an onsite meteorological station.

The August 2002 sampling event included the collection of both short-term (2-hour) and long-term (24-hour) ambient air samples over a two-day period. Laboratory results of the August 2002 short-term samples indicated that the Site is not a significant contributor to concentrations of VOCs in ambient air. August 2002 results of longer-term sampling indicated that detected concentrations were generally not appreciably above background in comparison to regional data with the exception of methylene chloride and benzene detected in one sample during one of the two 24-hour sampling events. Concentrations of these two chemicals were inconsistent with concentrations from other onsite samples. In addition, concentrations of detected chemicals at the Site were below the Agency for Toxic Substances Disease Registry (ATSDR) minimum risk levels (MRLs) and State of California reference exposure levels (RELs), as available. Details regarding the August 2002 perimeter air sampling event can be found in the "Ambient Air Quality Evaluation Report" [Geosyntec, 2002b].

Additional perimeter air sampling was performed in May, August, and December 2003. For each of these sampling events, six consecutive 8-hour composite samples were collected from perimeter locations around the Site. Details regarding the methods and materials are included in each event-specific report [Geosyntec, 2003a, 2003c, and 2004a]. **Table 4-2** of Appendix M presents a statistical summary of the May, August, and December 2003 laboratory data. **Table 4-3** of Appendix M presents a data comparison to regional background data obtained from the California Air Resources Board (CARB) North Long Beach air toxics monitoring station and a statewide summary from all CARB monitoring stations. As shown in **Table 4-3** of Appendix M, average concentrations of detected analytes are similar to the average concentrations detected in 2002 at the California Air Resources Board North Long Beach air toxics monitoring station and the statewide summary. **Table 4-4** of Appendix M presents a historic summary of the detected chemicals and concentration ranges for all four rounds of perimeter air monitoring conducted at the Site prior to Pilot Study No. 3 activities.

Based on these 2002 and 2003 data, it appears that the Site, in its undisturbed state, is not causing adverse air quality impacts over and above local or regional background levels.

Additional conclusions include the following:

- Sampling location AA-07, near the southwest corner of the Site (see **Figure 3-1** of **Appendix M**), can be generally established as a background or upwind location for the Site. Although the wind directions were more variable during the December 2003 round of sampling, location AA-07 can be generally considered as a background or upwind location during the majority of daytime hours.

- The concentrations of detected analytes from the background or upwind location were either very similar to or less than the remaining sampling locations around the perimeter of the Site.

- The average concentrations of detected analytes from the Site are similar to those detected in 2002 at the California Air Resources Board North Long Beach air toxics monitoring station.

- Other potential local sources of chemicals detected in ambient air at the Site include the adjacent power plant, the nearby waste water treatment plant, various adjacent industrial operations, and automobile emissions from traffic on Magnolia Street and Hamilton Avenue.

3.4.3.2 Perimeter Monitoring During Pilot Study No. 3

An ambient air monitoring program was implemented as part of Pilot Study No. 3 field activities. The primary objective of this ambient air monitoring program was to monitor for potential offsite impacts during field testing activities to better understand potential impacts during implementation of the preferred remedial alternative at the Site, as well as to ensure protectiveness to the community and the onsite workers. To accomplish this objective, perimeter air quality data were collected using both real time instrumentation and through the collection of 8-hour composite SUMMA canister samples. Ambient air samples were collected in general accordance with the procedures used for the perimeter air sampling program previously performed in 2002 and 2003 [Geosyntec, 2002b, 2003a,c]. Wind speed and direction data were also collected with the onsite meteorological station.

3.4.3.2.1 Real Time Monitoring

Real-time perimeter air monitoring was performed during Phases I, II, III, IV, V & VI, and Phase VIII of the Pilot Study No. 3 field investigation program at six perimeter locations shown on **Figure 3.1-1**. Perimeter air monitoring location AA-04 was relocated and renamed AA-04A for sampling events performed during Phase VIII, the Pit F investigation. Real-time perimeter air monitoring included measurements for VOCs using a PID, dust using a Dust Track monitor, and odors using worker perception according to the SCAQMD odor classification scale. Real-time perimeter air monitoring was conducted at each location using a "walk-around procedure" approximately every hour throughout each workday. The real-time perimeter air monitoring results are tabulated in **Table D-6** of **Appendix D**.

For real-time air monitoring activities, specific action levels above background conditions were established for each monitored parameter. No significant VOC or dust readings above background were measured at perimeter air monitoring locations during the Pilot Study No. 3 field activities. Elevated detections of VOCs were measured on June 30 at AA-3, but the SUMMA canister used for this sample may have been contaminated (see discussion in **Table 3.4-1**). On two occasions on May 25, 2004, odor levels above background (SCAQMD Level I) were noted at a northern Site perimeter air monitoring location that was downwind of the lagoons being disturbed as part of Phase IV Pilot Study No. 3 activities.

3.4.3.2.2 Time-Averaged Sampling

Perimeter air monitoring during Phase III, Phase IV, and Phase VIII included the collection of 8-hour integrated SUMMA canister air samples. Chemical speciation of perimeter air during these phases was assessed because field activities during these Phases were more representative of anticipated remedial activities. Phase III consisted of gross disturbance of impacted soils during trenching, and Phases IV and VIII consisted of intrusion into the lagoons and Pit F, all of which are features at the Site with potential emissions concerns. One 8-hour sample was collected from each of the six perimeter air monitoring locations during working hours of each day. Perimeter air monitoring locations are shown on **Figure 3.1-1**. Sample names and dates are identified in **Table D-5** of Appendix D. Note the use of monitoring location AA-04A for Phase VIII activities near Pit F.

3.4.3.3 Emergency Action Perimeter Air Monitoring

Perimeter air monitoring was conducted as part of the 2005 through 2006 Emergency Action work. The Emergency Action perimeter air monitoring program included the collection of both real time perimeter air quality measurements and time integrated perimeter air samples for laboratory testing at seven locations along the property perimeter. Refer to Figure 3.1-1 of Emergency Action Completion Report (Project Navigator, Ltd., 2006a) for locations of perimeter air sampling.

Similar to Pilot Study No. 3, real-time air monitoring activities for the Emergency Action work included measurements for VOCs using a PID, dust (or particulate matter) using a Dust Track monitor, and odors using worker perception according to the SCAQMD odor classification scale. Real-time perimeter air monitoring was conducted at each location using a "walk-around procedure" approximately every hour throughout each workday. Action levels for real-time air measurements were established and measurements were used to guide application of vapor suppressants, dust controls, or modification of Emergency Action work practices, as needed to control concentrations of VOCs, dusts and odors at the property perimeter. VOCs and dust were also monitored in the work area in compliance with the SCAQMD Rule 1150/1166 Permit.

Emergency Action perimeter air monitoring work tasks also included the collection of 10-hour[11] integrated SUMMA canister air samples from each of the seven perimeter locations each workday[12]. SUMMA canister samples were analyzed for VOCs by EPA Method TO-15. SUMMA canister data were evaluated against agency approved chronic and acute chemical specific comparison criteria[13]. Only five detections of naphthalene out of over 750 samples were reported to marginally exceed the chronic comparison criteria. Daily exposure for an entire year or more at concentrations above the chronic comparison criteria would be needed before health effects might be observed. Therefore, the observed naphthalene concentrations did not result in a significant offsite exposure.

Samples of air-borne dust were also collected during the Emergency Action at two downwind and one upwind location using Hi-Volume particulate samplers for analyses of total particulate matter (PM-10) and metals and polyurethane foam (PUF) samplers for analysis for polynuclear aromatic hydrocarbons (PAHs). The PUF and PM-10 Hi-Volume air sampling events were conducted during the first weeks of excavation of Lagoons 4 and 5, resulting in a total of four PUF and PM-10 Hi-Volume air sampling events during the Emergency Action. Concentrations of PM-10 and metals were below approved comparison criteria.

3.4.3.4 Perimeter Air Data Analyses

Tables N-1 through **N-11** of Appendix N include summaries of detected analytes from the 8-hour samples collected from perimeter air monitoring locations during the eleven working days of Phase III, Phase IV, and Phase VIII field work. Wind rose diagrams for each 8-hour sampling event are included as **Figures N-1** through **N-11** of Appendix N. Wind directions at different times of each day are shown in **Table D-6** of **Appendix D**. The laboratory data reports are provided in Appendix W. A brief evaluation of analytical results from each sampling event is provided in **Table 3.4-1**.

A summary of Emergency Action air monitoring data is presented in **Table 3.4-2**. Emergency Action perimeter air monitoring data indicate the ability to control VOC, PAHs, and dusts to approved action levels at the property perimeter. Based on the number of complaints from nearby residents, offsite migration of odors has been shown to be the most challenging aspect to control during active waste excavation and handling.

[11] The SUMMAs were changed from 10-hour samples to 9-hour samples during the week of October 31, 2005, after daylight savings time ended, in order to prevent the work crews from working and sampling in the dark.
[12] The number of sampled perimeter locations was reduced to four during Site preparation and after the excavation and loading of drilling mud was completed.
[13] California Office of Environmental Health Hazard Assessment Reference Exposure Level and Agency for Toxic Substances and Disease Registry (Federal) Inhalation Minimal Risk Level.

3.4.3.5 Perimeter Air Monitoring Summary

In summary, measured wind directions at the Site during Pilot Study No. 3 have been generally consistent with those recorded during previous perimeter air monitoring events. The southwest corner, monitoring location AA-07 (same location as station EA-AA-06 during the Emergency Action work), is upwind of the Site and is considered a consistent background sampling location.

Laboratory data indicate that concentrations of analytes detected from upwind or background sampling locations were generally similar to downwind detections, with the exception of the sample collected on June 30, 2004, that is anomalous and may not be representative of ambient air (see **Table 3.4-1**). In addition, measured concentrations were below health-based comparison criteria. The data collected indicate that the Site was not a significant contributor to concentrations of VOCs in ambient air during Pilot Study No. 3 work activities.

Summary of Section 4: Health Risk Assessment Considerations

Risk Pathways

Receptor Groups	Incidental Ingestion of Soil	Dermal Contact with Soil	Inhalation of Dust and/or Vapors in Outdoor Air	Inhalation of Indoor Air Vapors	Groundwater/ Surface Water Interaction	Drinking Water	Groundwater Vapor
Residential	Onsite Resident	Onsite Resident	Onsite Resident	Onsite Resident	Pathway Incomplete	Pathway Incomplete	Onsite Resident
Commercial	Onsite Commercial Workers	Onsite Commercial Workers	Onsite Commercial Workers	Onsite Commercial Workers	Pathway Incomplete	Pathway Incomplete	Onsite Commercial Workers
Recreational Park	Pathway Incomplete	Pathway Incomplete	Onsite Recreational User Onsite Recreational Worker	Onsite Recreational User Onsite Recreational Worker	Pathway Incomplete	Pathway Incomplete	

Original Soil/Waste Baseline Risk Assessment

Baseline Health Risk Assessment Report

Environmental Science & Engineering, Inc., June 9, 1997

Recent Studies

Re-Evaluation of Air Pathway Analysis / Revised Air Pathway Risk Assessment
Geosyntec Consultants 2002

May 2003 Perimeter Air Sampling Report
Geosyntec Consultants, 2003

Tidal Study and Well Gauging Results Letter Report
Geosyntec Consultants, 2003

August 2003 Perimeter Air Sampling Report
Geosyntec Consultants, 2003

Report of Findings, Perimeter Air Sampling Report
Geosyntec Consultants, 2004

Groundwater Remedial Investigation
Geosyntec Consultants, 2007

Groundwater Baseline Health Risk Assessment
Geosyntec Consultants, 2007

Reevaluation/Refinement

- Source term assumption of chemicals in Lagoons 1 through 5
- Flux equation used to estimate flux from lagoons into air
- Air dispersion model

Reevaluation/Refinement

- Reevaluate soil, waste, and groundwater risk

Conclusion

- Onsite soil/waste estimated risks elevated
- No air impact to community
- Two of three groundwater pathways are incomplete
- Onsite groundwater poses marginal risk
- No offsite groundwater impacts

COPC List Generated

Soils and Waste

VOCs	SVOCs	Inorganics	Pesticides/PCBs
1,1,1-Trichloroethane	1-Methylnaphthalene	Antimony	Aldrin
1,2,4-Trimethylbenzene	2-Methylnaphthalene	Arsenic	Aroclor 1248
1,2-Dichloroethane	2,4-Dichlorophenol	Barium	Aroclor 1260
1,3-Butadiene	2,4-Dimethylphenol	Cadmium	Endosulfan II
Acetone	2,4,6-Trichlorophenol	Copper	
Benzene	Benzidine	Lead	
Chlorobenzene	Benzo(a)pyrene	Mercury	
Chloroform	Bis 2-ethylhexylphthalate	Nickel	
Ethylbenzene	Di-n-butyl phthalate	Silver	
Freon 11 (TCFM)	Dibenzofuran	Thallium	
n-Hexane	Fluoranthene	Vanadium	
Methylene Chloride	Indeno(1,2,3-cd)pyrene	Zinc	
Naphthalene	Phenanthrene		
Styrene	Phenol		
Toluene	Pyrene		

Groundwater

VOCs
1,2,4-Trimethylbenzene
1,3,5-Trimethylbenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Benzene
sec-Butylbenzene
Chlorobenzene
Chloromethane
Ethylbenzene
Isopropylbenzene
Isopropyltoluene
Naphthalene
n-Butylbenzene
n-Propylbenzene
Toluene
Xylenes

Reference: Table 4.4-1

Summary of Section 4: Health Risk Assessment Considerations		**Figure 4**
Revised Feasibility Study Ascon Landfill Site, Huntington Beach, California	September 2007	Project Navigator, Ltd.®

4.0 HEALTH RISK ASSESSMENT CONSIDERATIONS

4.1 Introduction

Several risk assessments and studies have been conducted for the Site, including:

- Baseline Health Risk Assessment (BHRA) conducted in 1997 as a part of the RI for soils/waste (ESE, 1997a).
- Baseline Health Risk Assessment conducted as a part of the RI for groundwater (Geosyntec, 2007b).
- Air Pathway Evaluation
    - Re-Evaluation of Air Pathway Analysis, Revised Air Pathway Risk Assessment (Geosyntec, 2002a)
    - Ambient Air Quality Evaluation Report (Geosyntec, 2002b)
    - Perimeter Air Sampling Program (Geosyntec, 2003a,c, 2004a)
- Supplemental Soil Vapor Investigation Letter Report (Geosyntec, 2006c).

These risk assessments and studies (**Figure 4.1-1**) were used to evaluate Site potential health risks associated with soil, air, and groundwater. This section summarizes the findings of those studies. (See Appendix A, Tables 4-1 through 4-4, for the summary tables presented in the initial FS).

Additional field studies have also been conducted at the Site since the completion of the 1997 RI work to evaluate potential remedial technologies appropriate for the Site (**Figure 4.1-1**). Pilot studies conducted in 1999 (Table 7-3 of Appendix A) included excavation of waste and treatability studies of waste handing methods such as stabilization and mixing. Additional fieldwork conducted as part of Pilot Study No. 3 (Project Navigator, Ltd., Geosyntec, 2004) included chemical analyses of soil and waste materials, downhole and surface flux measurements, vapor suppression testing, soil gas sampling, lagoon sampling, trenching, and remedial technology bench-scale testing. Emergency Action work during 2005 and early 2006 resulted in many analyses of perimeter air during invasive work activities (i.e., grading, open-face excavation, stockpiling) (Project Navigator, Ltd., 2006a, b). Finally, soil vapor at depth along the western perimeter (i.e., near offsite structures) and vapor emissions Site-wide were investigated during 2006 (Geosyntec, 2006c).

Section 3 of this document presents the chemical data for the various Site wastes and the results of ambient air testing performed and evaluated as part of data preparation for this RFS. This additional information and all previously collected data have been considered in identification of COPCs and establishment of risk-based concentrations to assist in the FS process.

4.2 Summary of Baseline Health Risk Assessments

Two Baseline Risk Assessments have been prepared for the Site for (1) Soil/Waste (ESE, 1997a) and (2) Groundwater (Geosyntec, 2007b). These risk assessments were conducted according to USEPA and CalEPA guidance and evaluated the potential risks to human health and the environment for chemicals detected in onsite soils and onsite and offsite groundwater. This section describes the risk assessment process used in each risk assessment and the findings and conclusions from each.

4.2.1 Summary of Baseline Health Risk Assessment for Soil/Waste (ESE, 1997a)

The BHRA (ESE, 1997a) was performed and submitted to DTSC to identify and evaluate the potential risks to human and ecological receptors posed by the current conditions at the Site. This section provides a summary of the BHRA (also see Tables 4-1 to 4-4 of Appendix A for the summary within the initial FS).

In the BHRA, potential exposures to offsite residents, offsite workers, onsite workers, and trespassers were evaluated together with the potential exposures to hypothetical onsite residents (adults and children) assuming the Site was redeveloped into residential property without any further cleanup. Both residential and occupational exposure scenarios were evaluated for exposure via inhalation of volatile chemicals and dust particles that may be released from the Site. Onsite workers and trespassers were evaluated by quantifying their potential exposures through the inhalation, oral, and dermal exposure pathways while at the Site.

In addition to the evaluation of human health exposures, potential exposures to ecological receptors were considered in assessments of biological conditions (Dudek, 1996, 2005 [Appendix B]).

4.2.1.1 Human Health Risk Assessment

The BHRA generally conformed to published EPA and Cal/EPA guidance documents (USEPA, 1989; 1991a, b). For example, to establish the range of potential risks from chemical exposures at the Site, both an average exposure case and a reasonable maximum exposure ("RME") case were considered. The average exposure scenario was evaluated using the arithmetic mean of the chemical concentration in soil combined with average intake values describing the extent, frequency, and duration of exposure.

The RME scenario represents the reasonable maximum hypothetical exposure at the Site. To determine potential exposures associated with the RME scenario, the 95% UCL of the mean concentration values in soil, lagoons, and pits were used to represent the exposure point concentrations combined with reasonable maximum intake values describing the extent, frequency, and duration of exposure.

Estimated non-carcinogenic adverse health effects were compared to EPA-established acceptable daily intakes, and potential carcinogenic health risks were compared to the EPA NCP acceptable risk range of 1×10^{-4} to 1×10^{-6}. The range of 1×10^{-4} to 1×10^{-6} is equivalent to one excess cancer in 10,000 and 1,000,000 exposed individuals, respectively.

COPCs were selected for inclusion in the BHRA using all available characterization data (over 20,000 data points) for soil, waste, groundwater, soil gas, and background soil. Not all chemicals detected at the Site were included in the BHRA. A formal selection of COPCs was conducted to identify those chemicals that could be responsible for more than 95% of the health and environmental risks. The selection criteria were initiated by eliminating from consideration those chemical families known to have low toxicity potential under environmental exposure conditions. Three chemical families that were eliminated were the petroleum-derived alkanes, alkenes, and cycloalkanes. These chemicals were not included as COPCs because they are, in general, only slightly toxic to humans and there is no evidence that these chemicals are mutagenic, teratogenic, or carcinogenic (Sandmeyer, 1981).

After elimination of the alkanes, alkenes, and cycloalkanes, the remaining chemicals detected at the Site were included in a final selection of COPCs using the Concentration/Toxicity Scoring method (USEPA, 1989). This method was used so that those chemicals potentially responsible for more than approximately 95% of the health risks would be included in the risk assessment.

The BHRA (ESE, 1997a) results indicated that, for several VOCs, estimated incremental cancer risks and noncancer hazard indices exceeded regulatory thresholds such as an incremental cancer risk of 1×10^{-6} and a hazard index ("HI") of 1, and were also above the upper-bound of the USEPA NCP risk range of 1×10^{-4} to 1×10^{-6}. The BHRA identified the following chemicals that contributed to the majority of estimated risks for the Site:

- 1,2-dichloroethane (1,2-DCA),
- 1,1,1–trichloroethane (1,1,1-TCA),
- Benzene,
- Methylene chloride, and

- Styrene.

These chemicals contributed to over 85% of the cumulative cancer risk and 99% of the noncancer hazard estimates presented in the BHRA and were identified as COPCs for further evaluation in the initial FS (Environ, 2000). Additional chemicals were identified as COPCs based on the results of pilot testing conducted in 1999 (Table 7-3 of Appendix A). Hypothetical onsite residential cumulative cancer risk and noncancer hazards for soil/waste were found to be 7.4 x 10^{-2} and 77, respectively, based upon the hypothetical child resident.

4.2.1.2 Ecological Risk Characterization

Potential exposures to ecological receptors were considered in an ecological risk assessment (Dudek, 1996), which has been supplemented by a recent, updated biological characterization of the Site (Dudek, 2005; included as Appendix B). Note, however, that the Site conditions, especially conditions of vegetation, have significantly changed following the Emergency Action in 2005 through early 2006 when compared to the conditions during the biological characterization update.

As discussed in Section 2.9, Dudek conducted a biological survey of the Site in July of 1996 (Dudek, 1996). The survey was conducted to determine the plant and animal species that inhabit the Site, and this survey was recently updated (Dudek, 2005; Appendix B). Data from the 1996 survey plus information collected from the Site during previous investigations were used to conduct an Ecological Risk Assessment ("ERA"). Details about the ERA and the results obtained were presented in the BHRA.

The Dudek survey conducted in 1996 indicated that the open lagoons and Pit F could pose a significant hazard to wildlife; however, since that date, two new covers have been placed over Pit F and a netting material was placed over Lagoons 1 and 2 to prevent wildlife from entering the lagoons. During the most recent survey conducted in December 2004, Dudek noted that no wildlife species were observed trapped in either the lagoons or the netting.

The results of the ecological assessments indicate that the Site is highly disturbed and supports little in the way of natural habitats that would serve as significant areas for the establishment of populations of important species. Potential risks to wildlife exist; but based on available observations, do not appear significant to wildlife populations. No sensitive wildlife species were observed onsite during either survey (see Appendix B).

4.2.2 Baseline Health Risk Assessment for Groundwater (Geosyntec, 2007b)

A human health risk assessment for groundwater has been completed as a part of the Groundwater RI, revised in 2007 (Geosyntec, 2007b). Groundwater monitoring has been conducted at the Site since 1988, with the most recent including one round conducted in 2002 (Project Navigator, Ltd., 2002b), four rounds in 2004 (Geosyntec, 2004b, c, d, e 2005a, b), and one round in December 2006 (Geosyntec, 2007a). The results confirm the presence of low levels of chemicals primarily associated with petroleum hydrocarbons in shallow onsite groundwater beneath the Site. Several chemicals had observed concentrations above their repective MCLs. Sampling was also conducted in a deeper well (MW-20) installed beneath the Site. Other than barium in concentrations significantly above background, no chemicals were detected in samples collected from this well.

As a part of the Groundwater RI, a Conceptual Site Model ("CSM") was developed for potential exposure to groundwater beneath the Site. Three potential exposure pathways were identified:

- Groundwater/Surface Water Interaction,
- Drinking Water, and
- Vapor.

A tidal study (Geosyntec, 2003b) was conducted to evaluate the groundwater/surface water pathway to determine if chemicals in groundwater beneath the Site might be migrating to the adjacent flood control channel. Data collected during the tidal study clearly indicate that Site groundwater does not discharge into the flood control channel. In addition, the groundwater flow direction continues to be away from the channel. Based on this information, no potential exposure pathway of groundwater to surface water appears to exist at the Site. Therefore, this pathway was not considered further in the groundwater health risk assessment.

Potential drinking water exposure pathways appear to be non-existent at the Site. There is no groundwater production of any kind (drinking water, agricultural, industrial) within three miles of the Site. This is due to the fact that groundwater in the vicinity of the Site is severely degraded by seawater intrusion and thus is not used (Orange County Water District, personal communication, 2003). In addition, the Semiperched Aquifer, the shallowest groundwater zone located below the Site subsurface, is not identified in the Water Board's Water Quality Control Plan for the region. Because of its shallow nature and poor water quality, it is doubtful that the Semiperched Aquifer would have any beneficial uses in the future. Based on groundwater data collected in March and April 2004, TDS concentrations in the shallow groundwater beneath the Site ranged from approximately 4,500 mg/l to 26,000 mg/l (Geosyntec, 2005b). The TDS is comprised mostly of dissolved sodium and chloride indicating seawater intrusion impacts (see Section 2.11 for discussion on seawater impacts). ESE (1997b) also noted that shallow groundwater quality in the Semiperched Aquifer was degraded and had high concentrations of TDS and nitrates (ESE, 1997b).

The potential does exist for VOCs present in groundwater beneath the Site to volatilize into the overlying soils and migrate to the surface where humans may be exposed. Currently, the only potentially exposed population would be Site workers and trespassers. However, following implementation of the remedial alternative, the Site may be developed in some manner. Prior to any development, potential human exposure to future Site users from VOCs present in the groundwater will be evaluated.

Commercial and residential exposures from groundwater were evaluated. Maximum chemical concentrations detected in Site groundwater were used in vapor intrusion models to evaluate potential human health risks. Incremental cancer risks for future residential exposures were estimated to be 4.4×10^{-6}. Incremental cancer risks for future commercial exposures were estimated to be 8.2×10^{-7}. Noncancer Hazard Indices for both residential and commercial exposures were below 1. The only significant incremental risk was due to benzene detected in Well B-4 in the interior of the Site which was calculated by assuming residential exposures (70 ug/l maximum accounting for 3.8×10^{-6} incremental risk, or 87 percent of the total incremental risk).

4.3 Summary of Air Pathway Evaluation

Due to the screening level nature of the 1997 BHRA, the air exposure pathway was re-evaluated to provide a realistic estimate of potential offsite risks associated with chemicals detected at the Site (Geosyntec, 2002a). The focus of the analysis was on the five chemicals identified above as the COPCs that contributed to the majority of estimated risks for the Site.

In addition to the air pathway risk assessment reevaluation, short-term (2-hour) and long-term (24-hour) ambient air sampling was performed around the perimeter of the Site in August 2002 (Geosyntec, 2002b). An additional three rounds of ambient air sampling were conducted in May, August, and December 2003 as a part of the Perimeter Air Sampling Program (Geosyntec, 2003a, c, 2004a). The primary objective of the ambient air sampling program was to evaluate existing ambient air quality with respect to VOCs at the perimeter of the Site. Many additional data were collected during the Emergency Action conducted in 2005 to 2006 for perimeter air but are not included in the reevaluation of the air pathway discussed herein.

This section provides a summary of the air pathway risk assessment and perimeter air monitoring findings with respect to potential offsite exposures from chemicals detected at the Site.

4.3.1 Air Pathway Risk Assessment

The 1997 BHRA for the Site was based on data collected during the RI conducted in 1996. Potential vapor emissions and subsequent offsite impacts from the five lagoons and Pit F were evaluated in 1997 using conservative assumptions rather than specific conditions at the Site.

The chemical concentration in the soil/waste was assumed to be either the maximum or 95% UCL of the mean for all COPCs for the RME evaluation. However, for several risk-driving chemicals (e.g., benzene, 1,2-dichloroethane, and methylene chloride) the maximum concentrations detected in any lagoon were used instead of the mean as exposure point concentrations in the calculations used to estimate health risks. For example, the RME scenario for the lagoons was based on the assumption that the maximum detected concentrations for these particular risk-driving COPCs were present throughout the entire area covered by the five lagoons.

Review of the data for these chemicals showed that some of the lagoons had significantly lower chemical concentrations than the highest observed value at the Site. Therefore, it was deemed prudent to reevaluate the estimated emissions and reassess the risks presented in the 1997 BHRA. In addition, a screening level air dispersion model was used to estimate offsite concentrations of chemicals in ambient air.

The air pathway was reevaluated to provide a realistic estimate of potential Site emissions and the resultant predicted exposure point concentrations (EPCs) at offsite locations. The refinements focused on three aspects of the analysis:

1. Source term assumption of chemicals (concentration of COPCs in waste) in Lagoons 1 through 5,
2. Flux equation used to estimate flux from lagoons into air, and
3. Air dispersion model.

In addition, recent changes in toxicity values were incorporated into the assessment. In the revised air pathway risk assessment (Geosyntec, 2002a) the risk-driving VOCs identified in the BHRA (e.g., benzene, 1,2-dichloroethane, 1,1,1-trichlorethane, methylene chloride, and styrene) were again evaluated. As a more refined yet conservative analysis, the maximum detected concentration in each lagoon was used in a lagoon-specific emission rate calculation rather than the maximum detected concentration throughout all five lagoons. The revised lagoon-specific emission rates were then used in the USEPA-approved Industrial Source Complex Short Term, Version 3 (ISCST3) model to provide estimates of the chemical-specific exposure point concentrations at offsite locations.

The ambient air concentrations predicted by the air dispersion modeling were used to estimate incremental cancer risk and noncancer hazard at offsite locations. Both potential acute and chronic exposures were evaluated using the maximum predicted 1-hour concentrations for acute exposures and the predicted annual average concentration for chronic exposures.

The results of the revised risk assessment (Geosyntec, 2002a) indicated that the maximum predicted 1-hour concentrations are at levels below health-based criteria that are protective of human health (Agency for Toxic Substances Disease Registry [ATSDR] MRLs, or Office of Environmental Health Hazard Assessment [OEHHA] RELs) for all chemicals and receptor locations. Thus, the COPCs for the Site are not expected to cause acute effects.

The annual average concentrations were used in the revised risk assessment calculations to evaluate potential chronic exposures from predicted chemical concentrations in ambient air to offsite residents and workers. The maximum predicted concentrations at each type of location were used in the calculation of incremental cancer risk and noncancer hazard. The results of the revised assessment (Geosyntec, 2002a) indicated that the predicted offsite annual average air concentrations of VOCs would not pose a significant cancer risk or noncancer hazard for offsite residents and offsite workers. Calculated cancer risk and noncancer hazard estimates were within the USEPA NCP risk range goal of 1 x 10^{-6} to 1 x 10^{-4} and below the noncancer benchmark level of 1.0, respectively.

The presence of chemicals due to sources other than the Site is an important consideration in evaluating risks from chemicals in ambient air. This is especially important for chemicals such as benzene which is known to be present throughout the Los Angeles Basin due to automobile emissions. Specific potential sources of chemicals in ambient air near the Site include, among others, major roads, the adjacent power plant, the adjacent oil storage facility, and the nearby wastewater treatment plant.

To evaluate the contribution of background chemicals to risk, predicted air concentrations and calculated risks from results obtained at the Site were compared to risks calculated using information from the ambient air monitoring conducted by SCAQMD at two locations that were approximately 0.5 mile and 1 mile from the Site. All of the chemicals evaluated in this assessment, with the exception of 1,2-DCA, were detected in the background samples. This finding is consistent with the air monitoring conducted during the Pilot Study in October 1999 (J&W, 1999) where 1,2-DCA was not detected in any of the perimeter sampling.

An additional point of reference is the CARB air toxics monitoring station in Long Beach, the closest to the Site. Predicted concentrations for benzene and styrene were similar to those measured both by SCAQMD in the Site vicinity and at the Long Beach monitoring station. Most notably, the data collected near the Site were actually two to four times less than the levels detected at the nearest CARB monitoring stations.

Predicted concentrations for methylene chloride and 1,1,1-TCA were higher than concentrations measured at the CARB monitoring station. As mentioned above, 1,2-DCA was not detected in background samples or in the J&W Pilot Study samples collected in October 1999 during active excavation.

4.3.2 Perimeter Air Monitoring

As discussed in Section 3.4.2, ambient air quality at the Site has been evaluated with several rounds of perimeter air sampling conducted between August 2002 and December 2003. In addition, perimeter air monitoring consisting of real time measurements and sample collection was conducted during field activities performed for Pilot Study No. 3 investigations. More recently, extensive perimeter air monitoring and sampling was conducted during the Emergency Action in 2005 through early 2006 when large areas of waste in Lagoons 4 and 5 were exposed during excavation and removal actions. The results of the ambient air monitoring studies can be used to evaluate potential exposure to offsite receptors and evaluate the findings of the air pathway risk assessment.

During the August 2002 sampling round, short-term (2-hour) and long-term (24-hour) ambient air sampling was performed along the Site perimeter (Geosyntec, 2002c). Laboratory results of the August 2002 short-term samples indicated that the Site is not a significant contributor to VOCs in ambient air. August 2002 long-term sampling indicated that concentrations were generally not appreciably above background with the exception of methylene chloride and benzene detected in a single sample during one of the two 24-hour sampling events. These concentrations were inconsistent with concentrations from other onsite samples. In addition, concentrations of detected chemicals at the Site were below the ATSDR MRLs and State of California RELs, as available.

Additional sampling was conducted in May, August, and December 2003 as part of the Perimeter Air Sampling Program (Geosyntec, 2004a) to further evaluate ambient air quality at the perimeter of the Site and to confirm the results of the previous air monitoring. For each of these sampling events, six consecutive 8-hour composite samples were collected from perimeter locations around the Site.

The sample results from the background or upwind perimeter locations were either very similar or slightly less than the results from the remaining sampling locations. Average concentrations of detected analytes were similar to those detected in 2002 at the CARB air toxics monitoring station in Long Beach. This information demonstrates that the Site, in its undisturbed state, is not contributing to increases in local or regional background chemical levels. The results of the monitoring were also consistent with the findings of the air pathway risk assessment (Geosyntec, 2002a).

An ambient air monitoring program was implemented as part of Pilot Study No. 3 field activities in 2004. The primary objective was to monitor ambient air while collecting data on the nature, magnitude, and possible rates of odor and chemical emissions that could be generated by excavating and handling the buried waste materials at the Site. To accomplish this objective, perimeter air quality data were collected using both real-time instrumentation and through the collection of 8-hour time-integrated SUMMA canister samples. The results of the ambient air monitoring indicated that concentrations of analytes detected from upwind or background sampling locations and downwind locations were generally similar. In addition, measured COPCs were below health-based levels, as discussed earlier. The results of the sampling indicate that the Site was not a significant contributor of VOCs to ambient air based on actual results of testing performed during the active excavation and sampling activities conducted as a part of Pilot Study No. 3. These findings are also supported by the Emergency Action perimeter VOC data collected in 2005 and early 2006, where measured concentrations of constituents were below health-based comparison criteria, with the exception of five detections of naphthalene that exceeded chronic comparison criteria out of over 750 samples analyzed. Daily exposure for an entire year or more at concentrations above the chronic comparison criteria would be needed before health effects might be observed. Therefore, the observed naphthalene concentrations did not result in a significant offsite exposure (Project Navigator, Ltd., 2006a, b). The Emergency Action has resulted in many additional perimeter air data that could be used in the future to design mitigation techniques during implementation of any remedial action.

4.4 Supplemental Soil Vapor Investigation Letter Report (Geosyntec, 2006c)

A supplemental soil vapor investigation was conducted at the Site in 2006. The objectives of this investigation addressed the data gaps identified in the Soil Vapor Technical Memorandum [Project Navigator, Ltd./Geosyntec, 2006a] (TM). The specific objectives were (1) to assess the presence and concentrations of chemicals of concern in soil gas along the northwestern perimeter of the Site and evaluate potential vapor intrusion into nearby commercial structures and (2) to assess surface emissions across the Site and evaluate these emissions with respect to background emissions from non-impacted, off-site soils.

