

WORK PLAN

PILOT TEST WORK PLAN

REMEDIAL EXCAVATION AND IN-SITU TREATMENT PILOT TESTING

FORMER KAST PROPERTY
CARSON, CALIFORNIA

Prepared for

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May 10, 2011

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**CERTIFICATION
PILOT TEST WORK PLAN**

**REMEDIAL EXCAVATION AND
IN SITU TREATMENT PILOT TESTING**

**FORMER KAST PROPERTY
CARSON, CALIFORNIA**

I am the Project Manager for Equilon Enterprises LLC, doing business as Shell Oil Products US, for this project. I am informed and believe that the matters stated in the this Pilot Test Work Plan for Remedial Excavation and In-situ Treatment Pilot Testing, Former Kast Property, Carson, California are true, and on that ground I declare, under penalty of perjury in accordance with Water Code section 13267, that the statements contained therein are true and correct.



Gene Freed
Project Manager
Shell Oil Products US
May 10, 2011

PILOT TEST WORK PLAN
REMEDIAL EXCAVATION AND
IN-SITU TREATMENT PILOT TESTING

FORMER KAST PROPERTY
CARSON, CALIFORNIA
Site Cleanup No. 1230
Site ID 2040330
Cleanup and Abatement Order No. R4-2011-0046

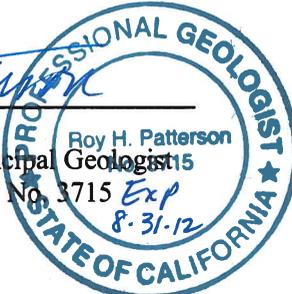
This Pilot Test Work Plan (Work Plan) for Remedial Excavation and In-situ Treatment Pilot Testing for the Former Kast Property was prepared on behalf of Equilon Enterprises LLC, doing business as Shell Oil Products US, by URS Corporation (URS) with technical support and contributions from Geosyntec Consultants, Inc. (Geosyntec). URS prepared the pilot test excavation portions of this document, and Geosyntec prepared the in-situ treatment pilot testing portion of the Work Plan. This Work Plan is being submitted in response to Cleanup and Abatement Order No. R4-2011-0046 issued by the California Regional Water Quality Control Board – Los Angeles Region on March 11, 2011.

The scope of services performed in preparation of this Work Plan may not be appropriate to satisfy the needs of other users, and any use or reuse of his document or the information contained herein is at the sole risk of said user. No express or implied representation or warranty is included or intended in this Work Plan, except that the work was performed within the limits prescribed by SOPUS with the customary thoroughness and competence of professionals working in the same are on similar projects. This report was prepared under the technical direction of the undersigned.

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TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1.0 INTRODUCTION.....	1-1
1.1 BACKGROUND	1-1
1.2 PURPOSE AND SCOPE OF PILOT TESTING.....	1-2
1.2.1 Purpose	1-2
1.2.2 Scope	1-2
1.3 WORK PLAN ORGANIZATION	1-4
2.0 PILOT TEST LOCATIONS	2-1
2.1 CRITERIA FOR PILOT TEST LOCATIONS.....	2-1
2.1.1 Presence of Concrete Reservoir Slabs	2-1
2.1.2 Presence of Petroleum-related Impacts in Shallow Soils.....	2-1
2.1.3 Presence of Utilities.....	2-2
2.1.4 Sufficient Working Area for Excavations and Equipment Operation.....	2-2
2.1.5 Property Access	2-3
2.2 POTENTIAL PILOT TEST LOCATIONS	2-4
3.0 EVALUATION OF GEOTECHNICAL PROPERTIES OF SITE SOILS	3-1
3.1 GEOTECHNICAL DATA NEEDS.....	3-1
3.2 GEOTECHNICAL INVESTIGATION TO ASSESS STRENGTH PARAMETERS OF SITE SOILS	3-1
4.0 PILOT TEST EXCAVATION APPROACHES	4-2
4.1 LARGE UNSHORED EXCAVATION TO APPROXIMATELY 10 FEET BGS WITH SLOPED SIDEWALLS	4-2
4.2 UNSHORED SLOT TRENCHES TO APPROXIMATELY 10 FEET BGS	4-3
4.3 CONVENTIONAL H-PILE CANTILEVERED SHORED EXCAVATION TO APPROXIMATELY 10 FEET BGS	4-4
4.4 CONVENTIONAL SHEET-PILE SHORED EXCAVATION TO APPROXIMATELY 10 FEET BGS	4-4
4.5 SLIDE-RAIL SHORED EXCAVATION TO APPROXIMATELY 10 FEET BGS	4-4
4.6 TRENCH-BOX SHORED EXCAVATION TO APPROXIMATELY 10 FEET BGS	4-5
4.7 UNSHORED SURGICAL EXCAVATIONS TO LESS THAN 10 FEET BGS	4-5
4.8 CONCRETE REMOVAL	4-6
4.9 SUMMARY.....	4-6
5.0 EXCAVATION PILOT TESTING	5-1
5.1 HEALTH AND SAFETY OF PUBLIC AND WORK CREWS.....	5-1
5.1.1 Health and Safety Plan and JSAs.....	5-1
5.1.2 Qualifications of Personnel Performing Work.....	5-1
5.2 SITE SURVEY	5-2
5.3 PERMITTING.....	5-2
5.3.1 Trenching Permit	5-2
5.3.2 South Coast Air Quality Management District Rule 1166 Permit	5-2
5.3.3 City of Carson Permits.....	5-2
5.3.4 Notification	5-3
5.3.5 California Environmental Quality Act (CEQA) Review	5-3
5.3.6 Permit(s) for ISCO In-situ Treatment Pilot Testing.....	5-3

5.4	DOCUMENTATION OF PRE-EXCAVATION CONDITIONS	5-4
5.5	UTILITIES.....	5-4
5.5.1	USA Notifications	5-4
5.5.2	Utility Surveys and Temporary Interruption.....	5-4
5.6	EXCAVATION METHODS	5-6
5.6.1	General Excavation Activities (Sloped Sidewall Excavations)	5-6
5.6.2	Slide-rail Shoring System Excavation Activities.....	5-7
5.6.3	Slot Trenching Excavation Activities	5-8
5.6.4	Use of Motorized Conveyor System for Soil Excavation in Back Yards of Properties	5-9
5.7	MATERIALS HANDLING	5-9
5.8	TRAFFIC CONTROL.....	5-10
5.9	AIR QUALITY MONITORING DURING EXCAVATION ACTIVITIES	5-11
5.9.1	Monitoring of Worker’s Breathing Zone for Worker Health and Safety	5-11
5.9.2	Monitoring for AQMD Rule 1166 and Rule 403 Compliance.....	5-11
5.9.3	Monitoring for VOCs and SVOCs and Meteorological Conditions	5-13
5.10	MITIGATION OF VAPORS AND ODORS	5-14
5.11	NOISE MONITORING AND CONTROL DURING EXCAVATION.....	5-15
5.11.1	Regulatory Noise Control Requirements	5-15
5.11.2	Noise Monitoring and Management	5-16
5.11.3	Vibration Monitoring of Home(s) During Excavation Activities	5-16
5.12	MONITORING OF STABILITY OF EXCAVATION WALLS	5-17
5.13	MONITORING OF STABILITY OF ADJACENT AND NEARBY STRUCTURES	5-17
5.13.1	Pre-excavation and Post-excavation Surveys	5-17
5.13.2	Crack Monitoring.....	5-18
5.14	EXCAVATION SIDEWALL AND BOTTOM SAMPLING.....	5-18
5.15	EXCAVATION BACKFILL AND SITE RESTORATION	5-19
5.15.1	Import Backfill Material	5-19
5.15.2	Backfill Placement and Compaction.....	5-20
5.15.3	Utility Restoration	5-20
5.15.4	Site Landscape Restoration.....	5-20
6.0	IN-SITU REMEDIATION PILOT TESTING.....	6-1
6.1	IN-SITU CHEMICAL OXIDATION PILOT TESTING.....	6-1
6.1.1	In-situ Chemical Oxidation Pilot Test Objectives	6-1
6.1.2	Site Conditions Relevant to ISCO	6-1
6.1.3	Site-Specific Feasibility Evaluation.....	6-2
6.1.4	Bench Testing	6-3
6.1.5	Flow and Transport Modeling	6-3
6.1.6	ISCO Pilot Test Planning.....	6-3
6.1.7	ISCO Pilot Test Implementation.....	6-4
6.1.8	Post-injection Monitoring Plan.....	6-8
6.1.9	ISCO Pilot Test Evaluation.....	6-9
6.2	BIOVENTING	6-9
6.2.1	Bioventing Pilot Test Objectives	6-10
6.2.2	Background.....	6-10
6.2.3	Bioventing Pilot Test Strategy	6-11
6.2.4	Bioventing Pilot Test Location Selection	6-11
6.2.5	Extraction Well and Soil Vapor Monitoring Probe Installation.....	6-12
6.2.6	Soil Laboratory Analytical Testing.....	6-12
6.2.7	Bioventing Pilot Test Equipment.....	6-13
6.2.8	Bioventing Pilot Test Implementation	6-14

6.2.9	Vapor Extraction Technology Evaluation.....	6-15
6.2.10	Respirometry Test Procedures	6-15
6.2.11	Bioventing Pilot Test Evaluation.....	6-15
7.0	RELOCATION OF RESIDENTS AND SECURITY DURING PILOT TEST ACTIVITES	7-1
7.1	TEMPORARY RELOCATION OF RESIDENTS AT AFFECTED PROPERTIES	7-1
7.2	SECURITY FOR RESIDENCES WHILE RESIDENTS ARE RELOCATED	7-1
8.0	CONTINGENCY PLAN.....	8-1
8.1	EMERGENCY RESPONSE PROCEDURES	8-1
8.2	MEDICAL EMERGENCIES.....	8-1
8.3	OPERATION SHUTDOWN	8-2
8.4	CONFINED SPACE ENTRY.....	8-2
8.5	UNANTICIPATED UTILITIES	8-2
8.6	OBSTRUCTION(S) ENCOUNTERED	8-2
8.7	SPILL OR HAZARDOUS MATERIALS RELEASE	8-3
8.7.1	General.....	8-3
8.7.2	AQMD Rule 403 Dust Control.....	8-3
8.7.3	AQMD Rule 1166 VOC Control.....	8-4
8.7.4	Highway Spill Response.....	8-5
8.8	SEVERE WEATHER SHUTDOWN	8-6
8.9	FIRE	8-6
8.10	PLACES OF REFUGE.....	8-6
8.11	COMMUNICATION	8-6
8.12	SUSPICIOUS ACTIVITY	8-7
9.0	SCHEDULE AND REPORTING	9-1
10.0	REFERENCES.....	10-1

APPENDICES

APPENDIX A	DISTRIBUTION OF SELECT COCS IN SHALLOW SOILS
APPENDIX B	SUMMARY OF POTENTIAL PILOT TEST LOCATIONS
APPENDIX C	ISCO BACKGROUND AND SITE-SPECIFIC FEASIBILITY EVALUATION

Figures

FIGURE 1	SITE VICINITY MAP
FIGURE 2	BORING REFUSALS WITH REFUSAL DEPTH RANGE

LIST OF ACRONYMS AND ABBREVIATIONS

1:1 H:V	One horizontal to one vertical
6-L	Certified 6-liter summa canister
air vac	Vacuum extraction
AIHA	American Industrial Hygiene Association
ASP	Activated sodium persulfate
ASTM	American Society for Testing and Materials
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, xylenes
Cal/OSHA	State of California – Division of Occupational Safety and Health
CAO	Cleanup and Abatement Order
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CHP	Catalyzed hydrogen peroxide
cm	Centimeters
CO ₂	Carbon dioxide
COCs	Constituents of Concern
CPR	Cardiopulmonary resuscitation
cy	Cubic yard
dB	Decibel
DBS	Department of Building and Safety
DERA	Designated Emergency Response Authority
DTSC	Department of Toxic Substances Control
EEC	Engineering and Environmental Consulting, Inc.
EHS	Environmental, Health and Safety
EOS	LA County Fire Department Health Hazardous Materials Division's Emergency Operations Section
Fe ²⁺	Ferrous iron
Fe ³⁺	Ferric iron
FEP	Fluorinated ethylene propylene
FID	Flame ionization detector
ft	Foot or feet
FTA	Federal Transit Administration
g	Grams
GAC	Granular activated carbon
Geosyntec	Geosyntec Consultants, Inc.
GPR	Ground penetrating radar
H ⁺	Hydrogen ions
H ₂ O ₂	Hydrogen peroxide
HAZWOPER	40-Hour hazardous waste operations
HI	Hazard Index
HSC	Health and Safety Code
HSP	Health and Safety Plan
Hz	Hertz
ID	Inner diameter
In/sec	Inches per second
inWC	Inches water column

IRAP	Interim Remedial Action Plan
ISCO	In-situ chemical oxidation
ITRC	Interstate Technology & Regulatory Council
JSAs	Job Safety Analyses
L	Liter
LA	Los Angeles
Landtec	Landtec GEM 2000
lb	Pound
Lv	Vibration velocity level
LEL	Lower explosive limit
m	Meter
met station	Meteorological station
mg/kg	Milligrams per kilogram
MnO ₄ ⁻	Permanganate
mph	Miles per hour
NAAQS	National Ambient Air Quality Standard
NAPL	Non-aqueous phase liquid
NELAP	National Environmental Laboratory Accreditation Program
NIOSH	National Institute for Occupational Safety and Health
O ₃	Ozone
OD	Outer Diameter
OES	State of California Governor's Office of Emergency Services
OSHA	Occupational Safety and Health Administration
OVA	Organic vapor analyzer
PAHs	Polycyclic aromatic hydrocarbons
PCE	Tetrachloroethene
PEL	Permissible Exposure Limit
PI	Plasticity index
PID	Photoionization detector
PM10	Particulate matter with an aerodynamic diameter of 10 microns or less
PPE	Personnel protection equipment
ppm	Parts per million
PPV	Peak particle velocity
PSE	Pacific Soils Engineering, Inc.
PSI	Pounds per square inch
PSIG	Pound-force per square inch gauge
PVC	Polyvinyl chloride
RAP	Remedial action plan
Regional Board	Regional Water Quality Control Board
RI	Risk Index
ROI	Radius of influence
RQs	Reportable Quantities
RWQCB	Regional Water Quality Control Board
SCAQMD	South Coast Air Quality Management District
scfm	Standard cubic feet per minute
SIM	Selected Ion Monitoring
Site	Former Kast Property, Carson, California
SOD	Soil oxidant demand
SOPUS	Shell Oil Products United States
SP	Sodium persulfate
SSO	Site Safety Officer

SVE	Soil vapor extraction
SVOCs	Semi-volatile organic compounds
TCE	Trichloroethene
TPH	Total petroleum hydrocarbons
TPHd	Total petroleum hydrocarbons as diesel
TPHg	Total petroleum hydrocarbons as gasoline
TPHmo	Total petroleum hydrocarbons as motor oil
URS	URS Corporation
USA	Underground Service Alert
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VdB	Root mean square velocity in decibels
VEW	Vapor extraction well
VOCs	Volatile organic compounds
VPH	Volatile petroleum hydrocarbons
VS2DTI	Variably Saturated Two-Dimensional Transport Interface
WDRs	Waste Discharge Requirements
Work Plan	Pilot Test Work Plan
µg/kg	Micrograms per kilogram
µg/L	Micrograms per liter
µg/m ³	Micrograms per cubic meter
%	Percent

1.0 INTRODUCTION

1.1 BACKGROUND

URS Corporation (URS), with technical support and contributions from Geosyntec Consultants, Inc. (Geosyntec), is conducting a series of environmental investigations of the Former Kast Property (Site) in Carson, California on behalf of Equilon Enterprises LLC, doing business as Shell Oil Products US (SOPUS). These investigations are in response to Section 13267 letters issued by the California Regional Water Quality Control Board – Los Angeles Region (RWQCB or Regional Board) on May 8 and November 18, 2008.

The Former Kast Property is a former petroleum storage facility from the mid-1920s to the mid-1960s that was redeveloped as the Carousel Community residential housing tract by others in the late 1960s. The site is located in the area between Marbella Avenue on the west and Panama Avenue on the east and E. 244th Street on the north to E. 249th Street to the south (Figure 1). Detailed Site background information, including information on historical site operations, onsite structures formerly present, Site demolition, and development was provided in the Plume Delineation Report (URS, 2010a) and the Site Conceptual Model (Geosyntec, 2010), included as Appendix A to the Plume Delineation Report. Investigations include both Site-wide assessment of impacts to soil vapor, soil, and groundwater in roadways and an adjacent rail right-of-way and property-specific investigations at individual residential properties. As of April 29, 2011, methane screening has been conducted at 259 of the 285 homes present in the Carousel Community; 259 homes have had soil sampling and testing along with sub-slab soil vapor probes installed, and 246 homes have had sub-slab soil vapor probes sampled. Additionally, 37 homes have had indoor air sampling and testing. Investigations of residential properties within the Former Kast Property are continuing as access is granted by individual homeowners or the owners' legal representatives.

On March 11, 2011, the Regional Board issued Cleanup and Abatement Order (CAO) No. R4-2011-0046 to SOPUS. Among other directives, Section 3.a. of the CAO orders SOPUS to “[d]evelop a pilot testing work plan, which includes 1) evaluation of the feasibility of removing impacted soils to 10 feet and removal of contaminated shallow soils and reservoir concrete slabs encountered within the uppermost 10 feet, including areas beneath residential houses; and 2) remedial options that can be carried out where site characterization (including indoor air testing) is completed; [and] 3) plans for relocation of residents during soil removal activities, plans for management of excavated soil on-site, and plans to minimize odors and noise during soil removal.” This Pilot Test Work Plan was prepared to address this directive.

Site investigations have detected soil impacts by a number of petroleum-related and some non-petroleum-related constituents. Total petroleum hydrocarbons quantified as gasoline-range organics (TPHg), diesel-range organics (TPHd), and motor oil-range organics (TPHmo) have been detected in Site soils and groundwater. A number of volatile organic compounds (VOCs), including compounds associated with petroleum hydrocarbons (e.g., benzene, toluene, ethylbenzene, xylenes [BTEX], trimethylbenzenes and other substituted aromatic compounds), and non-petroleum-related VOCs, including the chlorinated solvents trichloroethene (TCE) and tetrachloroethene (PCE) and related breakdown products have been detected in Site soils and to a lesser extent in soil vapor. In addition, polycyclic aromatic hydrocarbons (PAHs), including naphthalene and benzo(a)pyrene, have been detected in Site soils associated with hydrocarbon-impacted soils. Figures showing ranges of detected concentrations of selected constituent

concentrations are provided in Appendix A. The vertical distribution of impacts in shallow soils at sample depths of 2 feet, 5 feet, and 10 feet bgs is shown on the figures in Appendix A.

The distribution of impacts by TPHd increases from the 2-foot sample depth to 5 feet bgs and further increases at the 10-foot sample depth as illustrated on Figure A-5. The lateral distribution of impacts in shallow soils is also evident on the figures provided in Appendix A, with the impacts at 5 and 10 feet bgs primarily occurring in fill soils placed by the developer within the former reservoirs and in a former low area in the west-central part of the Site. Lesser levels of impact are more widely distributed in soils at 2 feet bgs (see Figures A-1 through A-6 for distribution of impacts by benzene, naphthalene, benzo(a)pyrene-equivalents, TPHg, TPHd, and TPHmo).

1.2 PURPOSE AND SCOPE OF PILOT TESTING

1.2.1 Purpose

In accordance with the requirement in Section 3.a. of the CAO, one of the purposes of the pilot testing program described herein is to evaluate the feasibility of the degree to which impacted shallow soils to a depth of 10 feet bgs and the concrete reservoir bases (slabs) located at approximately 10 feet bgs beneath portions of the former locations of the oil storage reservoirs can be effectively removed, including beneath residential houses. A further purpose of excavations to expose the concrete reservoir slabs is to observe the nature and condition of the concrete where exposed. If it is established that certain excavation methods cannot completely remove contaminated shallow soils within the upper 10 feet, the pilot test will evaluate what degree of removal can effectively be accomplished using different excavation methods. Additionally, the pilot test will evaluate the feasibility of conducting surgical excavations in areas with limited access, such as back yards of residences, and methods for moving excavated soils from back yards to the front of the residences for management and disposal. The pilot testing program will also develop information regarding the feasibility of specific in-situ remedial options to treat impacted soils, including treatment beneath hardscaped areas and beneath residential houses.

Information developed during pilot testing will be used in a subsequent assessment of potential environmental impacts of the residual concrete slabs of the former reservoirs that will include: 1) the impact of the remaining concrete reservoir bases on waste migration; 2) whether there is a need for removal of the concrete where still present; and 3) the feasibility of removing the concrete floors beneath (i) unpaved areas at the Site, (ii) paved areas at the Site, (iii) homes at the Site, as required by Section 3.b. of the CAO.

Information from the pilot testing will be used to develop and assess different potential remedial strategies, and will be incorporated into the analysis and recommendations that will be contained in the Remedial Action Plan for the Site, as required Section 3.c.

1.2.2 Scope

In accordance with State Water Resources Control Board Resolution No. 92-49 (as amended on April 21, 1994 and October 2, 1996), SOPUS is aware of and has considered the following cleanup and abatement methods or combinations thereof, to the extent that they may be applicable to Site conditions:

- Source removal;
- In-place treatment of soil;

- Chemical oxidation; and
- Bioventing.
- Excavation or extraction of soil for onsite or offsite treatment; or for appropriate recycling, reuse, or disposal.

Source removal and excavation or extraction of soils are addressed in the pilot testing of excavations, and in place treatment of soil is addressed in the pilot testing of in-situ remediation technologies.

1.2.2.1 Excavation Pilot Test Evaluation

To address diverse site conditions and objectives, a number of excavation approaches were considered in developing this Pilot Test Work Plan and will be evaluated through pilot test implementation. The goal of most of these excavation approaches is to evaluate the technical feasibility and effectiveness of excavating the upper approximately 10 feet of soils from the Site and removing the underlying concrete reservoir bases. Because of the varying degree of residential property development, location and size of building footprints, presence of hardscape and utilities, and available area of non-hardscaped yard areas, a variety of approaches have been considered and will be implemented for the pilot test. These approaches are listed below. They are further described, including information requirements necessary to implement them, in Sections 2.0, 4.0 and 5.0 of the Work Plan. Other procedural and operational information, contingencies, monitoring required, etc. are discussed later in this Pilot Test Work Plan.

Test excavation approaches considered include:

- Unshored excavation to approximately 10 feet bgs with sloped sidewalls;
- Unshored slot trenches to approximately 10 feet bgs;
- Conventional H-pile and lagging shored excavation to approximately 10 feet bgs;
- Conventional sheet-pile shored excavation to approximately 10 feet bgs;
- Slide-rail shored excavation to approximately 10 feet bgs;
- Trench-box shored excavation to approximately 10 feet bgs; and
- Unshored, small surgical excavation to less than 10 feet bgs.

For all of these excavation approaches, construction equipment such as backhoes, track-mounted excavators, and front-end loaders would be used to excavate soil from designated pilot test excavation areas and load the soil into bins or trucks for transport and offsite disposal. If necessary, minimal temporary stockpiling of soil may occur. Any stockpiled excavated soil would be placed on plastic sheeting with bermed edges and covered to mitigate vapor and odor emissions and to prevent erosion and runoff. To the extent feasible, excavated soils will be loaded and transported from the Site the same day excavation occurs. The excavated areas will be backfilled with clean imported soil or sand/cement slurry. After an excavation is backfilled, the surface will be landscaped per original conditions or as agreed to with the property owner. Drainage (weep drains or drain fields) may be added to the subsurface as needed to ensure successful landscape restoration.

1.2.2.2 In-situ Remediation Technology Pilot Test Evaluation

Evaluations will also be made regarding the feasibility of two in-situ technologies to treat shallow soil including areas beneath structures and hardscape (e.g. paved areas). In-situ chemical oxidation (ISCO) and bioventing will be evaluated in this pilot test. In-situ remediation pilot testing will require limited amounts of excavation. Therefore, requirements for planning, permitting, materials handling, monitoring, methodologies, etc., related to excavation pilot testing may also apply to the in-situ remediation pilot testing.

ISCO typically involves the injection of liquids or gases containing oxidants. An oxidant is a reactive chemical that gains electrons from other chemicals (such as petroleum hydrocarbons) and in the process adds oxygen to the chemical. This process is referred to as “oxidation” and transforms the chemical of concern into more benign compounds. Oxidants must be delivered with adequate uniformity for the contaminants of concern to meet the remediation goals. In-situ treatment typically requires some time (months) for the treatment processes to achieve the remediation goals. The ISCO pilot test will focus on:

- Evaluating which oxidants (liquids/gases) may be suitable for use at the site;
- Assessing if oxidants can be delivered with adequate uniformity at the Site, specifically areas beneath pavement and/or structures, to contact impacted soils;
- Collect data that may be used for full-scale system design; and
- Developing a Site-specific understanding of ISCO processes, such as oxidant consumption rates to support design of full-scale ISCO alternatives.

Bioventing is another in-situ technology applicable to the remediation of petroleum hydrocarbons in shallow soils. In this process, air is extracted or injected into the subsurface to provide oxygen and enhance biodegradation of petroleum compounds. The bioventing pilot test will focus on the effectiveness of this technology through vapor extraction. Bioventing pilot testing will be conducted to:

- Assess site conditions that may be suitable for bioventing;
- Evaluate the limitations of bioventing including the degree of concentration reduction that may be expected and the time frame for remediation;
- Evaluate effectiveness of different system design configurations;
- Collect data that may be used for full-scale system design; and
- Evaluate design parameters for a full-scale bioventing system in terms of well design, well spacing, and equipment selection/sizing.

1.3 WORK PLAN ORGANIZATION

Information provided in this Pilot Test Work Plan is organized into the following sections:

Section 1.0	Introduction
Section 2.0	Pilot Test Locations
Section 3.0	Evaluation of Geotechnical Properties of Site Soils
Section 4.0	Pilot Test Excavation Approaches

Section 5.0	Excavation Pilot Testing
Section 6.0	In-situ Remediation Pilot Testing
Section 7.0	Relocation of Residents and Security during Pilot Test Excavation and Restoration
Section 8.0	Contingency Plan
Section 9.0	Schedule and Reporting
Section 10.0	References

2.0 PILOT TEST LOCATIONS

2.1 CRITERIA FOR PILOT TEST LOCATIONS

With input from the Regional Board, a number of factors were considered to develop criteria for identifying potential pilot test locations suitable for addressing the objectives of the pilot tests. These criteria are discussed in the following sections, and locations identified that meet these criteria are discussed in Appendix B and summarized in Table B-1.

2.1.1 Presence of Concrete Reservoir Slabs

Because a primary objective of the pilot test, as required in Paragraph 3.a. of the CAO, is to evaluate the feasibility of removing contaminated shallow soils and reservoir concrete slabs within the uppermost 10 feet, suitable locations are limited to those properties that overlie the former reservoirs. Locations of the former reservoir bases were estimated based on Site maps included in geotechnical documents prepared by Pacific Soils Engineering, Inc. (PSE) in the late 1960s for the entities that purchased and developed the Site for residential use, Lomita Development Company and Barclay Hollander Curci, Inc. These locations were cross checked with locations shown on Sanborn Fire Insurance Maps. Additional criteria used to identify locations of former reservoir slabs include boring refusal at or near 10 feet bgs and boring refusal at depths shallower than 10 feet bgs indicating the presence of concrete debris (see Figure 2, Boring Refusals with Refusal Depth Range). Table B-1 in Appendix B provides information on property locations selected as potentially suitable for pilot testing relative to the former reservoirs.

According to a geotechnical report prepared by PSE (letter report dated June 11, 1968), the concrete from the westernmost portion of the central reservoir was entirely removed during excavation/grading for Tract 24836. This tract includes the properties on both sides of Marbella Avenue extending from 244th Street on the north to the cul-de-sac at the south end of Marbella. This area of the Site, while under consideration for pilot testing, is less suitable than other areas of the Site where the reservoir slabs are still believed to be present.

The in-situ remediation technologies are not intended to address the Regional Board's request to evaluate the removal of the reservoir concrete slabs, so the presence/absence of the reservoir floor is not a critical factor in selecting the pilot test locations for these technologies.

2.1.2 Presence of Petroleum-related Impacts in Shallow Soils

Based on Regional Board input, the presence of petroleum-related impacts in shallow soils was considered as a criterion for identification of pilot test locations. This criterion is not technically necessary for evaluation of the feasibility of excavating shallow soils and the underlying concrete reservoir base, but may be applicable for testing in-situ remediation technologies. Generally, locations with a risk index (RI) ≥ 10 or Hazard Index (HI) ≥ 1 were considered suitable for inclusion in the excavation portion of the pilot test; however, locations with a RI between 1 and 10 were also considered as potentially suitable. Properties meeting these criteria are summarized in Table B-1 in Appendix B.

Other factors considered in evaluating presence of petroleum-related impacts include elevated TPH concentrations or elevated concentrations of other constituents of concern (COCs), including VOCs and SVOCs. Documented staining of soils, noticeable odors, and field instrument readings with a

photoionization detector (PID) are also factors considered. These criteria were used for identification of potential pilot test locations only and are not intended as criteria for final remedies.

It will be important to conduct ISCO pilot tests in areas that are representative of median to high concentrations of petroleum hydrocarbons. ISCO Pilot tests will most likely be completed in front yards. Two pilot tests, one for liquid injection and the other for gas injection, are described in Section 6.1. Therefore, up to two properties may be needed. Bioventing pilot test locations should have higher TPH concentrations, and consequently, the selected locations should have TPHd or TPHmo concentrations of at least 5,000 mg/kg within the upper 5 feet of the soil.

2.1.3 Presence of Utilities

As with any subsurface activities, locating underground and overhead utilities in the work area is of critical importance, both from the perspective of worker safety and the potential for utility interruptions. For identification of potentially suitable pilot test locations, avoidance of utilities that cannot be deactivated without impact to a significant part of the neighborhood is an important criterion, as utility service interruption to the neighborhood should be avoided. Utility maps were obtained from the City of Carson, and URS has developed an understanding of utility locations through more than two years of site investigations in the Carousel community. Utilities that cannot be interrupted and that need to be avoided for pilot testing include 6-inch water mains that are present 3.5 feet inside residential front yards from the western edge of the sidewalk on the west side of named streets and 3.5 feet inside front yards from the southern edge of the sidewalk on the south side of on numbered streets. Because these water mains are over 40 years old and are the sole water supply for the neighborhood, they will be avoided in selecting pilot test locations. This avoidance will limit pilot test excavations to the east side of named streets and north side of numbered streets.

Electrical power service to the neighborhood is overhead, with power lines running down the middle of each block at the rear of the properties. These overhead utilities will not impact pilot test excavations in front yards or small-scale excavations in back yards, but would be a factor for larger-scale excavations in the back yards if equipment would need to operate in proximity of the overhead lines.

Sewer mains are located in the eastern side of named streets and the northern side of numbered streets. There is also a large sewer lateral that traverses the block between Marbella and Neptune Avenues along the property lines between 24506 and 24512 Marbella and 24509 and 24513 Neptune and the block between Neptune and Ravenna along the property lines between 24508 and 24512 Neptune and 24509 and 24513 Ravenna. Large-scale pilot test excavations in the streets, or in the vicinity of these laterals, would require re-routing of sewer lines to maintain sewer service to the community. While this technically could be accomplished, it would result in temporary interruption of sewer service to the community and will be avoided. Therefore, large-scale excavations in the streets or in the vicinity of the sewer laterals are not planned as part of this pilot test.

2.1.4 Sufficient Working Area for Excavations and Equipment Operation

In order to conduct pilot testing in a safe and effective manner, a sufficiently large work area is needed for equipment access and layback of excavation walls or placement of shoring. Many of the yards in the Carousel community are small with limited lawn or landscaped areas that could be excavated. Each of the properties that were not eliminated based on the presence of utilities that cannot be interrupted was evaluated for space considerations. Estimated yard areas are summarized in Table B-1 in Appendix B.

Space requirements differ for the different excavation approaches considered. For large, unshored excavations, a 36 x 36-foot area would be required to excavate and expose a 10 x 10-foot section of the concrete reservoir base, assuming 3 feet of setback and 1:1 layback of slopes. This would require a very large yard or possibly two yards with contiguous lawn areas and an excavation covering most of both yards. Several pairs of properties were identified and are summarized in Appendix B and listed in Table B-1, and are depicted on Figure B-1.

For the slot-trench excavation approach, space requirements are much less. Deep yards extending 20 feet or more from the sidewalk to the structure would be best for this type of test excavation; the width of the excavation is less important but should be at least 15 feet. Properties suitable for slot trenching are described in Appendix B and listed in Table B-1, and are depicted on Figure B-2.

To test the feasibility of using either trench-box or slide-rail shoring systems to excavate to approximately 10 feet bgs and expose and remove the concrete reservoir bases, a working area at least 6 feet wider and deeper than the size of the shored excavation is needed. Assuming a 10 x 10-foot excavation, an area of approximately 16 x 16 feet would be needed. Properties potentially suitable for pilot testing slide-rail or trench-box shoring are described in Appendix B and listed in Table B-1, and are depicted on Figure B-3.

Due to the need for equipment access and the generally narrow side yards between property lines and dwellings, front yard locations were given precedence in evaluating shallow soil impacts for identifying suitable locations. To evaluate the feasibility of small-scale surgical excavations to address “hot-spots” in back yards, surgical excavation is proposed at one location that had an RI of 260 in a sample from a back yard boring. Three additional locations were identified to evaluate deeper excavations by slot trenching or “build-a-box” shored excavations in back yards of houses that had RIs >10 in samples collected at 10 feet bgs. Properties identified to evaluate the feasibility of working in back yards are described in Appendix B and listed in Table B-1, and are depicted on Figure B-4.

In addition to the actual excavation area, properties suitable for pilot testing need to have sufficient working area for equipment operation, materials handling, and soil loading for offsite transport. We assume that an Encroachment Permit can be obtained from the City of Carson for excavator equipment operation and for temporary staging of trucks for soil loading.

Many of the Site conditions affecting suitability of properties for excavation pilot testing also apply to suitability of properties for in-situ pilot testing. For example, the same criteria for presence of petroleum-related impacts and utilities apply to both types of testing. It is anticipated that the same permitting process with the City of Carson will be required for both types of pilot testing. Permitting is discussed below in Section 5.3.

2.1.5 Property Access

Owners of approximately 90 percent of the properties in the Carousel community are engaged in litigation against Shell Oil Company and SOPUS. Of the suitable properties identified, all but one is represented by plaintiffs’ counsel (see discussion of identified properties in Appendix B). The ability to conduct pilot testing at individual properties is directly related to SOPUS’ ability to negotiate access to suitable properties. Property access negotiation is assumed to be the responsibility of attorneys representing Shell and plaintiffs’ counsel and is outside the purview of the technical consulting team.

2.2 POTENTIAL PILOT TEST LOCATIONS

Properties identified as potentially feasible locations for different types of pilot test excavations are described by planned excavation type in Appendix B and summarized in Table B-1. Recommended locations of different types of pilot test excavations are shown on Figures B-1 through B-4 in Appendix B. SOPUS proposes to conduct pilot test excavations at a total of six locations to evaluate the following excavation approaches: 1) a large unshored excavation with sloped sidewalls in front yards of two adjacent properties; 2) a series of adjacent slot trenches that would encompass the available non-hardscaped space in a front yard, 3) an excavation in a front yard shored using slide-rail shoring technology; 4) an excavation in a front yard using trench-box shoring; 5) a surgical excavation in a backyard with limited access; and 6) a series of adjacent slot trenches encompassing the available non-hardscaped space in a back yard. Actual locations for different types of excavations will be established based on further evaluation including access considerations. Locations for in-situ pilot testing will be selected from properties identified in Table B-1, subject to access. If possible, in-situ pilot testing will be collocated at properties where excavation pilot testing is conducted.

Inclusion of a property as a suitable candidate for a particular pilot test technique should not be interpreted as a recommendation that the technique is necessary, would be appropriate, or that it would ultimately be proposed for that property in the Remedial Action Plan. Criteria used for selecting potential properties for the pilot test are not intended as criteria for final remedies. Remedial approaches for specific properties and cleanup levels for the Site will be proposed in future submissions to the Regional Board, including the Remedial Action Plan, as required in Section 3.c. of the CAO.

3.0 EVALUATION OF GEOTECHNICAL PROPERTIES OF SITE SOILS

3.1 GEOTECHNICAL DATA NEEDS

Data on geotechnical properties of Site soils will be needed for design of pilot excavations and shoring systems. Soil index and shear strength properties from geotechnical testing of Site soil samples will be used for a geotechnical evaluation of allowable temporary slopes for unshored sloped sidewall excavations, establishing required setback distances from structures, and for shoring design considerations.

3.2 GEOTECHNICAL INVESTIGATION TO ASSESS STRENGTH PARAMETERS OF SITE SOILS

In order to provide the geotechnical parameters for design of excavation slopes, setbacks, and shoring systems, two soil borings will be advanced to an approximate depth of 25 feet bgs at each pilot excavation site to collect relatively undisturbed samples for soil index properties and strength testing. The borings will be drilled using a truck-mounted hollow-stem auger drilling rig, and relatively undisturbed samples will be collected using a California-modified split-spoon sampler. Due to drill rig access considerations, the geotechnical borings will be located in front yards of the properties selected for pilot testing. The presence of the concrete reservoir bases will likely require coring of the concrete to allow sampling below the reservoir bottom. Upon completion, the boreholes will be backfilled using high-solids cement/bentonite grout from the bottom of the boring to 10 feet bgs and with hydrated bentonite from 10 feet bgs to the ground surface.

Because geotechnical properties data are needed for shallow soils, the geotechnical program will require driving of samples in the upper 10 feet of soils. This will require a variance from Shell's utility clearance procedures, which normally require borehole clearance with a hand auger or vacuum extraction (air vac) rig to 10 feet bgs.

Upon collection of samples, laboratory tests will be conducted to evaluate soil index properties and shear strength parameters of subsurface soils. Laboratory tests will include in-situ moisture content and dry density (American Society for Testing and Materials [ASTM] D 2937), Atterberg limits (ASTM D 4318), sieve analysis (ASTM D 422), direct shear test (ASTM D 3080), and expansion index (ASTM D 4829).

The geotechnical investigation will need to be completed before finalizing allowable excavation sidewall slopes, setbacks from structures, and shoring design. The geotechnical investigation will also need to precede preparation of Grading Plans and Grading Permit Applications to be submitted to the City of Carson.

4.0 PILOT TEST EXCAVATION APPROACHES

4.1 LARGE UNSHORED EXCAVATION TO APPROXIMATELY 10 FEET BGS WITH SLOPED SIDEWALLS

The purpose to of this approach is to evaluate the feasibility of conducting large-scale unshored excavations with sloped sidewalls to remove soils to approximately 10 feet bgs and the underlying concrete reservoir bases. Excavation would be conducted using a track-mounted excavator with appropriate measures taken to protect the adjacent residential structure(s), sidewalks, curbs and gutters, and streets. This type of remedial excavation is commonly used, but is more often applied to open areas that do not have nearby structures or other surface features that need to be protected. It will be evaluated to provide a basis for comparison to other excavation techniques and to evaluate its applicability to the Former Kast Property. Due to the utilization of sloped sidewalls, this method may result in leaving in place wedges of potentially impacted soils below the sloped sidewalls at some locations.

Geotechnical soil data will need to be obtained to develop appropriate design parameters for excavations. Relatively undisturbed soil samples will need to be collected and tested for soil index and shear strength parameters so that a licensed geotechnical engineer can develop recommendations for allowable temporary slopes and setback requirements for adjacent structures. Based on observed soil properties, we have preliminarily assumed that slopes of one horizontal to one vertical (1:1 H:V), or a 45-degree angle, will be acceptable and a minimum building setback of 3 feet may be allowed. Based on these assumptions, and the 10-foot planned depth of excavation, an excavation area of 30 x 30 feet would be necessary to expose and remove a 10 x 10-foot area of the reservoir base. Assuming a 3-foot setback around the four margins of the excavation, the required area for this type of excavation would be 36 x 36 feet, plus working room for equipment. Depending on site conditions, it may be possible to lay back the upper 6 feet of the excavation sidewalls and excavate near-vertical sidewalls below, exposing a larger area of the reservoir base. This alternative will require geotechnical evaluation.

Based on aerial photograph evaluation to estimate open areas not covered by buildings or hardscape, there are no individual properties with front yard areas large enough to conduct a large unshored excavation on a single property. There are, however, a number of adjacent properties with contiguous lawn areas not divided by driveways that may be suitable for pilot testing of a large unshored excavation. These properties are identified in Appendix B.

Large-scale excavation would expose a large surface area of soil that will have potential for vapor and odor releases. This type of excavation may require substantial odor control efforts and likely would require application of odor suppressant chemicals or foam. Odor control is discussed below in Section 5.10.

There are a number of stability and safety considerations that will need to be addressed for large-scale excavation. It will be necessary to monitor the edge and sidewalls of the excavation and adjacent structures for stability, as well as conducting noise vibration monitoring during excavation activities. Organic vapor monitoring will be required for health and safety purposes and per South Coast Air Quality Management District (SCAQMD) Rule 1166 Permit requirements for excavation of VOC-impacted soils. Methane monitoring will also be implemented in the excavation for worker and community safety.

With proper training and procedures in place for confined space entry, as discussed in Section 8.4, this approach would allow workers to enter the excavation for sidewall soil sampling and compaction testing of backfill upon completion of pilot test excavation.

Overall, large-scale unshored excavation is considered unlikely to be effective as a remedial approach due to the large area of excavation needed for sloped sidewalls and setbacks, and the potential that wedges of potentially impacted soil beneath sloped sidewalls would not be reached, but it will be evaluated to test feasibility of this excavation method, subject to access to suitable adjacent properties with a large enough collective working area and to obtain information about potential odor, dust or other issues associated with large excavations. This system of excavation will be evaluated in the pilot test.

4.2 UNSHORED SLOT TRENCHES TO APPROXIMATELY 10 FEET BGS

Unshored slot trenches are an alternative excavation approach that will be considered to evaluate the feasibility of removing shallow soils to approximately 10 feet bgs and the underlying concrete reservoir base in smaller, unshored, sequentially excavated slot trenches. Trenches will be excavated using a rubber-tired backhoe or excavator in a series of slots approximately 3 feet wide, extending outward from structures or other hardscape that are to be protected. The slots are typically excavated in an alternating pattern where a series of slots are excavated adjacent to a slot that previously has been excavated and backfilled or adjacent to native soils yet to be excavated. This pattern approach allows for increased daily excavation production while maintaining trench stability. The trenches will be excavated to expose and remove the concrete reservoir base. It may be necessary to use a vibratory breaker attachment, or stinger, on the excavator to break the concrete in order to remove it. Side wall and bottom soil samples will need to be collected from the excavator bucket or using a hand-held sampling device working from the ground surface, as personnel would be unable to enter the excavations due to safety considerations.

Upon completion of daily slot excavations, concrete removal, and sampling (as appropriate), the slots will be backfilled using 1-sack sand/cement slurry to approximately 3 feet bgs and backfilled with imported topsoil from the top of the slurry to the surface. The slurry backfill will typically will be allowed to set overnight before excavation will commence on adjacent slots. By sequentially excavating and backfilling a series of slot trenches, excavations can be conducted throughout the majority of open areas not covered by hardscape or structures, subject to appropriate set-back distances. This type of excavation could potentially be applied in back yards of properties.

Geotechnical investigations will be needed for development of geotechnical parameters for excavation design, and the same type of safety and stability monitoring would be required during the excavation and backfill process for slot trenches as for large unshored excavations.

This approach has the advantage of not requiring a very large working area and can be implemented in yards with irregular configurations. The surface area of exposed soil available for vapor and odor release is reduced, and the extent of odor control is expected to be reduced in comparison with a large-scale unshored excavations. Safety is enhanced because personnel will not enter the excavation except for compaction testing of the upper 3 feet of soil backfill. Because of all the potential advantages of slot trenching, the method will be evaluated in the pilot test.

4.3 CONVENTIONAL H-PILE CANTILEVERED SHORED EXCAVATION TO APPROXIMATELY 10 FEET BGS

Conventional H-pile cantilevered shoring systems are typically used for large deep excavations for construction projects or remedial excavation of large contiguous areas. Cantilever shoring systems are constructed by drilling shafts around the margins of the excavation and placing and cementing H-piles in the shafts or backfilling the shafts around the H-piles with pea gravel so that the H-piles can be retrieved after the excavation is backfilled. Alternatively, H-piles may be driven into the ground around the margins of the excavation; however, this installation approach creates significant vibration that can be damaging to structures. The piles are typically placed to a depth of two or more times the anticipated depth of the excavation. The cantilever system relies on the passive resistance of the soil below the excavation line into which the piles are placed to resist loads and support the excavation walls. Timber lagging is typically installed between the piles creating a wooden wall along the side of the excavation.

Implementing this type of shoring system would require use of large truck-mounted auger drilling equipment to drill borings to a depth of 20 to 30 feet bgs at a spacing of approximately 8 feet along the planned margins of the excavation. Coring of the concrete reservoir bases would be required to allow the shafts to penetrate a sufficient depth to achieve the passive resistance needed to support the excavation walls. H-piles would then be placed in the borings using a crane and would be grouted in place with structural concrete below the planned depth of excavation and 2-sack slurry above or placed using pea gravel. Excavation would then proceed, and timber lagging would be installed as the excavation proceeds. This type of shoring system can be used for large excavations, including irregular shapes. It is very disruptive to install, and would be very difficult to implement adjacent to residential structures without significant risk of damage to the structures.

This excavation approach is better suited to large construction excavations and not to excavating in a residential setting. Furthermore, there are other potential shoring methods outlined below, which are less potentially damaging to structures, and will potentially accomplish the same result. Therefore, conventional H-pile cantilevered shoring systems are not recommended for pilot testing and application adjacent to existing residential structures and will not be evaluated in the pilot test.

4.4 CONVENTIONAL SHEET-PILE SHORED EXCAVATION TO APPROXIMATELY 10 FEET BGS

Sheet-pile shoring is another type of cantilever shoring that may be used in certain situations. Like H-pile shoring, sheet-pile shoring relies on the passive resistance of the soil below the excavation line into which the sheet piles are placed to resist loads and support the excavation walls. The sheet piles consist of interlocking steel panels that are driven vertically into the ground. Because they derive their support from placing the piles into the ground below the planned depth of excavation, they would need to be driven to below the base of the concrete reservoir slabs. The slabs would present an impediment to driving of sheet piles, and therefore this method is not applicable and will not be evaluated in the pilot test.

4.5 SLIDE-RAIL SHORED EXCAVATION TO APPROXIMATELY 10 FEET BGS

Slide-rail shoring systems consist of vertical corner posts and spreader posts that are pushed or driven into the ground at excavation corners and laterally along the excavation walls that support a series of panels and spreader beams installed from the top and slid into place. As the excavation is deepened, additional

panels are installed past one another to create an overlapping, height-adjustable shoring system. The slide-rail modular shoring system can be used to shore excavations of various dimensions, subject to available dimensions for the panel components. The system derives lateral support from panels placed between the corner posts and, in larger excavations, from spreader beams placed across the excavation. The slide-rail system can be used for excavations 8 x 8 feet up to 32 x 32 feet in dimension. An advantage of slide-rail shoring is that it does not need to extend beneath the planned depth of excavation, and it would not be necessary to core through the reservoir bases and install the shoring below the depth of the reservoir bases for pilot testing.

Slide-rail shoring can be installed adjacent to structures and has previously been used for excavation in residential areas. Manually constructed “build-a-box” shoring similar to slide-rail shoring could be used for excavation in back yards of properties. Soil samples can be collected using the excavator or by personnel entry into the excavation before the lower panels are placed.

When excavation is complete, the panels are removed from the bottom up as the excavation is backfilled. Backfill compaction can be accomplished using a sheep-foot roller attached to the excavator, eliminating use of slurry.

This shoring system is more economical, easier to install, and creates less vibration than driven H-pile or sheet-pile systems. It will, however, generate noise and vibrations that will need to be monitored. Because of the potential advantages of this system, the slide-rail shoring method will be evaluated in the pilot test.

4.6 TRENCH-BOX SHORED EXCAVATION TO APPROXIMATELY 10 FEET BGS

For smaller excavations, use of trench-box shoring may be appropriate. This type of shoring essentially consists of a preassembled shoring box that is installed intact. It may be fabricated of aluminum rather than steel for weight considerations. This type of shoring could be used to excavate a defined area within a yard to approximately 10 feet bgs to break up and remove the exposed portion of the concrete reservoir base. It is placed in the excavation as digging proceeds; therefore, excavation sidewalls would be covered and not available for observation and sampling. A methodology would need to be developed to allow observation and sampling of sidewalls prior to covering the walls by the shoring box. It may have applicability in tight areas that need to be excavated. Therefore, trench-box shoring will be evaluated in the pilot test.

4.7 UNSHORED SURGICAL EXCAVATIONS TO LESS THAN 10 FEET BGS

Pilot testing will include a limited excavation to less than 10 feet bgs to evaluate the feasibility and effectiveness of conducting surgical excavations of small areas, including in back yards, for “hot spot” removal, and would not include concrete slab removal. This limited excavation work will be conducted using a mini excavator that is small enough to access back yard areas along narrow side yards. Excavation sidewalls will either be vertical or sloped as field conditions require. For safety considerations, personnel will not be allowed entry into excavations deeper than 4.5 feet. Bottom and sidewall samples likely will need to be collected from the excavator bucket or from the surface using specially fabricated sampling tools.

Multiple methods will be evaluated for moving excavated soil from the back yard to the front yard for transport and disposal. Methods that will be considered include use of man-portable bins, using a Bobcat or equivalent loader, using an electrically powered conveyor system along the side yard of the property, and potentially loading soils into super-sacks that can be lifted over the residential structure using a crane (subject to utility clearance).

We have identified a specific location for conducting this aspect of the pilot test where Phase II Site Investigation data indicate impacts by PAHs with a resulting risk index of greater than 100, subject to ability to gain access from the property owner. Therefore, unshored surgical excavations will be evaluated in the pilot test.