Soil gas samples were collected at seven locations on the northwest border of the Site. Semi-permanent soil gas probes (SGPs) were installed and sampled in general accordance with the Workplan and DTSC's Advisory- Active Soil Gas Investigations dated January 28, 2003.

The surface emissions survey was conducted in general accordance with South Coast Air Quality Management District Rule 1150.1 Attachment A, Instantaneous Landfill Surface Monitoring. Non-lagoon and Pit F areas of the Site were traversed using a 25-foot wide walk pattern. Continuous monitoring was conducted with a calibrated Photovac MicroFID flame-ionization detector (FID) organic vapor analyzer with a 0.5 ppmv detection limit that was fitted with a probe extension that facilitated measurements 3 inches above the ground surface.

The concentrations of the chemicals detected in the soil gas samples were compared to risk-based screening levels (RBSLs) for the vapor intrusion pathway. The RBSLs were calculated using the DTSC version of the Johnson and Ettinger model (2005) assuming default commercial exposure assumptions and a target risk of 10^{-5} and a target hazard quotient of 1. The detected concentrations did not exceed the RBSLs calculated for commercial exposures.

During the surface emissions survey, instantaneous measurements were observed, and a range was recorded. The upgradient sample, the offsite green belt sample, and the offsite Edison Park sample were 1.5 ppm, 1.2 ppm, and 1.6 ppm, respectively. The highest single instantaneous value observed during the onsite surface emissions survey was only slightly higher, at 2.5 ppm, below any level of concern (**Figure 3.4-1**).

4.5 Selection of Constituents of Potential Concern (COPCs)

As discussed in Section 4.2, COPCs were selected in the 1997 BHRA using a concentration-toxicity score approach. A significant amount of additional Site data (over 80,000 data points) has been collected over the intervening years since the 1997 BHRA, including soil/waste matrix and downhole and surface flux data during Pilot Study No. 3. An evaluation of the new data and additional evaluation of the old data were conducted to ensure that the appropriate COPCs were included for consideration in the RFS.

To identify additional COPCs for the RFS, a soil data set, created by combining soil data from Pilot Study No. 3, the RI, and the TM1ROF, was developed to best represent the baseline condition of the Site assuming a minimum remediation scenario. This data set was used to compare the maximum concentration of each detected chemical to the USEPA Region IX (2004) residential soil PRGs. All chemicals detected in at least one sample in the data set were considered in the COPC selection process. A chemical was selected as a COPC if the maximum detected concentration exceeded its respective residential soil PRG.

COPCs in groundwater were identified using the data from the 2002, four 2004, and one 2006 sampling events. All organic chemicals found in groundwater were included in the COPC selection process and are listed in **Table 4.4-1**. Metals of elevated concentrations included selenium and barium, but both were considered in the Groundwater RI to be within background levels for recharge waters or not representative of shallow groundwater quality. Also, since the drinking water pathway is incomplete, these metals in groundwater were not considered as COPCs for the Site.

In addition to the soil data evaluation, the downhole flux data were evaluated. This data set consisted of over 1,800 data points for the VOCs on the TO-15 analyses list. Although a direct correlation of the downhole flux data with potential surface exposures is difficult to do, this data set was thought to be important for identifying what levels and types of chemicals may be present in soil gas. Therefore, the downhole flux data were compared to soil gas screening levels developed by the CalEPA for residential land use, the California Human Health Screening Levels (CHHSLs). These soil and downhole flux data were used in the COPC selection process to identify additional chemicals to include as COPCs for soil.

The updated COPC list for the Site is presented in **Table 4.4-1**. The COPC selection process is presented in **Figure 4.4-1**.

4.6 Risk-Based Concentrations for Soil

The results of the BHRA for soil/waste indicated that onsite exposures to soil and waste might result in an unacceptable risk to potential residents living on the Site considering the very conservative assumptions used in the assessment. For example the BHRA assumed residential exposures to the highest concentrations measured in waste and soil. To address these potential risks should the Site be redeveloped, Risk-Based Concentrations ("RBCs") for soil were developed for the Site for use in the feasibility and remedial planning process assuming four scenarios:

- Construction worker,
- Residential development,
- Commercial development, and
- Recreational development.

The commercial and recreational scenarios are considered the most likely for the CHP parcel portion of the Site, considering the surrounding land use, and are consistent with the surrounding areas and the City of Huntington Beach zoning for the general area. The residential scenario was included due to the current residential land use zoning of the Site. The construction worker scenario is considered the plausible scenario for the City parcel because the narrow width of the parcel and proximity to Hamilton Avenue and Magnolia Street preclude residential or commercial development and allow only construction operations (i.e., street widening, utility trenching).

RBCs are media-specific concentrations that are protective of human health given certain designated land uses. RBCs for soil developed for the Site express both a chemical concentration and an exposure route, rather than chemical concentrations alone, because protectiveness may be achieved by reducing exposure to COPCs by means other than physical or chemical removal (such as capping an area, limiting access, administrative controls or by waste stabilization). Appendix P describes the procedures used for developing RBCs for the Site and the results obtained.

Soil Risk-Based Concentrations

The following exposure routes were evaluated for potential future onsite commercial workers and residents:

- Incidental ingestion of soils,
- Dermal contact with soils,
- Inhalation of dust/vapors in outdoor air, and
- Inhalation of indoor air vapors.

The inhalation of outdoor and indoor air vapors route was evaluated for the recreational user of the Site, and only the inhalation of indoor air vapors route was evaluated for the indoor recreational worker. Indoor air was evaluated for the recreational scenarios because it is assumed that either a recreation center and/or maintenance building may be placed within a potential park located over a capped area of the Site. The construction worker scenario exposure routes included incidental ingestion, dermal contact, and inhalation of dust/vapors in outdoor air.

An important consideration in developing RBCs for the Site is the final disposition of contaminated media. For the purpose of developing RBCs, two basic scenarios were evaluated: (1) a scenario in which COPCs may be present at the surface (0-ft Cover RBC) and (2) a remedial alternative scenario in which it was assumed a 4-foot cover of soils is placed over the waste material (4ft-Cover RBC). As a result of the 4-ft cover scenario, direct contact with COPCs in soil would not be possible, and the only potentially complete exposure pathways would be exposure to VOCs that have migrated from the subsurface into indoor and outdoor air. The 0-ft Cover RBC can be used to evaluate areas of the Site where a cover is not planned (i.e., the City parcel). The 4-ft Cover RBC can be used to evaluate areas where a cover is planned (i.e., the interior of the Site, or the CHP parcel). For the unrestricted use areas, the 0-ft Cover RBC would be applicable for all soils to a depth of 10 feet, or to groundwater if at less than 10 feet depth, since these soils could plausibly be brought to the surface in a residential scenario (e.g., swimming pool construction). The RBCs are presented in **Table 4.5-1**.

For the recreational scenarios, it is assumed that any park or open space would be developed over a capped zone and that a minimum of a four-foot thick soil cover, or equivalent, would be in place over any residual potentially impacted material. Since direct contact to soils beneath the cover would be precluded, the recreational RBCs were derived assuming VOCs could possibly migrate into outdoor and indoor air.

RBCs were developed for individual chemicals to establish concentrations whereby the risk posed by an individual chemical would be at or below the acceptable risk level of 1×10^{-6} cancer risk or a HI of less than 1 for residential and recreational scenarios. For commercial and adult recreational worker scenarios, acceptable risk levels of 1×10^{-5} and HI of 1 were used. As presented in **Table 4.5-1**, the most conservative (lowest) of the RBCs based on either cancer risk or noncancer effects was selected. For lead, the Cal-EPA Leadspread version 7 software was used to derive soil lead RBCs.

Because of the mixture of COPCs at the Site in any given area, a determination of the risk posed by any chemicals remaining following completion of remedial actions can only be accurately determined using final soil confirmation data obtained from the unrestricted use areas and/or taking into account the characteristics of any restricted use. These test results will provide the basis for developing a post-remediation risk assessment. During the planning phase of any end use development work at the Site, the need for and design of engineering controls, such as vapor barriers, passive venting zones, active air movement systems beneath building slabs or elevated structures, could be made based on the actual data collected at the time the remedy is completed. The final cleanup levels, as determined by confirmation soil analyses and combined with any specific engineering controls implemented, will meet the RAOs identified in Section 6. Any cap that may be selected as the remedial alternative for the Site, or portion of the Site, would be designed to be protective of human health and the environment and meet the RAOs. The post-remedy risk assessment applies only to the areas to be cleaned to unrestricted use.

Because some chemicals, especially metals, are naturally occurring in the environment, the presence of these chemicals in Site soils must be evaluated against the background of what would be expected to be naturally occurring in this area. This is particularly relevant for chemicals such as arsenic where the residential RBC is below levels typically found in Southern California soils. Table 3-25 of Appendix A presents the metals concentrations detected in background soils at the Site. If a metal RBC is below its respective background concentration, then final cleanup values presumably will be based on the background value.

Mitigation of Any Risk Due to Groundwater

As discussed in Section 4.3.3, unacceptable risks were identified for the residential indoor air vapor migration pathway due to concentrations of benzene in groundwater beneath a limited area of the Site. Remedial technologies consisting of *in situ* groundwater treatment techniques and engineering controls are identified in Section 8 as being potentially suitable for hot spot remediation of groundwater or mitigation of vapors from groundwater, if needed. Because future land use at the remediated Site is not certain, one or more of these techniques may be implemented, as appropriate, to enable unrestricted use. However, remediation of impacted soils and wastes (source removal) may alter shallow groundwater conditions, as well as change the vadose zone vapor migration pathways due to the improved physical properties of the compacted backfill soils.

For these reasons, a specific process for addressing potential risks from groundwater is proposed. The proposed process consists of the following steps:

- Following remediation of impacted soil and wastes, a soil vapor survey will be conducted in the unrestricted use areas. Shallow soil gas samples will be collected from unrestricted use areas at a depth of approximately 10 feet bgs, if possible, or shallower if groundwater is within the upper 10 feet bgs. If samples cannot be collected at depths of greater than 5 feet bgs, additional lines of evidence will be used to evaluate the vapor intrusion pathway such as soil vapor pressure testing to determine if barometric effects are occurring, surface flux measurements and groundwater data. Laboratory reporting limits will be established at levels low enough to allow for the determination of potential indoor air vapor migration risks using conservative modeling techniques.

- If results of the soil vapor survey indicate unacceptable risks, investigations will be conducted to assess the respective contributions from soil or groundwater to the risk. The potential for soil and groundwater to contribute to soil vapors will be investigated using geoprobe sampling, or other appropriate techniques. Specifically, this would be accomplished as follows. If the soil gas COPCs are found in unacceptable concentrations (e.g., through CHHSL comparison or risk calculation), then a hydraulic push rig will be used to sample the soil and the groundwater beneath the soil at the soil vapor location. The level of volatiles in soils can be ascertained using headspace field tests and laboratory analyses using EPA 5035 Encore sampling, or equivalent. The results of the groundwater analyses could not be used for risk assessment purposes but will provide appropriate screening to determine if additional groundwater sampling and testing or groundwater remediation is required.

- If it is verified that groundwater is the source of the detected vapor, groundwater would then be addressed using one or more of the technologies identified in Section 8 and retained after screening.

- If soil is identified as a potential source of vapor, those soils may be addressed through remediation using techniques such as soil vapor extraction (SVE). As previously noted, the soils recycled during implementation of the preferred remedy would be tested prior to placement on the Site. These tests would be used to confirm the suitability for use in accordance with the final land use options selected, thereby assuring no placement of recycled materials where they could pose unacceptable health risks.

Because vapor risk due to soil or groundwater will be assessed and mitigated following remediation of the Site soils, there is no present need to formulate RBCs for groundwater. The remedial alternative selected for the Site shall meet the RAOs identified in Section 6, which address all media, including groundwater, at the Site.

4.7 Risk Assessment Considerations for the RFS

Based on the risk-related information presented herein, the following items should be considered in the selection of the preferred remedial alternative as described in Section 10.

- The 1997 BHRA for onsite soils indicates that if the Site were developed in its current state (liquid and solid wastes exposed at the surface with no protective layer), that potential onsite exposures would likely result in an unacceptable level of cancer risk and noncancer hazard related to chemicals detected at the Site. For the purposes of the remainder of this RFS, this scenario is referred to as the No Action Alternative. With respect to the No Action Alternative, the perimeter air monitoring studies show that the Site in its current condition is not a significant contributor of VOCs in ambient air even during the active excavation and sampling activities conducted as a part of the Pilot Study No. 3 and during the Emergency Action conducted in 2005 through early 2006. Further, the testing of chemical suppressants and foams reported in Appendix F indicated that the vapors and odors could be controlled by use of these materials in conjunction with managing the size of the excavation exposed within any one day. However due to the nuisance from odors detected during Emergency Action activities during July 2005 through January 2006, additional controls may be needed to better manage odors, even though Emergency Action air quality data have demonstrated that there were no health risks to offsite receptors from the Site (Project Navigator, Ltd., 2006a, b).

- Soil RBCs were derived for different land uses to account for the different types of development options being considered. These values can be used to evaluate the various remedial alternatives to determine if they are consistent with the Remedial Action Objectives (“RAOs”) established in Section 6. In addition, the RBCs can be used to evaluate post-remediation risks once the selected remedy is implemented and the future land use is determined. For the unrestricted use areas, the 0-ft Cover RBC would be applicable for all soils to a depth of 10 feet, or to groundwater if at less than 10 feet depth, since these soils could plausibly be brought to the surface in a residential scenario.

- The results of the downhole flux chamber studies discussed in Appendix F indicate that some of the media on the Site contain sufficient VOCs to produce emissions. This information will be considered in more detail in the remedial alternative evaluation and during final design of the selected remedial approach.

4.8 Post Remediation Risk Evaluation

In order to demonstrate that any residual concentrations in the soil and soil vapor are protective of human health, a post remediation health risk assessment will be conducted. The post remediation risk assessment will account for possible simultaneous exposures to more than one chemical or waste constituent by evaluating the cumulative risk and hazard due to the residual chemical concentrations by adding the ratio of each chemical's concentration to its corresponding RBC and multiplying the sum by 1E-05 or 1E-06 for the commercial and residential scenarios, respectively. The post remediation risk assessment will also consider possible receptors and routes of exposure to indoor air emissions due to vaporization of any remaining chemicals or waste constituents on site. The evaluation will utilize the data collected by the post-remediation soil vapor investigation to further evaluate exposure risks due to soil vapor on site.

Summary of Section 5: Applicable or Relevant and Appropriate Requirements

Description of 'Applicable or Relevant and Appropriate Requirements'

- The term "Applicable Requirements" means "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site…" (40 CFR 300)
- The term "Relevant and Appropriate Requirements" means "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or state environmental or facility siting laws that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site…." (40 CFR 300)

ARARs

Potential Chemical – Specific Requirements

Type/Name of Potential ARAR	Citation	Potentially Applicable or Relevant and Appropriate
FEDERAL ARARs		
Clean Air Act (CAA)		Relevant and Appropriate
National Primary and Secondary Ambient Air Quality Standards (NAAQS)	40 CFR 50-80	Relevant and Appropriate
National Emissions Standards for Hazardous Air Pollutants (NESHAP)	42 USC 7401 *et seq.*	Relevant and Appropriate
Clean Water Act (CWA)	33 USC 1251 *et seq.* 40 CFR 100-140, 400-470	Relevant and Appropriate
National Primary and Secondary Drinking Water Standards	40 CFR 141.50-51, and 141.61-62 and 40 CFR 143.3	Relevant and Appropriate
Resource Conservation and Recovery Act (RCRA)	42 USC 6901 *et seq.* 40 CFR 240-271	Relevant and Appropriate

See Table 5.2-1 for complete info

Potential Action – Specific Requirements

Type/Name of Potential ARAR	Citation	Potentially Applicable or Relevant and Appropriate
FEDERAL ARARs		
National Pollutant Discharge Elimination System (NPDES) under the CWA	33 USC 1342 40 CFR 122-125	Relevant and Appropriate
Underground Injection Control	270.60(b) and 40 CFR 144, 146, 147 et seq.	Applicable
RCRA Section 3020(b)	42 U.S.C. § 3020(b)	Relevant and Appropriate
Spill Prevention Control and Countermeasure (SPCC) under the CWA	40 CFR 112	Relevant and Appropriate
National Oil and Hazardous Substances Pollution Contingency Plan (NCP)	40 CFR 300 *et seq.*	Relevant and Appropriate
Department of Transportation (DOT) Hazardous Material Act Regulations	*49 CFR 172-178*	Applicable
Federal Occupational Health and Safety Act	40 CFR 1910 *et seq.*	Relevant and Appropriate

See Table 5.2-2 for complete info

Potential Location – Specific Requirements

Type/Name of Potential ARAR	Citation	Potentially Applicable or Relevant and Appropriate
FEDERAL ARARs		
Municipal Solid Waste Landfill Closure	40 CFR 258	Relevant and Appropriate
Underground Injection Control	40 CFR 144, 146, 147 et seq.	Relevant and Appropriate
Endangered Species Act	16 USC 1530 *et seq.* 40 CFR 6.302 50 CFR 17, 200, 402	Relevant and Appropriate
Migratory Bird Treaty Act	16 USC § 703-711	Applicable
Fish and Wildlife Coordination Act	16 USC 661 *et seq.* 33 CFR 320-330	Relevant and Appropriate
Coastal Zone Management Act	16 USC 1451 *et seq.*	Relevant and Appropriate

See Table 5.2-3 for complete info

Potential "To-Be-Considered" Criteria

Name of To-Be-Considered ARAR	Citation
SWRCB Resolution 88-63	SWRCB Res. 88-63
SWRCB Resolution 68-16	SWRCB Res. 68-16
SWRCB Resolution R8-2002-0007	SWRCB Res. R8-2002-0007
SWRCB Resolution 92-49	SWRCB Res. 92-49
SCAQMD Best Available Control Technology (BACT)	SCAQMD BACT Guidelines Document
Risk Assessment Guidance for Superfund (RAGS) Part B	EPA/540/R-92/003
EPA Region IX PRGs 2002	Region IX PRG Table, 2002
EPA Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments	EPA/530/SW-89/047 July
Alternative Cap Design Guidance – EPA Region I	Revised Alternative Cap Design Guidance Proposed for Unlined, Hazardous Waste Landfills in the EPA Region I, February 5, 2001
City of Huntington Beach Soil Clean-Up Standard	City Specification 431-92
Orange County Health Care Agency – Public Health Division of Environmental Health	Orange County Code Article 2, Section 4-5-17

See Table 5.2-4 for complete info

Other Federal and State Laws

Reviewed as ARARs but were judged not to contain standards or regulations pertinent to the RAOs at the Ascon Landfill Site.

Summary of Section 5: Applicable or Relevant and Appropriate Requirements		Figure 5
Revised Feasibility Study Ascon Landfill Site, Huntington Beach, California	September 2007	Project Navigator, Ltd.

5.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

5.1 Introduction

Based on the results of the Remedial Investigation (“RI”), the Baseline Health Risk Assessment (“BHRA”) for soil, and the groundwater risk assessment (ESE, 1997a, 1997b, Geosyntec, 2005b, 2007b), federal, state and local environmental requirements were reviewed and evaluated to identify specific remedial goals and objectives. Applicable or Relevant and Appropriate Requirements (“ARARs”) are required to protect human health and the environment and to provide a long-term, cost-effective remedial solution for the Site.[1]

5.2 Description of Applicable or Relevant and Appropriate Requirements

5.2.1 General

Remedial actions must attain and be consistent with ARARs, unless waived or granted a variance by the USEPA. ARARs are legally enforceable standards, criteria, or limits promulgated under Federal or state law.

The terms "applicable" and "relevant and appropriate" requirements are defined as follows:

- The term "Applicable Requirements" means “those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site..." (40 CFR 300)

- The term "Relevant and Appropriate Requirements” means “those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or state environmental or facility siting laws that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site..." (40 CFR 300)

Other requirements to be considered (TBC) include Federal, State, and Local advisories and guidelines that, although not legally binding and do not have the status of ARARs, may be used to establish remedial criteria in order to protect public health and the environment.

Federal and state non-promulgated standards (standards which are not of general applicability or are not legally enforceable), policies, or guidance documents are not ARARs. However, if no ARARs are available for a specific waste constituent, chemical, and/or specific site condition, or if the specified existing ARARs do not adequately protect public health and the environment, then regulatory policies and guidance documents are to be considered to ensure such protection.

In preparing the list of potential ARARs for the Site’s initial FS, input from other agencies was solicited by DTSC. Letters were received from the Orange County Health Care Agency (April 15, 1997), the SCAQMD (April 16, 1997), and the RWQCB (May 29, 1997). Additionally, in the process of preparing the RFS, ARARs were reevaluated and revised where new regulations or changes to regulations had been

[1] In addition to ARARs, other non-enforceable criteria, policies, or guidance may be used to establish Remedial Action Objectives and screen remedial alternatives under 400 CFR 300.430(e)(2)(I).

promulgated. ARARs were also updated to reflect potential new alternatives proposed within this RFS. Not every ARAR will be applicable to every alternative within the range of potential remedies.

The ARARs summarized in **Tables 5.2-1** through **5.2-3** are grouped into three major categories of requirements: Chemical-Specific, Location-Specific, and Action-Specific. Within these categories, subcategories for Federal versus state and local ARARs are presented. The following sections describe these three groupings of ARARs in more detail. The To-Be-Considered ("TBC") Criteria have been summarized in **Table 5.2-4**.

5.2.2 Potential Chemical-Specific Requirements

The potential chemical-specific ARARs identified for remedial action alternatives at the Site include the following Federal laws:

- Clean Air Act (CAA), which regulates air emissions of substances that may harm public health or natural resources,
- Clean Water Act (CWA) regulates the discharges of pollutants to surface water,
- Resource Conservation and Recovery Act (RCRA) establishes standards for the generation, management, and disposal of solid and hazardous wastes, and
- Safe Drinking Water Act (SDWA) specifies standards for drinking water quality.

Potential state and local chemical-specific ARARs may include:

- The Hazardous Waste Control Act (HWCA), as administered by the DTSC, mandates the control of hazardous wastes from point of generation through accumulation, transportation, treatment, storage, and ultimate disposal,
- The Porter-Cologne Water Quality Control Act, as implemented by the RWQCBs, mandates regulations pertaining to land disposal unit design and construction that minimize dangers from discharges to surface water and groundwater,
- The Air Toxics Act, as implemented by the SCAQMD, requires the preparation and submittal of inventory emissions plans and reports by specified facilities which exceed certain emission thresholds for designated toxic air contaminants, and
- The California Integrated Waste Management Board regulations pertaining to solid waste, as set forth in the California Code of Regulations, Title 14, promote the health, safety and welfare of the people of the State of California, and are aimed to protect the environment by establishing minimum standards for the handling of solid wastes.

Details and descriptions of each potential chemical-specific ARAR applicable to the Site are summarized in **Table 5.2-1**.

5.2.3 Potential Action-Specific Requirements

The potential Federal action-specific ARARs identified for remedial action alternatives at the Site include the following:

- National Pollution Discharge Elimination System (NPDES) under the CWA,
- Underground Injection Control Program under the SDWA and RCRA, defines requirements for the underground injection of hazardous wastes (Class I injection wells),
- The NCP, under CERCLA, describes the organizational structure and procedures for preparing for and responding to discharges of oil, hazardous substances, pollutants, and contaminants, and
- Department of Transportation Hazardous Material Transportation Act, and Regulations specify Federal standards for transportation of hazardous materials.

State and local action-specific ARARs were identified and include the following:

- NPDES Waste Discharge Requirement Permit Programs, as implemented by the RWQCB,
- HWCA which provides standards for closure and post-closure requirements, staging piles, Corrective Action Management Units (CAMUs), and thermal treatment units,
- Title 27 regulations pertaining to non-hazardous, solid waste landfills as implemented by the Local Enforcement Agency (LEA),
- Regulations pertaining to Class II injection wells, as administered by the Division of Oil, Gas, and Geothermal Resources (DOGGR),
- California Vehicle Code, which regulates offsite transportation of hazardous material,
- Mulford-Carrell Air Resources Act, as implemented by the SCAQMD, includes control measures aimed at reducing emissions of identified pollutants,
- California Occupational Safety and Health Act (CalOSHA), establishes California requirements for worker safety, and
- CEQA.

Table 5.2-2 provides a summary of the Federal, state, and local potential action-specific ARARs.

5.2.4 Potential Location-Specific Requirements

The location-specific ARARs identified for proposed remedial alternatives at the Site include the following potential Federal ARARs:

- Regulations pertaining to municipal solid waste landfills and flood plain and unstable area controls,
- Statutes and regulations governing underground injection wells,
- Migratory Bird Treaty Act, which prohibits the unregulated “take” of migratory birds;
- Fish and Wildlife Coordination Act, which prohibits actions that jeopardize the existence of wildlife and their habitat, and
- Coastal Zone Management Act, which requires that activities directly affecting the coastal zone be consistent with the state program.

The following potential location-specific state and local ARARs were identified:

- HWCA restricts the construction or substantial modification of hazardous waste treatment, storage, or disposal facilities within certain fault or floodplain areas,
- Water Code (23 CCR 2547) regulations regarding earthquake standards for new facility design,
- California Coastal Act, as administered by the Coastal Commission and implemented by the City of Huntington Beach, provides for permitting of activities conducted within coastal zones,
- California Endangered Species Act, as implemented by the California Department of Fish and Game, to prevent the take or disruption of habitat of any species determined to be endangered by the state, and
- State statutes and regulations relating to injection wells.

Table 5.2-3 provides a summary of the Federal, state, and local potential location-specific ARARs.

5.2.5 Potential "To-Be-Considered" Criteria

These "To-Be-Considered" criteria are listed in **Table 5.2-4**.

5.3 Land Use Restrictions

Site RAOs are required to be compatible with future intended land use and consistent with conditions imposed by DTSC in consultation with the City of Huntington Beach. In the event that a selected remedy results, either through design or as determined by post-remedy sampling, in wastes remaining onsite and/or groundwater concentrations remaining which exceed acceptable risk levels for unrestricted land use, institutional controls, such as deed restrictions on future land use as well as rezoning, may be required. A land use restriction will be executed if the Site is not remediated to unrestricted use.

Chapter 6.5 of the HWCA (Health and Safety Code Section 25220, *et seq*.) permits DTSC to designate certain real property as hazardous waste property or border zone property. This information is transmitted to the planning and building departments of each city, county, or regional council associated with the site locality. The local governing authority is required to record and maintain any land use restrictions, including deed restrictions imposed on the hazardous waste property or border zone property. Prior to any planned development of the property, a variance from DTSC may be required.

Summary of Section 6: RAOs, COPC-Containing Media, Cleanup Levels, and Waste Volumes

Remedial Action Objectives
• Developed to ensure protection of human health and the environment, including further degradation of groundwater • Developed for each impacted media • Developed for both the Cannery Hamilton Properties, LLC and City Parcels

Additional Soil Cleanup Levels

City of Huntington Beach Screening Levels for Hydrocarbon Clean-Up		
Land Use	**TRPH (418.1)**	**TPH (8015M)**
Residential and Recreational	<500 mg/kg	<500 mg/kg
Commercial and Industrial	<1,000 mg/kg	<1,000 mg/kg
Roadways		
0 – 4 ft Below Road Surface	N/A	<1,000 mg/kg Total, <100 mg/kg for <C14
Below Road Surface	<1,000 mg/kg	<1,000 mg/kg

Reference: City of Huntington Beach Specification 431-92 (Table 6.3-A in RFS)

Site Solid Waste Types*	Location/Description	Volumes
Tarry Liquids	Tarry oils near the surfaces of Lagoons 1, 2, and 3	26,000 cy
Highly Liquid Drilling Muds	Drilling muds of relatively low strength and considered saturated with oil/liquid; present throughout most areas of the Site, including materials in Lagoons 4 and 5, and materials likely present beneath tarry liquids in Lagoons 1, 2, and 3	369,000 cy
Unsaturated Drilling Muds	Drilling mud of higher strength that are typically mixed with coarser-grained drill cuttings and typically not noted as being "saturated;" present in most areas of the Site below ground surface	186,000 cy
Impacted Soils	Impacted soils (including fill sands and silts, and contaminant-impacted construction debris); contains mixtures of sand, silt, and mud; present throughout the Site	291,000 cy
Pits A – E, G, H	Similar to other Site impacted materials; located in northwest and southeast areas of Site	16,000 cy
Pit F Waste and Pit F-Impacted Soils	Pit F and impacted materials outside of Pit F, located in the southeast area of the Site (previously known as the styrene pit)	41,000 cy
Minimally Impacted Soil	Top several feet of fill throughout the Site	364,000 cy
Construction Debris	Construction debris scattered throughout the Site on surface and below ground surface	69,000 cy
Potentially Impacted Native Clay	Potentially impacted clay beneath the Site's surface	61,000 cy
*Other waste types addressed in Section 6 include groundwater and NAPL	**TOTAL**	**1.4 Million cy**

Reference: Table 6.5-1

6.0 REMEDIAL ACTION OBJECTIVES, COPC-CONTAINING MEDIA, CLEANUP LEVELS, AND WASTE VOLUMES

6.1 Introduction and Media of Interest

The development of Remedial Action Objectives ("RAOs") and proposed cleanup levels starts with the assessment of potential risk to identified receptors from the chemicals of potential concern ("COPCs") detected at the Site.

RAOs are goals specific to various media that sufficiently protect human health and the environment. The NCP specifis that RAOs be developed which address the contaminants of concern, the media of concern, the potential exposure pathways, and the preliminary remediation levels. Most commonly, RAOs are achieved through a combination of contaminant levels reduction and/or exposure reduction. As set out in CERCLA, when assessing alternative remedial actions and developing proposed RAOs, each remedial action must:

- "attain a degree of cleanup of hazardous substances, pollutants, and contaminants released into the environment and of control of further release at a minimum which assures protection of human health and the environment…"
- Comply with or attain a level of "…any standard, requirement, criteria, or limitation under any Federal environmental law…" or "any promulgated standard, requirement, criteria, or limitation under a State environmental or facility siting law that is more stringent than any Federal standard, requirement, criteria, or limitation…"

As discussed more fully in Section 3.2.3, the physical and chemical properties of the waste types, combined with their geographic locations on the Site, are utilized when considering and establishing waste-handling methods and cleanup level determinations. This RFS classifies all Site wastes into one of the following types, each discussed in Section 3.2.3 or 3.3.4:

1. Tarry liquids (near the surfaces of Lagoons 1, 2, and 3)
2. Highly-liquid drilling muds (present in most areas of the Site)
3. Drilling muds (unsaturated, present in most areas of the Site)
4. Impacted soils (which contain mixtures of sands, silts and muds)
5. Pits A-E, G, and H materials
6. Pit F waste and Pit F-impacted soils
7. Fill materials and construction debris
8. Concrete fill materials
9. Groundwater.

Lagoons 1, 2, and 3 contain surface water during the wetter months of the year, COPC-containing liquid petroleum waste, drilling mud, and soil. Lagoons 4 and 5 contain surface water during the wetter months of the year, COPC-containing drilling mud, and soil, with thin, localized layers of liquid petroleum waste. Based on the results presented in Section 3.0, the Pit F area contains styrene waste and soil. The remaining waste pits (A through E, G, and H), as well as the former lagoon areas, are believed to contain COPC-containing soils and drilling mud of varying liquid content. In addition to these COPC-containing media, there are construction debris and non-impacted or minimally impacted fill materials at the Site that are generally believed not to contain significant concentrations of COPCs (see Section 3.2.3 for chemical characteristics of these materials). Groundwater at the Site has also been identified as containing COPCs (Geosyntec, 2005b, 2007b).

These Site wastes are grouped according to means of handling and determining remedial feasibility as follows:

- Groundwater,
- Tarry Liquids (Lagoons 1 through 3),

- Soil/Solid Waste (Impacted Soil, Minimally Impacted Soils, Pits, Drilling Muds, Highly Liquid Drilling Muds, and Debris), considered separately for the Cannery Hamilton parcel and the City parcel, and
- Pit F waste and Pit F-Impacted Soils.

RAOs were developed for each medium to protect human health and the environment and are used to guide the selection of general response actions, remedial technology types, and process options to be used to ensure protection (Section 8).

COPCs and RBC levels for various potential Site land use scenarios are presented below in Sections 6.2 and 6.3, and development of RAOs is presented in Section 6.4. Estimated waste volumes are presented in Section 6.5.

6.2 Constituents of Potential Concern

As discussed in Section 4.2, not all chemicals detected in soils at the Site were included in the BHRA described in Section 4. A formal selection of COPCs was conducted to identify the chemicals responsible for more than 95% of the health and environmental risks. As was noted in Section 4.3, a significant amount of additional Site data, including soil matrix and downhole and surface flux data during Pilot Study No. 3 and groundwater data from the Groundwater Remedial Investigation (Geosytnec, 2005b, 2007b), has been collected over the intervening years since the BHRA was published. These data, in conjunction with previous data collected at the Site, were evaluated to ensure that the appropriate chemicals were included for consideration as COPCs in the RFS. As shown in **Table 4.4-1**, the primary COPCs identified at the Site include VOCs, SVOCs, and metals. COPCs for groundwater are identified in the Groundwater RI (Geosyntec, 2005b, 2007b) and include all VOCs detected in groundwater during the 2002 through 2006 sampling events (**Table 4.4-1**).

6.3 Risk-Based Concentration Levels

6.3.1 Risk-Based Concentrations for Soil

As noted in Section 4.5, RBCs were developed for the Site for each COPC assuming residential, commercial, and recreational development scenarios. These scenarios are considered the most likely for the Site considering surrounding land use (**Figure 1.2-1** and **2.5-1**). Soil RBCs developed for the Site express both a chemical concentration and an exposure route, rather than chemical concentrations alone, because protectiveness may be achieved by reducing exposure by means other than physical or chemical removal (such as, among others, capping an area, limiting access, restricting surface uses, or waste stabilization). Development of RBCs for soil is discussed in detail in Section 4.5.2, and the soil RBCs are shown in **Table 4.5-1**. Soil cleanup goal RBCs were developed for use in evaluating cumulative risk remaining onsite following completion of remedial actions. It is anticipated that risks will be mitigated through a combination of remediation and implementation of specific engineering controls and that cumulative risks will be within the risk range of 1×10^{-4} to 1×10^{-6}. Appendix P describes the procedures used for developing RBCs for the Site and the results obtained.

In addition to the RBCs discussed previously in Section 4.5, the City of Huntington Beach Soil Cleanup Standards should be considered, where applicable, as soil cleanup levels for the Site. Petroleum hydrocarbon cleanup levels were obtained from the City of Huntington Beach Specification 431-92 as presented below in **Table 6.3-A**.