4.8 CONCRETE REMOVAL

For all excavation types except small surgical excavations, the concrete reservoir bases will be exposed at the bottom of the excavations. As described in Section 5.6 below, a smooth-edge bucket will be used to scrape residual soil or debris from the underlying concrete reservoir slab to allow observation of the nature and condition of the slab. A number of methods may be field tested to penetrate and remove the slab exposed in the excavations. In larger excavations, it may be possible to break the slab for removal using the excavator or backhoe bucket. This is a common construction practice. If difficulty is encountered breaking the slab, another approach that can be tested is using a hydraulic ram affixed to the excavator/backhoe arm, referred to as a “stinger,” to break the slab into pieces that can be removed with the bucket. Lastly, for shored excavations and if safety conditions allow, it may be possible to use concrete saws to cut the concrete by personnel entering the excavation. This would constitute “confined space entry,” which is addressed in Section 8.4.

4.9 SUMMARY

In summary, the following methods of excavation/shoring will be evaluated in the pilot test:

- Large unshored excavation to approximately 10 feet with sloped sidewalls;
- Unshored slot trenches to 10 feet;
- Slide-rail shored excavation;
- Trench box shored excavation; and
- Unshored surgical excavation.

The following methods of excavation/shoring will not be evaluated in the pilot test due to their inapplicability to residential areas and interference by the remaining concrete reservoir slabs with the shoring systems:

- Conventional H-pile shored excavation, and
- Conventional sheet piled shored excavation.

5.0 EXCAVATION PILOT TESTING

5.1 HEALTH AND SAFETY OF PUBLIC AND WORK CREWS

5.1.1 Health and Safety Plan and JSAs

Protecting the health and safety of the public and of Site workers during pilot testing is of paramount importance to SOPUS and its consultants and contractors. Pursuant to State of California – Division of Occupational Safety and Health (Cal/OSHA) Hazardous Waste Operations Standards (Title 8 California Code of Regulations [CCR], Section 5192) and Code of Federal Regulations (Title 40 CFR, Section 1910.120), URS prepared a Site-specific Health & Safety Plan (HSP) Addendum for pilot test field operations to be conducted at the Site. The HSP plan addresses the following:

- Identifies and describes potentially hazardous substances which may be encountered during field operations;
- Specifies protective equipment and clothing for onsite activities; and
- Outlines measures that will be implemented in the event of an emergency.

Field personnel will review requirements of the HSP prior to commencing field work and will sign a copy of the Safety Plan Compliance Agreement in accordance with the HSP.

All work will be done in accordance with the HSP Addendum and Job Safety Analyses (JSAs) that will be prepared for specific work tasks and activities that will be conducted for the pilot tests. JSAs will be prepared either by URS or by subcontractors performing specific work activities and will be reviewed and approved by URS prior to start of the work. Site field personnel conducting the pilot tests will review applicable JSAs at daily tailgate safety meetings.

All pilot test excavation field work will be monitored by an appropriately trained Site Safety Officer (SSO). The SSO shall conduct a Site safety briefing at the start of each workday, when work conditions change, when new personnel arrive onsite to participate in field activities, or when varying site operations warrant such a meeting. In addition, the subcontractor performing excavation and backfilling activities shall provide an OSHA-trained “competent person” to monitor excavation work at all times.

An exclusion zone will be established surrounding the work area. Except in unusual circumstances, only appropriately trained and qualified personnel will be allowed entry into the exclusion zone. If need arises for personnel without the requisite 40-hour hazardous waste operations (HAZWOPER) training need to enter the exclusion zone, all work will stop and the area will be screened for organic vapors and other conditions that may affect worker safety before allowing untrained personnel into the area.

Residents of the properties where pilot testing is conducted will be temporarily relocated during excavation and restoration work as described in Section 6.1 below and will not be allowed in the exclusions zone or general work area during pilot test excavation and backfilling activities.

5.1.2 Qualifications of Personnel Performing Work

All URS and subcontractor personnel performing work related to the pilot tests will be appropriately trained and qualified for the specific work tasks they perform. All personnel actively engaged in the field

work and who work inside the exclusion zone shall have met the HAZWOPER training requirements of 29 CFR 1910.120(e), including:

- Forty hours of initial offsite training or its recognized equivalent;
- Eight hours of annual refresher training (as required);
- Eight hours of supervisor training for personnel serving as Site Safety Officer; and
- A minimum of three days of work activity under the supervision of a trained and experienced supervisor.

The pilot test will be conducted under the technical direction of California Licensed Professional Geologists and Engineers. Subcontractors performing the excavation and site restoration work will have appropriate contractor's licenses and certifications relevant to the scope of work they perform.

5.2 SITE SURVEY

Prior to start of work and preparation of a Grading Permit Application, a property survey will be conducted by a California-licensed Professional Land Surveyor. The survey will document existing conditions at each parcel, including property boundaries, building location(s), existing hardscape and landscaping, and all underground and overhead utilities that encroach into that parcel.

5.3 PERMITTING

All necessary permits and approvals will be obtained prior to conducting the planned pilot tests. Copies of relevant permits will be maintained onsite at all times during the work. Specific permits that have been identified are discussed below.

5.3.1 Trenching Permit

The subcontractor retained to perform the excavation work associated with this pilot test shall have a valid OSHA Trenching Permit per 29 CFR 1926.650, 29 CFR 1926.651, and 29 CFR 1926.652 and Cal/OSHA Trenching Permit CCR Title 8 Section 341.

5.3.2 South Coast Air Quality Management District Rule 1166 Permit

Excavation of VOC- and volatile TPH-impacted soils within the geographic area encompassed by the SCAQMD must be conducted and managed in accordance with the requirements of SCAQMD Rule 1166, Volatile Organic Compound Emissions from Decontamination Soil. Because the volume of soil to be excavated at individual pilot test locations is less than 2,000 cubic yards, it is anticipated that the pilot test excavations will be done under a Various Locations Rule 1166 Contaminated Soil Mitigation Plan issued by SCAQMD to the URS subcontractor performing the excavation and soil management work. The Various Locations Permit contains strict notification, monitoring and reporting requirements, discussed further in Section 5.9.2, that will be met by the appropriate subcontractor holding the permit.

5.3.3 City of Carson Permits

5.3.3.1 Grading Permit

Grading Permits will be obtained from the City of Carson Department of Building and Safety (DBS) for the individual pilot test excavations. Per conversations with DBS, a separate Grading Permit will be

required for each property where pilot test excavations are conducted. The City of Carson follows the LA County Department of Public Works Grading Guidelines. Based on these guidelines, a geotechnical soils engineering report and grading plans will be prepared for each affected parcel after the properties where pilot test excavations have been finalized and access has been obtained.

5.3.3.2 Sewer and Gas Line Permits

Because it will be necessary to temporarily terminate, cap, and later replace sewer service lateral lines, a Sewer Permit will need to be obtained from the City of Carson DBS. The DBS will also issue a permit for temporary termination, removal, and replacement of the gas service lateral on affected properties.

5.3.3.3 Encroachment Permit

Although pilot excavation work will be conducted on private property, we anticipate that equipment will need to be staged on city streets, necessitating partial lane closures. An Encroachment Permit for equipment staging and operations and a Trash Bin/Containers Permit for roll-off bins (if placed on the street) will be obtained from the City of Carson Engineering Services Department, if required in addition to the Encroachment Permit.

We anticipate that the City Engineering Department will require a Traffic Management Plan as part of the Encroachment Permit Application. A URS subcontractor that has been providing traffic control services in the community throughout the site investigation process will prepare a Traffic Control Plan to meet the City's traffic management requirements.

5.3.3.4 Landscape Permit

Landscape restoration following backfill of pilot excavations will require a Landscaping Permit from the City of Carson Planning Department.

5.3.4 Notification

Notification of the proposed pilot test excavation activities will be provided to the Cal/OSHA – Notification of Excavation and Trenching by the remediation subcontractor retained to perform the excavation.

5.3.5 California Environmental Quality Act (CEQA) Review

As stated in background Section 15 of the CAO, submittal of plans, including this Pilot Test Work Plan, is exempt from CEQA. Upon review of this Work Plan, Regional Board staff will make a determination whether implementation of the Work Plan may have significant effect on the environment, and if so, the Regional Board will conduct the necessary and appropriate environmental review prior to Executive Officer approval of the Work Plan.

5.3.6 Permit(s) for ISCO In-situ Treatment Pilot Testing

Although not a part of permitting for the excavation pilot test, we anticipate that it will be necessary to obtain a permit from the LA County Fire Department for oxidant storage for the ozone injection test.

5.4 DOCUMENTATION OF PRE-EXCAVATION CONDITIONS

Prior to start of pilot test field activities at individual properties, the conditions of existing structures, hardscape, and landscaping will be thoroughly evaluated and documented in the presence of the homeowner. Documentation will consist of written notes, digital photographs, and videos. Existing cracks or other distress present in structures or concrete will be documented and measured. Cracks will be monitored by direct measurement using a dial caliper capable of measuring distances to ± 0.001 inch or using commercially available crack monitoring devices installed on the existing cracks, such that any potential change of crack size during the pilot test can be monitored and documented.

Existing landscaping that will be removed or potentially damaged during pilot testing will be documented so that it can be replaced with comparable vegetation acceptable to the homeowner.

5.5 UTILITIES

5.5.1 USA Notifications

Underground Service Alert (USA) will be notified prior to subsurface investigation activities, to allow marking of underground utilities that may exist in the area. The outline of the planned trench or excavation area will be clearly marked with white paint or surveyors flagging as required by USA. USA will contact utility owners of record within the vicinity and notify them of our intention to conduct subsurface explorations in proximity to buried utilities. The utility owners of record, or their designated agents, will be expected to clearly mark the position of their utilities on the ground surface throughout the area designated for excavation. URS will request a face-to-face onsite meeting with utility line writers to provide increased level of confidence that existing utilities are identified, located, and clearly marked.

5.5.2 Utility Surveys and Temporary Interruption

In addition to USA notification, a private utility-locating contractor will be subcontracted to locate and identify potential subsurface obstructions prior to any subsurface soil disturbance. The utility-locating subcontractor will use surface geophysics in an effort to identify subsurface lines and obstructions. Geophysical methods that may be used include magnetic, electromagnetic, ground penetrating radar (GPR), and electromagnetic line location.

Utilities present in the Carousel community that will need to be avoided or temporarily interrupted are described below:

5.5.2.1 Electrical Service

Electrical service to the community is by overhead power lines located in the middle of each block or along the back property line of houses on 244th and 249th Streets. Overhead utilities will be avoided, and there are no plans for temporary service interruption due to the effects on the surrounding community. Suitable setbacks will need to be established in accordance with OSHA requirements from overhead power lines for pilot excavations in back yards of properties.

5.5.2.2 Water Service

Water mains are located in the front yards of residential properties approximately 3.5 feet in from the western edge of the sidewalk on the west side of named streets and 3.5 feet in from the southern edge of the sidewalk on the south side of numbered streets. Water mains will be avoided and there are no plans

for temporary service interruption. Pilot test excavations in front yards will be limited to properties that do not have water service mains in the yards.

Water service laterals to houses where pilot excavations are conducted in front yards will need to be temporarily interrupted by cutting and capping the lines. Pot holing may be conducted, if necessary, to locate water service laterals and for cutting and capping of lines. Such work will be conducted by a licensed plumbing contractor in accordance with City of Carson and California Water Service Company (the local water purveyor) requirements.

5.5.2.3 Sewer Service

Sewer mains are located in city streets and will not be affected by excavation work associated with this pilot test. Sewer service laterals to houses where pilot test excavations occur in front yards will need to be capped, removed, and replaced when excavation is completed and excavations have been backfilled. Sewer work will be conducted by a licensed plumbing contractor in accordance with City of Carson and County of Los Angeles requirements.

5.5.2.4 Natural Gas Service

Gas mains are located in city streets and will not be affected by excavation work associated with this pilot test. Where gas mains occur alongside yards of properties, these areas will be avoided and will not need to be relocated.

Gas service laterals to houses where pilot test excavations occur in front yards will need to be capped, removed, and replaced when excavation is completed and excavations have been backfilled. Gas lateral line work will be conducted by a licensed plumbing contractor in accordance with City of Carson and Southern California Gas Company requirements.

5.5.2.5 Telecommunications

Telecommunications service trunk lines are located in a common trench with gas mains in the street and will not be affected by the work. Telecommunications lines to houses where excavation occurs in front yards may need to be removed and replaced. We have assumed that replacement of telecommunications lines will be done by HCI, the AT&T contractor that routinely does telephone cable work in the neighborhood with costs for reinstallation paid by SOPUS.

5.5.2.6 Oil Pipelines

According to geotechnical reports prepared by PSE for the developer, oil pipelines were removed when encountered during grading and site development. Because the objectives of the pilot test excavations include evaluating the feasibility of removing concrete reservoir bases, pilot test excavations will be conducted at locations where the reservoirs were previously present. All of the soils that occur above the reservoir bases are fill soils that were placed by the grading contractor when the reservoirs were dismantled. Therefore old oil pipelines are not anticipated to be present in locations and at depths where pilot test excavations will be conducted. In the event encountered, their condition will be recorded and, if feasible, they will be capped and removed.

5.6 EXCAVATION METHODS

5.6.1 General Excavation Activities (Sloped Sidewall Excavations)

Excavation of impacted soil will begin by removing soil in marked areas. Soil will be excavated using a track-mounted excavator or backhoe and loaded directly into an awaiting front-end loader bucket and then immediately placed into a transport vehicle (i.e., end-dump, truck and transfer, or super-ten dump truck). To the extent possible, impacted soil will be direct loaded into approved waste haulers for transport to the appropriate disposal facility. All excavation activities will be performed from existing ground level to minimize the need for workers to enter the excavations.

Impacted soil will be excavated using a 30,000 pound (lb) track-mounted excavator with a smooth bucket. Various size excavation equipment and buckets will be utilized based on specific area needs. The smooth bucket will eliminate the “soil tilling” effect, which can cross-contaminate underlying clean soil with impacted soil from above. The smooth-edge bucket also will allow for any residual soil or debris to be “scraped” away from the underlying concrete reservoir slab. To the extent possible, excavated soil will be direct-loaded into onsite dump trucks staged parallel to the length of the excavation. Impacted soil that cannot be direct-loaded (using the excavator) into a dump truck will be loaded into 3 cubic yard (cy) wheel loader and transported to the truck loading area. To minimize the risk of cross-contamination and/or offsite “tracking” of impacted soil, waste haulers will be loaded on plastic and will be kept on specified project haul routes to and from the soil stockpile staging area. In the unlikely event that it is necessary to temporarily stockpile onsite before loading, soils will either be placed upon Visqueen plastic sheeting and covered with plastic, or they will be temporarily placed in a covered bin. This approach for temporarily stockpiling soils onsite, if necessary, applies to all excavation types that will be pilot tested.

General handling of the impacted soil will be conducted with track mounted excavator, rubber-tired loader, and water truck or water buffalo. Areal extent of excavation areas will be constantly monitored throughout the course of the project as each lift is removed.

Planned excavation equipment for this type of excavation includes:

- 30,000 lb excavator;
- 3 cy rubber-tired loader; and
- Water truck or water buffalo trailer.

As excavation proceeds at individual pilot test locations, varying depths will be created based on subsurface conditions. The excavation will be made with side slopes at the horizontal to vertical ratio recommended by the geotechnical engineer and approved by the City of Carson in the Grading Permit for the particular property being excavated. The basic excavation protocols will be altered as needed as subsurface removals are conducted and to address any previously unknown utilities, concrete debris or foundations unearthed. At no time will workers enter any excavation deeper than 4.5 feet without the specific approval of an OSHA-trained “competent person” and satisfaction of “confined space entry” protocols (Section 8.4).

When the concrete reservoir bases are be exposed at the bottom of the excavations, a smooth-edge bucket will be used to scrape residual soil or debris from the underlying concrete reservoir slab to allow observation of the nature and condition of the slab. A number of methods may be field tested to penetrate

and remove the slab exposed in the excavations, including breaking the slab using the excavator or backhoe bucket, using a hydraulic ram affixed to the excavator/backhoe arm, referred to as a “stinger,” to break the slab into pieces that can be removed, and possibly using concrete saws to cut the concrete by personnel entering the excavation. This would constitute “confined space entry,” which is addressed in Section 8.4.

Dust suppression using water trucks or a water buffalo trailer will be performed continuously during all excavation activities.

Care will be taken to ensure that all loose soil is brushed off the transporter prior to covering with a tarp. Loose soil brushed off the transporter will immediately be shoveled and/or scraped back into the excavation or an appropriate temporary container.

Weather conditions will also be considered during day-to-day activities. Rainfall is not anticipated during the season when the pilot test excavation will likely occur; however, if precipitation occurs, collected rainwater will be pumped from the excavation areas and transferred to an aboveground storage tank or DOT-approved 55-gallon drums. Following analysis of the collected water to evaluate potential chemical impacts, the disposition of the water will be determined. Impacted water will be disposed of in accordance with Federal, State, and Local regulations.

Specific excavation methodologies are as follows:

- Excavation areas will be surveyed and delineated prior to breaking ground.
- Decontamination area will be constructed prior to excavation initiation.
- Hand excavation will be utilized to locate and confirm underground utilities (if any).
- Impacted soil will be excavated and direct loaded into loader and/or awaiting waste transports.
- Excavation side slopes will not exceed slopes recommended by the geotechnical engineer and per the approved Grading Plans.
- Excavated soil will be transported and disposed of at proper disposal facility(ies).
- Excavation bottom and sidewall samples will be collected when excavations are complete.
- Excavations will be backfilled upon completion as described in Section 5.15.

These methodologies may be modified as appropriate depending on the final permitting requirements or site-specific conditions encountered at a particular location.

5.6.2 Slide-rail Shoring System Excavation Activities

Excavation of impacted soil using a temporary shoring system referred to as a “slide-rail” system will be tested. The shoring system is constructed of four corner posts and sliding side panels that can be adjusted at various depths as needed based on the project requirements. The slide-rail system is installed by pre-drilling the four corner post locations and placing the side rail panels between the posts, thus creating a four-sided box. Once established (approximately 4 feet below ground surface), the soil within the system will be excavated and handled as referenced above. As the excavation extends to 8 feet bgs, the next panel is slid into place within the four corner posts and pushed down to extend the depth of shoring. Observations of sidewall conditions and sidewall samples can be collected before the shoring panels are pushed into place.

This type of excavation procedure is engineered such that areas ranging from 10 to 20 feet wide by 10 to 40 feet long and excavation depths up to 24 feet bgs can be achieved without the use of soldier piles and wood lagging or steel plate.

The slide-rail system also allows for backfill and compaction of the excavation by removing the slide panels while the excavation is being backfilled. Once the lower reaches of the excavation are backfilled, the bottom panels are removed. Backfill of the next section is completed, and the next section of panels is removed and so on until the excavation area is backfilled to grade. Once backfilled to approximately 1 to 2 feet below grade, the corner posts are removed by vibratory means. With the corner posts removed, backfill of the excavation is complete and the area is ready for restoration.

The excavated soil will be loaded directly into an awaiting front-end loader bucket and then immediately placed into a transport vehicle (i.e. end-dump, truck and transfer, or super-ten dump truck). To the extent possible, impacted soils will be direct-loaded into approved waste haulers for transport to the appropriate disposal facility. All excavation activities will be performed from existing ground level to minimize the need for workers to enter the excavations.

Impacted soil will be excavated using a rubber-tired backhoe or a track-mounted excavator with a 36-inch wide smooth bucket. Various size buckets and excavation equipment would be utilized based on the specific area needs.

Planned excavation equipment for this type of excavation includes:

- Rubber-tired backhoe or excavator;
- Rubber-tired loader; and
- Water truck or water buffalo trailer.

These methodologies may be modified as appropriate depending on the final permitting requirements or site-specific conditions encountered at a particular location.

5.6.3 Slot Trenching Excavation Activities

Excavation of impacted soil by slot trenching will be tested, which involves removing soil in an “A-B-C” pattern to allow for selective excavation without the need for an engineered shoring system. This type of excavation procedure is designed such that narrow excavated trenches can be excavated and then immediately backfilled with imported soil or sand-cement slurry, depending on the site and sub-surface conditions. Excavated soil will be loaded directly into an awaiting front-end loader bucket and then immediately placed into a transport vehicle (i.e. end-dump, truck and transfer, or super-ten dump truck). To the extent possible, impacted soil will be direct loaded into approved waste haulers for transport to the appropriate disposal facility. All excavation activities will be performed from existing ground level to minimize the need for workers to enter the excavations. Impacted soil will be excavated using a rubber-tired backhoe or a track-mounted excavator with a 36-inch wide smooth bucket. Various size buckets and excavation equipment would be utilized based on the specific area needs.

The general progression of the slot-trenching methodology consists of first excavating the “A-slot” and then backfilling the A-slot(s) with 1-sack sand-cement slurry or approved clean fill soil compacted to a minimum of 90% relative density or in accordance with City requirements as identified in the Grading Permit. If sand-slurry is utilized for the backfill material, the sand-slurry will need to cure and setup

overnight prior to excavation the adjacent “B-slots.” This excavation/backfill pattern will be repeated until planned excavation extent is completed and impacted soil has been removed.

Planned excavation equipment for this type of excavation includes:

- Rubber-tired backhoe or excavator;
- Rubber-tired loader; and
- Water truck or water buffalo trailer.

These methodologies may be modified as appropriate depending on the final permitting requirements or site-specific conditions encountered at a particular location.

5.6.4 Use of Motorized Conveyor System for Soil Excavation in Back Yards of Properties

Excavation of impacted soil in the back yards of residences will be tested by removing soil and shuttling the soil via a motorized conveyor belt system to allow for the relocation of soil in areas not accessible by medium-sized excavation equipment. This system allows for small equipment as well as hand excavation activities to proceed and soil to be moved to a location suitable for loading onto transport vehicles.

Impacted soil will be excavated by manual and mechanical means and placed in the receiving hopper of a motorized conveyor assembly. The conveyor runs off a 5 to 10 horsepower electric motor that can be adjusted for speed depending on the distance traveled and discharge location. Electrical power will be provided by a portable generator. As the impacted soil is placed in the hopper, the soil exists onto a 24-inch wide conveyor belt and travels to the discharge point where the soil comes off the belt into a loader bucket or stockpile location. The soil is then loaded into awaiting transport vehicles for eventual disposal.

This same process can be reversed so that the clean import fill can be sent back into the excavation area for restoration.

Excavation of impacted soil will be conducted using a mini-excavator, rubber-tired loader, water buffalo trailer and by manual efforts.

5.7 MATERIALS HANDLING

Dust suppression will be performed during excavation and loading activities by spraying the soil and work area, as required. The focus of this effort, further discussed in Sections 5.9.2 and 8.7.2, will be over areas where impacted soil is mechanically disturbed by excavation equipment. Care will be taken to ensure that the soil is not over-saturated which could generate runoff that would need to be managed and increase the weight of soil to be disposed.

Excavated impacted soil and concrete debris will be transported offsite by a state-licensed waste hauler for appropriate disposal or recycling. Soils to be excavated during pilot testing will be profiled, and approval will be obtained from the disposal/recycling facilities before excavation activities begin. All documentation pertaining to waste disposal profiles and waste disposal acceptance will be in place prior to any offsite shipments of waste.

Soil excavated from back yards will be transported from the rear of the house to the street either in small man-portable bins, using an electrically powered conveyor, or using a Bobcat (or similar) loader. Final methods for the transportation of back yard soils to be pilot tested and used will be determined on consultation with the remediation subcontractor retained to conduct the work.

Excavated material will either be direct loaded into trucks or temporarily stockpiled in covered bins or encapsulated in Visqueen plastic sheeting until loading and offsite transport can be coordinated on a daily basis. Stockpiling of excavated soils (if any) on plastic sheeting will be minimized, and if possible excavated soils will be loaded and transported offsite the same day. Soils will be sprayed with water mist as they are loaded for dust, vapor and odor control in accordance with Rule 1166 requirements (see Section 5.9.2 below). All transport vehicles will be loaded on plastic sheeting. Loaded trucks will be covered with tarps prior to leaving the site.

In accordance with Rule 1166, an organic vapor analyzer (OVA) consisting of a PID calibrated to hexane will be used to monitor excavated soils and the excavation face for VOCs to determine if the soils are classified as “VOC-contaminated,” defined by Rule 1166 as having PID readings of 50 parts per million (ppm) or greater. Monitoring shall be performed a distance of not more than 3 inches above the soil surface. If soils with total VOC concentrations exceeding 50 ppm measured with the PID are encountered, the soils will be stockpiled and covered, placed in AQMD-approved covered bins, or direct loaded, and the affected work area and load of soil will be sprayed with water or an approved vapor suppressant.

Waste manifests will be completed for each load removed from the site and will accompany the haul truck to the disposal facility. Once at the facility, weigh tickets with the exact tonnage of material per load will be generated by the facility operator. The weigh tickets and accompanying waste manifests will serve as documentation of the proper disposal of the impacted material. URS will maintain a detailed log of waste bin (if used) and truck loading operations. The truck log will include the manifest number and bin or truck identification.

During excavation activities, equipment removed from the excavation area(s) will be decontaminated on a daily basis. The dry decontamination area will be constructed over level ground surface covered with plastic sheeting. Prior to egress offsite, all non-disposable equipment in contact with wastes and impacted soil will be dry-decontaminated using chisels, scrapers, shovels, brooms and/or hand-held brushes (as necessary). Solids such as soil and/or debris removed from the decontamination pad will be collected, stockpiled and disposed of with the excavated soil.