Table 6.3-A. City of Huntington Beach Screening Levels for Hydrocarbon Cleanup

Land Use	TRPH (418.1)	TPH (8015M)
Residential and Recreational	<500 mg/kg	<500 mg/kg
Commercial and Industrial	<1,000 mg/kg	<1,000 mg/kg
0'-4' Below Road Surface	N/A	<1,000 mg/kg Total, <100 mg/kg for <C14
Below Road Surface	<1,000 mg/kg	<1,000 mg/kg

6.3.2 Risk-Based Concentrations (RBCs) for Groundwater

Groundwater contaminant concentrations detected beneath the Site during groundwater monitoring events since 2002 do not pose a significant vapor inhalation risk for a commercial land use of the Site (Geosyntec, 2005b, 2007b). For residential land use, groundwater contaminant concentrations have been detected which, based on conservative risk modeling results, exceed the 1×10^{-6} cancer risk threshold for vapor inhalation due principally to elevated benzene concentrations in groundwater. RBCs for groundwater remediation or controls, if required, will be established such that any cumulative risk remaining onsite from vapor inhalation following completion of remedial actions and implementation of specific engineering controls will be less than 1×10^{-6} to enable unrestricted use.

6.4 Development of Remedial Action Objectives

The results of the BHRA for soil and waste indicated that COPCs in soil and waste at the Site might pose a potential risk for onsite receptors. Primary routes of exposure include direct contact with soil through incidental ingestion and dermal contact, inhalation of fugitive dust and VOCs in outdoor air, and inhalation of VOCs in indoor air. Soil cleanup goal RBCs were developed for the Site (see below), expressed as both a chemical concentration and an exposure route and such that the cumulative risk remaining onsite following completion of remedial actions will be protective of human health and the environment.

The results of the Groundwater RI (Geosyntec, 2005b, 2007b) indicate that VOCs, SVOCs, and metals have been detected in shallow groundwater beneath the Site at concentrations greater than the California or Federal MCLs. Based on the guidance established in SWRCB Resolution No. 88-63, the Water Quality Control Plan for the region (CA-RWQCB, 1995), and the groundwater data, the present use of groundwater in the East Coastal Plain Hydrologic Subarea (which includes the Site) is limited to the following designated beneficial uses: Municipal and domestic supply, agricultural supply, industrial service supply, and industrial process supply. However, as discussed in Section 2.11, the groundwater in the area of and beneath the Site contains high concentrations of TDS and nitrates in the Semiperched and Talbert Aquifers, because of saltwater intrusion. Groundwater composition in both the Semiperched and Talbert Aquifers in the area of and beneath the Site does not qualify it as a drinking water resource, as defined by SWRCB Resolution No. 88-63, due to the elevated TDS and chloride concentrations. Thus, the shallow groundwater should not be considered a viable potential source of drinking water and is not considered as such in the RFS. Although groundwater is not a source of drinking water at or near the Site, RAOs will address protection of groundwater to prevent further degradation of groundwater quality.

The Groundwater RI also evaluated the potential for chemicals detected in shallow groundwater to migrate to the adjacent Huntington Beach Flood Control Channel. A tidal influence study (Geosyntec, 2003b) was conducted, as discussed in Section 2.6, that demonstrated that the direction of water flow is from the channel towards the Site. This exposure pathway is therefore not complete.

Although the shallow groundwater beneath the Site does not meet drinking water standards and there is no complete pathway for chemicals in groundwater to migrate to the adjacent Flood Control Channel, there does exist the potential for VOC vapors to migrate from the subsurface into indoor air in limited areas of the Site, should a structure be placed on the Site. The results of the Groundwater RI (Geosyntec, 2005b, 2007b) indicate that potential health risks from this pathway are just above the risk threshold of 1×10^{-6} in limited areas of the Site. The maximum detected benzene concentration reported since 2002 is located in Well B-4, located in the southwest quadrant of the Site. Since 2002, benzene has not been detected in any of the wells located in the other quadrants of the Site. In summary, the results of the RIs and risk assessments indicate that chemicals in groundwater and soils and waste in their present state may pose an unacceptable risk only to certain potential onsite receptors using conservative assumptions.

The RAOs for the media of interest at the Site are listed in the table below.

Table 6.4-A. Site Media and Remedial Action Objectives

Media	Remedial Action Objectives
Groundwater	Prevent ingestion of and dermal contact with groundwater and inhalation of VOCs from groundwater. Prevent degradation of groundwater quality and migration of COPCs to offsite groundwater (e.g., to City parcel).
Tarry Liquids (Lagoons 1, 2, and 3)	Prevent human and ecological exposure to tarry waste in Lagoons 1, 2, and 3. Prevent migration of COPCs from tarry waste to groundwater.
Soil/Solid Waste – CHP Parcel (Impacted Soil, Minimally-Impacted Soil, Pits, Drilling Muds, Highly Liquid Drilling Muds, Debris)	Prevent human and ecological exposure to solid wastes. Prevent migration of COPCs from solid waste to groundwater.
Soil/Solid Waste -- City Parcel	Prevent human (e.g., City worker) and ecological exposure to solid wastes. Prevent migration of COPCs from solid wastes to groundwater.
Pit F Waste and Pit F-Impacted Soils	Prevent human and ecological exposure to Pit F waste and Pit F-impacted soils. Prevent migration of COPCs from Pit F waste and Pit F-impacted soils to groundwater.

6.5 Estimated Volumes of Wastes

6.5.1 General

Estimated waste volumes for the Site, utilizing the Site data and different assumptions regarding the structure of the various areas of the Site are described in the initial FS (Environ, 2000) and the WMCROF (Project Navigator, Ltd., 2002a). The volume estimates herein are based on a re-analysis of the present database of 203 Site borings, each of which was reviewed, and waste designations assigned to the lithologic layers based on the physical (i.e., USCS classification, blow-count records) and chemical (i.e., odor, PID/FID) observations made during drilling and, to a limited extent, based on the results of chemical analyses from the recovered core materials. For both geographically-delineated wastes and material property-defined wastes, the upper surface of the Site was bounded by a GIS-based topographic surface. The lower boundary of the impacted materials is the top of the native clay layer, beneath which little, if any, contamination was noted in the boring logs, except where the clay is noticeably absent in the vicinity of Pit F.

As discussed in Section 1.3, most of the Site was covered by lagoons at various times in the past. Historically, the lagoons were divided and enclosed by berms in various configurations such that the number and sizes of the lagoons varied substantially over the years (**Figures 1.3-a** through **1.3-n**). Currently, there are five lagoons present at the Site. Lagoons 1, 2, and 3 are distributed in a roughly north-south direction from the south central to the central portion of the Site. Lagoons 4 and 5 lie in the north central and northeastern portions of the Site. Lagoon 1 is the smallest, with a surface area of approximately 50,000 square feet (ft^2). Lagoon 4 is the largest with a surface area of approximately 128,000 ft^2.

Pits A through G are of relatively limited areal extent, with sides less than 100 feet long.

The previous waste volume estimates have been refined using the Environmental Visualization System® (“EVS”)-GIS modeling program. Combined with the reevaluation of the Site lithology information (described above), the steps below summarize how the waste volume was estimated for each waste (**Table 6.5-1**).

- Tarry liquids in Lagoons 1, 2, and 3 -- estimates of surface areas were determined using GIS and multiplied by an estimated thickness of tarry liquids for each lagoon. Very limited data are available for estimating the thickness of the lagoon tars due to the difficulty in obtaining accurate bottom measurements. For Lagoons 1 and 2, an estimated tarry liquid thickness of 5 feet was presumed; for Lagoon 3, an estimated tarry liquid thickness of 2 feet was presumed. The total volume of tarry liquids in Lagoons 1, 2, and 3 is estimated to be approximately 25,500 cy (**Figure 3.2-7**).

- Highly liquid drilling mud -- It was further assumed that highly liquid drilling mud dominates the materials beneath the tarry liquids in Lagoons 1, 2, and 3 and extends to the depth of the native clay, which is believed to exist beneath the lagoons. In order to facilitate EVS-GIS modeling of this material in the lagoons, "virtual borings" were placed within the area of each lagoon. These artificial borings were used to impose a conical geometry (versus cubic) for each lagoon, which provides an approximation of the actual lagoon bottom geometry. The volume of highly liquid drilling mud contained beneath Lagoons 1, 2, and 3 is included in the Site-wide volume determined for this waste (**Table 6.5-1**). Highly liquid drilling mud in Lagoons 4 and 5 is assumed to be present from the surface to approximately 8 feet below surface, on average. The volume of highly liquid drilling mud contained in Lagoons 4 and 5 is estimated to be 59,000 cy (**Figure 3.2-8)**. This volume incorporates information from the 2005 – 2006 Emergency Action, where the surface of Lagoons 4 and 5 was reduced to an approximate elevation of 12 feet MSL.

- The volume of materials associated with the former Pits A - E, G, and H locations are based on the depths from the ground surface to the top of the native clay layer in the vicinity of these pits (**Figure 3.2-12**). The combined volume of Pits A, B, and H, located in the northwest corner of the Site, is approximately 8,200 cy. The combined volume of the southeastern Pits (C, D, and G) is approximately 3,925 cy. Pit E, located south of Pit F and north of the Pits C, D, and G group, has an estimated volume of 4,100 cy. These pit areas are composed of a mixture of fill materials, impacted soils, and drilling mud.

- Pit F is estimated to contain approximately 75 cy of liquid/semi-liquid wastes near the surface, and the associated area volume of impacted and non-impacted overburden material within the vicinity of the pit comprises an estimated 40,700 cy of soil[1]. Impacted groundwater volume in the Pit F area is estimated to be near 1.5 million gallons, estimated using average depths of impacted saturated zones, approximate lateral extents, and assumed porosity of 0.4 (**Figure 3.2-13**).

- The volumes of remaining non-native solid wastes not discussed above (including highly liquid drilling mud throughout the Site and not in Lagoons 4 and 5, drilling mud [unsaturated], impacted soils, non- or minimally-impacted fill soils, and concrete/construction debris) were also estimated using EVS-GIS modeling of the waste distributions from the reanalyzed boring logs. The approximate in-place volumes of each of these wastes are as follows:

  - Highly liquid drilling mud (excluding Lagoons 4 and 5): 310,000 cy (**Figure 3.2-9**)
  - Drilling mud (unsaturated): 186,000 cy (**Figure 3.2-10**)
  - Impacted soils: 291,000 cy (**Figure 3.2-11**)
  - Fill soils: 364,000 cy (**Figure 3.2-14**)
  - Concrete/construction debris: 69,000 cy.

- In addition, the native clay beneath the waste at the Site is likely to be partially impacted. Although limited data are available for this material, it is presumed that up to a 1-foot thickness of this clay is impacted over the area of the Site. This equates to an impacted volume of approximately 61,000 cy.

Using the above methods, the in-place volume for the Site is approximately 1,422,500 cy. Using the estimated expansion factors for each respective wastes, as shown on **Table 6.5-1**, the excavated volume of wastes described above is approximately 1,575,600 cy.

6.5.2 Comparison of Volume Estimates

Each of the previous volume estimates has used different assumptions, which were summarized in the WMCROF (Project Navigator, Ltd., 2002a). **Table 6.5-2** compares the previous and current volume estimates. As shown in the Table, the previous studies have underestimated the volume by up to 20% because the previous estimates do not include impacted soil down to the clay layer.

Additionally, a provision must also be made for the potential to handle waste-impacted stormwater during construction activities, as part of the remediation work. The significant surface area of the Site, combined with the water retention properties of the lagoons, results in the possibility of accumulating large volumes of surface water and/or stormwater which may require treatment prior to offsite disposal or discharge under appropriate regulatory agency permits.

6.5.3 Weight Estimates

The weight of each potential solid waste was estimated by multiplying the *in-situ* volume by an estimated material density. For some wastes, density data were obtained (Section 3.2.6) and these values were

[1] Soil volume estimate based on approximate impact area of 55,000 ft^2 (see **Figure 3.2-13**) and average depth of 20 ft bgs and includes overburden with slight or no impacts.

used to estimate the material bulk density. The total tonnage for all solid wastes combined is approximately 2,001,700 tons (**Table 6.5-1**).

Summary of Section 7: Summary of Treatability and Pilot Studies

Original Study

Initial Feasibility Study Report

ENVIRON 2000

Treatability Studies

- *Ex Situ* Stabilization
- *Ex Situ* Solvent Extraction

Pilot Tests

- *Ex Situ* Stabilization
- *Ex Situ* Solvent Extraction

Pilot Test No. 1

Field Solvent Extraction & Emissions Testing

- Evaluate potential odors and air emissions during performance of these treatment technologies to aid in the design of emission control techniques to be used during full-scale implementation of Site remedial actions
- Evaluate Site-specific material handling issues to aid in the design of the selected soil remediation alternatives
- Demonstrate and evaluate pilot-scale performance of waste treatment techniques selected for treatment of Site waste materials
- Evaluate the characteristics of recovered oil and other products

Conclusions

- Onsite noise levels below regulatory guidelines
- DTSC-approved air monitoring action levels not exceeded
- No onsite worker exposed or offsite release generated above air monitoring action levels
- No emissions generated in excess of SCAQMD permit limits
- Separated waste streams required additional effort to yield a cleaner separated product

Pilot Test No. 2

Field Stabilization Testing

- Evaluate through appropriate air monitoring if the additives used for stabilization, when mixed with lagoon or former lagoon area wastes and impacted soils, generate VOCs that reach concentrations of concern
- If VOCs are generated above levels of concern, demonstrate that these VOCs can be promptly mitigated through the use of various vapor-suppressing products

Conclusions

- Onsite noise levels below regulatory guidelines
- DTSC-approved air monitoring action levels not exceeded
- No onsite worker exposed or offsite release generated above air monitoring action levels
- Generated stabilized product from the 5 mix designs, passed all chemical and physical DQO evaluation criteria

New Study

Pilot Study No. 3 Waste Characterization, Emissions and Excavation Testing Program Workplan

Project Navigator, Ltd./GeoSyntec Consultants, 2004

Pilot Study No. 3 (Phase IX)

- *Ex Situ* Chemical Oxidation
- Sludge Fluidization

Pilot Test No. 3 (Phase IX)

***Ex Situ* Chemical Oxidation**

- Evaluate the effectiveness of *Ex Situ* Chemical Oxidation treatment to reduce emissions (to less than 50 ppm) and TPH concentrations (to below relevant standards) in impacted soils and drilling muds

Sludge Fluidization

- Explore potential use of additives to facilitate pumping the lagoon tarry liquids and drilling muds without generating emissions above regulatory limits

Conclusion

***Ex Situ* Chemical Oxidation**

- *Ex Situ* chemical oxidation is rejected as a process option

Sludge Fluidization

- Sludge Fluidization is feasible for making certain drilling muds and tarry liquids pumpable

7.0 SUMMARY OF TREATABILITY AND PILOT STUDIES

7.1 Introduction

Various treatability and pilot studies have been designed to test approaches for handling and/or treating waste types:

- Initial FS treatability and pilot studies (Appendix X) are summarized in Section 7.2.1.
- Results of Pilot Study No. 3 Phase IX (Appendix Y) are summarized in Section 7.2.2.

7.2 Findings of the Treatability and Pilot Studies

Section 7.2 summarizes the findings of the treatability and pilot studies.

7.2.1 Treatability Studies

Ex situ Solvent Extraction Study: *Ex situ* onsite solvent extraction technology used a biosurfactant/solvent (water) to mix with the Site's tarry sludges and sediments from Lagoons 1 and 2 to extract and concentrate petroleum hydrocarbons. Initial screening/observations indicated favorable oil/water separation and increased pumpability for the two runs of the tarry material but the run of the semi-solid material failed. The best mix design was recirculated, which favorably decreased the product's viscosity and exhibited superior separation qualities.

Ex situ Stabilization: The *Ex situ* stabilization processes tested various mix designs with Lagoons 1 and 2 (semi solid) waste and Lagoon 4 (more solid) wastes. The initial data did not identify any characteristics incompatible with the stabilization process. *Ex situ* Asphalt Recycling (Section 8) was rejected during the preliminary screening of process options based on effectiveness and implementability criteria. The results for the remaining mix designs were favorable.

The best mix design was 40% solid/semi-solid material from the Site, 58% aggregate/stabilizers (available at the Site), and 2% emulsion. The leachable concentrations of VOCs, SVOCs, and metals in the final product were reduced to non-detectable concentrations in the leachate collected from the final product.

Stabilization Study: *A stabilization/fixation technology was evaluated for use on the Site.* The process evaluated used proprietary chemical agents and additives to stabilize mobile constituents of concern within a waste matrix. Because VOC and odor emissions were observed, a full-scale pilot project was recommended.

Two field pilot tests were performed to further evaluate the feasibility of full-scale implementation of two remedial technologies:

- *Ex situ* Solvent Extraction, and
- *Ex situ* Stabilization – with a focus on emissions/odors.

The objectives of the pilot tests were to simulate full-scale remedial activities.

Pilot Test No. 1: This test was designed to evaluate excavation, waste handling, waste mixing, and *Ex situ* Solvent Extraction testing in the presence of a thorough air monitoring/sampling program. **Figure 11-3** of Appendix A shows a process diagram of the solvent extraction system. *Ex situ* Solvent Extraction was rejected (see Section 8) during the preliminary screening of process options based on effectiveness and implementability criteria.

Pilot Test No. 2 -- Field Stabilization Testing: This test was designed to evaluate the various Site wastes that could be excavated and stabilized using a surface mixing stabilization process, to produce a reusable product (engineered backfill) without the emission of elevated VOC concentrations. The feasibility of application of surface mixing during Pilot Test 2 was based on the low levels of VOC and odor emissions observed during Pilot Test No. 1. The following conclusions were developed:

- Onsite noise levels were below the regulatory guidelines.
- The DTSC-approved air monitoring action levels were not exceeded.
- Approved exposure levels were met.
- The stabilized product passed all the chemical and physical DQO evaluation criteria.

7.2.2 Pilot Study No. 3 (Phase IX)

7.2.2.1 *Ex Situ* Chemical Oxidation

Phase IX of the Pilot Study No. 3 program was developed to assist in improving material handling efficiency and controlling VOC emissions. A strong chemical oxidant was mixed with the waste material to oxidize the waste to carbon dioxide and water. The study also included testing to reduce odors and VOC emissions. The scope of this study was described in the Phase IX Addendum and involved applying the reagent to the waste, measuring the VOC emissions of the waste with a PID before and after addition (and repeating this process), and qualitatively assessing the odors before and after treatment. The technology effectively decreased the concentration of TRPH, but the light end hydrocarbons (C6 to C12) were not reduced. Furthermore, TRPH concentrations were effectively reduced only at reagent concentrations that would be cost prohibitive.

The Odor Pro product (used to reduce odors and VOC emissions) was not included in the evaluation of Suppression Agents in Section 8 due to its poor performance in controlling VOC emissions from the lagoon drilling mud and the fact that the foam products tested during Pilot Study No. 3 effectively controlled both VOC and odor emissions.

7.2.2.2 Sludge Liquification

A hot water bath and proprietary surfactants were used to evaluate the pumpability of the tarry liquids in Lagoons 1 and 2 and to determine if any recoverable oil could be separated from the tars. Notable problems included the large quantity of water required, product heating and emissions, and cross-contamination of the separated phases. These adverse features led to the elimination of *Ex situ* Solvent Extraction as a viable process option during preliminary screening. In addition, no testing was performed on pumpability of the drilling mud.

Products from two vendors, Petromax Technologies and Texas Envirochem (TEC) Group, were tested. Sludge Liquification testing was performed at the Site on December 13 and December 14, 2004. Samples were collected from drums containing materials generated during the Pilot Study No. 3 activities and transferred into 5-gallon pails. The following table (**Table 7.2-A**) shows the waste type and associated sample location from the Pilot Study No. 3 work utilized for testing.

Table 7.2-A. Sludge Liquification Sampled Materials

Waste Type	Drum (Sample) Location
Tarry Liquids – Lagoons	PNL-L1A (Lagoon 1-Sample A)
Drilling mud – Lagoon	PNL-L4A and PNL-L5B (Lagoon 4 -Sample A and Lagoon 5-Sample B)
Drilling mud – Former Lagoon	PNL-BA6

The Petromax products generated a pourable product that did not stick to the sides of the sample container. PID emissions were below 50 ppm at all times, but there were still odors present following product addition. Petromax estimated that the product was added at a ratio of approximately 1:4 to 1:6 product to waste.

TEC's additive (ACL) produced a semi-pourable state, although the viscosity appeared to be significantly greater than after addition of the comparable Petromax product. Addition of the ACL product generated emissions greater than 50 ppm, which necessitated use of the HE-1000 product for control. Odors were very strong, and the odors associated with the ACL were even stronger than the untreated waste. Large quantities (greater than the theoretical 6%) of TEC's ACL product were added to the tarry liquids. Similar to the HE-1000/drilling mud test, following product addition, the viscosity appeared to be significantly higher than after addition of the comparable Petromax product.

7.3 Implications for the Feasibility Study

Section 7.3 discusses how the studies fold into the present FS process.

***Ex Situ* Chemical Oxidation.** Based on the results of the Phase IX bench study, *Ex situ* Chemical Oxidation is rejected as a process option in preliminary screening (Section 8). The primary test objective, to remediate the light end hydrocarbons (C6 to C12), was not met, and TRPH concentrations were effectively reduced only at reagent concentrations that were cost prohibitive. In addition, the objective of evaluating VOC emissions reduction was not assessed for impacted soil due to sample characteristics and not assessed for drilling mud because these materials were not tested.

Sludge Liquification. Based on the results of the Sludge Liquification bench studies described above, this technology is feasible for making certain drilling mud and tarry liquids from the Site pumpable, without generating significant emissions (or with application of certain mitigating steps). The above results were taken into consideration in evaluating the feasibility of Sludge Liquification for treatment and removal of drilling mud and lagoon tarry liquids during the preliminary and final screening of this remedial technology (Fluidization and Pumping).

Summary of Section 8: Screening of Remedial Technologies and Process Options

Initial Feasibility Study Report
ENVIRON 2000

Results of Preliminary Screening Confirmed → Identify Waste Types and Media → Identify General Response Actions → Identify Technologies for Each General Response Action → Screen Technologies and Process Options → Retained Technologies/ Process Options

Media	Remedial Action Objectives	General Response Actions
Groundwater	Prevent ingestion of and dermal contact with groundwater and inhalation of VOCs from groundwater. Prevent degradation of groundwater quality and migration of COPCs to offsite groundwater (i.e., to City parcel).	• No Action • Institutional Controls • Monitoring • Containment (Engineering Controls) • Collection/Treatment/Discharge • Treatment (in situ)
Tarry Liquids *(Lagoons 1-3)*	Prevent human and ecological exposure to tarry waste in Lagoons 1, 2, and 3. Prevent migration of COPCs from tarry waste to groundwater.	• No Action • Institutional Controls • Containment • Removal/Treatment (emissions reduction and disposal preparation)/Disposal
Soil/Solid Waste -- CHP Parcel *(Impacted Soil, Minimally-Impacted Soil, Pits, Drilling Muds, Highly Liquid Drilling Muds, Debris)*	Prevent human and ecological exposure to solid wastes. Prevent migration of COPCs from solid waste to groundwater.	• No Action • Institutional Controls • Containment • Removal/Treatment (emissions reduction and disposal preparation)/Disposal • Recycle (Debris only)
Soil/Solid Waste -- City Parcel	Prevent human (e.g., City worker) and ecological exposure to solid wastes. Prevent migration of COPCs from solid wastes to groundwater.	• No Action • Institutional Controls • Containment • Removal/Treatment (emissions reduction and disposal preparation)/Disposal • Recycle (Debris only)
Pit F Waste and Pit F-impacted soils	Prevent human and ecological exposure to Pit F waste and Pit F-impacted soils. Prevent migration of COPCs from Pit F waste and Pit F-impacted soils to groundwater.	• No Action • Institutional Controls • Containment • Removal/Treatment (emissions reduction and disposal preparation)/Disposal • Recycle (Debris only)

Resultant Process Options per Media

Groundwater
- Institutional Controls including Deed Restriction(s)
- Monitoring
- Containment option of Capping
- Collection options including Interceptor Trenches, Wells, Vapor Control Systems, and Excavation with subsequent *ex situ* treatment options including Granular Activated Carbon Filtration and Oil/Water Separation and discharge
- *In Situ* Treatment options including Chemical Oxidation and Natural Attenuation enhanced with oxygen and/or other amendments

Tarry Waste
- Institutional Controls including Deed Restriction(s), Fencing, Signs
- Removal option of Excavation with Foam Suppressants for emissions control and treatment for transportation and disposal including Cement, Fly Ash or other Stabilizing Agent and Fluidization and Pumping through Pressure Shear Mixing or Hydroblasting with disposal options of Truck or Rail to Landfill

Soil/Solid Waste – CHP Parcel
- Institutional Controls including Deed Restriction(s), Fencing, Signs
- Containment options of Capping (multiple options of cap design) and Sediment Control Barriers (Storm Water Containment)
- Removal option of Excavation with Foam Suppressants for emissions control and treatment, if needed, for transportation and disposal including Cement, Fly Ash or other Stabilizing Agent with disposal options of Truck or Rail to Landfill and Slurry Injection Technology
- Recycle option of Debris Breaking/Crushing for onsite concrete debris

Soil/Solid Waste – City Parcel
- Removal option of Excavation with Foam Suppressants for emissions control and treatment, if needed, for transportation and disposal including Cement, Fly Ash or other Stabilizing Agent with disposal options of Truck or Rail to Landfill and Slurry Injection Technology
- Recycle option of Debris Breaking/Crushing for onsite concrete debris

Pit F Waste and Pit F-Impacted Soils
- Institutional Controls including Deed Restriction(s), Fencing, Signs
- Containment option of Sediment Control Barriers (Storm Water Containment)
- Removal option of Excavation with Foam Suppressants and Sprung Structures for emissions control and treatment for transportation and disposal, if needed, including Cement, Fly Ash or other Stabilizing Agent with disposal option of Truck or Rail to Landfill.

See Table 8.4-1 and 8.5-1 through 8.5-6 for complete info

8.0 SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

8.1 Introduction

The initial Feasibility Study ("initial FS") (Environ, 2000) presented a preliminary screening of remedial technologies and process options for the Site based on implementability and proven effectiveness as presented in Table 7-1 and 7-2 of the initial FS (Appendix A). The results from the initial FS screening were reviewed as a starting point for developing a list of remedial technologies and process options for this RFS.

This section is organized as follows:

- Section 8.2. Review of Initial FS Findings - Presents results of review of the results of the initial FS (Environ, 2000) preliminary screening of technologies and process options and indicates which technologies/process options will be rescreened in this RFS.
- Section 8.3. Impacted Media – Identifies each of the wastes or impacted media identified at the Site.
- Section 8.4. Identification of General Response Actions ("GRAs") – Presents a discussion of the identified GRAs for each media.
- Section 8.5. Identification and Screening of Remedial Technologies and Process Options – Provides a description of identified remedial technologies and process options that correspond to each GRA for each media, discusses the advantages and disadvantages of these technologies/process options for the Site, and screens each process option with regards to effectiveness, implementability, and cost.

8.2 Review of Initial FS Findings

Numerous documents related to the evaluation and collection of additional data at the Site have been prepared since the initial FS. In 2004, the RPs developed and implemented Pilot Study No. 3, as described in Appendix D, with results summarized in Section 3. The Emergency Action was completed in January 2006, with results presented in the Emergency Action Completion Report and Emergency Action Completion Report Addendum (Project Navigator, Ltd.a, b, 2006). These additional investigations, analyses, and evaluations did not result in information that would significantly change the results of the initial screening of technologies and/or process options, as presented in Tables 7-1 and 7-2 of the initial FS (Appendix A). For the most part, those approaches that were rejected in the initial FS screening are still inappropriate for the wastes encountered at the Site.

The results of the initial FS preliminary screening (Table 7-2 of Appendix A) were mostly confirmed, as discussed below, and used as the foundation for an expanded screening evaluation in this RFS. The following is a summary of the review of the preliminary technology screening performed in the initial FS and any implications pertinent to this RFS:

- The initial FS's screening rejection for *Ex situ* Biological Treatment was confirmed – this remedial technology type continues to be rejected and will not be re-screened.
- Screening results for Thermal Treatment remedial technology type are partially confirmed. Thermal desorption is rescreened in this RFS as a potential option for reducing emissions of excavated materials during excavation or cap construction.
- The initial FS's screening rejection for *In situ* Stabilization remedial technology type was not confirmed in this RFS. *In Situ* Stabilization was rejected in the initial FS because it was not a complete treatment for both metals and hydrocarbons, the primary contaminants in the impacted Site materials. *In situ* Stabilization may be applicable in combination with a separate remediation process (e.g., thermal desorption) for remediation of petroleum

hydrocarbons and may be beneficial for pre-treatment prior to physical removal of tarry liquids and highly liquid drilling mud.

- The initial FS's screening rejections for the other four *in situ* treatment technologies – Biological Treatment, Immobilization, Physical Separation, and Soil Vapor Extraction – are confirmed.

8.3 Impacted Media

A conceptual waste management approach was developed to focus the evaluation, screening, and selection of technologies and process options based on the issues identified in this RFS Sections 3, 4, 5, and 6. These primary issues are as follows:

- Management of Pit F area impacted soils – odors and handling issues due to the sticky nature of the material,
- Management of tarry liquids and drilling mud – odors and handling issues due to their semi-solid nature,
- Management of groundwater, including NAPL and groundwater removed from excavations.

Focus on these issues calls for grouping the Site wastes according to similar anticipated physical properties (i.e., viscosity, ease of handling) to aid in remedial planning. This approach recognizes the various wastes identified at the Site, the risks associated with potentially leaving them on the Site, and the likely issues relating to future Site development which could be associated with leaving those wastes on the Site under some form of cap.

The specific wastes and waste locations discussed in Section 3 are grouped into corresponding media of interest for the purpose of the feasibility study. However, solid waste found within the City parcel is considered separately from solid waste in the Cannery Hamilton Properties, LLC ("CHP") parcel because separate ownership of these parcels may dictate or enable different remedial considerations. The media of interest and grouped corresponding waste types at the Site are:

Media	Waste Type (Section 3.2.3 and 3.3)
Groundwater	• Groundwater • Non-Aqueous Phase Liquids (NAPL)
Tarry Liquids	• Tarry Liquids in Lagoons 1, 2, and 3
Soil/Solid Waste	• Highly Liquid Drilling mud in Lagoons 4 and 5 • Highly Liquid Drilling mud (Non-Pit and Non-Lagoon Areas) • Drilling mud (higher strength/lower moisture) • Impacted Soils • Pits A, B, C, D, E, G, and H Areas • Minimally-Impacted Fill Materials • Native Soils
Pit F Waste and Pit F-Impacted Soils	• Pit F Area

For the purpose of this study, surface water is not included as a waste type due to its temporary occurrence on the lagoons during the rainy season. Any surface water found on the ponds at commencement of remediation will be treated and discharged, as appropriate, as part of the remedial action, and surface waters that accumulate during remediation will be handled according to the future Construction Storm Water Pollution Prevention Plan to be maintained during implementation of the remedy at the Site. Also, all remedial alternatives will have provisions for surface water control following their respective remedial actions. Section 8.5.2 discusses options to address surface water, should any accumulate on the Site during remedial activities.

The media of interest and their respective remedial action objectives ("RAOs") were discussed in Sections 6.1 and 6.4.

8.4 General Response Actions

General Response Actions ("GRAs") are a range of actions that could satisfy the RAOs and are determined for each media of interest. The GRAs for the media of interest are identified as follows and are listed in **Table 8.4-1**.

For groundwater beneath the CHP parcel, the GRAs address the remediation of known impacts and the detection of any migration offsite. The City parcel, potentially a future offsite property, presently has no groundwater impacts, and, therefore, GRAs specified for the groundwater under the City parcel are not needed. The potential GRAs identified for groundwater are:

- No Action,
- Institutional Controls,
- Monitoring,
- Containment,
- Collection/Treatment/Discharge, and
- Treatment (*in situ*).

GRAs identified for the tarry liquids (i.e., materials from Lagoons 1 through 3) are:

- No Action,
- Institutional Controls,
- Containment, and
- Removal/Treatment (emissions reduction and disposal preparation)/Disposal.

GRAs identified for the soils or solid wastes, for the CHP and City parcels and for the Pit F area, are:

- No Action,
- Institutional Controls,
- Containment,
- Removal/Treatment (emissions reduction and disposal preparation)/Disposal, and
- Recycle.

Some GRAs (e.g., Removal/Treatment/Disposal) are composites of several potential actions anticipated to be necessary. For example, a removal action (primary GRA) performed at many areas of the Site will necessitate a means of reducing emissions and/or a treatment step to prepare for transportation and disposal (e.g., solidification, mixing with soils)(secondary GRAs). Technologies and process options that address these secondary GRAs will be screened and evaluated along with the primary action.

The No Action GRA provides a baseline that is required as part of the FS process, reflecting a No Action remedial alternative that will be a baseline alternative solely for comparison to other alternatives.

An Institutional Control GRA provides protection through administrative and engineering controls, such as deed restrictions.

The Monitoring GRA for groundwater provides a check on containment of known impacts and helps to identify new releases to groundwater at the Site. Monitoring at the downgradient perimeter identifies potential offsite impacts and at the upgradient perimeter identifies potential impacts from offsite.

The Containment GRA is designed to reduce the infiltration of surface water into groundwater and to prevent the migration of COPCs to other media. In addition, Containment actions may eliminate certain exposure pathways (e.g., vapor inhalation, ingestion, and dermal contact) for human and biological receptors. Therefore, the results of Containment actions at a site would include reduction of risks to human health and the environment and prevention of further degradation of groundwater quality.

A Removal GRA provides permanence with regards to elimination of exposure at the Site, but the potential exposure is relocated to another site. Also, Removal GRAs include significant short-term impacts (e.g., noise, truck traffic/emissions, waste emissions).

Finally, a Recycle GRA, particularly suited, but not limited, to debris found at the Site, provides benefits of reducing many short-term impacts (i.e., less offsite disposal) while enhancing long-term benefits (i.e., beneficial reuse onsite).

8.5 Identification and Screening of Remedial Technologies and Process Options

The process options for the affected materials at the Site are listed by media in **Tables 8.5-1** through **8.5-5** and are discussed in the following sections. **Tables 8.5-1** through **8.5-5** also show the results of a screening of the process options based on effectiveness, implementability, and relative cost. A qualitative scale of High/Moderate/Low was used to rank the effectiveness, implementability, and relative cost of each of the process options, and the judgement as whether the process option would be retained or rejected for inclusion in the remedial alternatives is found in the final column of each respective table.