Rinse water generated during equipment decontamination will be contained in properly labeled drums and transported to an approved offsite facility for disposal as investigative-derived waste.

Again, these methodologies may be modified as appropriate depending on the final permitting requirements or site-specific conditions encountered at a particular location.

5.8 TRAFFIC CONTROL

As noted in Section 5.3.3.3, a Traffic Management Plan will likely be required by the City as part of the Encroachment Permit process. A URS subcontractor will provide traffic control (signage, flagman, and barricades, if necessary) during implementation of the pilot testing activities.

5.9 AIR QUALITY MONITORING DURING EXCAVATION ACTIVITIES

Several types of air monitoring will be performed during pilot test operations for worker health and safety purposes in accordance with the HSP and AQMD monitoring and reporting requirements, to assess potential release of VOCs and SVOCs to the atmosphere that will need to be considered during full-scale remedial activities, and monitoring for odors. The anticipated approach and methodology to be used for each of these activities is summarized below, but may be modified as deemed necessary and appropriate depending on the final permitting requirements or site-specific conditions encountered at a particular location.

5.9.1 Monitoring of Worker's Breathing Zone for Worker Health and Safety

Real-time monitoring of the worker's breathing zone will be conducted per the HSP during field operations for pilot testing. Monitoring will be conducted using a PID with a 10.2 eV lamp for total non-methane organic vapors as described in the HSP. Monitoring of the breathing zone will be conducted continuously during excavation operations. As work progresses, the frequency of monitoring may be decreased to not less than every 15 minutes, as described in the HSP. Action levels for upgrading of personnel protection equipment (PPE) are also provided in the HSP.

In addition to monitoring with a PID, the work area and excavations will be monitored with a flame-ionization detector (FID) for methane in the ppm range and a four-gas meter for methane in the percent level, oxygen, carbon dioxide, and hydrogen sulfide.

Written documentation of monitoring for worker health and safety will be maintained on field forms to maintain records that will include name of person taking readings, equipment calibration and "bump check" time and readings, date and time of readings, concentrations detected, changes in PPE implemented based on readings detected per the HSP.

In addition to atmospheric monitoring, personal exposure monitoring will be conducted for up to three maximally exposed workers. Personal monitor devices will be worn by individuals working in the immediate vicinity of the excavation at locations where they may come into contact with airborne dust and vapors. During selected soils excavation activities, personnel will be monitored to assess exposure to various constituents. Exposure to gasoline vapors will be evaluated by OSHA PV2028 (or equivalent) utilizing calibrated sampling pumps and charcoal media. PAHs will be sampled by NIOSH Method 5506 utilizing calibrated sampling pumps with a PTFE membrane filter and XAD sampling tube. Benzene, toluene, ethyl benzene, and xylenes will be sampled by NIOSH 1501 using calibrated pumps and charcoal media or validated passive samplers. All samples will be collected by or under the direction of an industrial hygienist. To aid in the selection of these assessments, colorimetric sampling tubes may be used as a screening device at a given location. The methods above will be used to evaluate full-shift exposure and where indicated, short-term exposure limits. Samples will be submitted to an American Industrial Hygiene Association-accredited laboratory for analysis with chain-of-custody protocol.

5.9.2 Monitoring for AQMD Rule 1166 and Rule 403 Compliance

As noted in Section 5.7, excavated soils and the excavation face will be monitored for VOCs using a PID calibrated to hexane in accordance with Rule 1166 monitoring requirements. Monitoring will be performed a distance of not more than 3 inches above the soil surface. Monitoring will be performed at a frequency of not less than one reading for every two cubic yards of soil excavated and not exceeding 15

minutes per monitoring readings. If PID readings of 50 ppm or greater are detected for a sustained period of 15 seconds, the AQMD will be notified within 24 hours of the first detection of VOC-contaminated soil in accordance with the contractor's Various Locations Rule 1166 Permit and appropriate vapor mitigation measures required per the Permit and described in Section 5.10 below will be implemented. If PID measurements of 1,000 ppm or greater are detected for a sustained period of 15 seconds, excavation work will be stopped and the AQMD will be notified within one hour of the detection. Appropriate vapor mitigation measures required per the Permit and described in Section 5.10 below will be implemented immediately. Once these notification and mitigation measures have been accomplished, work will resume.

Written records of Rule 1166 monitoring will be kept on field forms in a format approved by the AQMD. Within 30 days of completion of pilot test excavation, written records of monitoring of VOC-contaminated soil, daily inspections of any covered stockpiles of VOC-contaminated soil, and disposal of VOC-contaminated soil will be provided to the AQMD by the remedial excavation contractor in accordance with the Various Locations Rule 1166 Permit.

Dust monitoring will be conducted during excavation and loading operations to monitor for dust and particulate matter at the excavation site property boundary using a miniRAM™ dust monitor, or equivalent, in accordance with AQMD Rule 403 requirements.

Rule 403 requires implementation of control measures to prevent, reduce, or mitigate fugitive dust emissions and includes a performance standard that prohibits visible dust emissions from crossing any property line. Any operation which generates fugitive dust is required to comply with the following:

1. Use best available control measures specified in Rule 403 to minimize dust emissions.
2. Do not allow particulate matter with an aerodynamic diameter of 10 microns or less (PM10) levels to exceed 50 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$).

PM 10 levels may be determined by simultaneous sampling, as the difference between upwind and downwind samples collected on high-volume particulate matter samplers or other U.S. EPA-approved equivalent method for PM10 monitoring. If sampling is conducted, samplers will be:

- (A) Operated, maintained, and calibrated in accordance with 40 CFR, Part 50, Appendix J, or appropriate U.S. EPA-published documents for U.S. EPA-approved equivalent method(s) for PM10; and
 - (B) Reasonably placed upwind and downwind of key activity areas and as close to the property line as feasible, such that other sources of fugitive dust between the sampler and the property line are minimized.
3. Do not allow track-out to extend 25 feet or more outside the property line.
 4. Remove all track-out at the conclusion of each workday.
 5. If the excavation involves a site of five or more acres, use at least one of the following measures to minimize track-out: (1) washed gravel pad, (2) paved surface, (3) wheel shaker, or (4) wheel washing system.

Should Rule 403 dust control standards be exceeded, mitigation measures will be implemented as discussed in Section 8.7.2. Note that pilot test activities are not subject to the additional Rule 403 requirements for a large operation, because soil moving activities will not exceed a soil throughput volume of 5,000 cubic yards repeated three times per day, and the total size of the pilot test excavation area is smaller than 50 acres.

5.9.3 Monitoring for VOCs and SVOCs and Meteorological Conditions

5.9.3.1 Meteorological Monitoring

Meteorological monitoring will be conducted using a portable meteorological station (met station) to monitor wind speed and direction and temperature at each pilot test location. The met station will be equipped with a datalogger to maintain continuous measurements of monitoring data. The station will have a visible weather vane so that field crew conducting real-time monitoring can accurately establish upwind and downwind directions relative to the work area.

Excavation and loading operations will cease if the wind speed is greater than 15 miles per hour (mph) averaged over a 15-minute period or instantaneous wind speeds exceed 25 mph.

5.9.3.2 Upwind and Downwind Monitoring for VOCs

Upwind and downwind monitoring for VOCs will be conducted by deploying individually laboratory-certified six-liter (6-L) Summa canisters for collection of time-weighted samples for laboratory testing. One Summa canister will be placed in the relative upwind direction and one downwind from the excavation area. The Summa canisters will be positioned so that the sample intake is located at a height of approximately 3 feet above the ground surface. Samples will be collected for VOC analysis daily during pilot test excavation operations.

The Summa canisters will be equipped with flow controllers set to collect a time-weighted sample over an 8-hour period. Each flow controller will be set so that canisters will be approximately 85 percent full (with a residual canister vacuum of approximately -5 inches of mercury) after 8-hour sample collection periods. The vacuum in each Summa canister will be measured using a gauge prior to sample collection and following sample collection, and vacuum readings will be recorded on a sampling log.

Summa canisters will be transported under chain-of-custody documentation for analysis for VOCs by EPA Method TO-15 by a laboratory accredited by the National Environmental Laboratory Accreditation Program (NELAP).

5.9.3.3 Upwind and Downwind Monitoring for SVOCs and Lead

As long as the pilot testing activities are compliant with Rule 403, limiting PM10 to no more than 50 $\mu\text{g}/\text{m}^3$, no ambient air chemical specific monitoring of lead or SVOCs (represented by benzo(a)pyrene) will be needed for these activities. This determination was made using a calculation of the maximum theoretical concentration of lead and benzo(a)pyrene in the air, using the maximum detected concentration for each constituent in shallow (0-10 feet bgs) residential soils among the approximately 10,000 samples analyzed, and assuming that the particulate matter in the air is entirely in the PM10 range and present at the maximum allowable concentration of 50 $\mu\text{g}/\text{m}^3$.

The maximum detected lead concentration in residential soil is 1,330 milligrams per kilogram (mg/kg). At the Rule 403 limit of 50 $\mu\text{g}/\text{m}^3$ of PM10, this would correspond to a lead concentration in air of 6.65 x

$10^{-2} \mu\text{g}/\text{m}^3$, which is well below the National Ambient Air Quality Standard (NAAQS) for lead of $0.15 \mu\text{g}/\text{m}^3$ and the OSHA Permissible Exposure Limit (PEL) of $50 \mu\text{g}/\text{m}^3$.

The maximum detected benzo(a)pyrene concentration in residential soil is 27 mg/kg; the next highest benzo(a)pyrene concentration among the approximately 10,000 samples analyzed was 15 mg/kg. At the Rule 403 limit of $50 \mu\text{g}/\text{m}^3$ of PM10, this would correspond to a benzo(a)pyrene concentration in air of $1.35 \times 10^{-3} \mu\text{g}/\text{m}^3$ as compared to the U.S. EPA screening level for residential air of $8.7 \times 10^{-4} \mu\text{g}/\text{m}^3$ and approximately equal to the European Union target limit for benzo(a)pyrene in air of 1 nanogram per cubic meter. It is well below the OSHA PEL for benzo(a)pyrene (indirectly as “Coal Tar Pitch volatiles”) of $200 \mu\text{g}/\text{m}^3$. The theoretical benzo(a)pyrene concentration assuming that the particulate matter in the air is entirely in the PM10 range and at the maximum detected concentration of 27 mg/kg is only 1.6 times the U.S. EPA screening level for residential air. Because of the extremely conservative nature of the theoretical concentration of benzo(a)pyrene in dust, the potential for benzo(a)pyrene concentrations in air to exceed these standards is exceedingly remote.

5.9.3.4 Odor Monitoring

Monitoring for odors will be done based on worker perception. Periodically during excavation and loading operations at a frequency of not less than once every 30 minutes, odors will be monitored at the downwind property boundary of the residential property where pilot excavation is occurring. Depending on findings, frequency of monitoring may be increased to hourly. Odors will be qualitatively compared and ranked on a scale of 1 to 5 in accordance with the odor perception scale provided below.

Odor Value	Odor Terminology	Odor Description
0	No odor	No detectable odor.
1	Very faint odor	An odor that would not be noticed by the average person, but that could be detection by the experienced inspector or a very sensitive individual.
2	Faint odor	An odor so weak that the average person might detect if his/her attention was called to it, but that would not otherwise attract attention.
3	Distinct Easily Noticeable Odor	An odor of moderate intensity that would be readily detected and might be regarded with disfavor.
4	Strong Decided Odor	An odor that would force itself upon the attention and that might make the air very unpleasant.
5	Very Strong Odor	An odor of such intensity that the air would be unfit to breathe.

If distinct easily noticeable odors (odor value 3) are detected at the downwind property boundary, mitigation measures described in Section 5.10 below will be applied and a recheck of doors will be performed.

5.10 MITIGATION OF VAPORS AND ODORS

In accordance with Section 3.a. of the CAO, and in accordance with Rule 1166, the pilot testing program will include measures to control and minimize odors during soil removal. During excavation activities,

personnel and equipment will be available to implement dust, vapor, and odor suppression control measures as needed. Dust particulates, vapor and odor control measures to be implemented and evaluated will proceed in sequential steps including: 1) application of water spray to the working area and excavated soils; 2) spraying the excavation surface and excavated soils with Simple Green™ using a pump sprayer; 3) application of a commercial vapor and odor suppressant chemical manufactured by Kuma Corporation and sold under the brand name Odex; and 4) application of vapor/odor suppressant foam, as required. Odex is an all-natural, biodegradable, odor neutralizing solution made entirely of food-grade products.

To mitigate offsite dust migration and resultant impacts to neighboring properties, periodic watering of the active excavation areas will be conducted throughout the excavation and backfill activities. In addition to dust suppression efforts, odor suppressants will be used as necessary to mitigate offsite migration of odors from the work area.

Water mist will also be used on soil placed in the transport trucks or bins. Odor suppressants will be applied as necessary to loads. Additionally, after the soil is loaded into the transport trucks, the load will be covered with a tarp to prevent soil distribution or dust generation during transport from the Site to the disposal facility. Soil will be brushed from truck tires and truck bodies. Trucks may also be required to run over rumble strips to remove excess soil before leaving the site.

Weather conditions will also be considered during day-to-day activities. Rainfall is not anticipated during the season when the pilot test excavation will likely occur; however, if precipitation occurs, collected rainwater will be pumped from the excavation areas and transferred to an aboveground storage tank or DPT-approved 55-gallon drums. Following analysis of the collected water to evaluate potential chemical impacts, the disposition of the water will be determined. Impacted water will be disposed of in accordance with Federal, State, and Local regulations.

Exposed soils in excavations not backfilled the same day will be covered with Visqueen or clean soil at the close of each workday to minimize odors during non-work hours. If necessary, exposed excavation faces will be sprayed with vapor suppressant foam or HydroSeal vapor suppressant barrier, also manufactured by Kuma Corporation.

As noted in Section 5.8.1, the work area and excavations will be monitored for potential presence of methane using a FID and a four-gas meter. If methane is detected at a concentration of 20 percent of the lower explosive limit (LEL), which would be approximately one percent, or 10,000 ppm, work will stop and the area will be ventilated using portable fans. Once vapor concentrations have been reduced to less than 10 percent of the LEL, vapor suppressant measures will be implemented as described in above.

5.11 NOISE MONITORING AND CONTROL DURING EXCAVATION

5.11.1 Regulatory Noise Control Requirements

Section 3.a. of the CAO specifies that the Pilot Testing Work Plan must include plans to minimize noise during soil removal. The City of Carson's Noise Control Ordinance Standard No. 1 limits exterior noise levels at residential structures to below 75 dBA for a cumulative period of more than 15 minutes in any one 30 minute period, and Standard No. 2 limits exterior noise levels to below 80 dBA for a cumulative period of more than 7.5 minutes in any 30 minute period. Based on e-mail correspondence received from the City of Carson on February 10, 2011, SOPUS' activities are exempt from the Noise Control

Ordinance under “Public Health and Safety Activities.” Under this section, all clean-up activities should be exempt since it’s for the protection of public health and safety.

5.11.2 Noise Monitoring and Management

Noise producing equipment that may be used over the course of the project includes construction vehicles, excavation equipment and power tools. The primary purpose of the noise monitoring program is to ensure that safe conditions are being maintained for onsite workers and to confirm that noise levels are not excessive at residential homes near the excavation site and in the surrounding community during excavation.

Ambient noise monitoring will be conducted to document noise levels at the site prior to commencing construction activities. Noise levels over the normal time frame that construction activities will occur will be documented. Noise levels will be monitored at the projected work areas across the site and at several locations along the site perimeter. Specific locations will be determined in the field based on observed site conditions.

Real-time noise monitoring will be conducted during pilot test excavation activities to document noise levels and to assess the need for noise mitigation. Noise mitigations would normally be triggered when noise levels at the perimeter of the site exceed the levels provided in the City of Carson Noise Ordinance. However, as noted above, based on correspondence from the City of Carson, SOPUS’ activities are exempt from the Noise Control Ordinance under “Public Health and Safety Activities.” None-the-less, to the extent feasible, noise control measures or modification of procedures causing the noise exceedance will be implemented to correct the exceedance to the extent possible.

Although not a physical method of noise abatement, public relations and community awareness is a positive method of lessening the impacts of construction-related noise and disturbances. There are numerous instances during the various phases of the proposed pilot testing activities where noise reduction is not feasible or warranted. In these cases, it will be especially helpful for the impacted nearby property owners to be made aware of the upcoming activity.

5.11.3 Vibration Monitoring of Home(s) During Excavation Activities

LA County Noise Ordinance Section 12.08.350 establishes a vibration perception threshold: The perception threshold is presumed to be a motion velocity of 0.01 in/sec over the range of 1 to 100 Hertz (Hz). Section 12.08.560 of the LA County Noise Ordinance prohibits operation of any device that creates vibration which is above the vibration threshold at or beyond the property boundary of the source, if on private property or at 150 feet from the source if on a public space or public right-of-way. We presume that the exemption under the Noise Ordinance Section 12.08.570 also applies to Section 12.08.560; however, vibration monitoring will be conducted during pilot test activities to document vibration levels induced by different excavation activities.

To evaluate the vibration effects of each pilot testing activity, and in compliance with the LA County Noise Ordinance, vibration monitoring will be performed during execution of each excavation approach. The table below is reproduced from Table 12-3 of the Federal Transit Administration (FTA) guidelines as published in the *Transit Noise and Vibration Impact Assessment*, May 2006. As shown in this table, the vibration perception threshold of 0.01 in/sec is well below the vibration levels associated with structural damage and compliance with the vibration threshold prescribed in the LA County Noise Ordinance should prevent any possibility of structural damage.

Construction Vibration Damage Criteria from Federal Transit Administration (2006)

<i>Building Category</i>	<i>PPV (in/sec)</i>	<i>Approximate Vibration Velocity Level (L_v)</i>
I. Reinforced-concrete, steel or timber (no plaster)	0.5	102
II. Engineered concrete and masonry (no plaster)	0.3	98
III. Non-engineered timber and masonry buildings	0.2	94
IV. Buildings extremely susceptible to vibration damage	0.12	90
* RMS velocity in decibels (VdB) are 1 micro-inch/second		

Vibration monitoring will be performed during installation and removal of shoring, and excavation and backfilling operations at the site. Vibration of the ground surface adjacent to the existing structures will be monitored by either a seismometer or accelerometer. Two to three instruments will be used at each site to evaluate vibration at differing distances and propagation paths. Specific locations will be determined in the field based on observed site conditions. Tri-axial (longitudinal, transverse, and vertical) vibration levels will be measured and reported in terms of peak particle velocity (PPV) and root mean square velocity in decibels (VdB). These results will be summed to estimate total vibration levels. Reports of monitoring results will be prepared on a daily basis. URS or a vibration monitoring subcontractor will evaluate the vibration monitoring results to evaluate if unacceptable vibration levels are occurring from the work. If unacceptable vibration levels are occurring, construction methods will be evaluated and modified, where possible, to reduce vibrations.

Vibration monitoring will be conducted under the direction of a qualified California Professional Civil Engineer or Professional Geophysicist.

5.12 MONITORING OF STABILITY OF EXCAVATION WALLS

Sidewalls of excavations will be monitored on a regular basis during excavation work and as long as excavations remain open by an "OSHA-trained Competent Person" provided by the excavation contractor. In addition to this OSHA requirement, a qualified URS geotechnical engineer will make periodic Site visits to observe excavations and areas surrounding the excavations for signs of instability.

An inclinometer should be installed in one of the borings drilled during the geotechnical investigation for pilot test location(s) where large unshored or shored trenches are planned for monitoring potential lateral movement during excavation. This boring should be drilled near the top of the future sidewall slope or shoring wall.

5.13 MONITORING OF STABILITY OF ADJACENT AND NEARBY STRUCTURES

5.13.1 Pre-excavation and Post-excavation Surveys

As noted in Section 5.4, pre-excavation and post-excavation surveys of homes at the properties where pilot excavations are conducted and at adjacent properties will be conducted to document pre-excavation conditions and any changes in those conditions following excavation. Documentation will consist of written notes, digital photographs, and videos.

5.13.2 Crack Monitoring

Existing cracks or other distress present in structures or concrete will be documented and measured. Cracks will be monitored by direct measurement using a dial caliper capable of measuring distances to approximately ± 0.001 inch, or using commercially available crack monitoring devices installed on the existing cracks, such that any potential change of crack size during the pilot test can be monitored and documented.

5.14 EXCAVATION SIDEWALL AND BOTTOM SAMPLING

After completing the excavations to the predetermined lateral and vertical limits, post-excavation samples will be collected to assess whether impacted soil is still present. Post-excavation samples will be collected from the sidewalls of excavation areas every 15 linear feet, with a minimum of one sample location per sidewall per excavation. Samples will be obtained at depths of 0.5, 2, 5, and 10 feet bgs at each sample location, consistent with the sample depths used for site characterization sampling. In addition, samples will be obtained from visibly impacted areas based on noticeably stained layers or blebs, or elevated PID readings (applies only to excavation methods that allow personnel entry into the excavation).

For excavations where the concrete reservoir bases are encountered, excavation floor samples will be collected just above and below the concrete slabs. For excavations where the concrete reservoir base is not encountered, one excavation bottom sample will be collected for every 225 ft² of excavation area or less (i.e., on an approximately 15 x 15-foot spacing, consistent with the sample spacing used for Phase II site characterization sampling).

Post-excavation samples will be collected using reusable, decontaminated sampling equipment or disposable sampling devices, placed in laboratory-provided glassware, and submitted under chain-of-custody documentation to the designated California-certified laboratory for analysis using U.S. EPA- approved methods.

The soil samples will be analyzed using the following methods:

Analysis Type	Method Number
Total Petroleum Hydrocarbons (TPH) as Gasoline (carbon-chain ranges C ₄ to C ₁₂) TPH as Diesel (carbon-chain ranges C ₁₀ to C ₂₈) and TPH as Motor Oil (carbon-chain ranges C ₁₇ to C ₄₄)	USEPA Method 8015B(M) (5035 preparation for TPH gasoline)
Volatile Organic Compounds (VOCs)	USEPA Method 8260B/5035
Polycyclic Aromatic Hydrocarbons (PAHs)	USEPA Method 8270 Selected Ion Monitoring (SIM)
Semi-Volatile Organic Compounds (SVOCs)	USEPA Method 8270C
California Code of Regulations, Title 22 Metals	USEPA Method 6010B/7471A

Given the limited depth of the proposed excavations, sampling may be conducted using stainless-steel hand augers or coring devices, or disposable sampling scoops affixed to an extendable arm.

Alternatively, samples may be taken from soil collected from the excavation sidewalls using the bucket of the excavator only after the bucket has been placed on the ground and immobilized. At no time will samples be collected by riding the bucket of the excavator.

5.15 EXCAVATION BACKFILL AND SITE RESTORATION

5.15.1 Import Backfill Material

Certified clean soil will be imported for backfill of excavations from an offsite source. Before importing the backfill soil to the site, samples of the proposed import soil will be submitted for laboratory geotechnical and chemical characterization analysis. Geotechnical tests include gradation, plasticity index (PI), maximum density and optimum moisture. A geotechnical engineer will approve the backfill soil prior to its import, placement, and compaction at the site. Depending on trench location and surface land use, different topsoil backfill materials may be placed in the upper 2 to 3 feet of the fill section to support landscaping.

The chemical characterization process for soil will be consistent with the Clean Imported Fill Material Information Advisory, published by the Department of Toxic Substances Control (DTSC) in October 2001. To assess the chemical properties of the backfill sources, samples of clean fill will be collected from the designated borrow area. All backfill soil samples will be placed in laboratory supplied 4-ounce glass jars and transported under chain-of-custody documentation to a state-certified laboratory for chemical analyses. The analytical results will be reviewed and compared to applicable regulatory criteria for acceptance prior to use as a backfill source.

The samples will be analyzed for:

- TPH (as gasoline, diesel, and motor oil) using EPA Test Method 8015B (M);
- VOCs using EPA Test Method 8260B;
- SVOCs using EPA Test Method 8270C
- PAHs using EPA Test Method 8270 SIM;
- CCR Title 22, Metals using EPA Test Methods 6010/7471A; and
- pH using EPA Test Method 9045.

Depending on the backfill source the soil samples may be further analyzed for:

- PCBs using EPA Test Method 8080, and
- Chlorinated pesticides and herbicides using EPA Test Method 8081A/8151.

The 1-sack sand slurry used for backfilling during slot trenching and other excavations as needed for short-term strength development will consist of a fluid, workable mixture of aggregate, cement, and water. Aggregate for sand/cement slurry will be a clean, washed fine aggregate or clean mortar sand conforming to the provisions of ASTM C404. Cement shall be Type IP or Type II. Water used for mixing the slurry will be clean, potable water free of organic contaminants, oils, salts, or other deleterious materials.

5.15.2 Backfill Placement and Compaction

Backfill soils will be placed in excavations in lifts of not more than 8 inches and compacted with a sheepsfoot roller attached to the excavator. Soils will be moisture conditioned prior to placement as fill to achieve compaction of 90% relative density or in accordance with City requirements as identified in the Grading Permit. Backfill and compaction, including testing and certification of the backfill by a third-party soils engineer, will be the responsibility of the remedial excavation contractor. URS will oversee the contractor's backfill operations and review compaction testing certification on behalf of SOPUS.

Compaction testing will be done by personnel entering the excavations. Access and egress will be provided in accordance with OSHA requirements.

Slot trenches backfilled with 1-sack cement slurry to 3 feet below ground surface and imported topsoil from the top of the slurry fill to the surface. Compaction testing of soils placed in the upper 3 feet will be done by personnel entering the excavation in accordance OSHA requirements. Drainage (weep drains or drain fields) may be added to the subsurface as needed to ensure successful landscape restoration.

5.15.3 Utility Restoration

Utilities temporarily disconnected to allow pilot excavations will be restored to service by appropriately skilled subcontractor personnel of second-tier subcontractors. Utility reconnections will be inspected and approved by City of Carson inspectors in accordance with relevant permit requirements.

5.15.4 Site Landscape Restoration

Following backfilling operations, URS will subcontract landscaping services, and the affected area will be landscaped per original conditions or as agreed to with the property owner. SOPUS will provide the homeowner with a menu of alternative landscape restoration options for consideration that will be prepared by a landscape architect/contractor. Any landscaping features (fences, patios, etc.) removed or damaged by pilot test operations will be repaired or replaced to the satisfaction of the owner.

6.0 IN-SITU REMEDIATION PILOT TESTING

6.1 IN-SITU CHEMICAL OXIDATION PILOT TESTING

The purpose of this element of the Work Plan is to evaluate the viability of ISCO for treatment of shallow soil at the site, including areas beneath structures and hardscape (e.g. paved areas). ISCO typically involves the injection and to a lesser extent extraction of liquids or gases containing oxidants. An oxidant is a reactive chemical that gains electrons from other chemicals (such as hydrocarbons) and in the process adds oxygen to the chemical. This process is referred to as “oxidation” and transforms the chemical of concern into more benign compounds. Oxidants must be delivered with adequate uniformity for the contaminants of concern to meet the remediation goals. In-situ treatment typically requires some time (months) for the treatment processes to achieve the remediation goals.

6.1.1 In-situ Chemical Oxidation Pilot Test Objectives

The overall objectives of the desktop, bench, and field evaluations outlined in this Work Plan are to develop information, both numerical and observational, that can be used to assess whether ISCO should be retained for further consideration during the development of site remedial strategies. Specifically:

- Evaluate which oxidants (liquids/gases) are suitable for use at the site;
- Evaluate whether oxidants can be delivered with adequate uniformity at the Site, including areas beneath pavement and/or structures, to contact impacted soils; and
- Evaluate potential oxidant consumption rates in the laboratory to support the evaluation.

6.1.2 Site Conditions Relevant to ISCO

Petroleum-related and non-petroleum-related constituents have been detected in soil, groundwater, and soil gas at the site during previous site investigations. These compounds include petroleum hydrocarbons of various molecular weight ranges (e.g. TPHg, TPHd, and TPHmo) as well as VOCs, including those associated with petroleum hydrocarbons (e.g., BTEX, trimethylbenzenes, and other substituted aromatic compounds), and chlorinated solvents (e.g. TCE, PCE, and related breakdown products).

The CAO’s scope addresses shallow impacted soil at depths to 10 feet bgs. As a result, ISCO is being evaluated for this depth interval. Soil vapor extraction (SVE) pilot testing conducted at the site in 2010 evaluated performance in this depth interval and at deeper depths. The SVE pilot testing and other previous site investigations provided data on soil properties and response to vacuum that are pertinent to the evaluation of ISCO. Appendix C summarizes findings from the SVE pilot test relative to evaluation of ISCO technology for soil and soil gas treatment at the site.

ISCO is a class of subsurface remediation technologies that utilize chemical oxidants to destroy organic contaminants in-place. Chemical oxidants are a class of compounds that are capable of breaking the molecular bonds of organic contaminants, degrading them to benign end products such as carbon dioxide. Chemical oxidants are commonly used in water treatment (drinking and wastewater), commercial aquariums, swimming pools, laundry operations, aquaculture, chemical analysis and synthesis, as well as other industrial processes. Oxidants add electrons, typically via oxygenation, to reduced compounds or elements.

There are four primary types of oxidants commonly used for ISCO. These include permanganate (MnO_4^-), ozone (O_3), catalyzed hydrogen peroxide (CHP), and activated sodium persulfate (ASP). Each of these oxidants has unique characteristics that influence the potential applicability of a class of oxidants to different sites and geologic conditions.

ISCO involves handling process chemicals that may have hazardous characteristics. This Work Plan will be supported by a Health and Safety Plan addendum for ISCO activities. This plan will be used to ensure safe work practices and compliance with local codes. The most common health and safety concern with ISCO is exposure to process chemicals. The potential for surfacing of amendments will be heightened as a result of the shallow depth of the target interval. Storage of oxidizers during the treatment process will be in compliance with the California Fire Code (CCR Title 24, Part 9). Hazards and controls will be developed in the HASP addendum and reviewed with local fire officials.

The RWQCB issues Waste Discharge Requirements (WDRs) for ISCO application in the Los Angeles Basin. WDRs for ISCO are typically based on Order No. R4-2007-0019, Revised General Waste Discharge Requirements For Groundwater Remediation at Petroleum Hydrocarbon Fuel, Volatile Organic Compound and/or Hexavalent Chromium Impacted Sites. Table I of Order R4-2007-0019 includes a list of the materials that can be used for in-situ remediation. A Report of Waste Discharge and Remedial Action Plan requirements are required under Section A of the general WDR. Based on the application, the RWQCB will determine whether a site-specific WDR or a general WDR is required for the pilot test.

6.1.3 Site-Specific Feasibility Evaluation

A site-specific feasibility evaluation was conducted based on available site data. The four classes of ISCO were screened relative to treatment of hydrocarbons at the Site including under structures and paved areas. Delivery approaches were then developed for field and lab screening for the retained classes of ISCO under the constraints identified for this application. A thorough description of these evaluations is provided in Appendix C.

Both sodium persulfate (SP) and ozone (O_3) were retained because these oxidants have been shown to treat hydrocarbons, and these oxidants have more favorable characteristics for the site and target depth interval as compared to permanganate and CHP. Both SP and O_3 generate reactive oxidizing free radicals capable of the destruction of a broad range of contaminants (ITRC, 2005). The typical reaction pathways and equations are summarized in the referenced manuscripts (ITRC, 2005). Both oxidants may be activated with heat, light, and/or transition metals such as iron and manganese. As a result, prediction of site-specific longevity of either oxidant is difficult and as a result site-specific bench-scale testing and/or pilot testing is typically needed.

The application of ISCO to areas at the Site including beneath structures and impervious surfaces influenced the screening of delivery methods, as discussed in Appendix C. Vertical wells were not retained for SP because gravity-driven flow will limit the lateral delivery from a vertical well. As a result, ozone pilot testing using vertical wells was retained. Horizontal wells are the most viable delivery method for liquid oxidants. Horizontal wells were retained for SP pilot testing. Further evaluation of delivery alternatives and well screen intervals will be conducted based on bench-scale testing results and modeling of the delivery approaches that are discussed in the next two sections.

6.1.4 Bench Testing

Bench-scale testing establishes a site-specific basis for designing field-scale ISCO. Bench-scale testing will be conducted to evaluate the kinetics of oxidant consumption, effects of oxidant dose and initial concentration, and confirm treatment of hydrocarbons. Bench-scale testing will be conducted to evaluate three specific objectives:

- Estimate the site-specific rate of consumption of persulfate and ozone;
- Evaluate hydrocarbon treatment under idealized conditions; and
- Evaluate the challenges of treating discrete masses of hydrocarbons.

Bench-scale testing results will be used to verify the pilot test layout and monitoring program in combination with the modeling described in the next section. Inherent differences between bench-scale and field-scale conditions can include differences in delivery efficiency, spatial variability in oxidant dose and soil properties including: density, porosity, water content and contaminant distribution.

Bench-scale testing will be conducted to measure SP and O₃ consumption rates by Site soils. These bench-scale tests will be conducted for a two-week period. Oxidant concentrations will be measured approximately six times during the experimental period. Three series of experiments will be conducted for persulfate and ozone to evaluate the difference in oxidant consumption at a range of initial oxidant concentration (equivalent to three unique doses on a g/kg basis). Additional details on planned bench testing is included in Appendix C.

6.1.5 Flow and Transport Modeling

Effective transport, or movement of the oxidant, and delivery of the oxidant to the target zone, is critical for successful ISCO treatment. Modeling will be used to confirm the ISCO pilot test layout, injection equipment and chemical requirements. Two models will be used. A simplified one-dimensional model of reactive transport will be used to evaluate the lateral delivery of both SP and O₃ from a well. A two-dimensional variability saturated flow model will be used to assess delivery of SP from a horizontal well. Additional details on flow and transport modeling is included in Appendix C.

6.1.6 ISCO Pilot Test Planning

Pilot test planning will be required to select pilot test locations and obtain the WDR from the RWQCB. ISCO pilot test locations will be selected in conjunction with the excavation pilot test locations. Inclusion of a property as a suitable candidate for a particular pilot test technique should not be interpreted as a recommendation that the technique would be appropriate, or that it would ultimately be proposed for that property in the Remedial Action Plan. Criteria used for selecting potential properties for the pilot test are not intended as criteria for final remedies. Remedial approaches for specific properties and cleanup levels for the Site will be proposed in future submissions to the Regional Board, including the Remedial Action Plan, as required in Section 3.c. of the CAO.

It will be important to conduct pilot tests in areas that are representative of median to high concentrations of petroleum hydrocarbons. Sub-areas that are identified will be field inspected and photographed to assess access and clearance:

- Assess typical foundation types;

- Side yard obstructions;
- Utility entry locations;
- Document existing conditions;
- Cracking and settlement; and
- Vegetation, debris or other access constraints.

Pilot tests will most likely be completed in front yards. Two pilot tests, one for liquid injection and the other for gas injection, are described in the following sections. Therefore, up to two properties may be needed. Field activities described in the following sections may be modified based on bench-scale testing and modeling results.

A remedial action plan (RAP) and notice of intent will be prepared for each pilot test as required by the LARWQCB WDR (Order No. R4-2007-0019). RAP requirements include: background water quality, potential adverse impacts to groundwater quality and descriptions of the geology and ISCO approach (see WDR Section A). A Health and Safety Plan addendum for ISCO activities will be prepared and used to permit storage and handling of oxidants with local fire officials.

6.1.7 ISCO Pilot Test Implementation

Current land use at the Site requires that considerable lateral distribution of chemical oxidant is necessary for ISCO to be viable beneath structures and paved areas. Successful implementation of ISCO relies upon adequate delivery and distribution of chemical oxidant to the impacted soil in a dose that achieves treatment goals.

Two pilot tests are planned to evaluate delivery and distribution of an injected liquid, i.e. SP, and a gas, i.e., O₃, respectively. The first pilot test will use a conservative dye tracer as a surrogate for best case SP delivery. The second pilot test will be conducted using ozone gas. These strategies were developed based on characteristics of SP and O₃, as well as, technical aspects of measuring the distribution of liquids and gases at field scale. Results from pilot testing will support bench-scale and modeling results; together pilot test results can be used to evaluate the feasibility of ISCO at the Site.

It is assumed that the pilot test can be conducted in areas planned for excavation following the ISCO pilot test to allow trenching and visual inspection/photography to document the lateral distribution and delivery of the injected fluids. However, depending on access availability and schedule constraints, a separate property may be appropriate solely for ISCO testing. Relocation of residents may be necessary for the ISCO pilot test (Section 7.0).

6.1.7.1 Liquid Tracer Test

A key objective of pilot testing is to evaluate the delivery and distribution of injected liquids. SP solutions are typically clear and as a result difficult to visually detect in post-ISCO soil samples. As a result a colored tracer dye such as Rhodamine was selected for field pilot testing to obtain visual evidence of distribution and delivery to the intended soils. The liquid tracer, such as Rhodamine or other tracer included the WDR, will be injected into a horizontal well. The expected delivery distance out from a well of a conservative tracer dye is expected to be greater than that for SP because SP is consumed (due to oxidation) during delivery. Excavation and careful examination of soils following the dye injection test

should elucidate whether the injected liquid contacts all materials or whether Site soil conditions develop preferential migration pathways leaving some impacted materials unaffected by the dye.

An electrical resistivity survey (e.g. <http://www.aestusllc.com/> GeoTrax™ or similar) will be conducted to identify variation in geologic conditions and macro-scale hydrocarbon distributions in the pilot test locations prior to well installation. Results of this survey will be used to confirm the pilot test well locations and confirm the location of underground utilities.

One 4-inch diameter Schedule 80 PVC horizontal well with 0.020-inch slots will be installed via trenching. The horizontal well will be installed at 3 feet bgs and will have approximately 20 feet of screen, given adequate clearance at the selected location.

The horizontal well will be installed in a trench and backfilled with pea gravel to six inches above the well. Six inches of 10/20 sand will be placed over the crushed rock, followed by flowable fill (e.g., soil cement) to the ground surface. Flowable fill was selected as a surrogate for an impervious surface seal such as a slab foundation or pavement.

Work zone monitoring and traffic control will be performed in accordance with Section 5.8. If necessary, dust and odor control methods will be implemented in accordance with Section 5.10. Excavated soils will be handled as described in Section 5.7.

The horizontal well will be connected to a cross-linked polyethylene tank equipped with a high-flow electric mixer. Tracer solution will be circulated within the tank to continue mixing the contents and provide up to 20 PSIG. PVC reinforced hose will be used to transfer the tracer solution to the horizontal well. A flow control valve, diaphragm-type or similar, and a two-stage pressure regulator will be used to control the flow rate and pressure applied to the well. A turbine-style totalizing flow meter will be placed upstream of the flow control valve to measure flow rates and volumes injected. A 4-in dial pressure gauge will be placed downstream of the flow control valve. Shut-off ball valves will be installed on the tank and well connection. A minimum of three 15-amp 120VAC circuits will be required.

Following well installation and mobilization of equipment and supplies to the Site, the following tasks will be performed:

A step pressure test of the injection well will be performed to develop a well performance curve of applied pressure versus flow rate for the well. Potable water will be injected during the step pressure tests. The test will start with gravity feed at atmospheric pressure (0 pounds per square inch [PSI]) and increase the applied pressure in 2 pound-force per square inch gauge (PSIG) increments up to a maximum of 15 PSI. Pressure and injection rate will be recorded at a minimum every 5 minutes and each pressure step will be maintained until flow rates stabilize to within 10 percent of the prior reading or for a maximum of 30 minutes. If surfacing is observed, the pressure will be immediately reduced and the well vented to the atmosphere and the step pressure test will stop.

A liquid tracer solution will be prepared by mixing dye (e.g., Rhodamine is typically sold at 20% by weight concentration) in potable water at a concentration that will be visibly detectable in soils. A sample of tracer solution will be collected and analyzed for tracer at Ozark Underground Laboratory to determine the initial tracer concentration.

A tracer injection test of up to 6 hours will be performed at the maximum well head pressure identified in the step pressure test. The tracer injection rate is expected to decrease with time at constant applied well head pressure as soils pores fill with fluid. Additional batches of tracer solution will be prepared, as needed. Injection volumes will be estimated from the flow modeling and step pressure test results.

After the tracer testing is complete, the tank and equipment will be cleaned and demobilized from the Site. Remaining system components (pumps, hoses/piping, and valves) will be decontaminated and disposed.

6.1.7.2 Ozone Pilot Test

As opposed to the liquid tracer test described above, a surrogate gas injection program using an inert gas is not considered for the gas pilot test because such gasses cannot be readily observed. Therefore, the gas portion of the ISCO pilot test will be conducted using ozone delivered through a vertical well. The ozone pilot test layout includes the elements described below.

One 5-foot long, 4-inch diameter 316SS wire-wrapped well screen will be installed from 3 to 8 feet below grade. The top elevation was selected to match the liquid tracer test and the 5 foot length was selected to double the applied ozone dose as compared to a 10 foot screen length in the available pilot test duration. The well screen will terminate with a flat metal plate on both ends with a ½-inch FNPT connection in the top plate. A 316 SS FNPT/compression fitting will be used to connect ½-inch outer diameter (OD) by 3/8-inch inner diameter (ID) fluorinated ethylene propylene (FEP) tubing or equivalent to the ground surface. A 1-inch Schedule 40 PVC protective sleeve will be placed over the FEP tubing prior to removing the augers and sealing the borehole.

The injection well will be installed by hollow-stem auger drilling methods. Six inches on filter sand, 6/9 Lonestar or equivalent, will be tremied to fill the bottom of borehole prior to placing the screen. Filter sand will be tremied over the screen and will extend 12 inches above the top of the well screen. A 6-inch layer of bentonite pellets will be placed over the well sand and hydrated. The remaining annulus will be sealed with slurry of pre-mixed high-strength concrete extending to the ground surface. Two part epoxy will be used to fill the annulus between the FEP-tubing and PVC protective casing that will be trimmed to approximately 6 inches above grade.

Four clusters of soil gas probes will be installed at radial distances of 5, 10, 20 and 25 feet, respectively, from the vertical injection well. Three elevations of soil gas probes will be installed in each cluster at depths of 3, 6, and 9 feet bgs.

Soil gas monitoring probes will be installed by direct-push drilling methods. Soil borings will be continuously sampled using a Geoprobe push-tube sampler. Samples will be collected at each soil gas monitoring point. A continuous log of the soil texture, color, and characteristics will be documented. Soils will be continuously screened for VOCs using a handheld PID. Soil samples will be composited in 1-foot intervals and submitted for laboratory analysis for petroleum hydrocarbons (e.g. TPHg, TPHd, and TPHmo).

Each soil gas monitoring point will be constructed from ¼-inch FEP or Nylaflo® tubing connected to a 6-inch long double woven stainless steel wire screens with compression fittings. Probes will be installed inside the cased borehole and a sand filter pack will be placed in the annulus to a height of 6 inches above the screen. Granular bentonite and water will be placed in two lifts of 3 inches each above the filter pack

and then a thick slurry of bentonite and water will be added to seal the remainder of the borehole annulus to ground surface. The top of the probe will be fitted with a compression-fit 316 SS ball valve to maintain an air-tight seal between installation and sampling. Soil gas probes may be completed at the surface with monitoring well boxes. Each probe will be installed in an individual core hole to eliminate any concern regarding imperfect seals between intervals, which may occur in multi-level installations within a single borehole.

Traffic control and work zone monitoring and will be performed in accordance with Sections 5.8 and 5.9. If necessary, dust and odor control methods will be implemented in accordance with Section 5.10. Soils cuttings will be handled as described in Section 5.7.

A turnkey ozone generation system in a trailer or cabinet enclosure will be leased and tested prior to mobilization to the Site. The ozone generation system will have the following performance specifications:

- Ozone production – minimum of 1.4 pounds per day continuous output;
- Ozone concentration – minimum of 1 percent by weight;
- Total gas output – minimum of 3.8 SCFM;
- Output pressure – minimum of 30 PSIG;
- Output oxygen concentration less than 35% by weight;
- Continuous air monitoring for ozone and oxygen leaks;
- Gauges, flow meters, filters and condensate drain;
- Sound level – less than 75dBA from city code; and
- FEP distribution tubing – minimum of 1/2-in OD and 3/16-in thickness.

Following well installation and mobilization of equipment and supplies to the Site, the following tasks will be performed:

Each soil gas monitoring point will be monitored for background concentration of methane, oxygen, carbon dioxide, and LEL using a handheld landfill gas monitor (Landtec GEM 2000 or equivalent) and using a handheld PID. Ozone concentrations will be measured using UV absorbance method (PCE Wedeco-brand LC series or equivalent).

A step pressure test of the injection well will be performed to develop a well performance curve of applied pressure versus flow rate. Air will be injected during the step pressure tests. The test will start at 5 PSIG and the applied pressure will be increased in 2 PSIG increments up to a maximum of 25 PSI. Pressure and injection rate will be recorded at a minimum every 5 minutes and each pressure step will be maintained until flow rates stabilize to within 10 percent of the prior reading or for a maximum of 30 minutes. If surfacing is observed, the pressure will be immediately reduced and the well vented to the atmosphere and the step pressure test will stop.

Ozone pilot testing will extend for a six week period. Delivery will be either pulsed or continuous over this time period. This duration of time is required to simulate full scale implementation. Short-term ozone field trials are confounded by the need to deliver an adequate dose of ozone and interference

between soil gas VOC/TPH and ozone sensors. Ozone is measured by a UV-absorption based meter that also responds to VOC/TPH in the soil gas. Therefore, adequate ozone must be delivered to oxidize the soil gas VOC/TPH before subsurface distribution of ozone can be evaluated. Bench-scale testing and reactive transport modeling will be used to verify the duration of the ozone pilot testing, i.e. estimate the time until steady state ozone distribution will be achieved and subsequent time required to deliver adequate ozone to assess petroleum hydrocarbon treatment effectiveness.

Soil gas readings will be collected at least twice daily for the first week, three times per week during the next two weeks and then weekly until the completion of the pilot testing. Each soil gas monitoring point will be monitored for pressure, methane, oxygen, carbon dioxide, and LEL using a handheld landfill gas monitor (Landtec GEM 2000 or equivalent) and using a handheld PID. Ozone concentrations will be measured using UV absorbance method (PCE Wedeco-brand LC series or equivalent). Resident relocation will not be necessary for the entire six week period.

6.1.8 Post-injection Monitoring Plan

The following parameters will be monitored post-injection to assess vertical and horizontal distribution and persistence of the conservative liquid and gaseous tracers:

An electrical resistivity survey (e.g. <http://www.aestusllc.com/> GeoTrax™ or similar) will be conducted to identify changes in petroleum hydrocarbon distribution and the tracer distribution. Locations showing the most significant changes will be selected for intrusive sampling.

Aerobic respirometry testing will be conducted 30 days after ozone injection has been completed. Respirometry testing is described in Section 6.2.10.

Two trenches will be installed perpendicular to the liquid injection well at locations identified during the resistivity survey. The trenches will be photographed and inspected for visual evidence of tracer. Soil samples will be collected along the centerline of each trench at distances of 1, 3, 5, and 10 feet from the centerline of the horizontal well.

Six soil borings will be advanced to 10 feet bgs in the liquid tracer pilot test area along the horizontal well for liquid tracer testing. These borings will be continuously sampled using a Geoprobe push-tube sampler. A continuous log of the soil texture, color, and characteristics will be documented. Soils will be continuously screened for VOCs using a handheld PID. Soil samples will be composited in 1-foot intervals and submitted for laboratory analysis for the tracer concentration.

Eight soil borings will be advanced to 10 feet bgs in the ozone pilot test area, at locations generally matched to the soil gas monitoring and sampled to establish baseline conditions. These borings will be continuously sampled using a Geoprobe push-tube sampler. A continuous log of the soil texture, color, and characteristics will be documented. Soils will be continuously screened for VOCs using a handheld PID. Soil samples will be composited in 1-foot intervals and submitted for laboratory analysis for petroleum hydrocarbons (e.g. TPHg, TPHd, and TPHmo).

Depending on the initial results of the ozone testing, it may be desirable to return to the site in approximately 6 months to evaluate whether conditions conducive to further biodegradation of the compounds are present. However, this would likely occur after the submittal of the pilot test report. Such evaluation would be presented later as an addendum to the report.

Data obtained during pilot testing will be evaluated and processed to support an evaluation of the feasibility ISCO for the Site.

6.1.9 ISCO Pilot Test Evaluation

The overall objectives of the pre-field and field pilot testing outlined in this Work Plan are to develop information, both numerical and observational, that can be used to assess if ISCO should be retained for further consideration during the development of site remedial strategies. Following field and lab testing, a pilot test report will be prepared which will address the following:

- Evaluate which oxidants (liquids/gases) are suitable for use at the site.
- Bench-scale testing will evaluate if adequate treatment can be achieved under idealized conditions and provide a site-specific basis for estimating the required oxidant and activator doses.
- Prior pilot test results will be combined with bench-scale test results to estimate the volumes and concentrations, therefore the quantities of oxidants that may be required.
- Evaluate whether oxidants can be delivered with adequate uniformity in the Site, specifically areas beneath pavement and/or structures.
- Tracer and oxidant injection testing will be performed to assess field-scale injection of liquids and gases.
- Multiple lines of evidence including soil gas readings, visual and chemical results from soil boring and trenches, and a resistivity survey will be used to assess this objective.
- Determine if the shallow target interval leads to surfacing, or potential surfacing, of injected fluids.
- Establish performance data to support an assessment of the feasibility of ISCO at the site.
- Estimates of the lateral distribution can be used to estimate required well spacing.
- Evaluate if variability in petroleum hydrocarbon concentration or discrete masses of hydrocarbons confound the effectiveness of ISCO.
- Provide more reliable assumptions for the duration of potential ISCO alternatives.
- Identify the most significant logistical constraints on ISCO deployment at the Site.
- Observe and document the effects of ISCO implementation on vegetation.

6.2 BIOVENTING

Bioventing is an in-situ technology to remediate petroleum hydrocarbons from vadose-zone soils. In this process, air is extracted or injected into the subsurface to provide oxygen and enhance biodegradation of petroleum compounds. Due to the residential occupancy of the Site and because we are targeting the shallow (i.e., 0 to 10 feet bgs) portion of the vadose zone, bioventing through injection will not be evaluated, and the pilot test will focus only on the effectiveness of this technology through vapor extraction. Although VOCs in soil vapor may be extracted from the subsurface during this process, the aim of the bioventing technology is to encourage microbial degradation rather than extract VOCs to the surface where off-gas treatment may be required.