Effectiveness was evaluated based on the proven reliability of the process option to achieve the RAOs for the specific waste type (i.e., protective of human health and the environment through controlling access, rendering the exposure pathway incomplete, or reducing toxicity, mobility, or volume). The implementability evaluation focused on the availability of the technology, compatibility with the Site conditions, compliance with Applicable or Relevant and Appropriate Requirements ("ARARs"), and ease of permitting. The implementability was also divided into sub-issues of Complexity and Level of Emission Control Required. The level of emission control that is needed is a focus due to the strong odors of some wastes and proximity to residences. The sub-issues are further described as follows:

- Complexity — The extent of regulatory (local approvals, permitting, etc.) and technical (e.g., waste facility acceptance) hurdles required to get the technology to the field, and
- Level of Emissions Control Required – A qualitative assessment of the extent of emissions control required to meet applicable standards. For example, a simple excavation and removal approach would include only two steps, excavation and loading directly into trucks for offsite disposal. However, for the *Ex situ* Solvent Extraction approach previously pilot tested at the Site, additional handling steps are required; hence the potential to produce additional emissions.

Finally, relative cost is assessed between similar process options to aid in selection of a representative process option, where appropriate, for each technology. The remedial alternatives for the Site will largely be comprised of these representative process options, although selection of the actual process option to be used will be determined during the remedial design.

Rejected technology types and process options are those that rank low for either or both effectiveness and implementability compared to the technologies and process options that were retained. A high relative cost was the other criterion that caused rejection from consideration as a representative process option.

Descriptions of the process options for each of the remedial technology types are presented below.

Several of the process options retained for further evaluation were subjected to bench scale treatability testing as described in the Phase IX Addendum to the Pilot Study No. 3 Workplan (Project Navigator, Ltd., 2004a, f). The results of these recent evaluations, along with the previous laboratory and field scale pilot studies, are summarized in Section 7 and Appendices X and Y.

For the Fluidization and Pumping and *Ex situ* Emissions Reduction remedial technologies and process options, insufficient data were available to properly evaluate the effectiveness of these processes on the specific wastes at the Site. Therefore, additional bench scale testing was performed during Pilot Study No. 3 to provide sufficient data to fully evaluate these process options. Pre-Pilot Study No. 3 pilot scale and bench scale tests were implemented at the Site and are described in Appendix X. The recent tests, summarized in Appendix Y, confirmed the effectiveness and implementability of several fluidization and emission reduction compounds.

8.5.1 Process Option Descriptions

This section contains descriptions of the process options found in **Tables 8.5-1** through **8.5-5**. To assist the reader, subtitles herein are of the format: "*GRA -- Remedial Technology Type -- Process Option*" when referring to a process option. The descriptions appear by GRA and generally in the order that they are listed within the tables.

8.5.1.1 No Action GRA

The No Action GRA for all media (**Tables 8.5-1** through **8.5-5**) is included as the basis for a No Action remedial alternative and exists and is retained only for that purpose. It consists of no process options.

8.5.1.2 Institutional Controls GRA

The Institutional Controls GRA (**Tables 8.5-1** through **8.5-5**) consists of Administrative Controls, including Deed Restrictions, and Engineering Controls, including Fencing and Signs and, in the case of Tarry Waste, Netting.

Institutional Controls -- Administrative Controls -- Deed Restrictions

Deed Restrictions can include prohibition of drilling groundwater source wells, prohibition of intrusive activities in soils, and restrictions on land use. Deed restrictions are an easily implementable, low cost means of effectively preventing certain exposures to groundwater (e.g., prohibition of installing groundwater wells) or waste (e.g., land use restrictions). Because CHP owns the Site and other parties own the mineral estates below the Site and have rights to access the Site, Deed Restrictions will be effective for the CHP parcel to the extent applicable to the mineral estates owners.

Institutional Controls -- Engineering Controls -- Fencing and Signs

Fencing and Signs used as Engineering Controls are deemed low in effectiveness for human protection from groundwater or protection of groundwater because these controls are easily ignored or bypassed. However, Fencing and Signs are retained as process options to be included in remedial alternatives for the CHP parcel (**Table 8.5-1**).

Institutional Controls -- Engineering Controls –Netting

An Institutional Control for Tarry Waste that was not used for groundwater or solid wastes is the Engineering Control of Netting designed to keep birds and other wildlife out of the exposed waste. Netting is rejected for inclusion in the remedial alternatives because of high maintenance and lack of permanence.

All Institutional Controls are rejected for the City parcel soils (**Table 8.5-4**) because this parcel will not be part of the controlled Site following remediation (i.e., the City parcel will be outside of any fenceline). However, if the goal of unrestricted land use cannot be obtained due to unforeseen technical reasons, then deed restrictions would be pursued for the City parcel. These potential restrictions would be limited in scope due to the undevelopeable geometry of this parcel (i.e., the City parcel could entertain only narrow, long uses such as street widening, utility corridors, or landscaping and could not include significant structures).

8.5.1.3 Monitoring GRA

Monitoring (**Tables 8.5-1**) for COPCs in groundwater through sampling and analytical testing is an effective means to check for new impacts to groundwater or offsite impacts. Monitoring of groundwater is retained as a process option to be included in remedial alternatives. The monitoring process option is not needed for the City parcel groundwater because 1) there are no present impacts to groundwater in the City parcel, 2) impacted soils and waste are to be removed from the City parcel in all applicable remedial alternatives (see Section 9), and 3) the City parcel is located hydraulically downgradient from the CHP parcel, and hence monitoring the groundwater at the CHP parcel perimeter will also monitor potential impacts to the City parcel groundwater.

Monitoring as a process option does not apply to waste types other than groundwater.

8.5.1.4 Containment GRA

The Containment GRA for groundwater and tarry and solid waste types (**Tables 8.5-1** through **8.5-5**) consists of Capping options, Vertical and Horizontal Barriers, Sediment Control Barriers, and Dust Control. The Capping process options include Monolithic Soils Cap, Geomembrane Cap, RCRA-Equivalent Cap, and a RCRA Cap, each with features that can be protective of groundwater quality by preventing percolation through capped waste materials and protective of human health by mitigating the impacts of upward diffusive and advective VOC vapors from groundwater and from waste. Capping also isolates waste from human contact, thereby eliminating dermal and ingestion exposure pathways.

Below are descriptions of Capping, Vertical Barrier, Horizontal Barrier, Sediment Control Barriers, and Dust Control process options.

Containment -- Capping -- Monolithic Soil Cap

A Monolithic Soil Cap consists of a soil cover over the waste with a permeability of less than 1×10^{-5} cm/sec when compacted to 90% relative compaction. The monolithic soil layer (**Figure 8.5-1**), is typically underlain by a physical barrier, such as crushed concrete, placed directly on top of the waste. Because a Monolithic Soil Cap is not designed as an impermeable layer to prevent infiltration of water, it would also not significantly impede upward migration of gaseous emissions from underlying wastes. However, risk models show that this type of cap system would be adequate for most onsite recreational use exposure scenarios. A Monolithic Soil Cap can be designed as an evapotranspirative cap (i.e., a cap that supports plants that transpire equivalent amounts of moisture as they receive through rain, thereby producing a water balance and minimizing water percolation to the waste).

Containment -- Capping -- Geomembrane Cap

- The Geomembrane Cap shown in **Figure 8.5-2** includes a vegetative soil cover similar to the Monolithic Soil Cap; however, a number of additional layers are included below the surface cover. For the Geomembrane Cap, a geotextile fabric is used to prevent the clogging of the physical barrier by sediment. Beneath the physical barrier, a 60 mil thick very flexible polyethylene (VFPE) geomembrane is installed. VFPE has very good puncture and impact resistance and is very well suited for capping areas with the potential for large surface settlements. As shown on **Figure 8.5-2**, the Geomembrane Cap also requires installation of liquid and gas collection systems within the waste layer, beneath the geomembrane.

Containment -- Capping -- RCRA-Equiavalent and RCRA Caps

- A RCRA-Equivalent Cap system (**Figure 8.5-3)** is identical to the Geomembrane Cap except that a geosynthetic clay liner ("GCL") is placed above the waste and foundation layer. A GCL is a factory-manufactured hydraulic barrier consisting of a layer of bentonite clay or other very low permeability material supported by geotextiles and/or geomembranes and mechanically held together by stitching and overlapping. Other characteristics of the Geomembrane Cap design, including vapor and leachate collection, would be retained should a Multilayer Cap be employed.

A RCRA Cap (**Figure 8.5-3**) provides ultimate protection of human health through elimination of the vapor pathway and protection of groundwater through the elimination of leaching of COPCs to groundwater. This is done through a layer of low-permeability clay or bentonite and clay mix. The RCRA cap is a specific multilayer cap with application to containing hazardous wastes with high potential for VOC impacts to air and leaching to groundwater. For protection of groundwater quality, the RCRA Cap, although most protective, is rejected from inclusion in the remedial alternatives because the additional features and cost do not provide significant additional protection compared to the less costly RCRA-Equivalent Cap. The potential components of each capping technology are tabulated in **Table 8.5-6**.

Comparisons between the three retained cap technologies (Monolithic Soil, Geomembrane, and RCRA-Equivalent) show that cost significantly increases as the level of protectiveness increases. Difficulty to implement also increases with protectiveness. Only the Geomembrane and RCRA-Equivalent caps provide easily implementable vapor and leachate control. The Monolithic Soil cap can provide vapor and leachate control when designed as an evapotranspirative cap, but the lack of an impermeable layer jeopardizes the long-term viability of any vapor collection system used with such a soil cap.

Containment -- Vertical Barriers

Vertical Barriers for containment of impacted groundwater include Slurry Trench Cutoff Walls, Grout Curtains, and Sheet Pile Walls. Vertical Barriers are designed to prevent the horizontal migration of wastes and cross-contamination with non-impacted materials.

Containment -- Vertical Barriers -- Slurry Trench Cutoff Walls

Slurry trenching is a means of placing a low permeability subsurface cutoff, or wall, near a waste source to capture or contain contamination (USEPA, 1984). For pollution migration control, most vertical barriers are constructed by the slurry wall technique (Sharma and Lewis, 1994). The slurry wall can be formed by excavating a trench along the entire perimeter of the Site and using a bentonite and water slurry to support the trench wall. The trench would then be backfilled with materials having a lower permeability than the surrounding soil, typically trench soil mixed with bentonite clay and water. Soil-bentonite and cement-bentonite slurry trench cutoff walls are the two most prevalent construction techniques. Soil-bentonite walls are composed of soil materials (often trench construction spoils) mixed with bentonite slurry (Suthersan, S., 1997). Cement-bentonite walls are constructed using a slurry of Portland Cement and bentonite set to form a permanent, low-permeability wall. In general, soil-bentonite slurry walls are less permeable and more resistant to chemical degradation than cement-bentonite walls. For this reason, only soil-bentonite cutoff walls were evaluated. Slurry walls would not be needed if the final design includes a cap over the Site that incorporates regrading of the berms and construction of an engineered cover which is keyed into the native clayey soils at the toe of the slope of the cap.

The main advantages and disadvantages of soil-bentonite Slurry Trench Cutoff Walls are the following:

Advantages

- Process offers the widest range of compatibilities to different wastes,
- Because of the high elasticity of the material, the wall is able to deform,

which reduces cracking and maintains barrier integrity, and

- Installation cost is relatively low.

Disadvantages

- May require odor control if impacted drilling mud are encountered.

Containment -- Vertical Barriers -- Grout Curtains

Grout Curtains are vertical cutoff walls constructed using one of the traditional grouting techniques. Grouting is the process of solidifying soil by injecting under pressure a slurry or grout of cement, bitumen, or clay into the pore spaces and voids of the soil to solidify them. The grout is injected along a line or "curtain" which transforms into a solid mass as the grout sets, reducing water or contaminant flow through the curtain. Grouting is generally effective in gravelly soils and coarse and medium-coarse sand. It is less effective in fine-grained soil, and is ineffective in clayey soil (Jumikis, 1971). Grout Curtains would not be needed if the final design includes a cap over the Site that incorporates regrading of the berms and construction of an engineered cover which is keyed into the native clayey soils at the toe of the slope of the cap.

Advantages

- Easily installed with available equipment, and
- Installation along the perimeter of the Site could easily be performed in areas with no construction debris.

Disadvantages

- Not effective in clayey soil.

Containment -- Vertical Barriers -- Sheet Pile Cut-Off Walls.

Sheet Pile Cut-Off Walls are vertical cut-off walls constructed using interlocking metal sheet piles instead of using a soil and bentonite slurry. Piles aligned in a linear curtain arrangement are driven into the soil using a pile driver. Sheet Pile Cut-Off Walls would not be needed if the final design includes a cap over the Site that incorporates regrading of the berms and construction of an engineered cover which is keyed into the native clayey soils at the toe of the slope of the cap.

Advantages

- Installation along the perimeter of the Site would be easily performed using available equipment, and
- Less permeable than grout curtains.

Disadvantages

- There is potential for leakage at sheet pile joints.

Vertical Barriers are rejected for solid wastes because implementation would be redundant with horizontal capping that will be keyed into the clay layer. Vertical Barriers also rejected for Pit F-impacted waste because of depth of waste near Pit F. Vertical Barriers are rejected as a remedial technology type for groundwater containment because they are ineffective for long-term containment of groundwater impacts.

Containment -- Horizontal Barriers -- Liners

Liners, as the various forms of caps, are designed as horizontal barriers to limit the vertical migration of COPCs to groundwater and VOCs to ambient air. Liners generally consist of impermeable, singular or composite, sheeting of HDPE or other synthetic material.

While the use of Liners may be moderately effective against leaching of COPCs to groundwater, their use is impractical over large areas such as the area of the Site. Liners are better suited for smaller areas such as Pit F where they are presently employed. Even when used for smaller areas, liners are vulnerable to chemical oxidation and do not offer long-term effectiveness. Liners are therefore rejected for inclusion in the remedial alternatives.

Containment -- Sediment Control Barriers -- Storm Water Containment

Sediment control by Storm Water Containment works because sediments migrate advectively through storm water flow. Any remedial alternative with COPC-laden materials exposed to the weather would require Storm Water Containment as a process option. A Storm Water Containment system would be documented in a Storm Water Pollution Prevention Plan and would include means of sediment containment.

Containment -- Dust Control -- Revegetation

Dust Control by Revegetation consists of planting and growth of various plants to minimize wind and water erosion and hold sediments in place through adherence to roots.

Containment -- Dust Control -- Capping

Dust Control by Capping is achieved through isolation of COPC-laden sediments, waste, or dust that could become airborne if exposed to wind.

8.5.1.5 Collection/Treatment/Discharge GRA (Groundwater)

Collection/Treatment/Discharge -- Collection

As shown in **Table 8.5-1** and **8.5-2**, the Collection process options associated with the impacted groundwater Collection/Treatment/Discharge GRA include Subsurface Drains (Interceptor Trenches with Pumps), Wells with pumps, Vapor Control Systems, Excavation, and NAPL Recovery (Bailing).

Advantages

- Uses readily available technology,
- Easy to implement.

Disadvantages

- May result in potentially long-term VOC emissions,
- May require onsite tankage,
- NAPL at the Site is viscous and difficult to collect in bailers, and
- Long term Operations and Maintenance (O&M) costs.

Most of these process options are needed for managing impacted groundwater and will be retained for inclusion in the remedial alternatives. NAPL collection by bailing is rejected due to the viscous nature of the NAPL found at the Site.

Collection options of Vapor Control Systems and Excavation are also rejected for groundwaters in the City parcel because Vapor Control Systems are only employed with capping and, hence, are unnecessary due to the absence of a cap in these areas.

Collection/Treatment/Discharge -- Ex situ Treatment

Treatment process options for the Collection/Treatment/Discharge GRA include Air Stripping, Granular Activated Carbon Filtration, and Oil/Water Separation.

As part of the Collection/Treatment/Discharge GRA, treatment of groundwater after collection would likely be required before any form of discharge. Groundwater Ex Situ treatment process options include Air Stripping, Granular Activated Carbon Filtration, and Oil/Water Separation.

Collection/Treatment/Discharge -- Ex situ Treatment -- Air Stripping

Air Stripping uses relatively clean air to remove contaminant VOCs dissolved in groundwater and transfers these contaminants into the gaseous phase, where they can be treated/discharged (Suthersan, 1997). There are various established air stripping options that can be grouped into two major classes: packed columns and packing-less systems. The conventional air stripper configuration used in groundwater remediation is a countercurrent packed column. In this setup, contaminated groundwater is pumped to the top of a packed column, where it flows by gravity over inert media, while simultaneously clean air is blown from the base of the column. Air flows up through the casing water, and this mixing of air/water over the media provides for contaminant transfer. The design of the stripping system is governed by a number of parameters such as the physical and chemical characteristics of the contaminants of concern, the water temperature, air/water ratio, column height, and the physical properties of the packing media. Depending on the air flow rate, types and concentrations of contaminants, and regulatory requirements, GAC or thermal oxidation may be required for treatment of the contaminant-laden off-gas.

Due to the relatively low concentrations of VOCs in groundwater beneath the Site, packing-less strippers should also be considered. There are a few variations of packing-less strippers, such as fine bubble aeration systems and low profile sieve tray air strippers.

The advantages and disadvantages of Air Stripping are as follows:

Advantages

- Generally a mature, cost-effective technology for removal of VOCs present in contaminated groundwater, and
- Several design variations are available and can be altered to meet Site-specific requirements.

Disadvantages

- Performance uncertain for low levels of VOCs; Bench and/or pilot testing may be required,
- Requires effluent air treatment,
- Extraction wells and above-ground equipment would be required,
- Treatment systems may require permitting, and
- Equipment can be prone to fouling due to inorganics precipitation (calcium carbonate, iron hydroxide, etc.) or biological growth, particularly due to brackish nature of groundwater beneath the Site.

Based on the unknown effectiveness of standard designs for low levels of VOCs, need for offgas treatment, and the brackish nature of the groundwater beneath the Site and its potential to exacerbate fouling, Air Stripping is rejected from further consideration.

Collection/Treatment/Discharge -- Ex situ Treatment – Granular Activated Carbon Filtration (GAC)

This process option consists of passing the water stream through a treatment vessel filled with GAC. Organic constituents, such as BTEX compounds, adsorb readily onto the GAC micropores, effectively removing them from the waste. Treated liquid exits the outlet of the GAC adsorber. GAC is commonly manufactured from coal and coconut shells, the latter generally providing higher adsorption rates but at an increased cost. GAC can be procured as virgin or reactivated product. Reactivation is a process where contaminants are desorbed from spent GAC.

As applied to groundwater treatment, this process option can have a pre-treatment consisting of bag filters or possibly organoclay media filters that would be sufficient in lieu of an oil/water separator.

Advantages –GAC Treatment for Groundwater

- Mature, off-the-shelf technology, and
- Expected to be effective for remediating low levels of VOCs.

Disadvantages – GAC Treatment for Groundwater

- Regular O&M may be required and includes waste management activities,
- Extraction wells and above-ground equipment would be required,
- Treatment systems may require permitting, and
- Pre-treatment is likely to be required.

Ex situ GAC treatment of groundwater is retained for further consideration (**Table 8.5-1**).

Collection/Treatment/Discharge -- Ex situ Treatment -- Oil/Water (Gravity) Separator

This process option consists of passing a water stream through an open-top tank equipped with coalescing media, an internal baffle and adjustable skimmer. The process is based on the difference between the specific gravity of water and insoluble oil globules. The proper hydraulic design and the retention time in the separator must be maintained to allow for phase separation to occur. The hydraulic retention time is a function of the rise in velocity of a standard size oil globule in the oil/water mixture. The effective hydraulic design of the separator entails the development of a properly sized quiescent zone of non-agitation before the liquid reaches the outlet baffle. Coalescing media enhances oil/water separation by causing agglomeration of oil globules, which, at an optimal size, increase the rise velocity of oil to the point where effective phase separation can occur. Often, emulsifying agents are added to water stream prior to entering the treatment vessel, which assist in breaking out oil/water emulsions for separation.

Collection/Treatment/Discharge -- Discharge

Three remedial technology types shown in **Table 8.5-1** exist for the *Collection/Treatment/Discharge* GRA: Onsite Discharge to the Ground, Offsite Discharge to Storm Drains or Sanitary Sewer (publicly owned treatment works - POTW), and Offsite Disposal at a Landfill's Treatment plant. The implementation of each of these technologies would depend greatly on the characteristics of the wastewater encountered (and whether or not treatment can be rendered). These three technologies are discussed in turn.

Collection/Treatment/Discharge -- Discharge -- Onsite Discharge to the Ground

Onsite treated surface water or groundwater could be used at the Site for dust control and soil compaction. Water from an onsite treatment plant could be pumped to a central water tank and water trucks employed for application. Wastewater would be recycled and thus reduces the quantity of imported fresh water required for construction activities. Treated water will need to meet certain treatment standards to be reused onsite.

Onsite Disposal to the Ground for use in dust control or soil compaction is retained for further consideration.

Collection/Treatment/Discharge -- Discharge -- Offsite Discharge to Storm Drains or Sanitary Sewer (POTW)

For any unused portion of the treated water, there are various options for disposal. One option is to discharge the treated water into the Huntington Beach Flood Control Channel (or via the City of Huntington Beach storm water drains adjacent to the Site) under an NPDES permit from the Santa Ana Regional Water Quality Control Board (Water Board). The Huntington Beach Flood Control Channel borders the Site at the southwest corner (see **Figure 1.1-1**). The channel merges with the Talbert Flood Control Channel between Magnolia and Brookhurst Streets, and the merged channels enter the Talbert Marsh Wetlands and flow eventually into the Pacific Ocean. In the initial FS, it was confirmed that the County of Orange Environmental Management Agency owns the Huntington Beach Flood Control Channel (Environ, 2000). It was also confirmed that if an NPDES permit could not be obtained, the Orange County Sanitation Districts (OCSD) may allow discharge of the treated water into the sanitary sewer system. During the Winter of 2004 - 2005, approximately 3.8 million gallons of surface water that collected in the lagoons onsite was pumped, treated, and discharged under a Special Purpose Discharge Permit with the OCSD (Project Navigator, Ltd., 2005b,c) to the sanitary sewer line adjacent to the Site.

The advantages and disadvantages of this remedial technology type are discussed below.

Advantages

- Depending upon the volume, likely to be less expensive than offsite disposal to a landfill, even after infrastructure construction, and
- Large volumes of water can be disposed in a short timeframe.

Disadvantages

- Water would still likely require pre-treatment as discussed in Section 8.5.4.2 to meet discharge requirements (NPDES or sewer),
- NPDES permit would need to be obtained (for discharge to Huntington Beach Flood Control Channel or City storm drains), in addition to a general NPDES permit for construction of the remedy,
- Sewer charges may be incurred if onsite treatment processes fail to meet sewer loading limits (OCSD disposal option),
- Difficulty in obtaining a Special Purpose Discharge Permit from the OCSD for the discharge of water from the Site unless in the case of an emergency, and
- Infrastructure, including piping for sewer connection or drainage line for storm channel outfall, would need to be constructed.

As shown in **Table 8.5-1**, Offsite Disposal to Storm Drain or Sanitary Sewer (POTW) is retained for further evaluation.

Collection/Treatment/Discharge -- Discharge -- Offsite NAPL/Groundwater Disposal to Landfill (with Treatment)

Offsite wastewater treatment may be the most cost effective or essential approach for managing certain impacted liquids generated during construction. For instance, some liquids including tarry liquids may not be treatable using standard approaches to meet discharge limits required for onsite use or offsite disposal to storm drains or the sewer system. In the Offsite Disposal to Landfill (with Treatment) remedial technology type, impacted liquids would be pumped from trenches or collection tanks directly into vacuum trucks and can then be taken to one or more of several commercially available recycling facilities in Los Angeles.

Advantages

- No design or treatability investigation required, and
- No additional infrastructure must be built, and no onsite treatment equipment is required.

Disadvantages

- Likely to be more expensive than storm channel or sewer disposal for large volumes, and
- Due to the potentially large volume of wastewater that would be managed, a large number of vacuum trucks would likely be required that would generate added traffic over a long period of time.

As shown in **Table 8.5-1**, Offsite NAPL/Groundwater Disposal to Landfill (with Treatment) is retained for further consideration.

8.5.1.6 *In situ* Treatment GRA (Groundwater)

In situ treatment options for groundwater (**Tables 8.5-1**) include Air Sparging, Chemical Oxidation, Permeable Reactive Zones, and Natural Attenuation/Bioremediation – Enhanced with Addition of Oxygen and other Amendments.

In situ Treatment / Air Sparging

In situ Air Sparging is the process of injecting air into the saturated subsurface to treat impacted groundwater. *In situ* Air Sparging is primarily effective in removing VOCs from saturated media through stripping, under relatively permeable conditions. Primary air sparging mechanisms include partitioning of volatile contaminants from the aqueous phase to the vapor phase (stripping) for subsequent transfer to and removal from the vadose zone through either passive or active methods [USACE, 1997].

Air is injected into the saturated zone via injection wells, to promote contaminant partitioning from the liquid to the vapor phase. Offgas may be captured and treated with a soil vapor extraction (SVE) and treatment system, if necessary. As for other groundwater technologies, groundwater monitoring would be conducted to document remedy performance.

Advantages

- Contaminants would be removed from groundwater reducing toxicity and volume of COPCs in groundwater.

Disadvantages

- Requires collection and treatment of vapors. Otherwise, contaminants are mobilized into vadose zone and atmosphere without treatment.
- Time is required for sparging action to affect entire treatment zone. Largely diffusion driven. Remediation could require months to a couple of years.
- Requires installation of aboveground equipment and extraction wells.

As shown in **Table 8.5-1**, *In situ* Treatment – Air Sparging, is rejected from further consideration due to its relatively low effectiveness and implementability. *In situ* Air Sparging mobilizes volatile groundwater contaminants, requiring recapturing and treatment with a secondary collection system. The presence of the shallow clay layer in the saturated zone is expected to inhibit collection of these vapors. In addition, there is documented evidence of the poor effectiveness of *In situ* Air Sparging for remediating low VOC concentrations.

In situ Treatment – Chemical Oxidation

Chemical Oxidation relies on the delivery of chemical oxidants to impacted media in order to destroy the contaminants by converting them to innocuous compounds commonly found in nature. The oxidants applied in this process are typically hydrogen peroxide (H_2O_2), potassium permanganate ($KMnO_4$), ozone, or to a lesser extent, dissolved oxygen (DO) [USEPA, 1998]. Chemical Oxidation is used for groundwater, sediment, and soil remediation. It can be applied to a variety of aquifer soil types. Chemical Oxidation can be used to treat volatile organic chemicals (VOCs) including benzene, toluene, ethylbenzene, and xylene (BTEX) [USEPA, 1998].

Pilot or bench-scale tests are typically employed before full-scale implementation (ITRC, 2001). The volume and chemical composition of individual oxidant treatments are based on contaminant mass and volume, subsurface characteristics, and pre-application laboratory test results. The oxidant chemical can be delivered via temporary or permanent injection wells or an infiltration trench along the downgradient boundary of the impacted area. After initial injection, periodically recharging or re-injection of oxidant solution may be necessary, based on results of groundwater monitoring data.

Advantages

- Eliminates expensive infrastructure required for a pump-and-treat system (no disposal of water or wastes).
- Oxidation of contaminants results in a long term permanent solution because the contaminants are destroyed. A reduction in contaminant toxicity, mobility, and volume is achieved.
- Oxidation occurs rapidly once contact with contaminants is achieved (benzene is readily amenable to oxidation, particularly by H_20_2/O_3).
- Equipment and labor are readily available.

Disadvantages

- Time is required to inject oxidant and establish contact with contaminants, and
- Requires installation of aboveground equipment and injection wells.

As shown in **Table 8.5-1**, *In situ* Chemical Treatment is retained for further evaluation. Further analyses of groundwater chemistry may be needed to verify that Chemical Oxidation will sufficiently achieve COPC destruction to meet the RAOs.

In situ Treatment – Permeable Reactive Zone

An *in situ* reactive zone is a subsurface zone where migrating contaminants are intercepted and permanently immobilized or degraded into harmless byproducts (Suthersan, 1997). Because VOCs are the target compounds at the Site, the reactive wall may be set up for *in situ* chemical oxidation reactions. During chemical oxidation, the target compound is converted by an oxidizing agent into harmless end products. Typical oxidizing agents that have been used in the past included chlorine dioxide, hypochlorite, H_2O_2, ozone, and $KMnO_4$. The reactive zone may also be designed with integrated bioremediation with oxidation, with oxidation acting as a pretreatment step to break down some complex organics, generating simpler organic molecules that are more amenable to biodegradation (Suthersan, 1997).

At the Site, there are two conditions which would significantly decrease the performance of an *in situ* reactive zone. First, the contamination at issue is believed to be very localized. Second, the groundwater gradient at the Site is relatively low, ranging from 0.0008 to 0.007 ft/ft.

The advantages and disadvantages of *In situ* Reactive Zones for the Site are:

Advantages

- Eliminates the expensive infrastructure required for pump-and-treat systems,
- Inexpensive installation – primary expense is installation of reagents (via injection wells or gravity feed) and O&M costs (only sampling required is groundwater monitoring),
- No disposal costs for "treated" groundwater,
- No significant space requirements, and
- Contaminant destruction (by oxidation/bioremediation mechanisms).

Disadvantages

- May not be technically feasible for Site due to low gradient and very localized impacts that require treatment,
- Effective implementation requires delivery and distribution of the required reagents in a homogeneous manner across the entire reactive zone.

Based on the questionable effectiveness of *In situ* Reactive Zones for localized remediation of VOCs at the Site, this technology type is rejected from further consideration.

In situ Treatment /Natural Attenuation/Bioremediation

Natural Attenuation refers to naturally occurring processes in soil and groundwater environments that act to reduce the mass, toxicity, mobility, volume, or concentration of contaminants over time. These *in situ* processes include biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants [USEPA, 1999]. Destructive mechanisms, such as biodegradation, are key processes in the successful application of natural attenuation because they provide an active component to reduce the mass of hazardous substances over time.

Oxygen release compound (ORC), or another oxygen-enhancing means, could be used during the process to supply oxygen to accelerate the rate of naturally occurring aerobic contaminant biodegradation in groundwater at the Site. ORC is typically applied using direct-injection techniques. This process requires ORC to be mixed with water to form an injectable slurry which is then pressure injected using a pump. Once in the groundwater, ORC particles sorb to or reside in the soil matrix and slowly release oxygen for periods of up to 1 year. One or more applications of ORC may be required as determined through evaluation of groundwater monitoring data.

If natural attenuation is used to contain groundwater impacts, then a Site-specific groundwater monitoring and contingency plan would be developed to ensure containment and to specify responses should impacts be found at the Site perimeter. Further analyses of groundwater chemistry may be needed to verify that natural processes are sufficient to contain impacts.

Advantages

- Biological degradation destroys contaminant mass. Other physical processes act to reduce concentration over time.
- Easily implemented. Only requires monitoring wells.
- No significant space requirements.

Disadvantages

- Mobility is not affected, and overall volume of impacted groundwater may increase due to dispersion.
- Time frame is dependent on the rate of biodegradation including oxygen concentration and other groundwater conditions. Could require many years.
- Periodic groundwater monitoring would be required to evaluate the rate at which natural processes are occurring. Trained specialists required for evaluation of monitoring data.

As shown in **Table 8.5-1**, Natural Attenuation/Bioremediation is retained for inclusion in the remedial alternatives.

8.5.1.7 Removal/Treatment (emissions reduction and disposal preparation)/Disposal GRA

The Removal/Treatment (emissions reduction and disposal preparation)/Disposal GRA (**Tables 8.5-3** through **8.5-5**) consists of the Excavation process option and supporting process options for emissions control and treatment for preparation for disposal (i.e., make suitable for transport). Emissions Control process options include using Foam Suppressants, Ex Situ Chemical Oxidation, Ex Situ Thermal Desorption, and Sprung Structures.

Removal/Treatment (emissions reduction and disposal preparation)/Disposal -- Emissions Reduction -- Foam Suppressants

During the Pilot Study No. 3 work, various emissions suppressants including water-based surfactants and foams were tested for effectiveness in mitigating odor and emissions in Pit F impacted soils. The Pilot Study No. 3, Phase VIII, investigation showed that Rusmar foam product was able to eliminate approximately 90 percent of PID emissions (see Appendix F).

Advantages

- Low cost relative to other “treatment” approaches, and
- Easily applied with a water solution spray using a simple pneumatic foaming unit.

Disadvantages

- Foam may only be effective if material is left undisturbed,
- Currently not a SCAQMD approved treatment method (per SCAQMD Rule 1166) for replacement of VOC-impacted materials onsite,
- Foam is likely not as effective as sprung structures, and
- Despite the effectiveness of the Rusmar foam product in controlling (i.e., suppressing) VOCs during the Emergency Action excavation activities conducted in 2005, detectable odors were noted coming from the Site during this time.

As shown in **Tables 8.5-2, 8.5-3, 8.5-4,** and **8.5-5**, Foam Suppressants are retained for further consideration.

Removal/Treatment (emissions reduction and disposal preparation)/Disposal -- Emissions Reduction – Ex Situ Thermal Desorption

Ex situ Thermal Desorption relies on thermal energy to destroy or separate contaminants from the waste. Low temperature thermal desorption uses relatively low amounts of energy at temperatures of 300°F to 1,000°F to physically separate organic contamination from wastes. In this process, soils and drilling mud containing organic contaminants are heated, driving off the water and organic contaminants, and producing a dry solid containing trace amounts of the organic residues. The volatilized contaminants are not oxidized and require a condenser, an afterburner, or must be captured on a carbon bed (Department of Health Services, "DHS," 199l). There are several process variations, the most significant being whether or not the heat is applied directly or indirectly to the surface of the contaminated medium. Only indirect thermal desorption treatment would be considered applicable to the Site due to the relatively high concentrations of organic contaminants. Processing rates for *Ex situ* Thermal Desorption systems vary widely and are a function of the moisture and oil content, grain size, and the residence time of the material in contact with the heating elements in the unit required to meet the performance objectives.

According to DHS (DHS, 1991) and California Base Closure Environmental Committee, "CBCEC" (CBCEC, 1994), the main advantages and disadvantages of *Ex situ* Thermal Desorption are the following:

Advantages

- Process is simple and can use readily available equipment,
- Energy costs are generally lower than high temperature systems, such as the rotary kiln, and
- The system can potentially handle large volumes of waste.

Disadvantages

- Some systems are effective only in treating VOCs, and
- Application of this process to the soils and drilling mud at the Site which are too wet may require a centrifuge to pre-dry these materials. The system may require subsequent treatment of the removed vapors.

An extensive literature review was conducted during Phase IX of Pilot Study No. 3 regarding the efficacy of *Ex situ* Thermal Desorption for the remediation of drilling mud and impacted soils to reduce TPH levels and emissions. The review showed that the effectiveness of *Ex situ* Thermal Desorption is well documented for treatment of both TPH-impacted soils and oil-based drilling mud. Additional details from this literature review are presented in Appendix Y. *Ex situ* Thermal Desorption is retained for further consideration.

Removal/Treatment (emissions reduction and disposal preparation)/Disposal -- Emissions Reduction – Ex Situ Chemical Oxidation

In the *Ex situ* Chemical Oxidation process, a strong chemical oxidant such as permanganate in a water solution is mixed with the waste matrix for a period of time sufficient for the components to react. The mixture then cures over a period of hours to days as required to reduce the target contaminant(s) to design levels. The reactions are slightly exothermic but do not impact the handling of the treated product. The basic advantages and disadvantages of *Ex situ* Chemical Oxidation are as follows:

Advantages

- Mechanical simplicity,
- No product stream cooling and liquid waste management is required, and
- Not as energy intensive of a process (fewer moving parts, no heat source required).

Disadvantages

- Not as well proven of a process for treatment of drilling mud and impacted soils,
- Exothermic reactions may create hard to control emissions during mixing and curing (as in Phase IX), and
- Pre-treatment may still be required to remove excess water and oil.

In Phase IX of Pilot Study No. 3, the RPs retained Environmental Technology Solutions (ETS) to test a proprietary "accelerated" *ex situ* chemical oxidation process on impacted soils and drilling mud from the Site. In ETS's process, hydrocarbons in the soil/clay matrix are oxidized by reacting the soil/clay with an ionized water solution containing hydroxyl free radicals and permanganate using a proprietary reaction process. The reactions take place in a pug mill, where the waste material is mixed with the reagents. Section 7 provides additional information on the ETS process and the results of the bench study. As discussed in Section 7, the third party vendor's tests performed on impacted soils (drilling muds were not tested) did not show significant reductions in TPH concentrations or VOCs in the waste matrix. Primarily based on the results of the Phase IX bench study, *Ex situ* Chemical Oxidation is rejected from further evaluation.

Removal/Treatment (emissions reduction and disposal preparation)/Disposal -- Emissions Reduction -- Sprung Structures (with vapor collection/treatment)

Sprung-type stressed membrane structures (engineered, relocatable, clearspan) equipped with vapor control and treatment equipment are potentially applicable to excavation and disposal of odiferous wastes (i.e., the Pit-F area impacted soils and lagoon materials). The unit substructure is rustproof, extruded aluminum, and the architectural membrane consists of acrylic or tedlar-coated Dupont Dacron® polyester fibers. The sprung structure would be sized to accommodate the area needed to be covered. The Pit F area could be covered with a "stock" structure. The structure would be erected over the area to be excavated, anchored to the ground based on soil conditions, and remain onsite for the duration of excavation. Following excavation, the structure would be dismantled. The sprung structure would be equipped with a vacuum blower, and potentially toxic vapors may be scrubbed using granular activated carbon or similar conventional technology.

Following are advantages/disadvantages of Sprung Structures (with vapor collection/treatment):

Advantages

- Most effective approach for controlling odors and emissions onsite. Would eliminate requirements for additional odor and emissions control and air monitoring outside the structure.
- Process may be only effective option for controlling odors and emissions from certain wastes.

Disadvantages

- Structure requires time for erection and dismantling (approximately one month).
- Spent GAC or other media treating offgas requires offsite disposal.
- Reduced excavation productivity due to need to work in enclosed space with workers potentially wearing respiratory protection, etc.

As shown in **Tables 8.5-2, 8.5-3, 8.5-4,** and **8.5-5**, Sprung Structures (with vapor collection/treatment), based on their high proven effectiveness, are retained for further consideration for Pit F and Pit F-Impacted Soils (due to proximity to residences) but are rejected for Tarry Waste and Solid Waste in the CHP parcel as unwarranted due to greater distance to receptors and much higher cost than other means to reduce emissions. Sprung Structures are also rejected for Solid Waste in the City property due to the lack of odorous waste believed to be present in the City property.

Removal/Treatment (emissions reduction and disposal preparation)/Disposal – Treatment for Disposal

The Removal/Treatment (emissions reduction and disposal preparation)/Disposal GRA consists of supporting process options to treat wastes to make them suitable for transport and disposal. For the tarry and solid wastes these include Cement, Fly Ash or other Stabilizing Agent, Fluidization and Pumping –

High Pressure Shear Mixing or Hydroblasting, *Ex Situ* Solvent Extraction – Hot Water Biosurfactant/Solvent

Removal/Treatment (emissions reduction and disposal preparation)/Disposal -- Treatment for Disposal -- Cement, Fly Ash or other Stabilizing Agent

Due to the liquid nature of the lagoon tarry liquids, *In situ* Stabilization Using Cement, Fly Ash or Other Amendments may be required prior to excavation using standard construction equipment. *In situ* Stabilization can also have the added benefit of immobilizing metals (such as leachable lead) that can otherwise render a waste hazardous.

To implement this approach, a volume of waste equivalent to one day's production would be segregated for stabilization. Using a long reach excavator equipped with a special "finger rake" head, large debris would be removed from the surface of the area to be solidified. Using the same excavator equipped with a special hydraulic mixing head, reagents would be injected to the waste and concurrently mixed. The mixer has the ability to thoroughly blend reagents by propelling the waste and reagent mixture vertically from top to bottom through the rotating mixer head. The reagents can be applied dry and through an injection hose on the hydraulic mixing head or applied as a slurry directly into the mixing cell. The slurry can be prepared onsite using a pug mill and conveyor system or delivered pre-mixed in slurry trucks.

After the reagent and waste are mixed, the stabilized material would be allowed to cure for approximately 12 to 24 hours. Following curing, the stabilized material can be excavated using a long reach excavator equipped with a 2 to 4 cubic yard bucket and loaded into appropriate containers for transportation by truck to an offsite disposal facility.

Advantages

- Process should be more feasible than *Ex situ* Stabilization, which may be impractical for the lagoon tarry liquids, and
- Process would immobilize most metals and, to some degree, petroleum hydrocarbons, thus mitigating the high cost for stabilization at an offsite disposal facility.

Disadvantages

- The sticky nature of the lagoon tarry liquids may complicate reagent mixing,
- The level of VOC and odor emissions during the mixing process are not well established, and
- Added reagents would add volume to the waste.

Based on the screening criteria shown in **Table 8.5-2**, *In situ* Stabilization and Excavation will be retained as a process option for remediation of the lagoon tarry liquids.

Removal/Treatment (emissions reduction and disposal preparation)/Disposal -- Treatment for Disposal -- Fluidization and Pumping – High Pressure Shear Mixing or Hydroblasting

The feasibility of adding emulsifying agents and using high shear mixing equipment for fluidization of the lagoon tarry liquids was confirmed during recent treatability studies (see Section 7). Proprietary emulsifying agents added to the waste encapsulate and permanently modify the opposing surface charges between hydrocarbon molecules and the inorganic particles (i.e., solids) to which they adhere. This process allows the hydrocarbons to flow freely in solution. The surface modification is accomplished by shearing the hydrocarbons from the inorganic particles. Treatment can be achieved by hydroblasting the emulsifying agents into the waste material at pressures of 3,000 to 5,000 psi or greater, or by injecting the product either *in situ* or *ex situ* into the waste using high-shear mixing. The fluidized waste can then be removed using a vacuum truck transfer into onsite tankage for offsite disposal/recycling. Fluidization and Pumping by addition of emulsifying agents and high shear mixing are discussed further in Section 7.

Advantages

- Process has been shown to be effective on a bench scale (see Section 7), and
- Process may be more cost effective than *In situ* Stabilization **.**

Disadvantages

- Costs of emulsifying agents are not well established,
- The level of VOC and odor emissions generated during the mixing process may require mitigation with vapor suppression products (Section 7), and
- Added reagents would add volume to the waste.

Fluidization and Pumping is retained for further consideration as a potentially cost effective alternative to *In situ* Stabilization and Excavation for Tarry Waste (**Table 8.5-2**) but rejected for Solid Waste in both parcels (**Tables 8.5-3 and 8.5-4**).

Removal/Treatment (emissions reduction and disposal preparation)/Disposal -- Treatment for Disposal -- Ex Situ Solvent Extraction – Hot Water Biosurfactant/Solvent

The feasibility of using hot water biosurfactant/solvent fluidization techniques to extract hydrocarbons from the waste was tested by J&W on a bench and pilot scale in 1998 and 1999 (J&W, 1998, 1999). In the bench test, using a proprietary surfactant and hot water bath of 140^{o}F to 180^{o}F, J&W evaluated the pumpability of the heavy tars in Lagoons 1 and 2 and evaluated if any free product could be separated from the tars. For the test, the tars, hot water, and surfactants were mixed together in a ratio of 75% water to 24% waste to 1% emulsion for several minutes, and the phases were allowed to separate. Laboratory analytical testing was performed on the separated phases (sediment, oil, and water).

In a follow-up field program, J&W tested a larger volume of waste material in a nearly identical process using the same type and quantity of amendment as in the bench scale test. J&W employed a centrifuge to enhance phase separation. The results of this testing indicated that the lagoon tars are pumpable using a heated water bath process without generating significant emissions.

Although successful phase separation was achieved, significant drawbacks were uncovered in the test, which limited the practical implementability of the method at the time. The most significant technical issue involved cross-contamination of separated water and sediment phases, with reduced BTU value of the recovered product and contaminant concentrations in the water phase similar to the waste oil. The J&W pilot study report did not provide process economic data. Additional details on the *Ex situ* Solvent Extraction testing performed by J&W are presented in Appendix X.

Advantages

- If successful, process would not generate significant emissions.

Disadvantages

- Process requires *heated* water in a 3:1 ratio to the waste material. There would be considerable expense to obtain a sufficient volume of water and energy for heating,
- Contaminated water phase may require treatment prior to reuse,
- Waste oil contained excessive water that reduced BTU content so resale value was low, and
- Cost effectiveness is unknown.

Based on the performance of this technology during previous bench and pilot testing, *Ex situ* Solvent Extraction is rejected from further consideration for Tarry Waste and Solid Wastes in both parcels and Pit F (**Tables 8.5-2, 8.5-3, 8.5-4,** and **8.5-5**).

Removal/Treatment (emissions reduction and disposal preparation)/Disposal – Disposal

Disposal process options as part of the Removal/Treatment (emissions reduction and disposal preparation)/Disposal GRA include Truck or Rail Transportation to Landfill and Slurry Injection Technology.

Removal/Treatment (emissions reduction and disposal preparation)/Disposal – Disposal – Truck or Rail Transportation to Landfill

Truck or Rail Transportation for offsite disposal at a landfill is potentially applicable to both the lagoon tarry liquids and Pit F-area impacted soils, if this material is stabilized or fluidized as described above. Process options associated with truck or rail transportation include use of end dump trucks, tractor trailers with roll-off boxes, railroad transfer stations with rail cars, and vacuum trucks for handling waste from the Site. The selection of truck and/or rail transportation would be determined based on an economic study of transportation and disposal costs at candidate land disposal or recycling facilities for each waste requiring offsite disposal. This economic study would be performed during remedial design after remedy selection.

Following are advantages/disadvantages of offsite disposal at a landfill via truck or rail transportation:

Advantages

- Process is simple, using readily available equipment, and
- Process is effective in removing wastes from the Site.

Disadvantages

- This option generates diesel emissions, and significant truck traffic, and
- There are potential future cleanup and liability considerations with respect to transportation and disposal at offsite disposal facilities.

As shown in **Tables 8.5-2, 8.5-3, 8.5-4,** and **8.5-5**, Truck or Rail Transportation to a Landfill (via various methods) is retained for further consideration.

Removal/Treatment (emissions reduction and disposal preparation)/Disposal – Disposal – Slurry Injection Technology (SIT)

SIT is potentially applicable to disposal of Tarry Waste and Solid Waste if these materials could be fluidized and injected into a permitted onsite disposal well. SIT implementation would involve pilot testing, permitting, well siting, design, and construction of an injection well and injection. The feasibility of SIT was evaluated for the Site and was documented in the *Preliminary Report Site Material Characterization and Slurry Injection Technology (SIT) Evaluation*, submitted to DTSC on February 6, 2004 (Project Navigator, Ltd., 2004b, Terralog, 2004).

Advantages

- May be less expensive than offsite transportation and disposal,
- Minimal long term liability, and
- Reduced offsite impacts due to decreased truck traffic.

Disadvantages

- Regulatory hurdles, permitting, and public approval may be difficult given public perception of waste injection technology,

- Drilling and eventual abandonment of an injection well and pilot testing to further evaluate injection feasibility would be required,
- Costs for fluidization of material have not been established,
- Requires a significant volume of water for fluidization of injected wastes,
- Permitting time may delay implementation of remedial action for 2 to 3 years, and
- Slower remediation timeframe.

8.5.1.8 Recycle GRA

The Recycle GRA consists of the process options of Asphalt Recycling and Debris Breaking/Crushing using Onsite Crushers.

Recycle -- Ex situ Asphalt Recycling

Ex situ Asphalt Recycling involves use of soil and aggregate from the Site to make commercial grade asphalt. In this process, the affected materials are mixed with aggregates and emulsion. J&W performed bench scale testing of the *ex situ* asphalt recycling process (J&W, 1999). Although the asphalt stabilized product generally met performance objectives with respect to process efficiency, contaminant levels, and geotechnical properties, the process required addition of 60% amendment to 40% waste, resulting in significant bulking of the material. Strong odors were also associated with the treated product. Unless suitable offsite use of this type of recycled product could be identified, which is unlikely given the Site history and contaminants reported in wastes, the addition of amendment that significantly increases the waste volume represents an unacceptable consequence of this approach.

The main advantages and disadvantages of Asphalt Recycling are listed below:

Advantages

- Process is simple, using readily available equipment and reagents, and
- Based upon bench testing the method had relatively high throughput rates compared to other process options.

Disadvantages

- Effectiveness of process in treating certain metals would need to be demonstrated,
- Satisfying the requirement that the end product must meet the requirements for commercial grades can generally be difficult,
- Emissions associated with treated product, and
- Significant waste bulking due to amendment addition.

As shown in **Tables 8.5-2** through **8.5-5**, *Ex Situ* Asphalt Recycling is rejected as a process option.

Recycle -- Debris Breaking/Crushing – Onsite Crushers

The options for addressing the concrete debris include onsite and offsite crushing (not considered based on cost). The Onsite Debris Crushing option consists of using mechanical equipment for crushing the concrete debris. The steel reinforcing bar from the concrete would be removed during crushing, or by laborers using shears or torch-cutting equipment. The concrete materials may require limited pressure washing using an emulsifying agent to remove oily residue (similar to that used for fluidization of the lagoon tarry liquids and drilling mud – see Section 8.5.2.2 and 8.5.3.2), and then separated into 2-ft. plus and 2-ft. minus sizes. The 2-ft. size is the maximum size for rubble to be processed through a crusher. The 2-ft. plus size materials can be sized to 2-ft. minus size using an excavator with pulverizer and hammer attachments. Steel reinforcing bar can be stockpiled and then removed as scrap salvage. The concrete sized to 2-ft. minus size can then be loaded with a loader into trucks and hauled to an onsite rubble stockpile for crushing into a ¾-inch base product that could be used onsite as backfill. Dust would be controlled at all times with water spray and water trucks. Advantages and disadvantages of Onsite Debris Crushing are as follows:

Advantages

- Process is simple using readily available equipment, and
- The generated crushed concrete can be used onsite as backfill, cap foundation, or drainage layer material.

Disadvantages

- Dust generated during the crushing operations would need to be controlled, and
- Noise levels would need to be controlled by limiting the hours of activity and/or restricting activities to remote areas of the Site.

With a high degree of proven effectiveness and ease of implementation, including experience during the 2005 Emergency Action work (where onsite concrete debris was collected throughout the Site, rebar cut from the concrete, and concrete broken to approximate 2-ft. minus sizes for use in the concrete buttress in Lagoon 4), Debris Breaking/Crushing (Onsite) will be retained for further consideration.

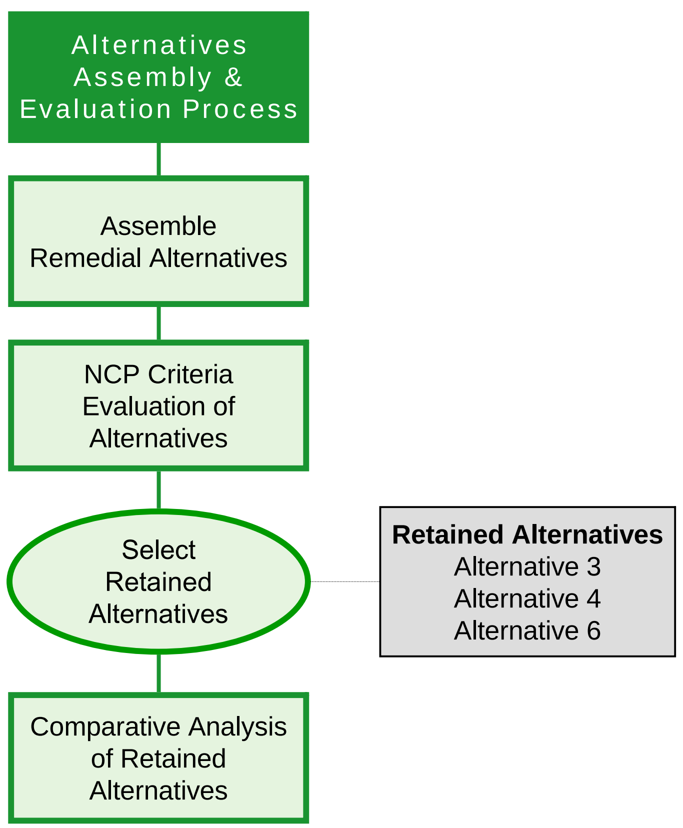
8.5.2 *Ex situ* Treatment - Surface Water

Any future surface water that may be impacted by Site wastes, including consolidation liquids and stormwater generated at the Site, can be treated onsite prior to discharge to a permitted outfall or sanitary sewer (see Section 8.5.4.3) or disposed offsite at a wastewater treatment plant. The initial FS compared the results of the surface water samples from the lagoons collected during the initial FS field studies (as presented in **Tables 3-19** and **3-19a** in Appendix A) with the typical requirements for discharge into storm drains or sanitary sewers. These analyses showed that TPH and benzene concentrations of 19 mg/L and 500 ug/L, respectively, were the most significant concentrations of contaminants in the surface water. In addition, during the 2004 – 2005 winter, several million gallons of rainwater collected in Lagoons 1 through 5. Samples of surface water from the lagoons were collected and submitted for laboratory analysis to facilitate removal of this rainwater from the Site to eliminate the potential for offsite discharges. Based on the results of these samples[1], the surface water in the lagoons was pumped through a treatment train consisting of sedimentation/equalization tanks followed by bag filters followed by GAC prior to discharge into an Orange County Sanitation District sewer connection adjacent to the Site.

Based on the experience with treating stormwater collected in the lagoons, onsite surface water treatment during remedy implementation would employ a combination of *Ex situ* physical (Oil/Water Separator) and *Ex situ* Chemical (GAC) treatment techniques to remove free product emulsions and soluble phase organics, respectively, prior to discharge. Both of these process options are mature and cost-effective for this type of application.

[1] Refer to the Surface Water Management Activities Letter Report and Addendum, March and April 2005 (Project Navigator, Ltd., 2005 b, c), for additional details.

Summary of Section 9: Assembly and Evaluation of Remedial Alternatives



Conclusions from Comparative Analysis of Alternatives 3, 4, and 6

Alternative 4 combines the benefits of both Alternatives 3 and 6, while minimizing their disadvantages

Components of Remedy Alternatives

Components of Remedy Alternatives	Alternative 1 No Response Action	Alternative 2 Limited Waste Removal	Alternative 3 Protective Cap	Alternative 4 Partial Source Removal with Protective Cap (See Note)	Alternative 5 Source Removal With Offsite Disposal and SIT	Alternative 6 Source Removal With Offsite Disposal
Move Waste off of City Property			●	●	●	●
Remove Pit F Area Waste		●	●	●	●	●
Remove Tarry Liquids in Lagoons 1, 2, and 3		●	●	●	●	●
Remove Lagoons 4 and 5 Wastes (partial or Complete)			●	●	●	●
Remove Pits A through E, G, and H				●	●	●
Remove All Waste					●	●
Protective Cap			●	●		

Reference: Table 9.2-1

Note: During Alternative 4, removal of Pits A-E, G, H depends on source removal area determined in the final remedial design.

NCP Criteria Analysis

NCP Criteria	Considerations	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
Overall Protection of Human Health	Protection of human health Protection of environment	- -	- -	M M	M M	H H	H H
Compliance with ARARs	Chemical-specific ARARs Action-specific ARARs Location-specific ARARs To be considered ARARs, and other criteria, advisories and guidance	- - - -	- H H H	H H H H	H H H H	H H H H	H H H H
Long-Term Effectiveness & Permanence	Magnitude of residual risk Adequacy and reliability of controls Approximate volume of wastes remaining at the site			H M-H H	M-H M-H M-H	L M-H L	VL H L
Reductions in Toxicity, Mobility, and Volume through Treatment	Treatment process used and materials treated Amount of hazardous substances destroyed or treated Expected reductions in toxicity, mobility, and volume Degree to which treatment is irreversible Type and quality of residuals remaining after treatment			L L H H H	L L H H H	L L H H L	L L H H L
Short-Term Effectiveness	Protection of community during remedial actions Protection of workers during remedial actions Environmental impacts Time until RAOs are achieved Approximate number of truck trips required (waste & imported soils) Level of air emissions control during removal and handling			H H M-H 1.5-2 Yrs M L	H H M-H 2.25-3 Yrs M L-M	H H M-H 6-9 Yrs H H	H H M-H 5.25-6 Yrs VH H
Implementability	Ability to construct and operate the technology Availability of goods and services Reliability of technology Ease of undertaking additional remedial actions Ability to monitor effectiveness of remedy Ability to obtain approval from agencies Coordination with other agencies Availability of offsite treatment, storage, and disposal (TSD) services and capacities			M-H M H M M-H M M M-H	M-H M H M M-H M-H M-H M-H	L L H N/A M-H VL-L VL-L M-H	M-H L-M H N/A H H H L-M
Cost	Present worth costs			M	M	H	VH
State Acceptance	DTSC acceptance of preferred remedy for the site			TBD	TBD	TBD	TBD
Community Acceptance	Community acceptance for the preferred remedy for the site			TBD	TBD	TBD	TBD

Reference: Table 9.5-1

Summary of Section 9: Assembly and Evaluation of Remedial Alternatives		Figure 9
Revised Feasibility Study Ascon Landfill Site, Huntington Beach, California	September 2007	Project Navigator, Ltd.®

9.0 ASSEMBLY AND EVALUATION OF REMEDIAL ALTERNATIVES

9.1 Introduction

Section 8 presents an initial and screening of remedial technologies and process options for the general response actions ("GRAs") corresponding to each medium of interest at the Site. The screening criteria consisted of implementability, proven effectiveness, and relative cost. **Tables 8.5-1** through **8.5-5** present the results of the screening and highlights the retained technologies and representative process options that are considered in assembling the remedial alternatives discussed in this section. This section covers the criteria used for evaluation of the remedial alternatives, waste quantities and cost estimates, a detailed evaluation of the alternatives, and the comparative evaluation between alternatives:

This Section is organized as follows:

- Section 9.2. Development of Remedial Alternatives – Explains the assembly process and identifies and describes the six remedial alternatives to be evaluated.

- Section 9.3. Evaluation Criteria and Other Considerations – Describes the 9 NCP criteria used to evaluate the six remedial alternatives.

- Section 9.4. Quantities and Cost Estimates – Describes the process of developing capital cost estimates for the six alternatives. Includes estimation of waste volumes, formulation of best and conservative case scenarios based on interpretation of key Applicable or Relevant and Appropriate Requirements ("ARARs"), Site parameters, estimation of production rates, and unit prices for key activities. Presents 30-year O&M cost estimates for the six alternatives and groundwater remediation considerations.

- Section 9.5. Nine Criteria Evaluation of Alternatives – Presents detailed assessments for each alternative against the 9 NCP criteria. In this process, three alternatives are retained for comparative evaluation.

- Section 9.6. Comparative Evaluation of Retained Alternatives – Compares the three retained alternatives from Section 9.5 against each other with respect to each of the 9 NCP criteria.

9.2 Development of Remedial Alternatives

The following representative process options for each media are resultant from the screening evaluation described in Section 8:

Groundwater
- Institutional Controls including Deed Restriction(s)
- Monitoring
- Containment option of Capping for prevention of downward leachate to groundwater and upward vapors to receptors
- Collection options including Interceptor Trenches, Wells, Vapor Control Systems, and Excavation with subsequent *ex situ* treatment options including Granular Activated Carbon Filtration and Oil/Water Separation and discharge
- *In Situ* Treatment options including Chemical Oxidation and Natural Attenuation enhanced with oxygen and/or other amendments following demonstration of Site-specific effectiveness

Tarry Waste
- Institutional Controls including Deed Restriction(s), Fencing, Signs

- Removal option of Excavation with Foam Suppressants for emissions control and treatment for transportation and disposal including Cement, Fly Ash or other Stabilizing Agent and Fluidization and Pumping through Pressure Shear Mixing or Hydroblasting with disposal options of Truck or Rail to Landfill

Soil/Solid Waste – CHP Parcel
- Institutional Controls including Deed Restriction(s), Fencing, Signs
- Containment options of Capping (multiple options of cap design) and Sediment Control Barriers (Storm Water Containment)
- Removal option of Excavation with Foam Suppressants for emissions control and treatment, if needed, for transportation and disposal including Cement, Fly Ash or other Stabilizing Agent with disposal options of Truck or Rail to Landfill and Slurry Injection Technology
- Recycle option of Debris Breaking/Crushing for onsite concrete debris

Soil/Solid Waste – City Parcel
- Removal option of Excavation with Foam Suppressants for emissions control and treatment, if needed, for transportation and disposal including Cement, Fly Ash or other Stabilizing Agent with disposal options of Truck or Rail to Landfill and Slurry Injection Technology
- Recycle option of Debris Breaking/Crushing for onsite concrete debris

Pit F Waste and Pit F-Impacted Soils
- Institutional Controls including Deed Restriction(s), Fencing, Signs
- Containment option of Sediment Control Barriers (Storm Water Containment)
- Removal option of Excavation with Foam Suppressants and Sprung Structures for emissions control and treatment for transportation and disposal, if needed, including Cement, Fly Ash or other Stabilizing Agent with disposal option of Truck or Rail to Landfill.

These retained process options were assembled into six remedial alternatives including the No Action alternative that is required by the NCP process for use as a baseline. Because of the feasibility study process, the developed alternatives address the priority of management of the different waste types based on the risk assessment and means of handling. The alternatives were also developed to encompass a wide range of remedial activities, from the No Action alternative to complete removal of all impacted media. Incorporated into the alternatives are the representative process options above. These alternatives are as follows and are described in detail below:

- Alternative 1 – No Action
- Alternative 2 – Limited Waste Removal
- Alternative 3 – Protective Cap
- Alternative 4 – Partial Source Removal with Protective Cap
- Alternative 5 – Source Removal with Offsite Disposal and SIT
- Alternative 6 – Source Removal with Offsite Disposal.

The remedial alternatives were assembled using appropriate GRAs and the representative process options that would help achieve the RAOs. For instance, each action remedy (Alternatives 2 through 6) uses removal of Pit F area wastes and tarry liquids in Lagoons 1, 2, and 3 because the Removal GRA was determined to be the only way to remediate these wastes and achieve the RAO of preventing exposures from these wastes. Thus, the remedial technologies and process options for managing the tarry liquids and Pit F area wastes are part of each of the six remedial alternatives, with the exception of Alternative 1. **Table 9.2-1** tabulates the major descriptive components (e.g., remove pits, remove tarry liquids from Lagoons 1, 2, and 3) of all of the remedial alternatives, and **Table 9.2-2** shows which process options are part of each of the various alternatives.

Each of the six alternatives are briefly summarized below and are shown on **Figures 9.2-1** to **9.2-6**:

- **Alternative 1: No Action (See Figure 9.2-1)**

  - This alternative is retained only as the baseline for alternative evaluation and screening.
  - No containment or removal actions are performed.
  - Waste remains on City parcel (refer to Section 1.2 for a description of the City parcel).
  - No deed restrictions are imposed; The Site remains as it is.

- **Alternative 2: Limited Waste Removal (See Figure 9.2-2)**

  - Uses the Institutional Controls and Removal GRAs,
  - Removal of Pit F area wastes with offsite disposal, and removal and appropriate treatment and discharge of impacted groundwater in the Pit F area,
  - Removal of the tarry liquids in Lagoons 1, 2, and 3 by 1) fluidization and pumping with offsite recycling at a fuel blending facility or 2) mixing with soil, excavation and offsite disposal at a landfill,
  - Stabilization of the lagoon areas (approximately 10 acres) with Geogrid™ and/or cement, or equivalent, and then covering with acceptable soils.
  - Infilling of Lagoons 1, 2, and 3,
  - Investigation of the location of Pacific Ranch #1 converted water well (former oil well) in the Lagoon 5 area and appropriately close, if found,
  - Investigation of the locations of AW-6 and AW-7 former groundwater monitoring wells, thought to be located under Hamilton Avenue based on anomalies found during a magnetic survey, and well destruction, if found,
  - SCOC property on the western portion of the Site (refer to Section 1.2 for a description of this property) remains as is,
  - Grade the Site to drain,
  - Waste remains on City parcel,
  - The Site perimeter would be fenced, and signs would be installed along the perimeter fence to prevent public access,
  - Maintenance of a long-term groundwater monitoring program to ensure compliance with the RAOs identified in Section 6, and
  - The CHP Parcel and City Parcel would be deed restricted to prevent any inconsistent development or activities at the Site.

- **Alternative 3: Protective Cap (See Figure 9.2-3)**

  - Uses the Institutional Controls, Removal, Containment, and Recycle GRAs for addressing soils and Institutional Controls, Monitoring, Containment, and Collection/Treatment/Discharge GRAs for addressing groundwater,
  - Removal of Pit F area wastes with offsite disposal, and removal and appropriate treatment and discharge of impacted groundwater in the Pit F area,
  - Removal of the tarry liquids in Lagoons 1, 2, and 3 by 1) fluidization and pumping with offsite recycling at a fuel blending facility or 2) mixing with soil, excavation and offsite disposal at a landfill,
  - Stabilization of the top several feet of remaining drilling mud in Lagoons 1, 2, and 3 (following tarry liquid removal) using either cement stabilization or Geogrid and/or geotextile layers or equivalent, and covering with acceptable soils,
  - Excavation and offsite disposal of a portion of the drilling mud in Lagoons 4 and 5 to allow for cap installation over this area of the Site after this portion of drilling mud has

been removed (the cost estimates and waste volumes are based on removal of approximately 2,000 cy of drilling mud from Lagoons 4 and 5)[1],

- Stabilization of the remaining drilling mud in Lagoons 4 and 5 in order to support the protective cap,
- Investigation of the location of Pacific Ranch #1 converted water well (former oil well) in the Lagoon 5 area and appropriately close, if found,
- Investigation of the locations of AW-6 and AW-7 former groundwater monitoring wells, thought to be located under Hamilton Avenue based on anomalies found during a magnetic survey, and well destruction, if found,
- Potential well destruction or modification of SCOC #40 and SCOC #41 oil wells in the SCOC property[2], if the soils remedial investigation in this area determines that the SCOC property is to be included under the cap,
- Removal, backfill, and reconstruction of the perimeter berms to an engineered slope to be situated inside the Cannery Hamilton parcel,
- Installation of shoring in the northern portions of Lagoons 4 and 5 during excavation of the north berm along Hamilton Avenue, in order to support the drilling mud in Lagoons 4 and 5 while the north berm is excavated in order to remove impacted materials from the City parcel,
- Excavation of impacted materials on the City's parcel to a depth that would achieve the RBCs (**Table 4.5-1**), anticipated to be the approximate elevation of top of clay, with offsite disposal and/or placement under the protective cap in the southwest portion of the Site and backfilling these areas to adjacent street elevation using minimally impacted soils or imported soils that are acceptable for use as backfill,
- Onsite breaking or crushing of construction debris to the degree necessary to reuse onsite and construct the cap,
- Capping the entire Site (Cannery Hamilton parcel), including the SCOC property if remedial investigation results from this area warrant capping[3], using a protective cap as containment and as a horizontal barrier[4],
- Maintenance of a long-term groundwater monitoring program to ensure compliance with the RAOs identified in Section 6, and
- The CHP Parcel would be deed restricted to prevent inconsistent development and activities, allowing for commercial or recreational use.

- **Alternative 4: Partial Source Removal with Protective Cap (See Figure 9.2-4)**

  - Uses the Institutional Controls, Removal, Containment, and Recycle GRAs for addressing soils and Institutional Controls, Monitoring, Containment, and Collection/Treatment/Discharge GRAs for addressing groundwater,
  - Removal of Pit F area wastes with offsite disposal and removal and appropriate treatment and discharge of impacted groundwater in the Pit F area,
  - Removal of the tarry liquids in Lagoons 1, 2, and 3 by 1) fluidization and pumping with offsite recycling at a fuel blending facility, or 2) mixing with soil, excavation and offsite disposal at a landfill,

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[1] The cost estimates and waste volumes developed for Alternative 3 are based on removal of drilling mud from Lagoons 4 and 5 (Appendix R) after completion of the Emergency Action conducted in 2005 - 2006, which included removal of over 30,000 cy of drilling mud from Lagoons 4 and 5 (Project Navigator, Ltd., 2006a, b).

[2] Well destruction or modification of SCOC #40 and SCOC #41 is dependent on obtaining access to the property and agreement from the mineral estate owners to destroy or modify these wells. Well destruction or modification is anticipated to be conducted by an outside party, and therefore costs for the well destruction or modification are not included in the remedy alternatives.

[3] Remediation of the South Coast Oil Corporation (SCOC) property is dependent on the results of the remedial investigation for soils. Any remediation of the SCOC property required from landfill operations is anticipated to coincide with the remediation that will be conducted at the remainder of the Ascon Landfill Site, and this area would either be capped with the rest of the Site under Alternative 3 or have contaminated soils removed such as in the City parcel. The remedial investigation results will not be available prior to finalization of this feasibility study.

[4] A protective cap would consist of at a minimum a drainage layer to minimize leachate and vegetative cover over the waste. The remedial design will determine if other protective elements such as a vapor mitigation barrier and/or leachate/vapor collection systems will be needed. The conservative cost estimates for Alternatives 3 and 4 include costs for a horizontal gas collection system.