6.2.1 Bioventing Pilot Test Objectives

The purpose of the bioventing pilot test is to evaluate the potential effectiveness of this technology at the Site and to provide parameters that may be used for full scale system design. Information obtained from the SVE pilot test (URS, 2010c) has been used in the design of the pilot test and will be incorporated into the evaluation of the bioventing pilot test results. Specific objectives of the bioventing pilot test are:

- Assess site conditions that may be suitable for bioventing;
- Evaluate the limitations of bioventing including the degree of concentration reduction that may be expected and the time frame for remediation;
- Evaluate effectiveness of different system design configurations such as:
 - Well construction layout (e.g., vertical versus horizontal extraction wells);
 - Mechanical venting requirements (e.g., passive versus active venting);
- Collect data that may be used for full-scale system design, including:
 - Radius of influence for oxygen delivery under low-flow conditions;
 - Oxygen utilization rate in the subsurface; and
 - Composition of bioventing off-gas; and
- Evaluate design parameters for a full-scale bioventing system in terms of well design, well spacing, and equipment selection/sizing.

6.2.2 Background

The aim of bioventing is to supply oxygen to the subsurface to enhance microbial degradation of hydrocarbons in the subsurface. This technology focuses on in-situ biodegradation rather than extraction of vapors.

Bioventing has frequently been utilized as a remedial technology at diesel fuel release sites (USEPA, 2004; Leeson and Hichee, 1996). Even though the composition of hydrocarbons detected at the former Kast Site are different from diesel and include higher molecular weight compounds, a significant portion of the hydrocarbons detected in soil at the Site are in the diesel range and are potentially amenable to bioventing.

There are different potential designs for bioventing systems. Air can either be injected into the subsurface or extracted. If vapor extraction is utilized, oxygen is supplied to the subsurface by replenishment from the atmosphere. Alternatively, passive vent wells may be installed to facilitate supply of oxygen to the subsurface.

An SVE pilot test has been conducted at three locations at the Site. The SVE pilot test examined vapor transport in varying depths (shallow 5 to 10 feet bgs; intermediate 15 to 25 feet bgs; and deep 30 to 40 feet bgs). The shallow SVE pilot test results are relevant to the proposed bioventing evaluation for remediation of shallow soils. Variable results were observed in these tests. The radius of influence in the shallow zone ranged from 24 to 78 feet. To evaluate the potential effectiveness of bioventing, supplemental data to those collected during the SVE pilot test systems are needed.

6.2.3 Bioventing Pilot Test Strategy

The bioventing pilot test will include several components to assess soil conditions, shallow vadose-zone flow characteristics, vapor extraction equipment needs, and oxygen utilization/hydrocarbon biodegradation rate.

Soil Characterization: Characterization of soil physical properties and contaminant distribution in soils at the pilot test locations are important to evaluate where this technology may be potentially applicable. Key soil physical properties include intrinsic permeability, moisture content, grain-size distribution, and fractional organic carbon content. An evaluation of the COC concentrations in soil (e.g., TPHg, TPHd, TPHmo) will provide an assessment of the potential hydrocarbon source in the area and evaluation of the soil vapor composition (e.g., total VOCs, methane, oxygen, and carbon dioxide) are important to assess baseline conditions and potential oxygen utilization.

Sub-surface Flow Characterization: Characterization of the shallow vadose-zone flow has been performed previously in the SVE pilot test. In the SVE pilot test, three tests were conducted throughout the Site and estimates were made of soil permeability and radius of influence. Similar tests will be conducted as part of the bioventing pilot test. In this pilot test, an examination of the effectiveness of vertical and horizontal extraction wells will also be performed.

Vapor Extraction Equipment Evaluation: The pilot test will also evaluate feasibility of equipment that may be used during the long-term operation of the technology. Three technologies have been identified for this pilot study: a passive wind-turbine vent, a solar-powered fan, and a small electric-powered fan (i.e., a radon-type fan).

Oxygen Utilization/Hydrocarbon Biodegradation Rate: At each test location, a respirometry test will be conducted to evaluate the oxygen utilization and hydrocarbon biodegradation rate. These factors will be important to evaluate the time required for remediation and develop a full-scale design

6.2.4 Bioventing Pilot Test Location Selection

Pilot tests are proposed for six locations: vertical wells will be evaluated at four locations and horizontal wells will be evaluated at two locations. The pilot test locations should have higher TPH concentrations, and consequently, the selected locations should have TPHd or TPHmo concentrations of at least 5,000 mg/kg within the upper 5 feet of the soil. Inclusion of a property as a suitable candidate for a particular pilot test technique should not be interpreted as a recommendation that the technique would be appropriate, or that it would ultimately be proposed for that property in the Remedial Action Plan. Criteria used for selecting potential properties for the pilot test are not intended as criteria for final remedies. Remedial approaches for specific properties and cleanup levels for the Site will be proposed in future submissions to the Regional Board, including the Remedial Action Plan, as required in Section 3.c. of the CAO.

This technology is not intended to address the Regional Board's request to evaluate the removal of the reservoir concrete slabs, so the presence/absence of the reservoir floor is not a critical factor in selecting the pilot test locations. After approval of the Work Plan, the summary of potential pilot test sites (identified in Section Appendix B) will be reviewed to identify pilot test locations and obtain access for the work. Where feasible and efficient, bioventing pilot testing may be co-located at a residence where other pilot testing will be performed.

6.2.5 Extraction Well and Soil Vapor Monitoring Probe Installation

At each bioventing pilot test location, an extraction well and soil vapor monitoring probes will be installed. For each vertical extraction well pilot test, three soil vapor monitoring probes will be installed at distances of approximately 5, 10, and 15 feet from the extraction point. For the horizontal extraction well pilot test, six soil vapor monitoring probes will be installed at distances of approximately 5, 10, and 15 feet from the extraction well (two probes at each distance). The locations of the monitoring probes may be adjusted based on conditions present at each pilot test location.

The vertical extraction wells will be installed by advancing a borehole to approximately 10 to 11 feet bgs with a 4-inch diameter hand auger. The extraction wells will be constructed of 2-inch diameter Schedule 40 PVC casing and factory-slotted screen with 0.020-inch slots. The screened interval will be from 5 to 10 feet bgs. The screen annulus will be filled with #2/12 filter pack sand from approximately 1 foot below to 1 foot above the screened interval. One foot of dry granular bentonite will be placed on top of the sand pack to preclude infiltration of hydrated bentonite grout. The well will be grouted to ground surface.

The horizontal extraction wells will be installed by creating a 15 to 20-foot long, 1-foot wide trench at a depth of 5 feet bgs. The length of the trench will depend on access available at the pilot test property. A 6-inch pea gravel layer will be placed at the bottom of the trench and a 15 to 20-foot section of 2-inch diameter Schedule 40 PVC factory-slotted screen with 0.020-inch slots will be placed on top of the 6-inch pea gravel layer. Both ends of the slotted pipe will be connected to 90 degree angles and plumbed to ground surface with 2-inch diameter Schedule 40 PVC casing. The PVC pipe will be covered with a 6-inch layer of pea gravel, a geotextile fabric and then backfilled to the surface.

The soil vapor monitoring probes will be installed by advancing a borehole to 6 feet bgs with a 4-inch diameter hand auger. The extraction well will be constructed of 1-inch diameter Schedule 40 PVC casing and factory-slotted screen with 0.020-inch slots. The screened interval will be from 4 to 5 feet bgs. The screen annulus will be filled with #2/12 filter pack sand from approximately 0.5 foot below to 0.5 foot above the screened interval. One foot of dry granular bentonite will be placed on top of the sand pack to preclude infiltration of hydrated bentonite grout. The well will be grouted to ground surface.

6.2.6 Soil Laboratory Analytical Testing

Soil samples will be collected from each vertical extraction well location and two locations along the horizontal well (prior to trenching for the horizontal well). Samples for chemical analysis will be collected at 0.5, 2, 5, and 10 feet bgs. Samples for soil physical property analysis will be collected at 2.5, and 6 feet bgs.

Soil sampling and handling methods, borehole logging, equipment decontamination, investigative waste management and other investigative protocols associated with boring and well installation will be as described in the Addendum to the IRAP Further Site Characterization Report and SVE Pilot Test Work Plan (URS, 2010b).

Each soil sample collected during the bioventing pilot test will be submitted to a California-certified analytical laboratory under chain-of-custody procedures and analyzed for the following parameters:

- TPHg, TPHd, and TPHmo using USEPA Method 8015 modified;

- VOCs using USEPA Method 8260B/5035; and
- SVOCs using USEPA Method 8270C and 8270SIM.

In addition to the above analyses, samples will be submitted to PTS laboratories of Santa Fe Springs, California and analyzed for:

- Air (gas) permeability using API RP40;
- Grain-size distribution using ASTM D-422/4464M;
- TOC using the Walkley-Black Method;
- Moisture content using ASTM D-2216;
- Bulk and grain density using API RP40;
- Total and air-filled porosity using API RP40; and
- Pore fluid saturations using API RP40.

6.2.7 Bioventing Pilot Test Equipment

The bioventing pilot test will be conducted using a portable SVE pilot test unit. This unit will consist of the following equipment:

- A positive displacement vacuum blower capable of extracting up to 250 SCFM and exerting a vacuum of up to 140 inWC;
- A moisture knock-out vessel;
- Various controls and instrumentation; and
- Two 1,000-pound carbon vessels containing granular activated carbon (GAC).

A sound enclosure will be prepared for the SVE pilot test unit and portable generator to permit longer continuous operation of the bioventing system. The system will be operated under a Various Locations Permit issued by the South Coast Air Quality Management District.

Other ancillary equipment to be used includes:

- Portable generator for providing power to the SVE pilot test unit;
- Digital and analog manometers and pressure gauges;
- Flow meter for measuring individual well flow rate;
- PID to measure concentrations of VOCs;
- FID to measure total volatile hydrocarbons, including methane;
- Four-gas meter to measure oxygen, carbon dioxide, and methane concentrations;
- Portable sampling pump and tubing;
- Vacuum chamber for soil vapor sampling;
- Tedlar sample bags for collecting vapor samples for field analysis;
- Wellhead fittings to facilitate using each well for extraction or monitoring;

- Flexible tubing and PVC piping and fittings used to connect the extraction well to the SVE pilot test unit; and
- Laptop computer for field data entry.

6.2.8 Bioventing Pilot Test Implementation

The bioventing pilot test will consist of the following tests:

- Baseline soil vapor concentration measurements;
- Flow characterization test;
- Vapor extraction technology evaluation; and
- Respirometry test.

6.2.8.1 Baseline Concentration Measurements

Each soil vapor monitoring point and extraction well will be sampled and analyzed for target analytes that will assist in evaluating the bioventing pilot test. Soil vapor samples will be collected following procedures used during the site characterization study (URS, 2009). Samples will be analyzed using field instruments for methane, total VOCs, oxygen, and carbon dioxide using a Landtec GEM-2000. No samples will be collected for fixed laboratory analysis.

6.2.8.2 Flow Characterization Test Procedures

At each extraction well, the following flow characterization tests will be performed:

- One-hour extraction test;
- Step test; and
- Constant rate test.

The parameters recorded during the flow characterization part of the pilot test include the following:

- Applied well head vacuum;
- Vapor flow velocity;
- Vacuum at flow rate measuring point;
- Vapor flow temperature;
- Ambient barometric pressure;
- VOC concentration;
- Oxygen concentration;
- Carbon dioxide concentration; and
- Methane concentration.

The one-hour extraction test will be conducted to evaluate initial chemical concentrations/composition and estimate the maximum vacuum and flow rate achievable from each well. A vacuum will be applied at the vapor extraction well for approximately one hour with samples collected after 30 and 60 minutes of

operation for field monitoring. The samples will be collected in 1-L Tedlar bags following procedures used during the site characterization study (URS, 2009) and analyzed for methane, total VOCs, oxygen, and carbon dioxide using a Landtec GEM-2000. No samples will be collected for fixed laboratory analysis. After completion of the one-hour extraction test, the test will be repeated with the well caps for the monitoring probes open.

The step test will be conducted to evaluate the vacuum-flow rate relationship for the extraction well. The applied vacuum will be adjusted to 25%, 50%, 75%, and 100% of the maximum achievable vacuum (established during the one-hour test). Each vacuum step will be conducted for approximately 30 minutes. The applied vacuum at the test well will be adjusted using the dilution air valve at the inlet to the SVE pilot test unit. After completion of the step test, the test will be repeated with the well caps for the monitoring probes open. No samples will be collected for field monitoring or fixed laboratory analysis during the step test.

Bioventing pilot testing will extend over an approximately two week period. The constant-rate test will be conducted to evaluate the flow conditions over an extended period. The test will run for 1 week to see if oxygen supply to the vadose zone is achievable without passive vent wells. Samples will be collected daily in 1-L Tedlar bags following procedures used during the site characterization study (URS, 2009) and analyzed for methane, total VOCs, oxygen, and carbon dioxide using a Landtec GEM-2000. No samples will be collected for fixed laboratory analysis. If no increase in oxygen concentration/decrease in VOC concentration is observed after one week operation, then the well caps to the monitoring probes will be opened so these can act as vent wells to facilitate oxygen delivery into the subsurface and the test will continue for an additional week. Resident relocation will not be necessary for the entire two week period.

6.2.9 Vapor Extraction Technology Evaluation

Tests will be conducted to evaluate the feasibility of different pumps to be used for a long-term bioventing system operation. Three fans will be evaluated: a wind turbine fan (Hurricane Turbine Ventilator / Model H100 or H150), a solar powered fan (DC Equipment Cooling Fan, 3.62" Sq X 1.26" Depth, 50 Cfm, 12 Vdc), and a radon mitigation fan (Radon Away Model GP501). The specific capacitance of the different pumps will be evaluated at each pilot test location to be compared with the pressure drop/flow rate relationships measured during the bioventing pilot test.

6.2.10 Respirometry Test Procedures

After completion of the constant-rate test, a respirometry test will be conducted to evaluate oxygen utilization. The vapor extraction system will be shut off and samples will be collected from the extraction well over a 1-week period to monitor changes in the soil gas concentrations for oxygen, carbon dioxide, methane, and total VOCs. Samples will be collected in a 1-L Tedlar bag following procedures used during the site characterization study (URS, 2009) hourly for the first 6 hours, then twice per day for the next 5 work days and monitored in the field with a Landtec GEM-2000. No samples will be collected for fixed laboratory analysis. If practical, respirometry tests will also be conducted in the soil vapor monitoring probes.

6.2.11 Bioventing Pilot Test Evaluation

Tables and figures summarizing the results of the bioventing pilot test will be prepared. Summary data will include:

- Laboratory analytical results;
- Field monitoring results;
- Vacuum-flow rate relationships from flow characterization tests;
- Calculated air permeabilities;
- Oxygen utilization rate calculated from respirometry tests; and
- Specific capacitance results for different blower/venting equipment tested.

A 2-dimensional model will be prepared to evaluate oxygen delivery to the subsurface. The model is based on the solution to the leaky-aquifer flow model (used for aquifer test analysis) that has been modified to evaluate vapor transport. The model will provide an estimate of the oxygen delivery rate as a function of distance from the extraction well. This delivery rate will be compared to the oxygen utilization rate determined from the respirometry test to estimate the potential radius of influence for bioventing wells.

An estimate of the remediation time frame for the bioventing technology will be based on hydrocarbon concentrations, oxygen utilization, and stoichiometric relationship between oxygen and the hydrocarbons (i.e., theoretical value of the volume of oxygen needed to biodegrade a unit mass of hydrocarbons). Uncertainties in these calculations will also be presented.

7.0 RELOCATION OF RESIDENTS AND SECURITY DURING PILOT TEST ACTIVITIES

7.1 TEMPORARY RELOCATION OF RESIDENTS AT AFFECTED PROPERTIES

Consistent with current practice, SOPUS will provide for temporary relocation of residents at affected properties during intrusive portions pilot testing. The homeowner will be given the option to stay at a hotel of their choice and make their own arrangements, or to stay at a hotel arranged by and direct billed to SOPUS' relocation subcontractor, CARTUS. Should the homeowner desire to make their own arrangements, Shell will provide a daily room allowance of \$165 per night based on two occupants per room.

If the homeowner has pets that will not be staying at the hotel, the homeowner will be given the option to board the pets at a facility selected and reserved by CARTUS, or to make their own arrangements to board the pets with an allowance of \$28 per pet per day. SOPUS understands that some pets have special needs, such as regular medication, that might increase the cost of boarding a pet, and will take such special needs requests under consideration when provided an explanation of the need.

In addition to the costs associated with hotel and pet accommodations, SOPUS will provide relocated residents a daily meal allowance of \$71 per day per adult, and \$36 per day per child. For the purposes of meal allowance calculations, a child is considered a person 12 years of age or younger.

Relocation of residents at adjacent properties to locations where pilot test excavations occur will be provided if determined necessary based on the nature of the excavation work and the potential for interruptions of access to the property, or due to disruptions in utility service to the property. Relocation of residents at adjacent or nearby properties will include the relocation services and security as discussed above.

7.2 SECURITY FOR RESIDENCES WHILE RESIDENTS ARE RELOCATED

While residents are temporary relocated, onsite security, consisting of two off-duty law enforcement officers, will be assigned to each construction area during the hours that URS is not present onsite. In the event of an emergency, including suspicious persons/activities at or near the residence, the Police/Fire Department/Ambulance will be contacted immediately, followed by the homeowner or homeowner's representative, and URS. If the situation is not an emergency, URS will be notified immediately or, if after hours, at the start of the next working day. All verbal notifications will be followed by written documentation of the incident within 24 hours; including date, time, and description of the incident; who was contacted, and time homeowner's representative and URS representative were notified.

8.0 CONTINGENCY PLAN

8.1 EMERGENCY RESPONSE PROCEDURES

In the event of an emergency, notify Site personnel of the situation. Survey the scene to evaluate if the situation is safe, evaluate what happened, and search for potential victims. An Emergency Response Checklist can be used to help remember things to do in an emergency.

The emergency response team will consist of employees who assume the following roles:

- Emergency Care Provider(s)
 - Provide first aid/CPR as needed.
- Communicator: Site Manager, SSO or Senior Oversight.
 - The role of the communicator is to maintain contact with appropriate emergency services, providing as much information as possible, such as the number injured, the type and extent of injuries, and the exact location of the accident scene. The communicator should be located as close to the scene as possible in order to transmit to the emergency care providers any additional instructions that may be given by emergency services personnel in route.
- Site Manager/SSO
 - The Site Manager and/or SSO should survey and assess existing and potential hazards, evacuate personnel as needed, and contain the hazard. Follow up responsibilities include replacing or repairing damaged equipment, documenting the incident, and notifying appropriate personnel/agencies described under incident reporting. It also includes reviewing and revising Site safety and contingency plans as necessary.

8.2 MEDICAL EMERGENCIES

At least one URS employee on Site will hold a current certificate in American Red Cross Standard First Aid. This training provides six and one-half hours of Adult CPR and Basic First Aid. The following items and emergency response equipment will be located within easy access at all times:

- First Aid Kit and Infection Control Kit;
- Eyewash – A 15-minute eyewash (required if corrosives are present) or an appropriate amount of portable sterile eyewash bottles will be available on Site for flushing foreign particles or contaminants out of eyes. The SSO will demonstrate the proper operation of the unit(s) prior to the start of work;
- Emergency Phone Numbers List; and
- Cellular phones for emergency communications in remote areas.

Drugs, inhalants, or medications shall not be included in the First Aid Kit.

Persons with injuries that are not particularly serious or life threatening should be escorted to the nearest occupational health clinic or urgent care facility, if feasible. The facility location and a transit map are included in the HSP. If a medical emergency exists, consult the emergency phone number list and request an ambulance immediately. Perform First Aid/CPR as necessary, stabilize the injured, decontaminate if necessary, and extricate only if the environment they are in is dangerous or unsafe and ONLY if the

rescuers are appropriately protected for potential hazards they may encounter during the rescue. When emergency services personnel arrive, communicate first aid activities that have occurred. Transfer responsibility for care of the injured/ill to the emergency services personnel.

Site injuries, illnesses, and incidents must be reported to the SSO and PM immediately following first-aid treatment. Work will be stopped until the PM or SSO have evaluated the cause of the incident and have taken the appropriate action to prevent a reoccurrence. Any injury or illness, regardless of severity, is to be reported. The SOPUS Project Manager shall be notified immediately by the URS PM in the event of an injury.

8.3 OPERATION SHUTDOWN

If known or possible hazardous situations are present, or if work tasks are unclear, any project team member may request that site operations be temporarily suspended while the underlying hazard is corrected or controlled. All project members are encouraged to exercise “stop work” authority as part of applying behavior-based safety principles. If the situation is related to emissions, during operation shutdown, all personnel will be required to stand upwind to prevent exposure to fugitive emissions. The SSO will have ultimate authority for operations shutdown and restart.

8.4 CONFINED SPACE ENTRY

Under certain circumstances (e.g., large excavations with sloped sidewalls or shored excavations), it may be necessary for personnel to enter excavations. This will be considered confined space entry and will require a Confined Space Permit be written by a qualified URS EHS representative. All necessary access and egress will be provided, consistent with OSHA and Cal/OSHA requirements, and confined space response personnel will be available onsite prior to personnel entering confined spaces. The space will be monitored for VOCs and methane prior to entry, and if necessary, personnel will enter the space under Level B PPE. Confined space entry is addressed in the HSP Addendum for pilot test implementation.

8.5 UNANTICIPATED UTILITIES

If unanticipated utilities are encountered during excavation, work will stop and the nature of the utility line will be assessed. The homeowner will be contacted to establish if the owner has knowledge of the nature and type of line. Utility line writers or service providers that marked utility locations in response to the USA utility location request will be contacted and asked to meet at the site to aid in identifying the line. If the line is potentially electrically energized, it will be tested for presence of an electrical current. Listening devices may be used to evaluate if there is gas or water under pressure in the line. Only after the nature and type of line has been established will the line be taken out of service and temporarily removed to allow excavation to proceed.

8.6 OBSTRUCTION(S) ENCOUNTERED

Based upon boring refusal data from the Site (Figure 2), it is highly likely that obstructions will be encountered in the excavations due to buried concrete. Borings had refusal at depths of less than 2 feet bgs to 10+ feet bgs. Historical information indicates that concrete rubble from demolition of the former reservoirs, including reservoir walls and concrete pedestals from the roof support system, were buried by the developer in the fill soils. Although grading reports prepared by PSE for the developer specified minimum burial depths of 7 feet bgs, refusal at depths shallower than 7 feet is common.

If refusal is met, the excavation will proceed slowly and carefully to identify the source of the refusal. Attempts will be made to widen the excavation or trench to allow removal of the item causing refusal. Concrete materials removed from the excavations will be observed, described and photographed, and their sizes recorded. This information will be important for evaluation of feasibility of using different excavation methods and will be included in the Pilot Test Report.

8.7 SPILL OR HAZARDOUS MATERIALS RELEASE

8.7.1 General

Small spills shall be immediately reported to the SSO and dealt with according to the chemical manufacturer’s recommended procedures found on the MSDS. Steps will be taken to contain and/or collect small spills for approved storage and disposal.

In the unlikely event of a larger release of hazardous materials as a result of Site activities, Site personnel will evacuate to the pre-designated assembly area. The local Designated Emergency Response Authority (DERA) will be notified by the SSO immediately and appropriate actions will be taken to protect the public health and mitigate the contaminant release. The DERA can be reached through the local police or fire department. The Site Safety Officer or Site Manager will make the following emergency contacts:

Roy Patterson	URS Project Manager	714-433-7699 (office) or 714-227-5924 (cell)
Chris Osterberg	URS Program Manager	714-433-7680 (office) or 714-227-1363 (cell)
Gene Freed	SOPUS Project Manager	818-991-5556 (office) or 661-203-0915 (cell)
EPA Response Center (if RQ is exceeded)		800-424-8802
Cal OES (if RQ exceeded or significant release)		800-852-7550

Dust particulate emissions, vapor and odor control measures to be implemented proceeding in sequential steps including: 1) application of water spray to the working area and excavated soils; 2) spraying the excavation surface and excavated soils with Simple Green™ using a pump sprayer; 3) application of a commercial vapor and odor suppressant chemical manufactured by Kuma Corporation and sold under the brand name Odex; and 4) application of vapor/odor suppressant foam, as required.

8.7.2 AQMD Rule 403 Dust Control

In general, a policy of “no visible dust emissions” will be in place for all activities conducted at the Site over the course of the project. At all times, Site personnel will be responsible to report any fugitive dust emissions visually observed on the Site so that procedures can be modified or steps can be taken to eliminate or minimize the dust emissions beyond the Site boundary. All personnel will also be responsible for modifying work procedures (if minor) or requesting modification of procedures (if major) for tasks they are conducting, to eliminate visible dust emissions when they are observed.

The following are the general dust control measures that may be implemented on the Project:

- Limit onsite vehicle speeds to 15 mph to prevent dust emissions caused by truck travel on unpaved surfaces;
- Use stabilized construction entrances to prevent track-out;
- Stop operations when wind exceeds 25 mph;
- Apply water in sufficient quantity to prevent the generation of dust plumes;

- Empty loader buckets and dump trucks slowly;
- Minimize the drop height from loader buckets; and
- Remove track-out at the conclusion of each day.