- Stabilization of the top several feet of remaining drilling mud in Lagoons 1, 2 and 3 (following tarry liquids removal) using either cement stabilization or Geogrid and/or geotextile layers or equivalent, and covering with acceptable soils,
- Removal of portions of Lagoons 4 and 5 drilling mud to approximate adjacent street elevation (exact elevation to be determined during remedial design)[5], by excavation and offsite disposal,
- Investigation of the location of Pacific Ranch #1 converted water well (former oil well) in the Lagoon 5 area and appropriately close, if found,
- Investigation of the locations of AW-6 and AW-7 former groundwater monitoring wells, thought to be located under Hamilton Avenue based on anomalies found during a magnetic survey, and well destruction, if found,
- Potential well destruction or modification of SCOC #40 and SCOC #41 oil wells in the SCOC property[6], if the soils remedial investigation in this area determines that the SCOC property is to be included under the cap,
- Excavation of impacted materials to approximate adjacent street elevation (exact elevation to be determined during remedial design) along an area parallel to Hamilton Avenue and Magnolia Street (refer to **Figure 9.2-4** for a depiction of the approximate location of source removal) with waste disposal offsite and/or placement of excavated materials under the higher protective cap in the southwest portion of the Site[7].
- Excavation of impacted materials on the City's parcel to a depth that would achieve the RBCs (**Table 4.5-1**), anticipated to be the approximate elevation of top of clay, with offsite disposal and/or placement under the higher protective cap in the southwest portion of the Site and backfilling these areas to adjacent street elevation using minimally impacted soils or imported soils that are acceptable for use as backfill,
- Removal of pit wastes (Pits A - E, G, and H) to approximate adjacent street elevation (exact elevation to be determined during remedial design), if part of partial source removal area[8], by excavation and offsite disposal and/or placement of excavated materials under the higher protective cap in the southwest portion of the Site,
- Removal, backfill and reconstruction of the perimeter berms to an engineered slope (After construction, the berms would be situated inside the Cannery Hamilton parcel.),
- Onsite breaking or crushing of construction debris to the degree necessary to reuse onsite and construct the cap,
- Construction of a low-profile protective cap as a horizontal barrier over the excavated areas of the CHP parcel along Hamilton Avenue and Magnolia Street with imported soil (for cap cover) and acceptable materials recycled from the waste segregation operations on the Site (for cap foundation),
- Construction of a protective cap as a horizontal barrier over the southwestern portion of the Site, including the SCOC property if remedial investigation results warrant capping[9]. The cap over the Site would be a sloped cap consisting of different elevations in different areas, where the southwestern portion of the cap would be at a higher elevation than the protective cap placed on top of the excavated areas at the

[5] The cost estimates and waste volumes developed for Alternative 4 are based on removal of drilling mud from Lagoons 4 and 5 to adjacent street elevation (see Appendix R) after completion of the Emergency Action conducted in 2005 - 2006, which included removal of over 30,000 cy of drilling mud from Lagoons 4 and 5 (Project Navigator, Ltd., 2006a, b).
[6] Well destruction or modification of SCOC #40 and SCOC #41, if needed, is dependent on obtaining access to the property and agreement from the mineral estate owners to destroy or modify these wells. Well destruction or modification is anticipated to be conducted by an outside party, and therefore costs for the well destruction or modification are not included in the remedy alternatives.
[7] The area of source removal for Alternative 4 will be determined during the remedial design.
[8] The cost estimate developed for Alternative 4 assumes removal of these pits.
[9] Remediation of the SCOC property is dependent on the results from the remedial investigation for soils. Any remediation of the SCOC property required from landfill operations is anticipated to coincide with the remediation that will be conducted at the remainder of the Ascon Landfill Site, and this area would either be capped with the rest of the Site under Alternative 4 or have contaminated soils removed such as in the City parcel. The remedial investigation results will not be available prior to finalization of this feasibility study.

north and east sides of the Site. The capped areas could vary in elevation and size depending on the area and vertical extent of source removal along the east and north sides of the Site that would be determined during the remedial design.
- Maintenance of a long-term groundwater monitoring program to ensure compliance with the RAOs identified in Section 6, and
- The CHP Parcel would be deed restricted to prevent inconsistent development and activities, allowing for commercial or recreational use.
- The protective cap in Alternative No. 4 will cover most of the current area of the Cannery Hamilton parcel (except for the Pit F area). The area along Hamilton Avenue and the northern and southern sectors of Magnolia Street will be at a lower elevation due to the planned excavation and removal of impacted materials to approximate street elevation here, with a protective cap then installed at this location, resulting in an approximate elevation of 8 ft MSL, plus or minus a few feet, at the top of the protective 'lower' cap along Hamilton Avenue and Magnolia Street. The remainder of the Site will also have a protective cap, but the cap will be installed at this area of the Site over the approximate existing elevation (after the removal of tarry liquids from Lagoons 1, 2, and 3, adjustments due to breaking or crushing of existing construction debris onsite, removal of a significant portion of drilling mud from Lagoons 4 and 5, and some grading work), therefore creating a generally higher cap in the southwestern portion of the Site than the lower cap along Magnolia Street and Hamilton Avenue, following the general topography of the Site in its current condition in most areas of the Site except for the northern portion of the Site along Hamilton Avenue. The transition between the lower and higher cap will be engineered and is anticipated to be a gentle slope. Refer to **Figure 9.2-4** for a visual representation of what the protective cap would look like and to see the areas of source removal.

- **Alternative 5: Source Removal with Offsite Disposal and SIT (See Figure 9.2-5)**

  - Uses the Removal, and Recycle GRAs for addressing soils and Monitoring, Collection/Treatment/Discharge and *in situ* Treatment GRAs for addressing groundwater,
  - Removal of Pit F area wastes with offsite disposal, and removal and appropriate treatment and discharge of impacted groundwater in the Pit F area,
  - Removal of the tarry liquids in Lagoons 1, 2, and 3 by fluidization and pumping, with the waste injected into a deep (approximately 4,000 to 5,000 feet bgs) disposal well(s) located along the southern portion of the Site,
  - Removal of Lagoon 4 and 5 drilling mud by excavation, fluidization, and pumping with the waste injected into a deep (approximately 4,000 to 5,000 feet bgs) disposal well(s) located along the southern portion of the Site,
  - Removal of the remaining drilling mud present at the Site by excavation, fluidization, and pumping with the waste injected into deep (approximately 4,000 to 5,000 feet bgs) disposal well(s) located along the southern portion of the Site or disposal offsite depending on the injection well(s) capacity,
  - Investigation of the location of Pacific Ranch #1 converted water well (former oil well) in the Lagoon 5 area and appropriately close, if found,
  - Investigation of the locations of AW-6 and AW-7 former groundwater monitoring wells, thought to be located under Hamilton Avenue based on anomalies found during a magnetic survey, and well destruction, if found,
  - Removal of the remaining pit wastes by excavation and offsite disposal,
  - Excavation and offsite disposal of the remainder of the impacted materials at the Site, including the SCOC property,[10] if needed, including impacted clay, if any,

[10] Remediation of the SCOC property is dependent on the results of the remedial investigation for soils in this area. Any remediation of the SCOC property required from landfill operations is anticipated to coincide with the remediation that will be conducted at the remainder of the Ascon Landfill Site, and this area would be excavated, if warranted, and backfilled with acceptable fill material under Alternative 5.

- Onsite breaking or crushing of construction debris and reuse of the recycled materials onsite as fill,
- Segregation of minimally impacted soils[11] for reuse in backfilling the completed excavation to street grade,
- Backfilling the excavated zones with either imported soil or acceptable materials recycled from the waste segregation operations on the Site, with completion at design grade, to enable unrestricted use at the Site with the exception of SCOC property used for oil pumping/drilling operations,
- Removal and/or treatment of impacted groundwater at the Site to meet the groundwater RAOs, if needed after post-remediation risk assessment (Post-remediation risk assessment would determine if potential treatment of groundwater would be required after remedy completion.) Implementation of Chemical Oxidation or Natural Attenuation with Enhanced Oxygen would be done following Site-specific demonstration of effectiveness, demonstrations that would be possible after the removal of the solid waste.
- Maintenance of a groundwater monitoring program to ensure compliance with the RAOs identified in Section 6.
- If groundwater RAOs are found to not be achievable following soils/waste removal, then the CHP Parcel would be deed restricted to prevent inconsistent development and activities, allowing for commercial or recreational use.

- **Alternative 6: Source Removal with Offsite Disposal (See Figure 9.2-6)**

  - Uses the Removal, and Recycle GRAs for addressing soils and Monitoring, Collection/Treatment/Discharge and *in situ* Treatment GRAs for addressing groundwater,
  - Removal of Pit F area wastes with offsite disposal, and removal and appropriate treatment and discharge of impacted groundwater in the Pit F area,
  - Removal of the tarry liquids in Lagoons 1, 2, and 3 by 1) fluidization and pumping with offsite recycling at a fuel blending facility, or 2) mixing with soil, excavation and offsite disposal at a landfill,
  - Removal of Lagoon 4 and 5 drilling mud by excavation with the waste going to offsite disposal facilities, or fluidization and pumping with offsite recycling at a fuel blending facility,
  - Removal of the remaining drilling mud present at the Site, with the waste going to offsite disposal facilities, or fluidization and pumping with offsite recycling at a fuel blending facility,
  - Investigation of the location of Pacific Ranch #1 converted water well (former oil well) in the Lagoon 5 area and appropriately close, if found,
  - Investigation of the locations of AW-6 and AW-7 former groundwater monitoring wells, thought to be located under Hamilton Avenue based on anomalies found during a magnetic survey, and well destruction, if found,
  - Removal of the remaining pit wastes by excavation and offsite disposal,
  - Excavation and offsite disposal of the remainder of the impacted materials at the Site, including the SCOC property,[12] if needed, with offsite disposal, including impacted clay, if any,
  - Onsite breaking or crushing of construction debris and reuse of the recycled materials onsite as fill,

[11] The chemical properties of minimally impacted soils were described in Section 3.2.3. These materials are expected to be acceptable for reuse on the Site. Confirmation testing would be conducted on this material to verify its acceptability for reuse onsite.
[12] Remediation of the SCOC property is dependent on the results of the remedial investigation for soils in this area Any remediation of the SCOC property required from landfill operations is anticipated to coincide with the remediation that will be conducted at the remainder of the Ascon Landfill Site, and this area would be excavated, if warranted, and backfilled with acceptable fill material under Alternative 6.

- Segregation of minimally impacted soils[6] for reuse in backfilling the Site, as appropriate,
- Backfilling the excavated zones with either imported soil or acceptable materials recycled from the waste segregation operations on the Site, with completion at design grade, to enable unrestricted use at the Site with the exception of SCOC property used for oil production operations,
- Removal and/or treatment of impacted groundwater at the Site to meet the groundwater RAOs, if needed after post-remediation risk assessment (Post-remediation risk assessment would determine if potential treatment of groundwater would be required after remedy completion.) Implementation of Chemical Oxidation or Natural Attenuation with Enhanced Oxygen would be done following Site-specific demonstration of effectiveness, demonstrations that would be possible after the removal of the solid waste.
- Maintenance of a groundwater monitoring program to ensure compliance with the RAOs identified in Section 6.
- If groundwater RAOs are found to not be achievable following soils removal, then the CHP Parcel would be deed restricted to prevent inconsistent development and activities, allowing for commercial or recreational use.

9.3 Evaluation Criteria and Other Considerations

Nine Evaluation Criteria were developed to address the CERCLA requirements and considerations as well as additional technical and policy considerations that have proven to be important for selecting among remedial alternatives. “These evaluation criteria serve as the basis for conducting the detailed analyses during the FS and for subsequently selecting an appropriate remedial action.” (USEPA, 1988) The nine NCP Evaluation Criteria and considerations used to evaluate the assembled alternatives proposed for the Site are presented in **Table 9.3-1**. These criteria are:

- Overall Protection of Human Health and the Environment,
- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs),
- Long-term Effectiveness and Permanence,
- Reductions in Toxicity, Mobility and Volume through Treatment,
- Short–term Effectiveness,
- Implementability,
- Cost,
- State Acceptance, and
- Community Acceptance.

Figure 9.3-1 shows the relationship between the preliminary screening criteria used in Sections 8 and 9.2 and the NCP Criteria:

Overall Protection of Human Health and Environment — This criterion, the first of two ”Threshold Factors,” without satisfying which the alternative can no longer be considered, provides a “go, no-go” check to assure that all remedial alternatives provide adequate protection of human health and the environment. Taken into consideration in assessing this criterion will be achievement of RAOs, compliance with ARARs, implementation risk, and level of residual risk following implementation.

Compliance with ARARs — This criterion, the second of the two Threshold Factors, is used to assess compliance with applicable laws, regulations, or other requirements. Assessment will be made with regard to compliance with chemical-specific ARARs, location-specific ARARs, and action-specific ARARs. Corresponding lists of ARARs determined to be potentially applicable to remediation of the Site are found in Section 5 and **Tables 5.1-1** to **5.3-3**.

Long-term Effectiveness and Permanence — This criterion, the first of five "Primary Balancing Factors," is used to assess the results of the remedy in terms of residual risk and the adequacy and reliability of any means to control residual risk. Also taken into account with respect to this criterion, is the type and quantity of projected residual waste remaining at the Site following implementation of each alternative.

Reductions in Toxicity, Mobility and Volume through Treatment — This criterion is used to assess the degree to which treatment is successful in reducing a contaminant's toxicity, mobility, and/or volume. Taken into consideration are whether treatment is used, the amount and types of wastes to be destroyed or treated, expected reductions in toxicity, mobility, and volume, degree to which the treatment is irreversible (i.e., permanent), and the type and quantities of residuals remaining after treatment.

None of the six assembled alternatives for the Site include destruction, mobility reduction through chemical stabilization or fixation that reduces toxicity, mobility, or volume as properties of the waste to be left onsite. However, a reduction in overall waste volume is achievable through removal actions. Also, treatment of some wastes may be accomplished at offsite disposal locations.

Short–term Effectiveness — Components of this criterion include assessment of protection of the community and Site workers during implementation of the remedial alternative, impacts to the environment brought about by implementation, and time until remedial objectives are achieved. Because of the volumes of waste to be excavated, handled, and removed, the level of emissions control that would be required and the number of truck trips to implement the alternatives is also included.

A principle objective of Pilot Study No. 3 was to assess potential impacts to the community and to Site workers through collection of "data on the nature, magnitude, and possible rates of odor and chemical emissions that may be generated by the buried waste materials at the Site when excavated and handled." Data from Pilot Study No. 3 regarding emissions from Site wastes, including downhole flux data and emissions control agent testing, and analyses regarding dispersion and potential impacts to the community, are found in Appendix F. This testing resulted in the selection of Rusmar® foam as an effective emissions control agent to mitigate against emissions and odors in the field during excavation and handling of the waste materials (see the flux Technical Memorandum, Attachment F1 of Appendix F). The emissions potential and dispersion modeling and analysis resulted in estimates of open face areas of exposed waste that could be feasible at given distances from the Site perimeter without adverse impacts to the community (see Attachment F2 of Appendix F). These estimates are used to estimate the projected rate of excavation and the time to complete each alternative with an excavation component.

During the Emergency Action activities conducted in 2005 through early 2006, odor and emissions control was employed nearly continuously during excavation of drilling mud and impacted materials from Lagoons 4 and 5 and the north berm adjacent to Hamilton Avenue. The degree of control needed was based on a combination of workface and perimeter air monitoring using handheld instruments to measure VOC concentrations at parts per million (ppm) levels, as well as community input (through a 24-hour community involvement line that allowed the community to call a phone number 24 hours a day, 7 days a week during the Emergency Action with questions or concerns regarding the Emergency Action construction activities). The Emergency Action air monitoring program (comprised of the Emergency Action Air Monitoring Plan and the SCAQMD Rule 1150/1166 Permit) required implementation of vapor suppression measures when VOC concentrations at the Site perimeter exceeded 0.5 ppm above background (the first threshold), or perimeter concentrations exceeded 5.0 ppm above background (the second threshold, requiring work to be stopped until readings returned to background levels), and/or workface concentrations exceeded 50 ppm (classifying the material as VOC-contaminated material per SCAQMD Rule 1166). When this occurred, several techniques were used to mitigate emissions and control odors:

- Rusmar® foam with a vanilla scent added to mask odors,
- Misters, to reduce odors, strategically located with respect to the excavation operations,
- Water spray, and
- Placement of minimally impacted soil over VOC-contaminated material.

In addition to the above measures taken during the Emergency Action, Soil Seal was also applied to all stockpiles of VOC-contaminated material at the end of each workday, or more frequently as needed, during the Emergency Action per the SCAQMD Rule 1150/1166 permit. Soil Seal was also applied to excavation cut faces at the end of the work days during the Emergency Action to further minimize potential odors and emissions from fresh excavation faces. Emissions were controlled to the degree that VOC concentrations in the work area did not reach levels requiring respiratory protection for workers. On some occasions, despite implementing the above measures, while excavating drilling mud or impacted soil from Lagoon 4 near the Site perimeter, real-time air monitoring indicated total VOC concentrations greater than the threshold of 5.0 ppm above background. Based on the Emergency Action Air Monitoring Plan, this necessitated suspension of the work until concentrations returned to background levels.

Odors were present almost continuously onsite during intrusive work activities and were the primary complaint expressed by local residents. Wind direction and velocity had a significant impact on odor perception in that an onshore wind direction and higher velocity resulted in offsite migration of odors.

Section 10.3.2 provides additional details on odors and emissions control during the Emergency Action activities.

Implementability — The implementability criterion considers the ability to construct and operate the technologies incorporated into the alternative; the reliability and availability of goods and services; ability to monitor effectiveness; capacity to obtain approval from regulatory agencies; coordination with other agencies; the availability of offsite treatment, storage, and disposal services and capacities; and the ease of undertaking additional remedial actions following implementation, if necessary.

The Emergency Action activities and construction of stormwater controls at the Site in 2005 through early 2006 involved excavation and offsite disposal of over 40,000 cubic yards of impacted materials from Lagoons 4 and 5 and the north berm along Hamilton Avenue. Excavation of these materials was possible using standard construction equipment such as excavators, as well as unconventional equipment, such as a pontoon-mounted excavator[13]. The drilling mud were mixed with varying quantities of soil from other parts of the Site, including the North berm, to facilitate handling for loading into waste haul trucks for transport to offsite transportation and disposal facilities. Production rates were limited by a work face size of 2,000 square feet imposed by the SCAQMD permit. Still, the feasibility level production rate of 1,250 cy/day used in the cost estimate (see Section 9.4) was easily achieved on a daily basis. Availability of permitted hazardous waste transporters (due to classification of excavated materials as non-RCRA hazardous, or California hazardous, – see Section 10.3.2) and transportation distance to the receiving waste facility limited haul-off capacity to about 1,300 cy/day maximum and about 900 cy/day on average. Section 10.3.2 provides additional details on waste removal-production rates and material handling during the Emergency Action activities.

Cost — The cost criterion considers present-worth costs for each alternative. Costing of alternatives is detailed in Section 9.4 and corresponding appendices. Evaluation of relative cost-effectiveness of alternatives is performed in the comparative analysis following the screening of alternatives.

State and Community Acceptance — These criteria are the two "Modifying Considerations." State and community acceptance of the selected preferred alternative is determined through review and public participation. Therefore these criteria are not addressed as part of this feasibility study, but will be evaluated during the review and comment process.

The following section describes the quantities involved in each assembled alternative, the capital, O&M costs, and the present worth costs.

[13] The pontoons allow the excavator to float, which helped to facilitate movement in the lagoon's low density drilling mud.

9.4 Quantities and Cost Estimates

For each of the alternatives described above, a detailed sequence of implementation steps was developed along with the estimated waste and import material quantities and corresponding costs. In addition, for each of the wastes disturbed during implementation of the alternatives, an estimate of the quantities of waste disturbed, disposed offsite, or relocated onsite was developed. Appendix Q presents the detailed calculations for each alternative along with the assumptions and notes explaining how each of the wastes is to be handled. To simplify the presentation of this process, figures were developed to show the disposition and mass balance for the volumes of waste for each alternative including:

- Material disposed offsite to either a landfill or to recycling, fuel blending, or combustion in a low temperature coal-fired burner, or injected deep into a well as a slurry using SIT,
- Material excavated and then replaced on the Site in a different location,
- Material that remains in place and is not disturbed, and
- Materials that are stabilized with either a Geogrid and/or geotextile fabric or by the use of soil/cement mixing.

Conservative and Best Cases were developed for each alternative based on interpretation of a number of key ARARs/Site parameters (e.g., applicability of SCAQMD Rule 1166) and uncertainties associated with management of the wastes onsite (e.g., removal of lagoon tarry liquids). These cases are described briefly below:

- The Conservative Case alternative scenario assumes that the maximum estimated quantity of each waste is encountered during the course of implementation. It also assumes that 10% of the wastes exposed during grading operations require offsite disposal due to being VOC-contaminated per SCAQMD Rule 1166[14]. For costing purposes, the conservative case assumes the most expensive approach to waste removal, handling and disposal. For example, for the tarry liquids in Lagoons 1, 2, and 3, the conservative case assumes that these materials will be fluidized and pumped from the lagoons into tanker trucks and transported to a fuel blending facility. In addition, for Alternatives 5 and 6, the conservative case requires that any minimally impacted soils containing leachable metals exceeding appropriate standards, cannot be used for backfilling unrestricted use areas. Instead, this material would be disposed offsite as California hazardous (non-RCRA hazardous) waste and fill would be imported for backfilling.

- For the Best Case alternative scenario, it is assumed that the likely minimum volume of wastes would be encountered during implementation. Where applicable, the Best Case also assumes that the wastes encountered during grading operations could be re-used onsite (i.e., encapsulated beneath a protective cap) without triggering SCAQMD Rule 1166 requirements for treatment and/or offsite disposal of VOC-contaminated materials. For costing purposes, the Best Case assumed the least expensive method of waste removal, handling, and disposal. For example, for the tarry liquids present in Lagoons 1, 2, and 3, it is assumed that these materials could be excavated using standard construction equipment and mixed with approximately 50% of their volume with impacted soils prior to loading into trucks or transferred into rail cars, and transported for offsite disposal. For Alternatives 5 and 6, the Best Case requires that minimally impacted soils may be stabilized using cement, fly ash, or other amendments if required prior to reuse, and that excess material not needed for backfilling unrestricted use areas must be disposed offsite as California hazardous waste.

[14] SCAQMD Rule 1166 requires treatment of VOC contaminated materials by SCAQMD-approved methods such as soil vapor extraction or thermal treatment, or disposal of these materials at a permitted landfill. At this time, offsite disposal of these materials is more cost effective than such approved onsite treatment methods.

The quantities of waste used in developing the cost estimates for each of the alternatives are presented in Appendix Q and shown on the figures identified below (also see **Table 6.5-1**):

- Alternative 1: No Response Action (See **Figure 9.4-1**)
- Alternative 2: Limited Waste Removal (See **Figure 9.4-2**)
- Alternative 3: Protective Cap (See **Figure 9.4-3**)
- Alternative 4: Partial Source Removal with Protective Cap (See **Figure 9.4-4**)
- Alternative 5: Source Removal with Offsite Disposal and SIT (See **Figure 9.4-5**)
- Alternative 6: Source Removal with Offsite Disposal (See **Figure 9.4-6**)

The volumes presented in the figures identified above were calculated from the *in situ* volumes based on an interpretation of the waste boundaries considering all of the borings, trenches, and investigations performed at the Site. The unit costs presented in Appendix R were developed to be all-inclusive numbers considering each of the steps required to remove the waste from the Site, reduce emissions, transfer it into trucks, transport it to an approved disposal facility, and place it into the landfill or other receiving facility/location. The unit prices also incorporated the conversion factors to translate the cubic yard volume into the weight in tons using the density data obtained during Pilot Study No. 3 and Emergency Action activities.

Based on the quantities summarized on the figures described above and the calculations presented in Appendix Q, the costs of implementation and O&M (over 30 years) for each alternative were estimated. Life cycle cost estimates for the alternatives are presented in Appendix R. The spreadsheets give a detailed breakdown of capital costs and a bottom line for O&M and life cycle costs. O&M costs are detailed in Appendix S (see Section 9.4.1). The Appendix R spreadsheets include a series of notes that explain the specific assumptions – related to material classification, waste processing, and scope – used in developing the cost estimates. Costs for Alternative 3, Protective Cap, are based on a range between construction of a Monolithic Soil Cap and a Multilayer cap over the Site. Appendix R contains the detailed estimates for construction of each of these cap types. Costs for Alternative 4, Partial Source Removal with Protective Cap, are based on a range between construction of a Monolithic Soil Cap and a Multilayer Cap[15]. The costs for Alternative 4 also include removal of all non-Pit F pits (A - H), though this alternative will likely only include removal of portions of these pits (removal to approximate adjacent street elevation)[16].

The implementation (capital) cost estimates were based on assumed levels of production for each of the wastes. The assumed production rates as shown on the tables in Appendix R included:

- 625 cy/day for tarry liquid wastes in Lagoons 1, 2, and 3 and soils impacted by Pit F area waste materials,
- 1,250 cy/day for impacted soils, highly liquid drilling mud, unsaturated (high strength) drilling mud, and impacted native clay materials,
- 2,500 cy/day for minimally impacted soils with VOCs less than 50 ppm, including soils re-graded to stabilize the berms and/or to fill in the lagoons once the tarry liquid materials have been removed. If imported soils are required to complete the soil cover over the waste materials, it is assumed that they could be delivered to the Site and placed at a rate of 2,500 cy/day.
- For SIT, a production rate of 250 cy of solids/day/well is assumed, based on empirical data from Terralog from other sites (Project Navigator, Ltd., 2004b, Terralog, 2004).

[15] The size, including elevation of the protective cap in Alternative 4, would be determined during remedial design. The cost estimates and waste volumes are based on removal of drilling mud in Lagoons 4 and 5 to adjacent street elevation, with the Protective Cap constructed over the Site after removal of these drilling muds from Lagoon 4 and 5 and other impacted soils along Hamilton Avenue and Magnolia Street, removal of Pit F area waste, removal of tarry liquids from Lagoons 1, 2, and 3, and general Site grading.
[16] The area of source removal and the protective cap in Alternative 4 would be determined during remedial design.

The production rates cited above for impacted materials were based on the findings of the air emissions for specified working areas and the results of the evaluation of various suppressants and foam materials tested during Pilot Study No. 3 (see Appendix F for further discussion of these related issues). The production rates listed above for impacted soils, minimally impacted soils, highly liquid drilling mud, and high strength drilling mud were verified during the Emergency Action activities conducted in 2005 through early 2006 (see discussion of implementability above and production rates in Section 10.3.2). The time to complete each alternative was also estimated based on the production rates described above. In addition to the time required for each task, it was assumed that 10% additional time would be required for days of lost production due to weather and other unforeseen circumstances.

Unit prices were developed for each key activity per alternative at the Site based on past experience with similar projects, contractor and vendor quotes, and general construction knowledge developed from performing similar activities within the Los Angeles Basin, including site-specific experience during the Emergency Action activities. The basis for each of the unit prices pertaining to waste handling, transportation and disposal is further described in **Table R-15**.

The cost categories for general Site remedial activities include:

- Project Services
- Design and Permitting of the final remedy
- Mobilization
- Clearing and Grubbing
- Health and Safety
- Air Monitoring
- QA/QC Oversight
- Site Water Management
- General Site Grading
- Surface Water Management
- Import Fill
- Reuse of Minimally Impacted Fill
- Backfill and Grading
- Seeding
- New Fence Installation
- Demobilization
- Site Survey, and
- Contingency.

Appendix R presents the detailed cost estimates and assumptions for each of the alternatives. Supporting detail regarding O&M costing is found in Appendix S and described below. **Figure 9.4-7** presents a summary of the costing for each alternative including:

- Remedial Alternative Number,
- Remedy Description,
- Estimated Remedy Construction Cost in Millions ($),
- O&M Costs in Millions ($),
- Total 30 Year Life Cycle Cost, Present Worth, in Millions ($),
- Volume of Waste Removed from the Site (in 1,000 cy increments),
- Estimated Number of One-Way Truck Trips (in thousands of trucks) for Waste Removal and Import Materials, and
- Estimated Duration of Remedy Construction (in months).

The costs associated with cleanup of the adjacent oil production property leased to SCOC on the western portion of the Site have been included in the total costs presented herein as a one line item in the cost estimates for applicable remedial alternatives, so that the remedial alternatives are all inclusive.

However, the cost estimate for this portion of this Site is a rough cost because no previous investigations have been conducted on this portion of the property. The RPs and Cannery Hamilton Properties, LLC gained access to SCOC's property during the first quarter of 2007 in order to conduct an investigation of this portion of the Site to determine what, if any, remediation will be required for this portion of the Site. This remedial investigation for soils in this area of the Site will be reported in a Remedial Investigation Report for Soils in the SCOC property, Well No. 80 area, and Ascon Properties area of the Site later in 2007. For purposes of this RFS, the technical approach for remediation of that property would be consistent with the selected remedial alternative for the Site. Well destruction or modification, if required, of oil wells SCOC #40 and SCOC #41, located on the SCOC leased property on the western portion of the Site, is anticipated to be conducted by an outside party, and therefore costs for the well destruction or modification are not included in the remedy alternatives. The alternatives do not take into account any issues which may arise as a result of the separately owned mineral estates under the Site or the associated existing mineral leases or how they may affect implementation of the alternatives.

9.4.1 30-Year Operation and Maintenance Costs Summary

As shown in Appendix S, 30-year present worth O&M costs were developed for Alternatives 2 through 6 based on passive land use only. The calculations assume a discount rate of 5 percent. The main components of post-remedy O&M costs are as follows:

- Landscape and General Site Maintenance,
- Groundwater, Soil Vapor, Ambient Air, and Stormwater Monitoring, as appropriate,
- Cap/liner maintenance (as appropriate, Alternatives 2-4),
- Five-Year Site Reviews, as appropriate,
- Site Security/Inspections, as appropriate,
- Equipment maintenance and waste disposal (Alternatives 3 and 4),
- Emergency Berm or Cap Maintenance due to Earthquake (Alternatives 2, 3, and 4), and
- Project management/public relations.

Maintenance and monitoring requirements vary by alternative, and the specific assumptions are listed in Appendix S. In general, maintenance/monitoring requirements and costs are highest for the capping alternatives (Alt. 3 and 4) and lowest for the complete source removal alternatives (Alt. 5 and 6). Note that Appendix S includes O&M estimates for both a Multilayer and Monolithic Soil Cap because the final Alternative 3 and Alternative 4 capping remedies would range somewhere between these two designs.

9.4.2 Post-Remedy Groundwater Remediation Considerations

As discussed in Section 4.3.3, marginally unacceptable risks were identified for the residential indoor air vapor migration pathway due to concentrations of benzene in groundwater beneath a limited area of the Site. In Section 8, remedial technologies consisting of a few *in situ* groundwater treatment techniques and engineering controls, as well as removal and appropriate discharge, were identified as being potentially suitable to hot spot remediation of groundwater or mitigation of vapors from groundwater, respectively. For the remedial alternatives that may allow for unrestricted land use of the Site (Alternatives 5 and 6), or portions of the Site (i.e., the City parcel, and the Pit F area) (Alternatives 3 and 4), one or more of these techniques would be implemented, as appropriate. However, at this time, several uncertainties may impact the specific remedial approach. For instance, remediation of impacted soils and wastes (source removal) may alter shallow groundwater conditions, as well as change the vapor migration pathways due to the improved physical properties of the compacted backfill soils.

For these reasons, a specific process for addressing potential risks from soils and/or groundwater in the unrestricted use area of the remediated Site is proposed. As shown on **Tables 8.5-1** and **9.2-2**, various process options for groundwater remediation were retained for possible inclusion in the assembled alternatives. The proposed process consists of the following steps:

- Following remediation of impacted soil and wastes, a soil vapor survey will be conducted in unrestricted use areas. Soil gas samples will be collected from unrestricted use areas at a depth of approximately 10 feet bgs, if possible, or shallower if groundwater is within the upper 10 feet bgs. If samples cannot be collected at depths of greater than 5 feet bgs, additional lines of evidence will be used to evaluate the vapor intrusion pathway such as soil vapor pressure testing to determine if barometric effects are occurring, surface flux measurements and groundwater data. Laboratory reporting limits will be established at levels low enough to allow for the determination of potential indoor air vapor migration risks using conservative modeling techniques. The estimated cost for a soil vapor sampling effort is expected to be about $10,000 to 15,000 per acre (Appendix T).

- If results of the soil vapor survey indicate unacceptable risks, investigations will be conducted to assess the respective contributions from soil or groundwater to the risk. The potential for soil and groundwater to contribute to soil vapors will be investigated using geoprobe sampling, or other appropriate techniques. Specifically, this would be accomplished as follows. If the soil gas COPCs are found in unacceptable concentrations (e.g., through CHHSL comparison or risk calculation), then a hydraulic push rig will be used to sample the soil and the groundwater beneath the soil at the soil vapor location. The level of volatiles in soils can be ascertained using headspace field tests and laboratory analyses using EPA 5035 Encore sampling, or equivalent. The results of the groundwater analyses could not be used for risk assessment purposes but will provide appropriate screening to determine if additional groundwater sampling and testing or groundwater remediation is required. Costs for conducting geoprobe sampling, with collection of soil and groundwater samples, is expected to be approximately $10,000 to $15,000 per acre, as shown in Appendix T.

- If it is verified that groundwater is the source of detected vapor, groundwater would then be addressed using one or more of the technologies previously identified. Additional details on groundwater remediation will be explored in conjunction with the remedial action plan for both groundwater and soil/waste for the Site.

- Any soil identified as a potential source of vapor may be addressed through remediation using techniques such as soil vapor extraction (SVE). As previously noted, the soils recycled during implementation of the preferred remedy would be tested prior to placement on the Site to confirm suitability for use in accordance with the applicable laws and regulations.

Costs for conducting post-remedy soil vapor, soil and groundwater surveys for risk assessment are not included in the individual Alternative cost estimates. Rather, due to the uncertainties documented above at this time, costs are provided to conduct these surveys on a per acre basis. Likewise, per acre groundwater remediation costs for the alternatives established in Section 9.2 are included in Appendix T, but are not included in the estimates, due to the above-described uncertainties.

9.5 Nine Criteria Evaluation of Alternatives

Table 9.5-1 presents a summary of the detailed evaluation of the six remedial alternatives against the nine NCP evaluation criteria. The results consist of relative rankings such as low, moderate, and high, as well as qualitative (e.g., defining environmental impacts during implementation) and quantitative (e.g., time for achieving remedial action objectives) descriptions where appropriate. **Table 9.5-2** contains the evaluation of each alternative with respect to the ARARs identified in Section 5 (Tables 5.2-1 through 5.2-4).

The following is a synopsis of the results of the nine NCP Criteria evaluation for each alternative.

9.5.1 Alternative 1 -- No Action:

9.5.1.1 Alternative 1 Description

Under Alternative 1, No Action, no action would be taken to contain, treat, or remove the impacted soils and wastes present at the Site. The existing fencing would restrict direct contact with affected soils by trespassers. The results of the BHRA, the updated risk evaluation presented in Section 4, the perimeter air monitoring reports, and recent air sampling data indicate that under the current conditions the Site does not pose a health risk to offsite residents or offsite workers. However, the lagoons and exposed wastes are hazards for trespassers. Waste would remain on the City parcel.

9.5.1.2 Alternative 1 Evaluation

Although Alternative 1 does not reduce risk at the Site, a detailed evaluation of the alternative was performed, as required by the NCP.

Overall Protection of Human Health and the Environment

Because no remedial action is implemented with Alternative 1, the waste volume would not be reduced, and potential hazards to trespassers from exposed wastes onsite and to the nearby community would not be reduced. In addition, localized impacts to groundwater would not be addressed.

The Site is located within an area that is designated as having high susceptibility to liquefaction-related ground failure during significant seismic events. Preliminary evaluation of the potential for seismic liquefaction has shown that the Site would likely not liquefy during a major seismic event (see Section 3.2.2)[17]. However, the continuity of the underlying clay layer could be disturbed, thereby allowing the contact of impacted materials into the underlying subsurface materials.

Compliance with ARARs

Because no activities would occur with the No Action alternative, chemical-specific ARARs described in Section 5 and RAOs described in Section 6 would not be attained. Location and Action-specific ARARs are not applicable because construction activities would not occur, and contaminated media would not be removed from the Site. This alternative is evaluated against each ARAR in **Table 9.5-2**.

As shown in **Table 9.5-1** and **Table 9.5-2**, because Alternative 1 does not comply with either of the threshold criteria by not removing wastes and not improving the Site to provide protection to the environment or the community, no further evaluation is warranted, and this alternative is rejected from further consideration in the comparative evaluation. **Figure 9.5-1** provides a graphical representation of the Alternative 1 evaluation.

9.5.2 Alternative 2 – Limited Waste Removal

9.5.2.1 Alternative 2 Description

Alternative 2, Limited Waste Removal, includes the removal of waste as shown on **Figure 9.2-2** and includes the quantities shown on **Figure 9.4-2**. Alternative 2 provides for removal of the tarry liquid waste in Lagoons 1, 2, and 3, followed by stabilization of the underlying wastes and backfilling, as well as removal of Pit F area wastes. In addition, the five lagoons, covering about one-third of the surface area of the Site, are covered with soil to prevent incidental contact from humans and animals. However, all remaining wastes onsite, such as the drilling mud and pits (other than Pit F), remain in place. Alternative

[17] Further evaluation of liquefaction potential should be considered during the remedial design.

2 also does not physically change the Site in terms of stabilizing/removing the perimeter berms, and therefore impacted materials would remain on the City parcel (refer to Section 1.2 for more information about the City parcel), and only half the Site is graded for drainage.

9.5.2.2 Alternative 2 Evaluation

Overall Protection of Human Health and the Environment

Although a small volume of waste is removed from the Site and a portion of the Site is covered, this Alternative does not address the hazards associated with wastes left onsite without an engineered protective cover.

Compliance with ARARs

Chemical-specific ARARs – The RAOs for the Site are to mitigate risk from ingestion, inhalation, and dermal contact with impacted soils and waste, to mitigate risk from exposure to groundwater or vapors from groundwater, and to protect groundwater from further degradation. Because only a small portion of the waste would be removed in this alternative and groundwater would not be protected from further degradation, these RAOs, and therefore chemical-specific ARARs as defined in Section 5, would not be met.

Location and Action-specific and to-be-considered ARARs – This alternative would be designed to comply with Action and Location-specific and to-be-considered ARARs defined in Section 5 for removal and offsite disposal of the tarry liquids and Pit F area impacted materials and for Site grading/backfilling operations.

Table 9.5-2 shows each applicable ARAR to the Site, as identified in Section 5 previously, and identifies the ARARs that Alternative 2 complies with and the ARARs that Alternative 2 does not comply with. As described above and shown in **Tables 9.5-1** and **9.5-2**, due to the small degree of waste treatment[18] and by not eliminating the hazards the Site poses to the community and environment, Alternative 2 does not comply with the two threshold criteria. Because it does not meet these threshold criteria, no further evaluation is warranted, and this alternative is rejected from further consideration in the comparative evaluation presented in Section 9.6. **Figure 9.5-2** provides a graphical representation of the Alternative 2 evaluation.

9.5.3 Alternative 3 -- Protective Cap

9.5.3.1 Alternative 3 Description

Alternative 3 involves the containment (i.e., encapsulation) of the impacted media by the construction of a protective cap system to minimize the vertical infiltration of surface water. The protective cap would be equipped with vapor barriers and means for venting to address vapor migration, if necessary. **Figure 9.2-3** shows that Alternative 3 involves removal of the tarry liquid wastes in Lagoons 1, 2, and 3 and the Pit F area wastes and appropriate discharge of groundwater in the Pit F area, as well as removal of a portion of the drilling mud in Lagoons 4 and 5 (**Figure 9.4-3** shows the quantities of waste materials removed). The existing perimeter berms along Magnolia Street and Hamilton Avenue would be removed, and, because portions lie within the City parcel, outside the Ascon property, or the CHP parcel (as identified in Section 1.2), they would be incorporated/re-engineered into the perimeter of the proposed protective cap within the CHP parcel. The remaining material in Lagoons 4 and 5 would be stabilized to the extent necessary to be able to support the protective cap installed over the drilling mud left in place in this area of the Site. Installation of shoring in the northern portions of Lagoons 4 and 5 is considered highly probable in order

[18] For the purposes of this RFS, treatment is defined as waste removal or encapsulation, as described on **Table 9.5-1**.

to support the drilling mud in Lagoons 4 and/or Lagoon 5 during excavation and removal of the materials from the City parcel.

A protective cap would be placed over the Site following removal of tarry liquids from Lagoons 1, 2, and 3, Pit F waste removal, breaking or crushing of surface concrete, and confirmation of a foundation layer on the portion of the Site where the cap will be installed. The cap would consist of, at a minimum, a drainage layer, a passive vapor collection system, vegetative cover over the waste, and a surface water collection system. Other protective elements such as additional liners for vapor mitigation, an active vapor collection system, or a leachate collection system may be added during the remedial design, if needed. Factors that would determine if the Site would require an active vapor collection system as part of Alternative No. 3 include data that would be collected during the remedial design phase. If the data show that the Site would generate sufficient gas (methane) after the existing Site's conditions have been altered during the preliminary steps of implementation of this alternative (i.e., removal of the tarry liquids, removal of a portion of the drilling mud from Lagoons 4 and 5, removal of Pit F area waste, and general Site grading) or during the O&M phase, then the passive vapor collection system would be changed to an active vapor collection system as part of Alternative 3. **Figure 9.5-3** depicts a conceptual implementation of the protective cap.

The Pit F-impacted area of the Site and impacted materials on the City's parcel would be removed from these areas and then backfilled with imported clean soils or minimally impacted materials[19] recycled from the Site. All recycled materials would be segregated, subjected to confirmation testing to ensure they are suitable for reuse as backfill in the unrestricted use areas or as cover in the cap. As described above, the metrics (e.g., cost, waste removed, remedy duration) for Alternative 3 are based on a range between a Monolithic Soil Cap and a RCRA-Equivalent Cap. The conservative case for Alternative 3 has a placeholder for an active vapor collection system to be included as part of the protective cap. However, as previously stated, the need for changing the passive system to an active system will be validated during the remedial design or O&M phase. Refer to **Figures 8.4-1 – 8.4-4** to see the ranges of possible caps for this alternative.

9.5.3.2 Alternative 3 Evaluation

Overall Protection of Human Health and the Environment

This alternative is designed to minimize the mobility and transport of contaminants via air, water, and ingestion pathways. With drainage and gas emissions controls, this alternative isolates the waste and diminishes the potential for direct human contact with the COPCs. Surface water infiltration can be mitigated, thereby reducing the potential for mobilization of constituents to groundwater beneath the Site. For the unrestricted use areas, post-remedy groundwater remediation and/or vapor mitigation would be conducted if required by the post-remedy risk assessment, although not anticipated to be needed because all waste and impacted soils will be removed from these areas, and groundwater in the Pit F area will be removed.

Compliance with ARARs

Chemical-specific ARARs -- Because the residual waste materials onsite are within a protective cap using control systems to address the RAOs (including groundwater RAOs), risks to future Site workers or recreational users from exposures to impacted soil and wastes and groundwater vapors would be mitigated.

[19] Minimally impacted materials were defined in Section 3.2.3 and would contain levels of TPH and COPCs below City of Huntington Beach cleanup standards and other ARARs after stabilization or treatment, if required.

Location- and Action-specific and to-be-considered ARARs **–** This alternative would be designed to comply with the location- and action-specific and to-be-considered ARARs outlined in Section 5 during construction of the cap and removal of waste materials offsite.

Table 9.5-2 shows each applicable ARAR to the Site, as identified in Section 5, and identifies the ARARs that Alternative 3 complies with and the ARARs that Alternative 3 does not comply with.

Long-term Effectiveness and Permanence

As shown in **Table 9.5-1**, the expected volume of wastes remaining onsite and the corresponding residual risk are relatively high compared with the other alternatives. However, this alternative is designed with maintenance, monitoring, and control systems to permanently isolate the media present at the Site, with only a slight risk of potential exposures. This technology has been used effectively at many other sites for the same purpose. A drawback of this remedy is the potential for shoring to breach the clay layer that is believed to be present beneath the Site, with the exception of the Pit F area, and thereby enable direct contamination of the SPA. (Shoring would likely be required in the northern portions of Lagoons 4 and 5 during excavation of the north berm to support the drilling mud in Lagoons 4 and 5 while the north berm that currently supports the drilling mud in Lagoon 4 and 5 is removed to remediate the City parcel.)

Excavation of Pit F-impacted materials and groundwater from the Pit F area will constitute an effective and permanent remedial action for the Pit F area of the Site.

Reductions in Toxicity, Mobility and Volume through Treatment

This alternative provides for encapsulation of wastes under a protective cap coupled with limited offsite disposal of waste materials. Thus, there is a high degree of mobility reduction and limited degree of volume reduction afforded. Residual wastes beneath the cap would include impacted native and fill materials, drilling mud, and construction debris (**Table 9.5-1**).

Short-term effectiveness

Similar to the other action alternatives, this alternative would provide the necessary protection to onsite workers and the community through controls such as the use of foam odor suppressants, sprung structures, water spray for dust control, and air monitoring at the construction area and at the Site perimeter. To minimize the risk of exposure to emissions from the waste, workers would be equipped with the appropriate PPE and receive training in Site health and safety procedures. Due to the relatively low volume of waste removal, this alternative would have a moderate amount of required truck trips, a relatively low level of emissions control required, and RAOs would be achieved quickly (1 ½ to 2 years). Approximately 124,000 cy[20] of material would be removed from the Site in this alternative, requiring an average number of 45,000 single one-way truck trips[21] to haul this material to the appropriate disposal facility. Potential odors and emissions that may arise from the excavation of impacted materials would be controlled through the use of mitigative measures identified above, but odors and emissions are still a potential source of nuisance to the community in addition to the anticipated truck traffic.

Implementability

Source removal activities would be conducted using proven, off-the-shelf technologies such as excavators, dump trucks, and shoring (see below for a brief description on the potential need for shoring during implementation). Caps are a proven, reliable technology for waste encapsulation for the long term and require ongoing O&M to ensure effectiveness. Materials and equipment are generally readily available, with the possible exceptions of import fill for the surface vegetative cover layer, clay (if part of

[20] The approximate quantity of material removed from the Site is a calculated average between the best and conservative case scenarios for Alternative 3.
[21] The approximate quantity of truck trips is a calculated average between the best and conservative case scenarios for Alternative 3.

the remedial design of the cap), and trucks to transport the fill and waste materials. If hazardous waste haulers are required to haul the waste material offsite to an appropriate disposal facility, then this may be an implementation factor that could increase the schedule for completion of the remedial action due to the limited number of certified hazardous waste haulers in California.

However, the engineering and design required for this alternative, as well as the overall implementation of this alternative are complicated. Stabilization of the remaining drilling mud in Lagoons 4 and 5 would be needed to some extent in order to support the protective cap and its load, and the subsequent consolidation of the drilling mud beneath the cap. Refer to Appendix K for more detail on the geotechnical evaluation of capping alternatives.

Shoring is also considered to be required in the northern portions of Lagoons 4 and Lagoon 5 during excavation of the north berm in order to support the drilling mud in Lagoons 4 and Lagoon 5 while the north berm that currently supports the drilling mud in Lagoon 4 and 5 is removed to enable removal of impacted materials from the City parcel. Installation of shoring is an available option, but does add some difficulty to implementation of the remedy. The sequencing of construction activities will have to be carefully determined and coordinated closely with the design and construction teams so that the schedule for the shoring installation and potential removal of the shoring is appropriately aligned with the removal of materials from the City parcel and the area just south of the City parcel where the new perimeter berms will be built as part of the northern edge of the protective cap and aligned with the construction of the protective cap. It is anticipated that any shoring installed in Lagoons 4 and 5 during implementation of Alternative 3 would be abandoned in place after the remedy is complete.

Ability to obtain the necessary agency approvals is expected to be moderately high given the reliability of the technology. The ability to undertake future remedial actions such as source removal would require excavation and removal of the cap materials.

Cost

The present worth cost for Alternative 3 is $38.3 million for a Monolithic Soil Cap system for best case assumptions defined above and $72.2 million for a RCRA-Equivalent Cap system, equipped with several liners, a drainage and gas collection layer, and vapor collection system, and with most conservative assumptions defined above.

Capital Cost – Capital expenditures for Alternative 3 would include removal and/or excavation and offsite disposal of tarry liquids and drilling mud associated with the lagoons and Pit F area impacted materials, berm reconstruction, final Site grading, and cap construction (with some excavated materials placed under a protective cap). Appendix R contains the detailed capital cost backup for this alternative.

O&M Cost – 30-year O&M cost estimate for Alternative 3 is detailed in Appendix S, and the main components of O&M are described in Section 9.4.1. For Alternative 3, O&M costs would increase with the increasing complexity of the cap (Monolithic to RCRA-Equivalent) and the associated maintenance of liners and treatment systems, as shown in Appendix S.

State Acceptance

The DTSC will review this RFS report and the development of remedial objectives and remedial alternatives presented herein and select a preferred alternative.

Community Acceptance

Comments from the community regarding Alternative 3 would be addressed after the public comment period for the Remedial Action Plan if this alternative is chosen by DTSC.

Figure 9.5-3 shows a graphical representation of the Alternative 3 evaluation. Alternative 3 is retained for further evaluation in Section 9.6.

9.5.4 Alternative 4 – Partial Source Removal with Protective Cap

9.5.4.1 Alternative 4 Description

Alternative 4 will include the excavation and offsite disposal of Pit F area waste, with removal and appropriate discharge of groundwater in the Pit F area, as well as the removal of tarry liquids from Lagoons 1, 2, and 3, consistent with Alternative 3. Also similar to Alternative 3, Alternative 4 consists of the containment of the impacted media by the construction of a protective cap system over the Site, but also involves the removal of significantly more waste materials. The additional waste and impacted material that will be removed under Alternative 4 includes approximately 62,000 cy more waste and impacted materials, including 46,000 cy[22] more drilling mud from Lagoons 4 and 5 than Alternative 3. Most of the additional waste material will be removed from the area closest to offsite receptors, along an area parallel to Hamilton Avenue and Magnolia Street (refer to **Figure 9.2-4** for a visual representation of this remedy alternative)[23].

The protective cap in Alternative No. 4 will cover most of the current area of the Cannery Hamilton parcel (except for the Pit F area). The area along Hamilton Avenue and the northern and southern sectors of Magnolia Street will be at a lower elevation due to the planned excavation and removal of impacted materials to approximate street elevation there. A protective cap will be installed at this location resulting in an approximate elevation of 8 ft MSL, plus or minus a few feet, at the top of the protective 'lower' cap along Hamilton Avenue and Magnolia Street. The remainder of the Site will also have a protective cap, but the cap will be installed at this area of the Site over the approximate existing elevation (after the removal of tarry liquids from Lagoons 1, 2, and 3, adjustments due to breaking or crushing of existing construction debris onsite, removal of a significant portion of drilling mud from Lagoons 4 and 5, and some grading work), creating a generally higher cap in the southwest portion of the Site than the lower cap along Magnolia Street and Hamilton Avenue. The cap will generally follow the present topography of the Site in most areas of the Site except for the northern portion of the Site along Hamilton Avenue. The transition between the lower and higher cap will be engineered and is anticipated to be a gentle slope. **Figure 9.2-4** depicts a conceptual implementation for the tiered protective cap of Alternative 4.

Alternative 4 includes maintenance of a groundwater monitoring program to ensure compliance with the RAOs identified in Section 6 for groundwater.

The existing perimeter berms along Magnolia Street and Hamilton Avenue would be removed from their current location and incorporated/re-engineered into the perimeter of the proposed cap, as portions of the berms lie within the City parcel, outside of the CHP parcel. The cap would consist of, at a minimum, a drainage layer, a passive vapor collection system, vegetative cover over the waste, and a surface water collection system. Other protective elements, such as additional liners for vapor mitigation, an active vapor collection system, and a leachate collection system, may be added during the remedial design, if needed. Factors that would determine if the Site would require an active vapor collection system as part of Alternative No. 4 include data that would be collected during the remedial design phase. If the data show that the Site would generate sufficient gas (methane) after the existing Site's conditions have been altered during the preliminary steps of implementation of this alternative (i.e., removal of the tarry liquids, removal of a portion of the drilling mud from Lagoons 4 and 5, removal of Pit F area waste, and general Site grading) or during O&M, then the passive vapor collection system would be changed to an active vapor collection system and included as part of Alternative 4. Refer to **Figure 9.5-4** to see what the protective cap will likely consist of.

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[22] This volume is based on the excavation of material in this area to approximate adjacent street elevation (4 ft MSL).

[23] The cost estimates and waste volumes developed for Alternative 4 are based on removal of impacted materials in the source removal area and drilling mud in Lagoons 4 and 5 to adjacent street elevation, after completion of the Emergency Action conducted in 2005 - 2006, which included removal of over 30,000 cy of drilling mud from Lagoons 4 and 5.

The Pit F-impacted area of the Site and impacted materials on the City's parcel would be removed from these areas and then backfilled with imported clean soils or minimally impacted materials[24] recycled from the Site. All recycled materials would be segregated, subjected to confirmation testing to ensure they are suitable for reuse as backfill in the unrestricted use areas or as cover in the cap. As described above, the metrics (e.g., cost, waste removed, remedy duration) for Alternative 4 identified in this report are based on a range between installation of a Monolithic Soil Cap and a RCRA-equivalent Cap.

9.5.4.2 Alternative 4 Evaluation

Overall Protection of Human Health and the Environment

The capped portion of the Site is designed to minimize the mobility and transport of contaminants through air, water, and ingestion pathways. This Alternative, with drainage and gas emissions controls, if needed, can effectively isolate the waste and greatly reduce the potential for human contact with the COPCs, and therefore would be protective of public health and the environment. Surface water infiltration would be effectively controlled, reducing the potential for mobilization of constituents to groundwater beneath the Site. For the unrestricted use areas, post-remedy groundwater remediation and/or vapor mitigation would be conducted if required by the post-remedy risk assessment, although not anticipated to be needed because all waste and impacted soils will be removed from these areas, and groundwater in the Pit F area will be removed.

Compliance with ARARs

Chemical-specific ARARs — Because the residual wastes left onsite are isolated with a protective cap that uses control systems to meet the RAOs (including groundwater RAOs), risks to future Site workers or recreational users from exposures to impacted soil and wastes and groundwater vapors would be mitigated (refer to Appendix P).

Location- and Action-specific and to-be-considered ARARs — This alternative would be designed to comply with the location-, action-specific, and to-be-considered ARARs outlined in Section 5 during construction of the cap and removal of waste materials offsite.

Table 9.5-2 shows each applicable ARAR to the Site, as identified in Section 5, and identifies the ARARs that Alternative 4 complies with and the ARARs that Alternative 4 does not comply with.

Long-term Effectiveness and Permanence

As shown in **Tables 9.5-1**, the expected volume of wastes remaining onsite is moderately high compared to other alternatives. However, this alternative would be designed with proper maintenance and control systems to indefinitely isolate the waste present at the Site and would be designed and constructed to be protective of human health and the environment, with only a slight risk of potential exposures with proper maintenance. This technology has been used effectively at other sites for the same purpose.

Excavation of Pit F-impacted materials and groundwater from the Pit F area will constitute an effective and permanent remedial action for the Pit F area of the Site.

Reductions in Toxicity, Mobility and Volume through Treatment

This alternative provides for encapsulation of wastes under a protective cap coupled with offsite disposal of waste materials. Thus there is a high degree of mobility reduction and smaller degree of volume reduction afforded. Impacted Site materials may be stabilized prior to backfilling into unrestricted use

[24] Minimally impacted materials were defined in Section 3.2.3 and would contain levels of TPH and COPCs below City of Huntington Beach cleanup standards and other ARARs.

areas. Waste residuals beneath the cap would include impacted native and fill materials, drilling mud, and construction debris (**Table 9.5-1**).

Short-term effectiveness

Similar to the other action alternatives, this alternative would provide the necessary protection to onsite workers, the community, and the environment through controls such as the use of foam odor suppressants, sprung structures, water spray for dust control, and/or air monitoring at the construction area and at the Site perimeter. To minimize the risk of exposure to emissions from the waste, workers would be equipped with the appropriate PPE and receive training in site health and safety procedures. In addition, only minimally impacted or clean import soil would be used as backfill in source removal areas, and the clay layer would not be breached in source removal areas (except as needed for the anticipated over-excavation at Pit F). This alternative would have a moderate number of truck trips, a moderate level of emissions control required, as well as a moderately long (2 ¼ to 3 years) time to reach RAOs. Approximately 186,000 cy[25] of material would be removed from the Site in this alternative, requiring an average number of 53,000[26] single one-way truck trips to haul this material to the appropriate disposal facility. In addition, depending on final Site use and grading requirements, a similar number of trips may be required to bring clean fill material onto the Site. Potential odors and emissions that may arise from the excavation of impacted materials would be controlled through the use of mitigative measures identified above, but are still a potential source of nuisance to the community in addition to the anticipated truck traffic.

Implementability

Appendix K discusses the geotechnical components of capping remedies, and provides verification that the protective cap in Alternative 4 is implementable based on the current knowledge of the Site. Source removal activities would be conducted using proven, off-the-shelf technologies, such as excavators and dump trucks. Caps, with ongoing maintenance and monitoring, are a proven, reliable technology for waste encapsulation for the long term. There are potential concerns with the availability of cap materials for construction, including soil and/or clay for the cover, if part of the cap design, the availability of trucks for transporting waste and import materials, and available landfill capacities. If hazardous waste haulers are required to haul the waste material offsite to an appropriate disposal facility, then this may be an implementation factor that could increase the schedule for completion of the remedial action due to the limited number of certified hazardous waste haulers in California.

Stabilization of the remaining drilling mud in Lagoons 4 and 5 would likely be needed to support the protective cap and its load, and the subsequent consolidation of the drilling mud beneath the cap, depending on the amount of drilling mud remaining in place below the protective cap in Alternative 4. Shoring may also be required in the northern portions of Lagoons 4 and Lagoon 5 during excavation of the north berm, but the need for shoring in Alternative 4 would likely be much less than in Alternative 3 due to the significant volume of drilling mud that will be removed from Lagoons 4 and 5 in Alternative 4 as compared to Alternative 3. The need for shoring in order to implement Alternative 4 will be determined during the remedial design.

Ability to obtain the necessary agency approvals is expected to be moderately high given the reliability of the technology. The ability to undertake future remedial actions such as source removal would require excavation and removal of the cap materials.

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[25] The approximate quantity of material removed from the Site is a calculated average between the best and conservative case scenarios for Alternative 4.

[26] The approximate quantity of truck trips is a calculated average between the best and conservative case scenarios for Alternative 4.

Cost

The present worth costs for Alternative 4 are $46 million for a Monolithic Cap with best case assumptions and $80.9 million for a RCRA-equivalent Cap design with conservative assumptions.

Capital Cost — Capital expenditures for Alternative 4 would include removal and offsite disposal of tarry liquids from Lagoons 1, 2, and 3 and Pit F area wastes; excavation and offsite disposal and/or placement of excavated materials under a protective cap of impacted materials in the source removal areas along Hamilton and Magnolia, including portions of Lagoons 4 and 5; berm reconstruction; final Site grading; and cap construction. Appendix R contains the detailed capital cost backup for this alternative.

O&M Cost — 30-year O&M cost estimate for Alternative 4 is detailed in Appendix S, and the main components of O&M are described in Section 9.4.1. O&M costs mirror those of Alternative 3, since the footprint of the cap would be similar even though the amount of waste material removed is much greater in Alternative 4 than Alternative 3, and the costs reflect the increasing complexity of the cap system (Monolithic to RCRA-equivalent), as shown in Appendix S.

State Acceptance

The DTSC will review this RFS report and the development of remedial objectives and remedial alternatives presented herein and select a preferred alternative.

Community Acceptance

Comments from the community regarding Alternative 4 would be addressed after the public comment period for the Remedial Action Plan if this alternative is chosen by DTSC.

Figure 9.5-4 provides a graphical representation of the above considerations. Alternative 4 is retained for further consideration in Section 9.6.

9.5.5 Alternative 5 – Source Removal with Offsite Disposal and Slurry Injection Technology

9.5.5.1 Alternative 5 Description

Alternative 5 involves source removal of all wastes onsite, including the lagoon tarry liquids, pits, drilling mud, impacted soils, former lagoon areas, and perimeter berms. After remediation, only imported or minimally impacted soils meeting applicable standards and construction debris (broken or crushed) would remain onsite for backfilling. The main distinction between Alternatives 5 and 6 is that in Alternative 5, drilling mud and lagoon tarry liquids would be slurried into a deep well(s) onsite using SIT (SIT is described in Section 8.5.2.6 and 8.5.3.9), subject to volume limitations presented by Site constraints, such as well construction in proximity to the Newport-Inglewood Fault. Appendix R describes the assumptions used to compute the projected volumes of slurried wastes for injection under Alternative 5. Alternative 5 is shown on **Figure 9.2-5**, and the quantities associated with this alternative are summarized on **Figure 9.4-5**. The specific measures required for the implementation of Alternative 5, Source Removal with SIT, are described in Section 9.2.

9.5.5.2 Alternative 5 Evaluation

Overall Protection of Human Health and the Environment

The potential for waste migration and human and ecological exposures are greatly reduced through removal and offsite disposal, at a landfill or through deep well injection, of all Site waste materials that cannot be reused. The Site would be backfilled by acceptable recycled materials or imported fill, after removal of all source removal areas. Post-remedy groundwater remediation and/or vapor mitigation would be conducted if required by the post-remedy risk assessment, after all waste and impacted soils have been removed from the Site, including removal of the groundwater in the Pit F area.

Compliance with ARARs

***Chemical-specific ARARs* —** All waste materials, except those that are acceptable for reuse, would be removed from the Site, and post-remedy groundwater remediation/vapor mitigation would be conducted as necessary. Therefore, Site RAOs to mitigate risks to future Site workers or residents from exposures to impacted soil, wastes, and groundwater vapors would be met.

Location- and Action-specific and to-be-considered ARARs — This alternative would be designed to comply with the location- and action-specific and to-be-considered ARARs[27] outlined in Section 5 during offsite removal of waste materials, backfilling, and final Site preparation operations.

Table 9.5-2 shows each applicable ARAR to the Site, as identified in Section 5, and shows that all identified ARARs would be complied with in Alternative 5.

Long-term Effectiveness and Permanence

As described above and reflected in **Table 9.5-1**, the volume of wastes remaining at the Site following remediation, and hence the associated residual risk, would be negligible.

Reductions in Toxicity, Mobility and Volume through Treatment

Alternative 5 offers a high reduction in the mobility and volume of the Site wastes (tarry liquids, drilling mud, impacted soils) by offsite disposal at landfills/waste recyclers and through onsite Slurry Injection Technology involving deep well injection. Only minimally impacted materials that can be recycled onsite[28] would remain after remedy implementation.

Short-term effectiveness

Similar to the other action alternatives, this alternative would provide the necessary protection to onsite workers, community, and environment through controls such as the use of foam odor suppressants, sprung structures, water spray for dust control, and/or air monitoring at the construction area and at the Site perimeter. To minimize the risk of exposure to emissions from the waste, workers would be equipped with the appropriate PPE and receive training in Site health and safety procedures. In addition, only minimally impacted soil or clean import soil would be used as backfill in source removal areas, and the clay layer beneath the Site would not be pierced in source removal areas, except as needed for potential over-excavation at Pit F. Due to injection via SIT of a significant quantity of the waste materials (over fifty percent), the number of offsite truck trips would be moderately high. However, the time to achieve RAOs (field time), of 6 to 9 years is very high due to the slow production rate of SIT deep well injection, even utilizing two wells (see Section 9.4 for discussion of production rates). The 6 to 9 year time frame does not include the time it could take to obtain the appropriate permits or for taking the technology online (see details below). Also, as a result of the number of steps it would take to excavate and prepare the waste slurries, the level of emissions control required is expected to be high.

Implementability

As shown in **Table 9.5-1**, significant technical, regulatory, and public perception issues are anticipated to make SIT injection a long, time-consuming, and possibly cost-prohibitive process. Specifically, activities such as permitting and approval from local agencies and conducting pilot studies and securing resources

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[27] This would include requirements of the Underground Injection Control Program of the SDWA (see Section 5.2).

[28] Minimally impacted materials would meet regulations for reuse onsite. This may require stabilization or other potential treatments prior to reuse.

(e.g., makeup water) would be required to get the technology implemented. The SIT injection rate is expected to be twenty to forty percent of the impacted material excavation and disposal production rate. There are potential concerns with the availability of trucks and offsite disposal facilities, though this is somewhat mitigated by the volume of injected waste. Based on experience at other sites, the technology is expected to be reliable in performing its intended function. No remedial activities except general O&M would be required following remedy implementation.

Cost

The present worth cost for Alternative 5 are $118 million and $153 million for the best case and most conservative case scenarios defined above, respectively.

Capital Cost – Capital expenditures for Alternative 5 would include excavation and offsite disposal of all Site materials through transportation to landfills/recycling facilities and deep well injection and backfilling and final grading. Appendix R contains the detailed capital cost backup for this alternative.

O&M Cost – A 30-year O&M cost estimate for Alternative 5 is detailed in Appendix S, and the main components of O&M, primarily monitoring of the injection well(s) for this alternative, are described in Section 9.4.1.

State Acceptance

The DTSC will review this RFS report and the development of remedial objectives and remedial alternatives presented herein and select a preferred alternative.

Community Acceptance

Comments from the community regarding Alternative 5 would be addressed after the public comment period for the Remedial Action Plan if this alternative is chosen by DTSC.

Figure 9.5-5 shows a graphical depiction of the above considerations. **Table 9.5-1** and the above descriptions show that that there are major drawbacks associated with Alternative 5 with respect to several of the Nine NCP criteria (Short-term Effectiveness and Implementability in particular). In addition, the costs for Alternative 5 may not accurately reflect the additional "pre-mobilizing" costs, including pilot test(s) and permitting, described above. For these reasons, Alternative 5 is rejected from further consideration in the comparative evaluation in Section 9.6.

9.5.6 Alternative 6 – Source Removal with Offsite Disposal

9.5.6.1 Alternative 6 Description

Similar to Alternative 5, Alternative 6 involves source removal of all impacted media that does not meet requirements for potential reuse onsite, including the lagoon tarry liquids, pits, drilling mud, impacted soils, former lagoon areas, and perimeter berms. After remediation, only imported or minimally impacted soils meeting applicable standards and construction debris (broken or crushed) would remain onsite for backfilling. All other materials would be disposed offsite at landfills and/or fuel blending or waste recycling facilities. Alternative 6 is shown on **Figure 9.2-6**, and the quantities associated with it are summarized on **Figure 9.4-6**. The specific major measures required for the implementation of Alternative 6 were described in Section 9.2.

9.5.6.2 Alternative 6 Evaluation

Overall Protection of Human Health and the Environment

The potential for waste migration and human exposures are greatly reduced through removal and offsite disposal at landfills or waste recycling facilities of all Site waste materials that cannot be reused. The Site would be backfilled by acceptable recycled materials or imported fill after removal of all source removal areas. Post-remedy groundwater remediation and/or vapor mitigation would be conducted if required by the post-remedy risk assessment, after all waste and impacted soils have been removed from the Site, including removal of the groundwater in the Pit F area.

Compliance with ARARs

Chemical-specific ARARs — All waste materials, except those that are acceptable for reuse, would be removed from the Site and post-remedy groundwater remediation/vapor mitigation would be conducted as necessary. Therefore, Site RAOs to mitigate risks to future Site workers or residents from exposures to impacted soil, wastes and groundwater vapors would be met.

Location- and Action-specific and to-be-considered ARARs — This alternative would be designed to comply with the location- and action-specific and to-be-considered ARARs outlined in Section 5 during removal of waste materials offsite and backfilling and final Site preparation operations.

Table 9.5-2 shows each applicable ARAR to the Site, as identified in Section 5, and shows that all identified ARARs would be complied with in Alternative 6.

Long-term Effectiveness and Permanence

All waste materials are removed and disposed offsite, resulting in a very low residual risk and high degree of permanence.

Reductions in Toxicity, Mobility and Volume through Treatment

Alternative 6 offers a high reduction in the mobility and volume of the Site wastes by offsite disposal at landfills/waste recyclers. Only materials acceptable for recycling (minimally impacted native materials and acceptable fill, stabilized as required) would remain onsite after testing to confirm its acceptability for reuse onsite.

Short-term effectiveness

Similar to the other action alternatives, this alternative would provide the necessary protection to onsite workers, the community, and the environment through controls such as the use of foam suppressants, sprung structures, water spray for dust control, and/or air monitoring at the construction area and at the Site perimeter. To minimize the risk of exposure to emissions from the waste, workers would be equipped with the appropriate PPE and receive training in Site health and safety procedures. In addition, only minimally impacted soil or import soil would be used as backfill in source removal areas. Due to the high degree of waste removal and the need for offsite transportation, the number of truck trips with associated impacts is very high. (Approximately 166,000 single one-way truck trips[29] are anticipated to be needed to implement Alternative 6, thereby creating more traffic.) The level of air emissions control required is also high due to the degree of waste removal and potential nuisance to the community due to anticipated odors from the required excavations. The time to reach RAOs in Alternative 6 is

[29] The approximate quantity of truck trips is a calculated average between the best and conservative case scenarios for Alternative 6.

approximately 5 ¼ to 6 years, but this time could potentially be longer if materials (i.e., import fill) are not readily available when needed during implementation of Alterative 6.

Implementability

Source removal activities would be conducted using proven, off-the-shelf technologies such as excavators and dump trucks. Due to the large amount of offsite waste disposal, there is a potential concern with the availability of trucks for transporting waste and import materials and for available daily landfill capacities. An implementation factor for Alternative 6 is the limited number of available hazardous waste haulers that are anticipated to be needed to haul the waste material to an offsite disposal facility (likely a hazardous waste disposal facility), thereby potentially increasing the schedule to complete this remedial action due to the significant volume of material that would need to be hauled offsite (approximately 1,215,000 cy[30]). There is a limited number of certified hazardous waste haulers in the State of California, and/or limited number of available disposal facilities that could accept material from Ascon, including a potential limited capacity at hazardous waste disposal facilities.

The ability to obtain the necessary agency approvals is expected to be high given the reliability of the technology.