The following additional dust control measures will be utilized at the Project as necessary to mitigate excessive dust emissions:

- Install a system to reduce track-out, i.e. rumble strips, wheel wash sump;
- Apply chemical dust/odor suppressants;
- Erect fencing or wind barriers;
- Cover trucks with a tarp and maintain required freeboard clearances (6 inches) to prevent dust generation during hauling operations;
- Maintain storage piles to reduce steep sides or faces;
- Cover stockpiles with plastic sheeting; and
- For open storage piles, apply water to at least 80 percent of the surface area on a daily basis when there is evidence of wind driven fugitive dust.
- Regardless of the project size or track-out control device selected, all materials tracked-out onto a paved public road must be removed promptly and not later than at the conclusion of each workday.
- Soil stabilizers and dust suppressants may be used to reduce dust emissions when necessary. They consist of commercially available chemicals applied to the soil surface that maintain the moisture levels in exposed soils or chemically bind the surface material to reduce fugitive dust emissions.

8.7.3 AQMD Rule 1166 VOC Control

In accordance with Rule 1166, an OVA consisting of a PID calibrated to hexane will be used to monitor excavated soils and the excavation face for VOCs to determine if the soils are classified as “VOC-contaminated,” defined by Rule 1166 as having PID readings of 50 ppm or greater. Monitoring shall be performed a distance of not more than 3 inches above the soil surface. If soils with total VOC concentrations exceeding 50 ppm measured with the PID are encountered, the soils will be stockpiled and covered, placed in AQMD-approved covered bins, or direct loaded, and the affected work area and load of soil will be sprayed with water or an approved vapor suppressant. If PID readings of 50 ppm or greater are detected for a sustained period of 15 seconds, the AQMD will be notified within 24 hours of the first detection of VOC-contaminated soil in accordance with the contractor’s Various Locations Rule 1166 Permit and appropriate vapor mitigation measures will be implemented.

If PID measurements of 1,000 ppm or greater are detected, excavation work will be stopped and the AQMD will be notified within one hour of the detection. In this event, the affected soil will and working area will be immediately sprayed with water or a vapor suppressant, and the contaminated soil will be immediately placed in AQMD-approved sealed containers or directly loaded into trucks, sprayed with water or an approved vapor suppressant and immediately transported offsite to the pre-approved disposal facility. Once these notification and mitigation measures have been accomplished, work will resume.

8.7.4 Highway Spill Response

As discussed in Section 8.7.1, immediate notification to the local DERA will be made by the SSO immediately and appropriate actions will be taken to protect the public health and mitigate the contaminant release. The SSO, Site Manager, URS Project Manager, URS Program Manager, and SOPUS Project Manager will also be notified as soon as practical.

The principal tasks in managing a vehicular release are:

- Safe approach;
- Isolation and containment;
- Notifications;
- Identification and hazard assessment; and
- Cleanup and disposal.

In the event of a highway accident that results in a release, URS or its subcontractor(s) will first insure the safety of the situation before approaching the vehicle. No approach to the vehicle to address environmental hazards will occur if there is a danger due to traffic, fire, or other causes. Once it is determined to be safe, the vehicle will be inspected to note damaged areas, the locations and approximate quantities of spills, and determine the nature of the materials released.

Released materials should generally be removed by appropriate crews with appropriate training, PPE, and knowledge of the materials involved. All materials should be prevented from entering waterways to the maximum extent possible. Materials will generally be removed by first collecting and/or sweeping up all solids for appropriate disposal. Liquids should be diverted to an area away from waterways where they may be removed with a vacuum truck or absorbent material.

The Fire Department will be notified via 911. The Los Angeles County Fire Department's Health Hazardous Materials Division's Emergency Operations Section (EOS) provides 24-hour-a-day response to spills and releases of hazardous materials and wastes throughout the County. In the event of a release of hazardous or potentially hazardous substances, EOS may be contacted at (323) 890-4317. Additionally, in accordance with California Health and Safety Code (HSC) Section 25507, any release or threatened release of hazardous materials will immediately be reported with appropriate information. If the release is in the right of way, the County Public Works street and road maintenance department will be notified. The LA County Department of Public Works can be contacted at (626) 458-3517.

The National Response Center will be notified at (800) 424-8802 if the spill equals or exceeds Federal Reportable Quantities (RQs). Federal notification requires additional information including media impacted by the release, time and duration of the release, precautions to take, known or anticipated health risks, and name and phone number for more information. In this instance, the State of California Governor's Office of Emergency Services (OES) Warning Center will also be notified at (800) 852-7550 or (916) 845-8911. The State OES may require written follow-up reports for releases subject to CERCLA and reportable quantities of extremely hazardous substances. If required, those reports will be submitted as soon as is practical and no later than 30 days.

Once the release is contained or cleaned up, additional notifications will be made, as needed. Cal/OSHA requires notification for serious injuries or harmful exposures to workers from hazardous materials. Cal/OSHA' Los Angeles office can be contacted at (213) 576-7451. The United States Coast Guard

requires notification of spills to waterways. Call the Los Angeles/ Long Beach Marine Safety Office at (310) 732-7380. The location (city/county/federal highway, etc) of the release may incur alternate or additional notification requirements.

8.8 SEVERE WEATHER SHUTDOWN

If performing outdoor activities, check for any potential severe weather that may impact the location and identify shelter areas that are available. If performing outdoor activities and thunder is heard or lightning is seen, take cover immediately in a safe location including a building or vehicle. Do not stay in (or on) convertibles, golf carts, riding mowers, open cab construction equipment or the like. Remain in the safe location until at least 30 minutes after the last thunder clap is heard. The SSO will have ultimate authority for operational shutdown and restart.

8.9 FIRE

To protect against fires, the following special precautions must be taken:

- Before any flame-producing devices, i.e., cutting torches or welding irons, are used in the exclusion zone, the SSO must be contacted and a hot work permit will need to be obtained. A detailed observation of the work area will be conducted to evaluate if potential fire sources exist. The fire sources must be removed to at least 35 feet away before work can commence.
- Two full 20-lb type ABC fire extinguishers must be located at the work area when cutting/welding is being conducted, and a fire watch will be posted.
- Upon completion of the cutting/welding activities the area will be observed for hot metal, slag, etc. The fire watch will remain on station for at least 15 minutes after the hot work is completed.

Type ABC fire extinguishers will be available on Site to contain and extinguish small fires. The L.A. County Fire Department shall be called by calling 911 in the event of any fire on Site.

8.10 PLACES OF REFUGE

In the event of a Site emergency requiring evacuation, all personnel will evacuate to a pre-designated area located a safe distance from any health or safety hazard (typically across the street from the work area, unless conditions dictate otherwise) and safely away from the area of influence. The SSO will designate a primary assembly area prior to the start of work each day. The daily pre-designated assembly area may have to be re-designated by the SSO in the event of an emergency where the area of influence affects the primary assembly area. Once assembled, the SSO shall take a head count. The SSO will evaluate the assembly area to verify that the area is outside the influence of the situation; if not, the SSO will redirect the group to a new assembly area where a new head count will be taken.

During any Site evacuation, employees shall be instructed to observe wind direction indicators. During evacuation, employees will be instructed to travel upwind or crosswind of the area of influence. The SSO will provide specific evacuation instructions to Site personnel regarding the actual Site conditions.

8.11 COMMUNICATION

A communication network must be set up to alert Site personnel of emergencies and to summon outside emergency assistance. Cell phone will be the primary communication means on the site. Where voice

communication is not feasible an alarm system (i.e., sirens, horns, etc.) should be set up to alert employees of emergencies. Radio communication may also be used to communicate with personnel in the exclusion zone. Portable phones should be used to communicate with outside agencies. Site personnel should be trained on the use of the Site emergency communication network. Emergency phone numbers shall be available in all field vehicles and used for outside communication. The SSO is responsible for establishing the communication network prior to the start of work, and for explaining it to all Site personnel during the Site safety briefing.

In the event of an emergency, personnel will use the following hand signals where voice communications are not feasible:

<u>Signal</u>	<u>Definition</u>
Hands clutching throat	Out of air/can't breathe
Hands on top of head	Need assistance
Thumbs up	OK/I'm alright/I understand
Thumbs down	No/negative
Arms waving upright	Send back support
Grip partner's wrist	Exit area immediately

8.12 SUSPICIOUS ACTIVITY

If *any* suspicious activity or unauthorized personnel is observed, contact the Field Manager/SSO who will contact the URS Project Manager. If the situation is not an emergency, URS should be notified immediately or, if after hours, at the start of the next working day. All verbal notifications should be followed by written documentation of the incident within 24 hours; including date, time, and description of the incident; who was contacted, and time homeowner's representative and URS representative were notified.

9.0 SCHEDULE AND REPORTING

The CAO requires that the pilot test be implemented and a Pilot Test Report that includes the findings, conclusions and recommendations drawn from pilot testing be submitted within 120 days of the issuance of the approval of this Work Plan. SOPUS and its consultants and contractors are committed to working diligently to this end; however, a number of factors will influence the length of time that will be required to implement this pilot test and prepare a report.

The ability to conduct the pilot testing program described in this Work Plan is dependent upon SOPUS obtaining access to properties suitable for the different types of excavation and in-situ pilot testing proposed. As previously noted, approximately 90% of the homeowners in the Carousel community are plaintiffs in litigation against SOPUS. As these homeowners are represented by legal counsel, access to their properties to conduct pilot testing must be arranged through plaintiffs' counsel. SOPUS' counsel will begin access negotiation following Regional Board approval of this Work Plan; however, we cannot predict if and when access will be granted to particular properties.

There are a number of permits that will need to be obtained, as described in Section 5.3 of this Work Plan. We have been informed by the City of Carson Department of Building and Safety that a Grading Permit will need to be obtained for each individual property where pilot test excavations will be conducted. A site survey and site-specific geotechnical investigation, including drilling of soil borings to collect samples for soil classification and strength testing, will need to be conducted to design excavations and shoring before the Grading Plan Permit application can be filed with the City. None of this can occur before access is granted. Multiple other planning and permitting activities will need to be completed prior to conducting pilot test excavations.

In addition to permits needed for excavation work, the ISCO portion of the in-situ treatment pilot test may require issuance of a WDR from the Regional Board. Our collective experience in obtaining WDRs for pilot tests, as well as full-scale application, is this process can take an unpredictable amount of time. While we expect timely cooperation from the Regional Board on this, it is an element that is outside SOPUS' control. We do not anticipate permitting issues for the bioventing pilot test. We have assumed that the bioventing tests can be conducted under a Various Locations Permit issued by the South Coast Air Quality Management District, similar to the permitting for the SVE pilot test conducted and reported in 2010.

While difficult to predict, we anticipate that a minimum of two months will be required to obtain necessary permits after access to individual properties is granted. This will make completing the pilot testing within the 120-day period allotted in the CAO a significant challenge.

A report presenting the findings, conclusions and recommendations drawn from pilot testing will be submitted to the Regional Board within 45 days following receipt of analytical data. Depending on the outcome of access issues, permitting, and final scheduling and sequencing of the work, SOPUS may request RWQCB approval to submit the Pilot Test Report in multiple submittals discussing results of individual aspects of the pilot test program.

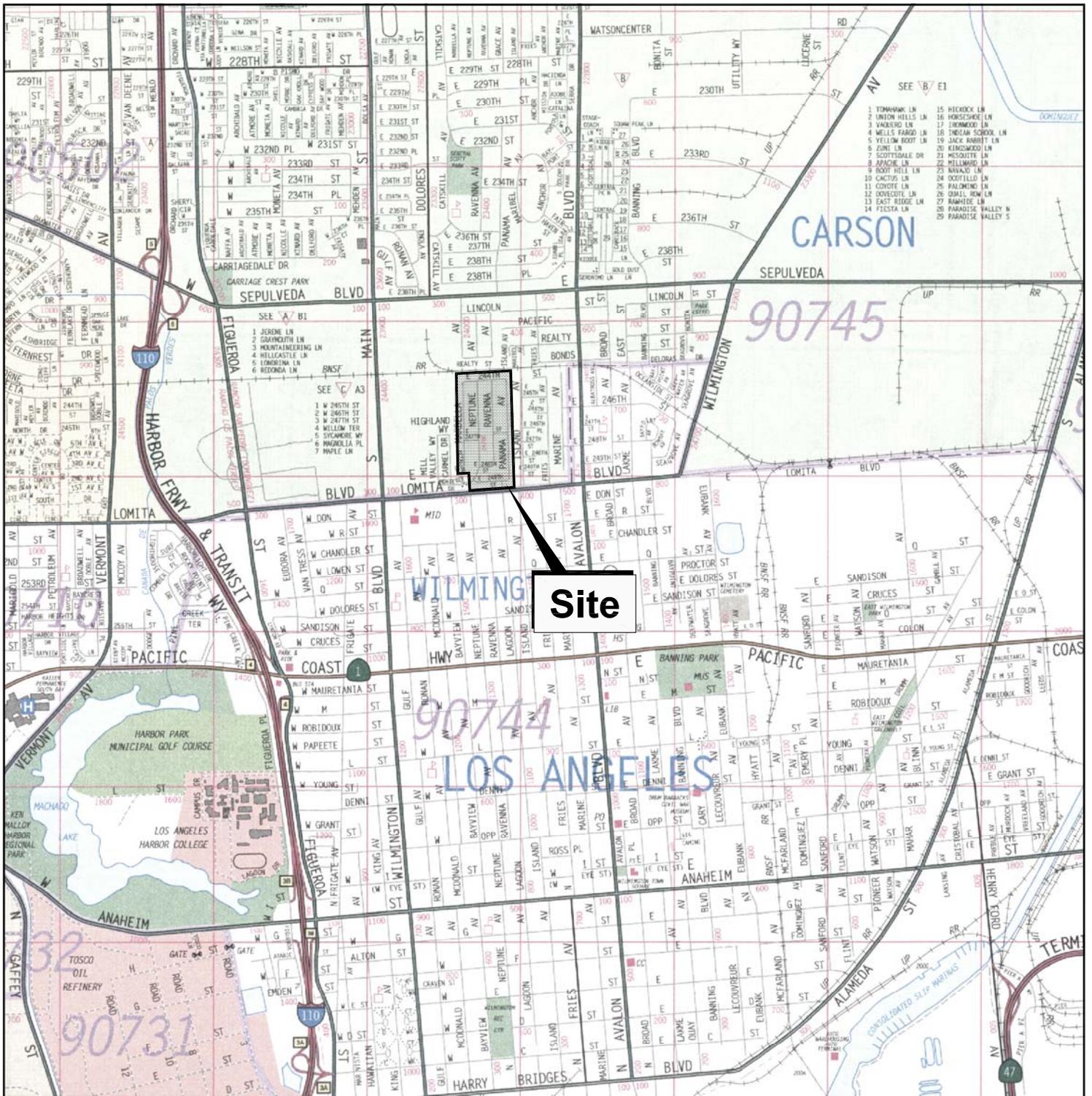
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FIGURES



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URS Corporation

SITE VICINITY MAP

Proj. No.:	49194314	Date:	May 2011
Project:	Former KAST Property	Figure:	1
Drawn by:	GN	Checked by:	AB



EXPLANATION

- APPROXIMATE PROPERTY LINE
- NO REFUSAL ENCOUNTERED
- REFUSAL ENCOUNTERED AT 0.1-2 FEET
- REFUSAL ENCOUNTERED AT 2.1-5 FEET
- REFUSAL ENCOUNTERED AT 5.1-7 FEET
- REFUSAL ENCOUNTERED AT 7.1-10 FEET
- REFUSAL ENCOUNTERED AT GREATER THAN 10 FEET

BORING TOTAL DEPTH RANGED FROM 9.5 TO 10.5 FEET BELOW GROUND SURFACE (BGS)
 COLOR INDICATES APPROXIMATE DEPTH AT WHICH DEEPEST REFUSAL WAS ENCOUNTERED

1/4 (6.9)	TOTAL NUMBER OF REFUSALS TO NUMBER OF BORINGS DRILLED IN YARD DEPTH OF REFUSAL (IN FEET) ENCOUNTERED
2/3 (7.1-8.5)	TOTAL NUMBER OF REFUSALS TO NUMBER OF BORINGS DRILLED RANGE OF REFUSAL DEPTHS ENCOUNTERED

* BORING TOTAL DEPTH GREATER THAN 10.5 FEET BGS
 YARD HAS NO OPEN SOIL (NO BORINGS ATTEMPTED)

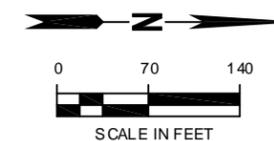


FIGURE 2
BORING REFUSALS WITH
REFUSAL DEPTH RANGE
PILOT TEST WORK PLAN

Proj. No.: 49194357	Date: MAY 2011
Project: FORMER KAST PROPERTY	Figure: 2

APPENDIX A

DISTRIBUTION OF SELECT COCs IN SHALLOW SOILS

≤ 2 FT. BGS

2 - 5 FT. BGS

5 - 10 FT. BGS



- Non-Detect (ND)
- ≤ 0.224 mg/kg
- > 0.224 to 2.24 mg/kg
- > 2.24 to 22.4 mg/kg
- > 22.4 mg/kg



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Soil Benzene Concentrations by Depth

Former Kast Property

Figure

A-1

SoilBenzene-011.Dwg H:\Cm\Ac\Geosyntec\Map\Arc\BeneMap\BeneMap.dwg 2011.05.27

≤ 2 FT. BGS

2 - 5 FT. BGS

5 - 10 FT. BGS



SoilBiosBar-011.Dwg - H:\Gis\ArcGIS\Map\Arc\BiosBar-011.Dwg - 2011-10-02

- Non-Detect (ND)
- ≤ 4.11 mg/kg
- > 4.11 to 41.1 mg/kg
- > 41.1 to 411 mg/kg
- > 411 mg/kg