Cost

The present worth cost for Alternative 6 ranges between $127 million and $171 million for the best and most conservative scenarios defined above, respectively.

Capital Cost – Capital expenditures for Alternative 6 would include excavation and offsite disposal of all Site waste materials through transportation to landfills/recycling facilities and backfilling and final grading. Appendix R contains the detailed capital cost backup for this alternative.

O&M Cost – 30-year O&M cost estimate for Alternative 6 includes groundwater monitoring and is detailed in Appendix S, and the main components of O&M are described in Section 9.4.1.

State Acceptance

The DTSC will review this RFS report and the development of remedial objectives and remedial alternatives presented herein and will select a preferred alternative.

Community Acceptance

Comments from the community regarding Alternative 6 would be addressed after the public comment period for the Remedial Action Plan if this alternative is chosen by DTSC.

Alternative 6 is retained for comparative evaluation in Section 9.6. **Figure 9.5-6** shows a graphical representation of the above considerations.

9.6 Comparative Evaluation of Retained Alternatives

As shown on **Figures 9.5-1** through **9.5-6** and discussed above, the alternatives that were retained following the detailed evaluation were:

Alternative 3 – Protective Cap,
Alternative 4 – Partial Source Removal with Protective Cap, and
Alternative 6 – Source Removal with Offsite Disposal.

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[30] The approximate quantity of material removed from the Site is a calculated average between the best and conservative case scenarios for Alternative 6.

In the following comparative analysis, these three Alternatives are compared to each other within the framework of the threshold and balancing criteria of the nine NCP criteria. Each of the retained alternatives provides, as required by the NCP Criteria, Overall Protection of Human Health and the Environment and compliance with ARARs because they remove and/or contain the Site's waste materials with sufficient measures that are protective of the human health and the environment.

Table 9.6-A. Long-term Effectiveness and Permanence	
Alternative 3	• The protective cap would provide adequate isolation of wastes, but Alternative 3 would present the most potential for residual risk of the three retained alternatives because it involves leaving a larger quantity of waste under the cap (approximately 124,000 cy of material would be removed from the Site). • The protective cap would require long-term monitoring and O&M. • Any residual groundwater risk is comparable among the three alternatives (see Section 9.4.2) because these alternatives are designed to meet the RAOs, and the protective cap would mitigate movement of COPCs from remaining materials to groundwater by controlling infiltration of rainwater. However, an additional disadvantage of Alternative 3 over Alternatives 4 and 6 is the potential for temporary shoring to breach the clay layer that is believed to be present beneath the Site, assuming that shoring will either not be required during implementation of Alternative 4 or to a much lesser extent than Alternative 3 (see Section 9.5.3 for more details about the potential need for shoring that may be required during implementation of Alternative 3).
Alternative 4	• Alternative 4 presents less potential residual risk than Alternative 3 because less Site material remains under a protective cap (i.e., approximately one and a half times more waste than Alternative 3 is disposed offsite). Also, the areas of the Site closest to offsite receptors are the areas from which more waste would be removed. • As with Alternative 3, the protective cap would require long-term monitoring and O&M. • Any residual groundwater risk is comparable among the three alternatives because these three alternatives are designed to meet the RAOs, and the protective cap would mitigate percolation of COPCs from waste to groundwater by controlling infiltration of rainwater.
Alternative 6	• Alternative 6 presents the least long-term residual risk between the three retained alternatives because all wastes are removed and disposed offsite. • The Site would no longer be subject to potential leaching because all waste and impacted materials are removed.
Overall	• Long-term potential risk is increased with the quantity of waste left at the Site. This makes Alternative 6, Source Removal with Offsite Disposal, the highest rated alternative when considering only long-term effectiveness and permanence.

Table 9.6-B. Reductions in Toxicity, Mobility, and Volume through Treatment	
Alternative 3	• Mobility of COPCs through leaching to groundwater and volatilization to ambient air is reduced with the protective capping of all the remaining waste onsite. A limited reduction in waste volume is achieved through offsite disposal.
Alternative 4	• COPC mobility to groundwater and air is reduced with the protective capping of all the remaining waste onsite. Alternative 4 has a greater waste volume reduction than Alternative 3 through offsite disposal (approximately one and a half times more waste material is removed from the Site in Alternative 4 than Alternative 3).
Alternative 6	• Alternative 6 achieves total waste volume reduction through offsite disposal of all waste and significantly impacted materials.
Overall	• In each of these alternatives mobility of COPCs is greatly reduced through waste

Table 9.6-B. Reductions in Toxicity, Mobility, and Volume through Treatment	
	isolation (i.e., protective capping) and/or reduction of the waste volume through offsite disposal. For each alternative, all wastes are either capped or disposed offsite; however, all three alternatives are comparable when comparing reductions in toxicity, mobility, and volume through treatment.

Table 9.6-C. Short-term Effectiveness	
Alternative 3	• Alternative 3 presents the least disturbance of waste, making this alternative the least likely to produce emissions, dust, and odors. • Alternative 3 presents the fewest truck trips, making it the alternative with the least impact on local roads and the community. • The RAOs are achieved in 1 ½ to 2 years, the shortest time frame of the three considered alternatives.
Alternative 4	• Alternative 4 presents more disturbance of waste than Alternative 3 and, hence, potentially greater emissions, dust, and odors. • Necessitates more truck traffic than Alternative 3 and, hence, more potential short term local impact. • The RAOs are achieved in 2 ¼ to 3 years, longer than Alternative 3, due to the higher volume of waste removed.
Alternative 6	• Of the three considered alternatives, Alternative 6 presents the most disturbance of waste and, hence, the greatest potential for emissions, dust, and odors (significantly more than Alternatives 3 or 4). • Truck traffic is greatest due to the high volume of waste removal (141,000 – 191,000 truck trips). Potential impacts to local roads and the community are the highest among the three considered alternatives. • The RAOs are achieved in a much longer timeframe than Alternatives 3 or 4, approximately 5¼ to 6 years.
Overall	The differences between the retained alternatives are: • The degree to which the potential for odors and emissions necessitates engineering controls, • The level of local impacts due to increased truck traffic, and • The time required before RAOs are achieved. Alternative 6 would require the greatest magnitude and duration of nuisances, and therefore the use of emissions controls (i.e., sprung structures and/or foam suppressants); Alternative 3 would require the least. Evaluation of these three factors makes Alternative 3, Protective Cap, the optimum alternative when considering short-term effectiveness.

Table 9.6-D. Implementability	
Alternative 3	• Alternative 3 requires availability of capping materials, and would likely require shoring in the northern portions of Lagoons 4 and/or Lagoon 5 during excavation of the north berm, as discussed in Section 9.5.3. Installation of shoring is an available option, but does add some difficulty to implementation of the remedy. The sequencing of construction activities will have to be carefully determined and coordinated closely with the design and construction teams so that the schedule for the shoring installation is appropriately aligned with the removal of materials from the City parcel and the area just south of the City parcel where the new perimeter berms will be built as part of the northern edge of the protective cap, and with the construction of the protective cap. • An additional drawback of this remedy is the potential for shoring to breach the clay layer that is believed to be present beneath the Site, with the exception of the

Table 9.6-D. Implementability	
	Pit F area. • Alternative 3 requires more geotechnical evaluation and stabilization than the other retained alternatives, in order to be properly implemented and support the protective cap on top of the remaining drilling mud on Lagoons 4 and 5. • Moderate availability of trucking resources and landfill capacity is needed for waste removal and import of capping materials.
Alternative 4	• Relative to Alternative 3, Alternative 4 requires more trucking resources and landfill capacity for removal and disposal of waste, and similar requirements for trucking resources for capping materials. Aside from the few side-effects from short-term effectiveness and availability of capping materials, and a geotechnical evaluation as part of the cap design, including the decision on whether shoring may be needed during implementation, Alternative 4 can be implemented relatively easily.
Alternative 6	• Alternative 6 does not rely on availability of capping materials, but requires significantly more trucking resources and landfill capacity than the other considered alternatives due to the removal and disposal of all waste. This alternative would be greatly impacted and much more than the others by any shortage of trucking availability and/or landfill capacity.
Overall	• All three alternatives are technically implementable; however Alternative 3 does present technical challenges in regards to stability of the cap installed over a large quantity of drilling mud left in place. Shortages in trucking resources and landfill capacity, as well as the potential implementability issues concerned with geotechnical stability of the cap and installation of temporary shoring in Alternative 3 are the leading causes for potential impacts to implementability. This makes Alternative 4 the most implementable of the considered alternatives.

Table 9.6-E. Costs	
Alternative 3	• Present worth cost of Alternative 3, including 30 years of monitoring and O&M, ranges between $38.3 million and $72.2 million, the least costly option of the considered alternatives. • Alternative 3 would permit recreational or commercial development after completion of the remedy, which may allow for minimal potential cost recovery through eventual development of the Site.
Alternative 4	• Present worth cost, including 30 years of O&M, ranges between $46 million and $80.9 million. • Alternative 4 would permit recreational or commercial development after completion of the remedy, which may allow for minimal potential cost recovery through eventual development of the Site.
Alternative 6	• Present worth cost, including 30 years of O&M, ranges between $127 million and $171 million, the most costly option. • Potential cost recovery through potential development of the Site would be greatest for Alternative 6.
Overall	• In general, cost of the alternatives is proportionate to the degree of waste disposal. Alternative 3 is the least costly and, therefore, the preferred alternative when considering the criteria of cost. Any potential cost recovery eventually obtainable through development of areas of the Site was not taken into account in the feasibility study process, but is considered fairly equal between the three alternatives based on the planned end use.

The benefits of Alternative 3 over the other two alternatives are that it would provide the least expensive and fastest means to provide adequate protection of human health and the environment, with the least impact to the environment, the surrounding communities, and the Site workers from implementation. The primary benefit of Alternative 6 over the other alternatives is that it provides the most long-term effectiveness and permanence through disposal of all waste, leaving the least potential residual risk at the Site.

The primary disadvantages of Alternative 3 over the other two alternatives is that it provides the least long-term effectiveness and permanence, leaves the most potential residual risk from the encapsulated waste, and has implementability issues due to the probable need for temporary shoring to be installed during implementation of the remedy. The disadvantages of Alternative 6 are that the long-term permanence and protection of human health and the environment are achieved at a cost of potential implementation impacts, including potential emissions, odors, truck traffic, and noise, and protection is achieved over the longest period of time and at the greatest economic cost (both of which are significantly greater than Alternatives 3 and 4 as previously discussed in this section).

The benefits of Alternative 4 over the other alternatives result from borrowing from the benefits of Alternatives 3 and 6 while mitigating the drawbacks of each. The benefits are:

- Alternative 4 achieves a higher degree of long-term effectiveness and permanence in the areas closest to potential receptors (i.e., the local communities, school, and park) than Alternative 3 (approximately one and a half times more waste is removed than in Alternative 3, or an average of approximately 62,000 cy more waste and impacted material, including approximately 46,000 cy more drilling mud from Lagoons 4 and 5).
- Alternative 4 has far fewer negative impacts than Alternative 6 (i.e., significantly less potential odors, emissions, dust, truck traffic, noise).
  - Implementation of Alternative 4 can be completed much faster than Alternative 6 (approximately 3 years shorter time to implement Alternative 4 than Alternative 6).
  - Alternative 4 will require approximately 114,000 fewer truck trips than Alternative 6.
  - Alternative 4 can be completed at a lower relative cost than Alternative 6 (implementation of Alternative 6 would cost approximately 2 and a half times the cost to implement Alternative 4).
- Shoring may not be needed for the implementation of Alternative 4, or may be needed to a much lesser degree than Alternative 3, therefore reducing the negative impacts that shoring could create (i.e., breaching the clay layer beneath the Site, detailed design and construction phasing for the installation of shoring, etc.).
- The geotechnical concerns in implementing Alternative 3 can be addressed and easily mitigated in Alternative 4 (see Appendix K).
- Alternative 4 would provide a much more aesthetically pleasing Site than Alternative 3 because the majority of the areas along Hamilton Avenue and Magnolia Street would be at a closer elevation to the adjacent street levels, the community park across the street on Hamilton, the high school across the street, and the green belt south of the Site along Magnolia Street.
- Alternative 4 provides the greatest balance and flexibility between short-term and long-term effectiveness.

Because Alternative 4 draws from the benefits of the other alternatives and softens the drawbacks of each, Alternative 4 has no drawbacks unique to itself.

Section 10 discusses the recommendation of Alternative 4 as the preferred remedy for the Site.

10.0 PREFERRED ALTERNATIVE FOR THE ASCON LANDFILL SITE

10.1 Introduction

Section 9 presented a detailed evaluation of six remedial alternatives for the Site. These alternatives are comprised of various remedial technologies and process options that would be utilized in the GRAs for the various wastes at the Site. These technologies and process options were retained following preliminary screening based on effectiveness and ease of implementation (Section 8.5), and a secondary screening based on effectiveness, an expanded evaluation of implementation, and relative cost (Sections 8.6 and 8.7).

The remedial alternatives were evaluated based on the nine NCP criteria and considerations (Section 9.5). Following the detailed evaluation, three alternatives were retained for comparative analysis (Section 9.6). These alternatives were:

- Alternative 3: Protective Cap
- Alternative 4: Partial Source Removal with Protective Cap
- Alternative 6: Source Removal with Offsite Disposal.

The detailed evaluation found that each of these alternatives achieved the "Threshold" Factors. However, Alternative 4 is much more implementable than Alternative 3 due to the extra measures necessary to address geotechnical stability of the cap in Alternative 3, including the need for shoring in Alternative 3 (shoring is not expected to be needed for implementation of Alternative 4, or to a much lesser degree than Alternative 3). Alternative 4 also rates higher than Alternative 3 in Long-term Effectiveness and Permanence due to the shoring that is expected to be installed in Lagoons 4 and 5 in Alternative 3 and the potential for the shoring to breech the clay layer.

As compared to Alternative 6, Alternative 4 has significantly fewer short-term impacts: approximately 114,000 fewer truck trips, approximately 3 years shorter schedule for implementation of the remedy, coinciding with 3 years less time with potential nuisances such as odors and emissions, noise, as well as continual truck traffic, and approximately one million fewer cubic yards of waste removed from the Site by trucks or rail generating approximately 85% fewer potential emissions from excavation of the waste and offsite hauling of the material to a disposal facility.

Based on the above evaluation, Alternative 4 presents the preferred remedial alternative for the Site.

10.2 Recommendation of the Preferred Alternative

Alternative 4 (Partial Source Removal with Protective Cap) is the recommended preferred alternative for the Site. Alternative 4 is recommended because with respect to the major drawback of Alternative 3, it is more effective in the long term, because of its permanence (i.e., more waste removed and from areas closest to potential offsite receptors) and because it has fewer short-term impacts than Alternative 6, because it is of lesser magnitude, shorter duration, and will involve fewer truck trips and therefore less risk of odors, emissions, dust, and noise.

Alternative 4 consists of the following elements (see Section 9.2 and **Figure 9.2-4**):

- Removal of Pit F area wastes with offsite disposal and removal and appropriate treatment and discharge of impacted groundwater from the Pit F area, and potential treatment of air when discharged from a negative-pressure sprung structure to minimize emission and odors,

- Removal of the tarry liquids in Lagoons 1, 2, and 3 by 1) fluidization and pumping with offsite recycling at a fuel blending facility, or 2) mixing with soil, excavation, and offsite disposal at a landfill,

- Stabilization of the top several feet of remaining drilling mud in Lagoons 1, 2, and 3 using either cement stabilization or Geogrid and/or geotextile layers, or equivalent, and covering with acceptable soils,

- Excavation of impacted materials on the City's parcel to a depth that would achieve the RBCs, anticipated to be the approximate elevation of top of clay, with offsite disposal and/or placement under the higher cap in the southwest portion of the Site, and backfilling to adjacent street elevation using imported soils or materials recycled from the waste segregation operations on the Site that are acceptable for use as backfill,

- Removal of portions of Lagoons 4 and 5 drilling mud to approximate adjacent street elevation (exact elevation to be determined during remedial design)[1], by excavation and offsite disposal[2],

- Investigation of the existence and location of Pacific Ranch #1 converted water well (former oil well) in the Lagoon 5 area and appropriate closure, if found,

- Investigation of the locations of AW-6 and AW-7 former groundwater monitoring wells, thought to be located under Hamilton Avenue based on anomalies found during a magnetic survey, and well destruction, if found,

- Potential well destruction, modification, or appropriate action for SCOC #40 and SCOC #41 oil wells in the South Coast Oil Corporation (SCOC) property[3], if the soils remedial investigation in this area determines that the SCOC property is to be included under the cap,

- Excavation of impacted materials to approximate adjacent street elevation (exact elevation to be determined during remedial design) along an area parallel to Hamilton Avenue and Magnolia Street (refer to **Figure 9.2-4** for a depiction of the approximate location of source removal) with waste disposal offsite and/or placement of excavated or, if necessary, stabilized, materials under the higher protective cap in the southwestern portion of the Site[4],

- Removal of pit wastes (Pits A **-** E, G, and H) to approximate adjacent street elevation (exact elevation to be determined during remedial design), if part of partial source removal area, by excavation and offsite disposal and/or placement of excavated materials under the higher cap in the southwest portion of the Site,

- Removal, backfill and reconstruction of the perimeter berms to an engineered slope (After construction, the berms would be completely situated inside the Cannery Hamilton parcel.),

- Onsite breaking or crushing of construction debris to the degree necessary to reuse onsite and construct the cap,

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[1] The cost estimates and waste volumes developed for Alternative 4 are based on removal of drilling mud from Lagoons 4 and 5 to adjacent street elevation (see Appendix R) after completion of the Emergency Action conducted in 2005 - 2006, which included removal of over 30,000 cy of drilling mud from Lagoons 4 and 5 (Project Navigator, Ltd., 2006a, b).
[2] The cost estimates and waste volumes developed for Alternative 4 are based on removal of drilling mud from Lagoons 4 and 5 (see Appendix R) after completion of the Emergency Action conducted in 2005 - 2006, which included removal of over 30,000 cy of drilling mud from Lagoons 4 and 5.
[3] Well destruction or modification of SCOC #40 and SCOC #41, if needed, is dependent on obtaining access to the property and agreement from the mineral estate owners to destroy or modify these wells. Well destruction or modification is anticipated to be conducted by an outside party, and therefore costs for the well destruction or modification are not included in the remedy alternatives.
[4] The area of source removal for Alternative 4 will be determined during the remedial design.

- Construction of a low profile cap as a horizontal barrier[5] over the excavated areas of the CHP parcel along Hamilton Avenue and Magnolia Street with imported soil for cap cover, and acceptable materials recycled from the waste segregation operations on the Site for a cap foundation meeting applicable engineering standards (Some materials would be stabilized using cement, fly ash, or other amendments, if required.),

- Construction of a cap as a horizontal barrier over the southwestern portion of the Site, including the SCOC property, if the soils remedial investigation in the SCOC property determines that the SCOC property is to be included under the cap[6]. The cap over the Site would be a sloped cap, consisting of different elevations in different areas, where the southwestern portion of the cap would be at a higher elevation than the cap placed on top of the excavated areas at the north and east sides of the Site. The capped areas may vary in elevation and size depending on the final area and vertical extent of source removal along the east and north sides of the Site, all of which will be determined during the remedial design. The constructed cap will be designed to include a lateral drainage system to collect and remove any leachate wastes and an effective gas collection and removal system.

- Maintenance of a long-term groundwater monitoring program to ensure compliance with the remedial action objectives ("RAOs") identified in Section 6. The long-term groundwater monitoring program would include monitoring and sampling perimeter wells[7], similar to the recommendations in the Groundwater RI (Geosyntec, 2005b, 2007b) and the interim groundwater monitoring program. Should impacts be found and verified above threshold levels at the Site perimeter, a contingency plan will be followed, as appropriate[8].

- Maintenance of a long-term monitoring system to ensure NAPL and/or dense NAPL are not migrating onsite or offsite.

- The CHP Parcel would be deed restricted to prevent residential development and/or intrusive soil or groundwater activities, allowing solely for commercial or recreational use. The City may be required to restrict certain uses for the City parcel.

- The protective cap in Alternative No. 4 will cover most of the current area of the Cannery Hamilton parcel (except for the Pit F area). The area along Hamilton Avenue and the northern and southern sectors of Magnolia Street will be at a lower elevation due to the planned excavation and removal of impacted materials to approximate street elevation here, with a protective cap then installed at this location resulting in an approximate elevation of 8 ft MSL, plus or minus a few feet, at the top of the protective 'lower' cap along Hamilton Avenue and Magnolia Street. The remainder of the Site will also have a protective cap, but the cap will be installed at this area of the Site over the approximate existing elevation (after the removal of tarry liquids from Lagoons 1, 2, and 3, adjustments due to breaking or crushing of existing construction debris onsite, removal of a significant portion of drilling mud from Lagoons 4 and 5, and some grading work), therefore creating a generally higher cap in the southwestern portion of the Site than the lower cap along Magnolia Street and Hamilton Avenue, following the general topography of the Site in its current condition in most areas of

[5] A cap will consist of at a minimum a drainage layer and vegetative cover over the waste. Other protective elements such as a vapor mitigation barrier and leachate/vapor collection systems may be added depending on the end land use of the property.
[6] Remediation of the SCOC property is dependent on the results from the remedial investigation for soils in this area to determine the extent of remediation needed, if any. Any remediation of the SCOC property required from landfill operations is anticipated to coincide with the remediation that will be conducted at the remainder of the Ascon Landfill Site, and this area would either be capped with the rest of the Site under Alternative 4, or have contaminated soils removed such as in the City parcel. The remedial investigation results will not be available prior to finalization of this RFS.
[7] The long-term groundwater monitoring program will be further detailed in the Remedial Action Plan for the Site.
[8] The contingency plan will be incorporated into the long-term groundwater monitoring program that will be included in the Remedial Action Plan for the Site.

the Site except for the northern portion of the Site along Hamilton Avenue. The transition between the lower and higher cap will be engineered and is anticipated to be a gentle slope.

Alternative 4 removes substantially more waste than does Alternative 3 -- approximately 62,000 cubic yards more, or nearly one and a half times more. Furthermore, Alternative 4 removes waste which is closest to offsite receptors, including the residential area along Magnolia Street, Edison High School on the northwest corner of Magnolia Street and Hamilton Avenue, Edison Community Park adjacent and to the north of the Site, and the residential area along Hamilton Avenue west of the Edison Community Park. Alternative 4 provides a lower profile cap near the street, which will enhance the Site's appearance, regardless of any eventual development on the surface of the cap.

As previously discussed, this benefit of greater waste reduction than Alternative 3 comes with many fewer short-term impacts than Alternative 6, while retaining the key favorable components of Alternative 6 and Alternative 3, which include removal of tarry liquids, removal of Pit F area wastes and impacted groundwater in the Pit F area, and reduction of risks during implementation. Alternative 4 will be completed with approximately 114,000 fewer truck trips, only 32 percent of the truck trips that would be required by Alternative 6. Alternative 4 will also be less disruptive with its approximate 2 and a half year average duration, which is 3 years shorter duration than Alternative 6's 5 and a half year average schedule.

Benefits of Alternative 4 are illustrated in **Figure 10.2-1**.

10.3 Alternative 4 Implementation

10.3.1 General Implementation Sequence

The following is a general implementation sequence for Alternative 4. A more detailed sequencing of activities under Alternative 4 will be generated during the remedial design process. **Tables 8** and **9** of **Appendix R** provide additional information on the specific waste volumes, construction time frames, unit costs, and assumptions.

Step 1 – Implement RAP/CEQA process. Define current Site conditions: Approximately 1.4 million cubic yards of material from native clay at approximately 0 feet above MSL to a maximum elevation of about 30 feet above MSL.

Step 2 – Mobilization & Site setup: Mobilize equipment (excavators, loaders, dump trucks, water tanks, etc.), materials, and construction personnel to the Site. Set up Site trailers, staging area, water supply, temporary utilities, and access roads.

Step 3 – Clearing and grubbing: Remove vegetation from portions of the Site undergoing waste removal and cap construction. Break or crush remaining surface concrete.

Step 4 – Remove Lagoons 1, 2, and 3 tarry liquids: Consisting of the top several feet of material in each of these three lagoons, estimated to be approximately 25,000 cubic yards.

Step 5 – Remove wastes from areas along Hamilton and Magnolia as shown in **Figure 9.2-4.** The source removal area will include the following areas:

- Impacted Site materials existing on City parcel,
- Pit F area impacted soils,
- Pit F area impacted groundwater,
- Portions of other pits located in the source removal zone,
- Portions of Lagoons 4 and 5 (removed down to approximate adjacent street elevation), and

- Other Site materials (soils, drilling mud, construction debris, etc.) in source removal zones.

Waste will be removed to approximate adjacent street elevation (exact elevation to be determined during remedial design), with the exception of the Pit F area and the City parcel, where waste will be removed at least down to and including impacted native clay, and groundwater will be removed in this area and appropriately discharged offsite after any needed treatment. (Appropriate engineering controls may be used if needed after post-remediation risk assessment).

The proximity of Pit F groundwater impacts to Pit F and the near-flat groundwater gradient in that area enable groundwater collection through dewatering of the soils excavation to be a feasible means to mitigate Pit F groundwater impacts. Excavation dewatering yields are estimated to be approximately 150 gallons per minute (gpm) from a 50-ft by 50-ft excavation floor[9]. With an impacted groundwater estimated volume of 1.5 million gallons (see Section 6.5.1) and estimated minimum excavation duration of 60 days, dewatering yields of this magnitude can potentially remove all impacted groundwater as it flows back to the excavation. The groundwater pumped from the excavation will be stored in tanks, tested, and treated according to process options retained in feasibility study (**Table 8.5-1**), namely oil/water separation to address NAPL, if present, and granular activated carbon filtration, then appropriately discharged.

Because of the odors emitted by Pit F-impacted materials, it is anticipated that the Pit F area excavation will be done under a sprung structure in a negative pressure atmosphere (i.e., the air treatment system maintains the ambient pressure inside the structure to be lower than outside, preventing emissions from escaping).

Step 6 – Reconstruct berms on northern and eastern Site boundaries to engineered slopes within the CHP parcel.

Step 7 – Construct cap over entire Site[10], with the exception of areas remediated to native clay (i.e., City parcel). The cap will include, at a minimum, a drainage layer and biotic barrier, a passive vapor collection system, vegetative cover over the waste, and a surface water collection system. Other elements, such as an active vapor mitigation system and a leachate collection system may be added during the remedial design if needed. Factors that would determine if the Site would require an active vapor collection system as part of Alternative No. 4 include data that would be collected during the remedial design phase. If the data show that the Site would generate sufficient gas (methane) after the existing Site's conditions have been altered during the preliminary steps of implementation of this alternative (i.e., removal of the tarry liquids, removal of a portion of the drilling mud from Lagoons 4 and 5, removal of Pit F area waste, and general Site grading) or during the O&M phase, then the passive vapor collection system would be changed to an active vapor collection system, and included as part of Alternative 4.

Step 8 – Final Site grading, seeding, and demobilization.

Step 9 – Establishment of final Site condition, monitoring and maintenance requirements, including groundwater monitoring (see Step 10): 38 acre (less areas remediated to native clay) cap. Approximately 1.2 million cubic yards of material remain onsite under a cap. Establishment and implementation of deed restrictions to prevent inconsistent development and activities, allowing for commercial or recreational use.

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[9] Estimate based on known head of vertical saturation, estimated conductivity, and professional judgment.

[10] Remediation of the SCOC property is dependent on the results from the remedial investigation for soils in this area. Any remediation of the SCOC property required from landfill operations is anticipated to coincide with the remediation that will be conducted at the remainder of the Ascon Landfill Site, and this area would either be capped with the rest of the Site under Alternative 4 or have contaminated soils removed such as in the City parcel. The remedial investigation results will not be available prior to finalization of this RFS.

Step 10 – A long-term groundwater monitoring program will be established that monitors perimeter groundwater for new detections and applies a contingency program to mitigate any detections greater than threshold levels[11] if they are found. The contingency program will be outlined in the Remedial Action Plan and will include MCL triggers for perimeter detections and subsequent actions to ensure that potential groundwater impacts are contained onsite. (History at the Site, namely the lack of offsite groundwater impacts, has demonstrated that impacts to groundwater have not significantly migrated. This long-term groundwater monitoring program will ensure that attenuation continues to prevent offsite impacts and that active remediation of groundwater impacts under the proposed cap is not warranted.)

Step 11 – Establish a long-term monitoring system to ensure NAPL and/or dense NAPL are not migrating onsite or offsite.

10.3.2 Applying Emergency Action 2005–2006 Findings to Alternative 4 Implementation

The Emergency Action findings pertinent to implementation of the preferred remedy focus on 1) Odors and Emissions; 2) Waste Removal-Production Rates; 3) Material Handling; and 4) Characteristics of Minimally Impacted Fill Materials. These are addressed separately below:

Odors and Emissions

During the Emergency Action activities, when handling materials near the perimeter of the Site, real-time air monitoring indicated total VOC concentrations measured with a PID were frequently greater than the Air Monitoring Plan action level of 0.5 ppm above background. When this occurred, several techniques were required to be used to mitigate VOC emissions and control odors:

- Water spray,
- Rusmar® foam with a vanilla scent added to mask odors,
- Misters, to reduce odors, strategically located with respect to the excavation operations, and
- Placement of minimally impacted soil over VOC-contaminated material.

Emissions were controlled to such a degree that VOC concentrations in the work area were such that respiratory protection was not required for workers. Different action levels for the air monitoring (from the Emergency Action Air Monitoring Plan and SCAQMD Rule 1166 Permit) during the Emergency Action included:

- 0.5 ppm (with a PID for VOCs) above background at the Site perimeter monitoring stations (if exceeded, implementation of mitigation measures was required),
- 0.05 mg/m^3 (with a monitor for dust) above background at the Site perimeter monitoring stations (if exceeded, mitigation measures for dust was required),
- 5.0 ppm (with a PID for VOCs) above background at the Site perimeter monitoring stations (if exceeded, work was required to be stopped, mitigation measure applied, and work not resumed until readings returned to background levels),
- 50 ppm (with a PID for VOCs) at the workface (classifying the material as VOC-contaminated material per SCAQMD Rule 1166), and
- 1,000 ppm (with a PID for VOCs) at the workface (requiring immediate application of mitigation measures and immediate placement in a sealed container or direct loading into trucks for offsite disposal).

On three occasions during the Emergency Action, while excavating drilling mud from Lagoon 4 near the Site perimeter, real-time air monitoring with a PID indicated total VOC concentrations greater than the Emergency Action Air Monitoring Plan action level of 5.0 ppm above background, necessitating

[11] The long-term groundwater monitoring program, including the contingency plan with threshold levels, will be further detailed in the Remedial Action Plan for the Site.

suspension of the work until concentrations dropped below background levels. Also, work was stopped during three other occasions during the Emergency Action due to PID measurements exceeding the work face action level of 1,000 ppm within three inches from the excavated material, and mitigation measures were applied and the material was immediately placed into a sealed container for offsite disposal.

Odors were the primary complaint expressed by local residents. Wind direction and velocity had a significant impact on odor perception. Wind directions were generally onshore and relatively low velocity (less than 10 miles per hour), which resulted in offsite migration of odors to the surrounding neighborhoods.

In summary, the emissions mitigation techniques employed during Emergency Action activities were effective in controlling onsite VOC emissions, but were somewhat less effective in mitigating offsite odors. During Alternative 4 remedial action, additional short-term odor control actions, such as the use of sprung structures during excavation of Pit F wastes, may be required to sufficiently mitigate odors to offsite receptors.

Waste Removal-Production Rates

During excavation of (TPH and metals) impacted soils during the Emergency Action, significant amounts of concrete and asphalt debris were encountered uniformly distributed throughout the depth of excavation. Soil mixing, truck hauling, and limits imposed by the receiving facility set the acceptable size limit of concrete and asphalt debris in soil to less than six to eight inches. The concrete debris tended to be in pieces with dimensions exceeding four feet. The sorting of the concrete and asphalt debris slowed the rate of excavation of the impacted soils because it could not be used to mix with the drilling mud.

The excavation production rate assumed in this RFS's cost estimates is 1,250 cubic yards per day for excavation of drilling mud and impacted soil. During the Emergency Action, the production rate of 1,250 cubic yards per day proved to be reasonable. During Alternative 4 implementation, more than one excavation face could theoretically be implemented and thereby increase the production rate. However, the limiting factors regarding excavation work faces are those imposed by the South Coast Air Quality Monitoring District (SCAQMD) Rule 1150 and 1166 permit requirements, which limited the excavation work face to 2,000 square feet during the Emergency Action work.

Material Handling

During previous investigations of the lagoon materials, sampling of the drilling mud indicated a consistency ranging from a relatively cohesive material, which could be excavated utilizing conventional excavation methods and equipment, to material that was less cohesive and flowed similar to a high viscosity liquid. The drilling mud also contained a significant amount of tar, particularly in the southeastern corner of Lagoon 4.

During the Emergency Action work, the drilling mud in Lagoons 4 and 5 was found to be relatively cohesive material with soil-like handling characteristics. Notable exceptions were the drilling mud located in the southeastern corner of Lagoon 4, and to a lesser extent, the material in the southwestern corner of Lagoon 5 (northern half). In those locations, the drilling mud contained a significant amount of tarry liquids, similar to those in Lagoons 1 and 2.

Another assumption made for the RFS cost estimates concerns the quantity of Site soils required for mixing with drilling mud and tarry liquids to facilitate handling required for offsite disposal in end dump trucks or rail cars. The amount of soil used to mix with drilling mud for the purpose of improving the handling characteristics of the drilling mud ranged from 25 to 50 percent during the Emergency Action. In a few isolated cases where the drilling mud contained a significant amount of tarry liquids, the amount of soil mixed with drilling mud was one to one. The required mixing ratios of soil to drilling mud required for offsite disposal closely match the assumed quantities in the RFS cost estimates.

Characteristics of Fill Materials

As discussed above, onsite fill materials were used to mix with drilling mud excavated from Lagoons 4 and 5 for handling and disposal purposes during the Emergency Action. The fill materials were sampled and analyzed, as needed for profiling for disposal purposes. A majority of the minimally impacted fill materials tested as non-RCRA hazardous, or California-hazardous, due to leachable lead, utilizing the California STLC test procedure. The California-hazardous threshold is 5 mg/L for lead, and analytical results from samples of fill material during the Emergency Action varied between ND and 110 mg/L. This finding potentially affects how fill material will be handled during implementation of Alternative 4. This finding was accounted for in the cost estimates of the Alternatives provided in Appendix R.

10.4 Summary

As discussed in Section 9.6 and earlier in this section, Alternative 4 is the recommended preferred remedial alternative for the Site. The Emergency Action conducted in 2005 through early 2006 further assisted in the evaluation of, and verified prior findings regarding, the comparative advantages of the alternatives presented in Section 9, particularly by providing insight into potential short-term impacts and feasibility of the alternatives, and confirmed that Alternative 4 is the best remedy for the Site.

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12.0 LIMITATIONS

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