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consultants

Santa Barbara, CA

May 2011

Soil Naphthalene Concentrations by Depth

Former Kast Property

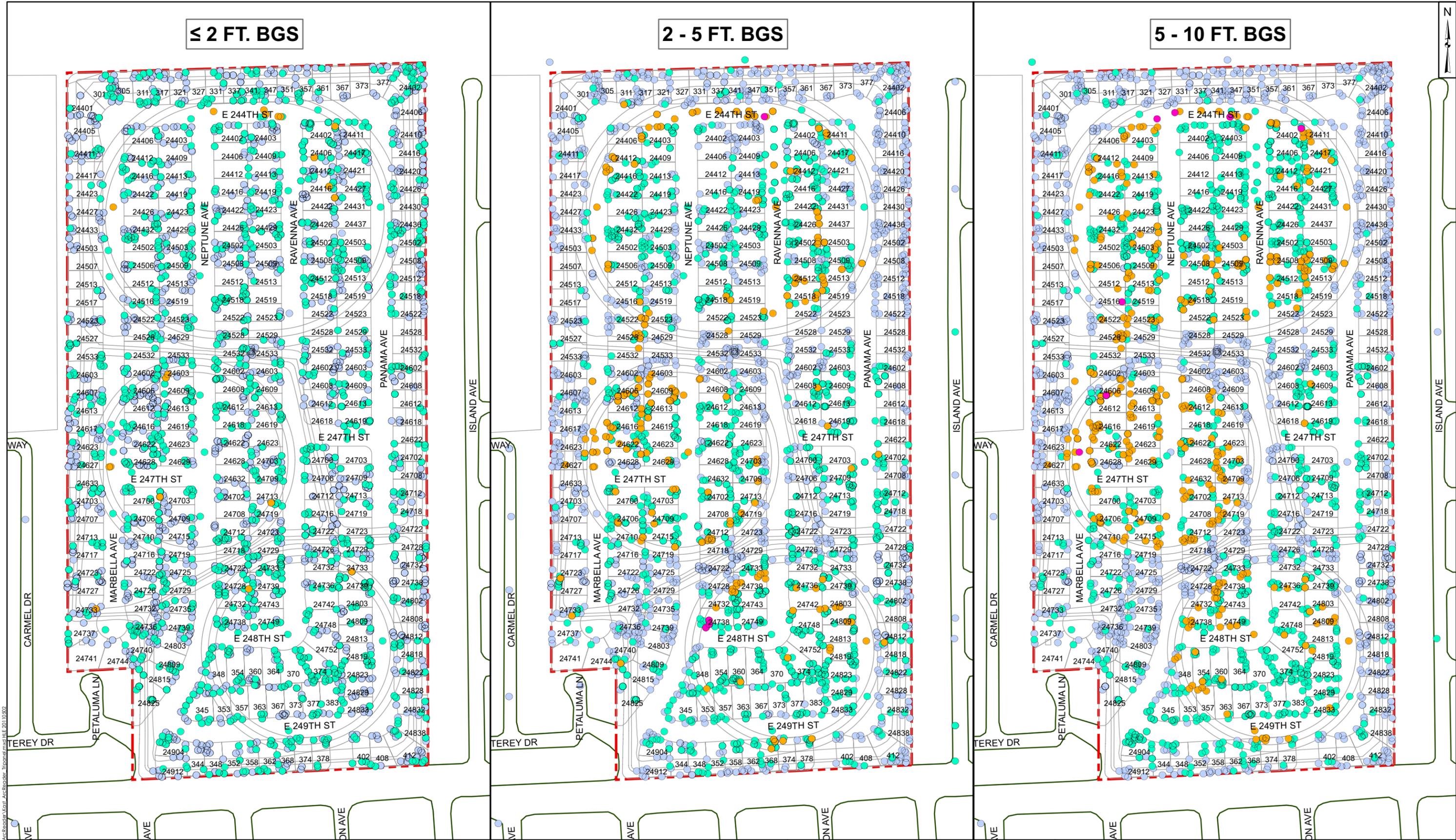
Figure

A-2

≤ 2 FT. BGS

2 - 5 FT. BGS

5 - 10 FT. BGS



- Non-Detect (ND)
- ≤ 500 mg/kg
- > 500 to 5000 mg/kg
- > 5000 mg/kg



Geosyntec
consultants

Santa Barbara, CA May 2011

Soil TPH as Gasoline Concentrations by Depth

Former Kast Property

Figure

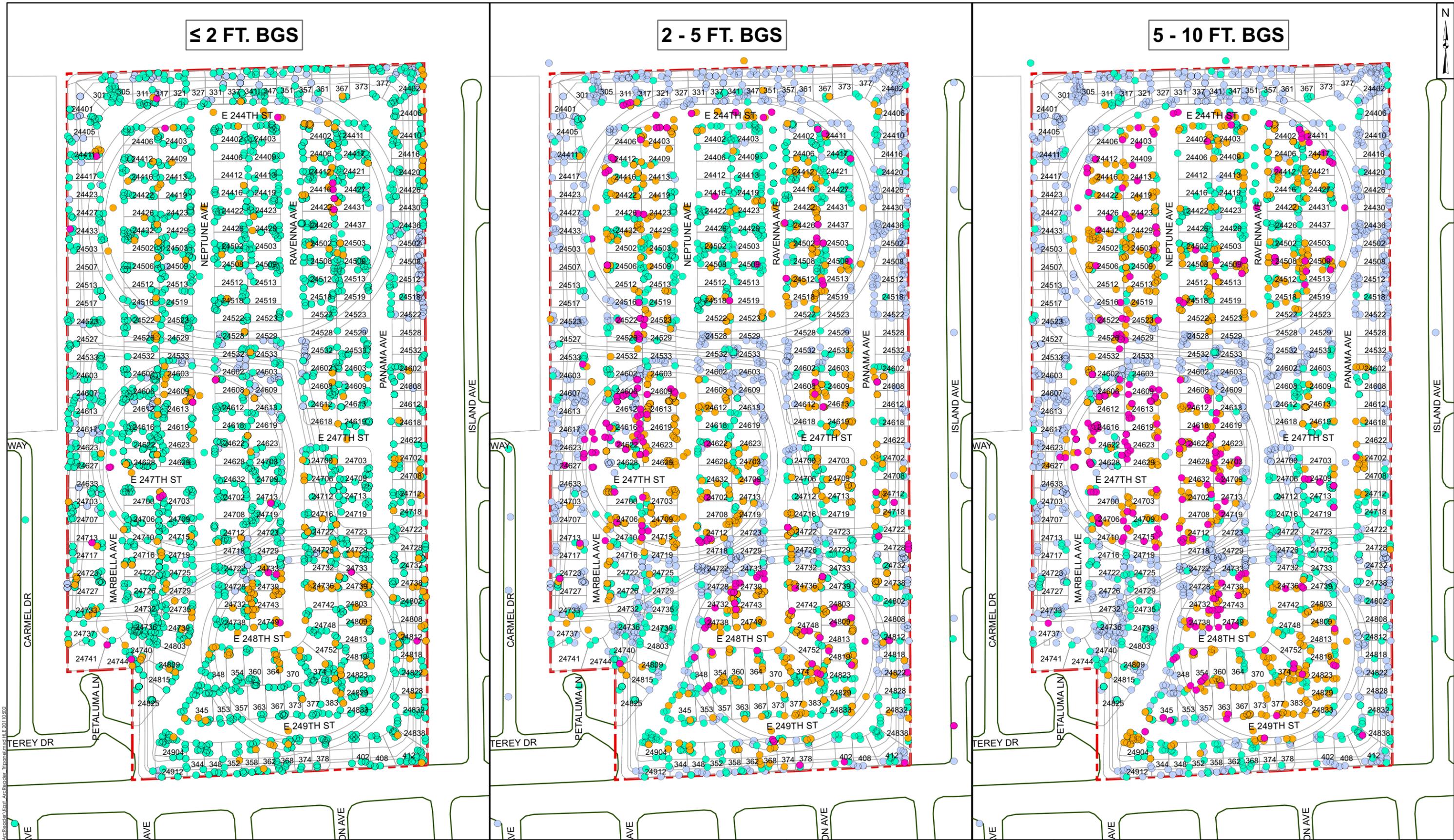
A-4

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≤ 2 FT. BGS

2 - 5 FT. BGS

5 - 10 FT. BGS



- Non-Detect (ND)
- ≤ 1000 mg/kg
- > 1000 to 10000 mg/kg
- > 10000 mg/kg



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consultants

Santa Barbara, CA

May 2011

Soil TPH as Diesel Concentrations by Depth

Former Kast Property

Figure

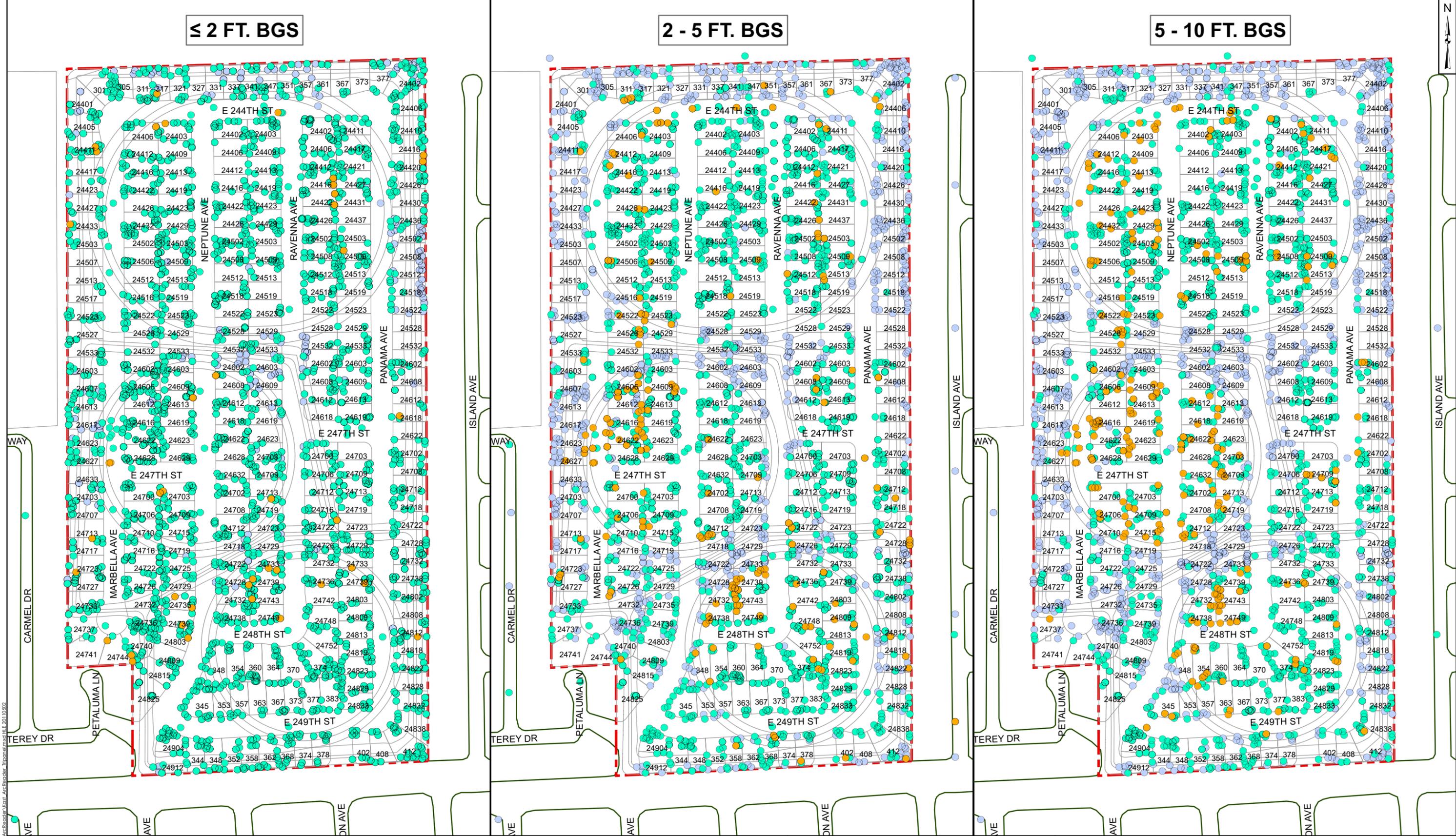
A-5

SoilBiosBar-011.Dobis-H.Gem.VacEstateProp.ArcRendered-10p01.mxd 10:52

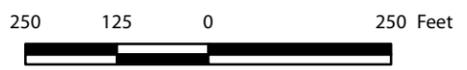
≤ 2 FT. BGS

2 - 5 FT. BGS

5 - 10 FT. BGS



- Non-Detect (ND)
- ≤ 10000 mg/kg
- > 10000 to 100000 mg/kg
- > 100000 mg/kg



Geosyntec
consultants

Santa Barbara, CA

May 2011

Soil TPH as Motor Oil Concentrations by Depth

Former Kast Property

Figure

A-6

SoilBiosBar-011.Dwg H:\Cm\Ac\Geosyntec\Map\Arc\Report\Map\Report.mxd 11/10/07

APPENDIX B

**SUMMARY OF POTENTIAL
PILOT TEST LOCATIONS**

APPENDIX B

SUMMARY OF POTENTIAL PILOT TEST LOCATIONS

B.1 LARGE UNSHORED EXCAVATION WITH SLOPED SIDEWALLS

The following properties or combinations of properties were identified as meeting the criteria described in Section 2.1 for pilot testing of large unshored excavations with sloped sidewalls. Inclusion of a property as a suitable candidate for a particular pilot test technique should not be interpreted as a recommendation that the technique is necessary, would be appropriate, or that it would ultimately be proposed for that property in the Remedial Action Plan. Criteria used for selecting potential properties for the pilot test are not intended as criteria for final remedies. Remedial approaches for specific properties and cleanup levels for the Site will be proposed in future submissions to the Regional Board, including the Remedial Action Plan, as required in Section 3.c. of the CAO. The criteria used to identify potential pilot test locations are intended for this purpose only and are not intended as criteria for final remedies. Locations of these properties are shown on Figure B-1.

- **24432 and 24502 Marbella Avenue** – These adjacent properties have front lawn areas that are contiguous and not separated by a driveway. In combination, the lawn area is approximately 46 feet wide and 33 to 37 feet deep and is large enough to pilot test a large unshored excavation. Both properties have a RI>1 but less than 10 for front yard samples; detected TPH concentrations are locally elevated with respect to 1996 RWQCB guideline cleanup levels. (Actual cleanup levels for the Site will be proposed after the pilot testing is complete and the Pilot Test Report has been approved by the Regional Board, in accordance with Section 3.c. of the CAO.) The properties are considered potentially viable for pilot testing because of their contiguous area.
- **24606 and 24612 Marbella Avenue** – These adjacent properties have front lawn areas that are contiguous and not separated by a driveway. In combination, the lawn area is approximately 40 feet wide and 30 to 36 feet deep and is large enough to pilot test a large unshored excavation. Both properties have a RI>10 for front yard samples, and detected TPH concentrations are elevated with respect to 1996 RWQCB guideline cleanup levels. Geotechnical reports by PSE indicate the reservoir base has been removed beneath these two properties, and the yard at 24606 Marbella has mature trees in the front yard, making these properties less suitable for pilot testing.
- **24612 and 24618 Neptune Avenue** – These adjacent properties have contiguous front yard lawn areas that are approximately 19 feet wide by 36 feet deep and 27 feet wide by 21 feet deep, respectively. In combination, these two properties do not have large enough yard areas to allow a large unshored excavation to 10 feet bgs with sloped sidewalls. If a front patio area can be removed, it would expand the depth of the front yard at 24618 Neptune to approximately 32 feet, making the combined yard area marginally suitable for a large unshored excavation. Soil samples from the front yards of both properties have a RI>10 and elevated TPH concentrations relative to RWQCB (1996) cleanup guidelines. Individually, either of these properties would be suitable for slot trenching or shored excavations using either slide-rail or trench-box shoring systems.
- **24728 and 24732 Neptune Avenue** – These adjacent properties have contiguous front yard lawn areas that are approximately 27 feet wide x 21 feet deep and 23 feet wide x 32 feet deep, respectively. In combination, the lawn area is approximately 50 feet wide and 21 to 32 feet deep and is large enough to pilot test a large unshored excavation. Soil samples from the front yards of both properties have a RI>10 and elevated TPH concentrations relative to RWQCB (1996)

cleanup guidelines. Individually, 24732 Neptune Avenue would be suitable for slot trenching or shored excavations using either slide-rail or trench-box shoring systems.

B.2 UNSHORED SLOT-TRENCH EXCAVATIONS

The following properties were identified as meeting the criteria described in Section 2.1 for pilot testing of unshored slot-trench excavations. As stated above, the criteria used to identify potential pilot test locations are intended for this purpose only and are not intended as criteria for final remedies. Locations of these properties are shown on Figure B-2.

- **374 248th Street** – This property has an irregularly shaped large front yard approximately 18 feet wide by 48 feet deep with a RI>10 for front yard samples. Detected TPH concentrations were elevated relative to 1996 RWQCB guideline cleanup levels.
- **368 249th Street** – This property has an irregularly shaped front yard with a RI>10 for front yard samples that would be suitable for testing a complex excavation configuration. TPH concentrations in select front yard samples exceed 1996 RWQCB guideline cleanup levels.
- **24416 Marbella Avenue** – The front yard is approximately 27 feet wide by 20 feet deep with a RI>10. Detected TPH concentrations were elevated relative to 1996 RWQCB guideline cleanup levels.
- **24616 Marbella Avenue** – This property has a front yard approximately 20 feet wide by 33 feet deep with a RI>10, and detected TPH concentrations were elevated relative to 1996 RWQCB guideline cleanup levels. The property is within the area where geotechnical reports by PSE state that the reservoir base was removed making it less suitable for pilot test excavation.
- **24628 Marbella Avenue** – This corner-lot property is not represented in litigation against Shell. The front yard is approximately 30 feet wide by 28 feet deep with a RI>1 but less than 10. Detected TPH concentrations in front yard soils exceed RWQCB (1996) guideline cleanup levels. The property is within the area where geotechnical reports by PSE state that a portion of the reservoir base was removed making it less suitable for pilot test excavation; however, the majority of soil borings advanced in both the front and back yards met refusal at depths ranging from 1.25 to 7.5 feet. The front yard would be suitable for pilot test excavations, and the property is a candidate for in-situ treatment testing. It was retained for consideration due to accessibility and potential for use for in-situ treatment testing.
- **24700 Marbella Avenue** – The front yard at this corner lot is approximately 28 feet wide by 28 feet deep, with a RI>10, and TPH concentrations are elevated with respect to 1996 RWQCB guideline cleanup levels. The location is within the area where geotechnical reports by PSE state that the reservoir base was removed making it less suitable for pilot test excavation.
- **24706 Marbella Avenue** – This property has a front yard that is approximately 16 feet wide by 37 feet deep with a RI>10 and TPH concentrations exceeding 1996 RWQCB cleanup guidelines. The yard is heavily vegetated and within the area where geotechnical reports by PSE state that the reservoir base was removed making it less suitable for pilot test excavation.
- **24612 Neptune Avenue** – This property has a front yard lawn area that is approximately 19 feet wide by 36 feet deep. Soil samples from the front yard have a RI>10 and elevated TPH concentrations relative to RWQCB (1996) cleanup guidelines.
- **24618 Neptune Avenue** – This property has a front yard lawn area that is approximately 27 feet wide by 21 feet deep. Soil samples from the front yard have a RI>10 and elevated TPH concentrations relative to RWQCB (1996) cleanup guidelines.

- **24622 Neptune Avenue** – The front yard of this property is approximately 17 feet wide by 36 feet deep, and soil samples have a RI>10 and TPH concentrations elevated relative to 1996 RWQCB cleanup guidelines.
- **24632 Neptune Avenue** – The front yard lawn area of this property is approximately 16 feet wide by 32 feet deep; samples from the front yard area have a RI>10 and elevated TPH concentrations relative to RWQCB (1996) guidance cleanup levels.
- **24702 Neptune Avenue** – This property has a front lawn area 18 feet wide by 20 feet deep with an RI>10 with TPH concentrations elevated relative to RWQCB (1996) guidance cleanup levels.
- **24718 Neptune Avenue** – The front yard at this property is L-shaped with an approximately 22-foot wide by 12-foot deep front section and a rear section that is approximately 11 feet wide and 25 feet deep. The RI for front yard soils is >10 and TPH concentrations are elevated relative to RWQCB (1996) guidance cleanup levels. This property is marginally suitable for pilot excavation as it is located along the edge of a former reservoir.
- **24732 Neptune Avenue** – The front yard lawn area of this property is approximately 23 feet wide by 32 feet deep; samples from the front yard area have a RI>10 and elevated TPH concentrations relative to RWQCB (1996) guidance cleanup levels.
- **24738 Neptune Avenue** – This corner-lot property has a front yard approximately 26 feet wide by 24 feet deep with an RI>10 and TPH concentrations elevated relative to RWQCB (1996) guidance cleanup levels. There is also a side yard along 248th Street that is approximately 8 feet wide by 50 feet long. Because the property is a corner lot at the intersection of Neptune and 248th Street, equipment could be staged on 248th Street; however, work at the intersection may be disruptive to access to the community, as Neptune Avenue is one of only two streets that access the neighborhood. It is therefore considered marginally suitable for pilot excavation.
- **24412 Ravenna Avenue** – The front yard of this property is L-shaped with a front portion approximately 26 feet wide and 14 feet deep and a rear portion that is approximately 16 feet wide and 18 feet deep with a RI>1 but less than 10. TPH concentrations are elevated with respect to 1996 RWQCB cleanup guidance.
- **24512 Ravenna Avenue** – The front yard lawn area at 24512 is approximately 20 feet wide by 32 feet deep and has an RI>10 with TPH concentrations elevated relative to 1996 RWQCB cleanup guidelines.
- **24736 Ravenna Avenue** – This property has an L-shaped front yard and lawn with a front portion that is approximately 27 feet wide and 14 feet deep and a rear portion that is approximately 19 feet wide and 16 feet deep. RI is >10 for front yard soil samples, and TPH concentrations are elevated with respect to 1996 RWQCB cleanup guidance.
- **24752 Ravenna Avenue** – This property is located at the outer corner of the intersection of Ravenna and 248th Street. The front yard area is irregularly shaped and ranges from approximately 10 to 25 feet wide by up to 42 feet deep. The RI is >10, and TPH concentrations are elevated relative to 1996 RWQCB cleanup guidelines. Engineering and Environmental Consulting, Inc. (EEC), consultants for plaintiffs' counsel, previously excavated a trench on this property and encountered stained hydrocarbon-impacted soils at depths below 2 feet bgs.

B.3 SLIDE-RAIL OR TRENCH-BOX SHORED EXCAVATIONS

The properties summarized below would be suitable for slide-rail or trench-box shored excavations. Some of these properties are also listed above as suitable for slot-trench excavations. As stated above, the

criteria used to identify potential pilot test locations are intended for this purpose only and are not intended as criteria for final remedies. Locations of these properties are shown on Figure B-3.

- **368 249th Street** – This property has an irregularly shaped front yard with a RI>10 for front yard samples that would be suitable for testing a complex excavation configuration. TPH concentrations in select front yard samples exceed 1996 RWQCB guideline cleanup levels.
- **24416 Marbella Avenue** – The front yard is approximately 27 feet wide by 20 feet deep with a RI>10. Detected TPH concentrations were elevated relative to 1996 RWQCB guideline cleanup levels.
- **24422 Marbella Avenue** – The front yard is approximately 18 feet wide by 20 feet deep with an RI>10 and detected TPH concentrations that exceed 1996 RWQCB guideline cleanup levels.
- **24616 Marbella Avenue** – This property has a front yard approximately 20 feet wide by 33 feet deep with a RI>10, and detected TPH concentrations were elevated relative to 1996 RWQCB guideline cleanup levels. This property is within the area where geotechnical reports by PSE state that a portion of the reservoir base was removed making it less suitable for pilot test excavation.
- **24628 Marbella Avenue** – This corner-lot property is not represented in litigation against Shell. The front yard is approximately 30 feet wide by 28 feet deep with a RI>1 but less than 10. TPH concentrations exceed RWQCB (1996) guideline cleanup levels. It is within the area where geotechnical reports by PSE state that a portion of the reservoir base was removed making it less suitable for pilot test excavation; however, the majority of soil borings advance in both the front and back yards met refusal at depths ranging from 1.25 to 7.5 feet. The front yard would be suitable for pilot test excavations and the property is a candidate for in-situ treatment testing.
- **24700 Marbella Avenue** – The front yard at this corner lot is approximately 28 feet wide by 28 feet deep, with a RI>10, and TPH concentrations are elevated with respect to 1996 RWQCB guideline cleanup levels. It is within the area where geotechnical reports by PSE state that the reservoir base was removed making it less suitable for pilot test excavation.
- **24612 Neptune** – This property has a front yard lawn area that is approximately 19 feet wide by 36 feet deep. Soil samples from the front yard have a RI>10 and elevated TPH concentrations relative to RWQCB (1996) cleanup guidelines.
- **24618 Neptune** – This property has a front yard lawn area that is approximately 27 feet wide by 21 feet deep. Soil samples from the front yard have a RI>10 and elevated TPH concentrations relative to RWQCB (1996) cleanup guidelines.
- **24622 Neptune** – The front yard of this property is approximately 17 feet wide by 36 feet deep, and soil samples have a RI>10 and TPH concentrations exceeding 1996 RWQCB guidance cleanup levels.
- **24732 Neptune Avenue** – The front yard lawn area of this property is approximately 23 feet wide by 32 feet deep; samples from the front yard area have a RI>10 and elevated TPH concentrations relative to RWQCB (1996) guidance cleanup levels.
- **24738 Neptune** – This corner-lot property has a front yard approximately 26 feet wide by 24 feet deep with an RI>10 and TPH concentrations elevated relative to RWQCB (1996) guidance cleanup levels. There is also a side yard along 248th Street that is approximately 8 feet wide by 50 feet long. Because the property is a corner lot at the intersection of Neptune and 248th Street, equipment could be staged on 248th Street; however, work at the intersection may be disruptive to access to the community, as Neptune Avenue is one of only two streets that access the neighborhood. It is therefore considered marginally suitable for pilot excavation.

- **24412 Ravenna** – The front yard of this property is L-shaped with a front portion approximately 26 feet wide and 14 feet deep and a rear portion that is approximately 16 feet wide and 18 feet deep with a RI>1 but less than 10. TPH concentrations are elevated with respect to 1996 RWQCB cleanup guidance.
- **24512 Ravenna** – The front yard lawn area at 24512 is approximately 20 feet wide by 32 feet deep and has an RI>10 with TPH concentrations elevated relative to 1996 RWQCB cleanup guidelines.
- **24736 Ravenna** – This property has an L-shaped front yard and lawn with a front portion that is approximately 27 feet wide and 14 feet deep and a rear portion that is approximately 19 feet wide and 16 feet deep. The RI is >10 for front yard soil samples and TPH concentrations are elevated with respect to 1996 RWQCB cleanup guidance.

B.4 PILOT TEST EXCAVATION IN REAR YARDS OF PROPERTIES

Properties identified for potential pilot test excavation in back yards of the residential lots are described below. As stated above, the criteria used to identify potential pilot test locations are intended for this purpose only and are not intended as criteria for final remedies. Locations of these properties are shown on Figure B-4.

- **24715 Neptune** – This property has a detached rear garage with a driveway providing access to the back yard. The back yard lawn area measures approximately 18 by 24 feet; samples from this area had a RI>10 and detected TPH concentrations above 1996 RWQCB cleanup guidelines. This property would be suitable for pilot text excavation in a back yard accessible to back-hoe excavation equipment for slot trenching or slide-rail shored excavation.
- **24406 Ravenna** – This property has front lawn approximately 35 feet wide by 14 feet deep and detached garage with back yard approximately 20 feet by 20 feet. RI is less than 1 in surface soils and 1.1 in surface and deep soils. Detected TPH concentrations are not significantly elevated with respect to 1996 RWQCB cleanup guidelines. The property would be suitable for test excavation in the rear yard by slot trenching or using slide-rail shoring, but does not meet target criteria.
- **24533 Ravenna** – This property has been identified for interim remedial action to address a single location in the back yard of the property where a RI of 260 was estimated due to presence of PAHs in soils at 2 and 5 feet bgs. Several samples from the back yard at this property had TPH concentrations above 1996 RWQCB guidance cleanup levels. This location has been identified for limited excavation to less than 10 feet bgs to evaluate the feasibility and effectiveness of conducting surgical excavations of small areas, including in back yards, for “hot spot” removal.
- **24619 Ravenna** – This property has a detached rear garage with a driveway that provides access to the back yard. The lawn area in the back yard is approximately 21 by 28 feet; samples collected from the back yard had a RI>10 and TPH concentrations above 1996 RWQCB guidance cleanup levels. This property would be suitable for pilot text excavation in a back yard accessible to back-hoe excavation equipment for slot trenching or slide-rail shored excavation.

**Table B-1
Potential Excavation Pilot Test Locations
Former Kast Property**

Property Information								Summary of Findings - Surface Soil (0 - 2 ft bgs)										Summary of Findings - Surface and Sub-Surface Soil (0 - 10 ft bgs)								
Property Address	Represented Party	Access Agreement Obtained	Within Reservoir Footprint?	Expanded Soil Sampling Conducted	Soil Sampling Date(s)	Refusal? # Borings w/ #Refusa/#Total	Max Boring Depth (ft)	Comments on Suitability for Pilot Testing or other Comments	Front Yard RI > 10?	Front Yard RI > 1?	Front Yard HI > 1?	Back Yard RI > 10?	Back Yard RI > 1?	Back Yard HI > 1?	Surface Soil RI	Surface Soil HI	Highest TPH as Gasoline	Highest TPH as Diesel	Highest TPH as Motor Oil	Depth with Max Surface TPH Concentration	Shallow & Deep Soil RI	Shallow & Deep Soil HI	Highest TPH as Gasoline	Highest TPH as Diesel	Highest TPH as Motor Oil	Depth with Max Surface and Sub-Surface TPH Concentration
331 244TH ST	Yes	No	Edge	Y	07/29/10	N/7	10	FY 26' wide x 18' deep. Suitable for med to lg excav or slot trench.	N	N	N	N	N	N	0.33	0.00074	0.099	100	610	0.5	0.55	0.0043	0.099	100	610	0.5
341 244TH ST	Yes	No	Edge	Y	06/28/10	N/12	10	FY 15' wide x 37' deep. Feasible for slot trench or lg excav if combined with adj property to E.	N	N	N	N	N	N	0.47	0.0017	0.16	170	460	0.5	0.55	0.0030	0.2	170	460	0.5
347 244TH ST	Yes	No	Edge	Y	06/22/10	N/8	10	FY 21' wide x 31' deep. Feasible for slot trench or larger excav if combined with adj property to W.	N	N	N	N	N	N	0.22	0.00013	0.096	280	1,100	2	0.27	0.00018	ND	36	110	10
351 244TH ST	Yes	Yes	Edge	Y	09/15/09 6/16/10	N/8	10	FY 20' wide x 17' deep with narrow extension to front of house. Suitable for slot trench only.	N	Y	Y	N	N	N	0.50	0.00024	0.21	830	2,500	0.5	4.2	0.064	0.21	6,600	15,000	3.5
357 244TH ST	Yes	No	Edge	Y	06/04/10	N/10	10	FY 20' wide x 30' deep. Suitable for med excav or slot trench.	N	N	N	N	N	N	0.52	0.00024	0.18	160	720	0.5	0.52	0.00024	0.18	160	720	0.5
361 244TH ST	Yes	Yes	Edge	Y	09/18/09 and 6/30/10	N/6	10	FY 19' wide x 18' deep. Suitable for med excav or slot trench.	N	N	N	N	N	N	0.29	0.00023	0.12	240	890	0.5	0.30	0.00025	0.12	240	890	0.5
374 248TH ST	Yes	No	Y	Y	11/03/10	Y, 2/25	10	Irregular FY avg 18' wide x 48' deep. Could do med sized excav or long slot trenches.	Y	Y	N	Y	Y	Y	4.4	0.067	0.74	5,300	5,900	2	150	0.60	590	36,000	59,000	4.5
353 249TH ST	Yes	No	Edge	Y	06/03/10	N/8	10	FY 22' wide x 25' deep. Could do med excav or slot trench.	N	N	N	Y	Y	N	0.90	0.00058	0.072	650	2,100	0.5	15	0.35	940	11,000	10,000	5
357 249TH ST	Yes	Yes	Edge	Y	05/26/10	Y, 1/7	10	FY 31' wide x 14' deep. Could do med excav.	N	N	N	Y	Y	N	10	0.0046	0.19	720	2,400	0.5	18	0.29	690	13,000	16,000	10
367 249TH ST	Yes	Yes	Y	Y	04/13/10	N/7	10	FY 16' wide x 17' deep. Could only do small excav.	N	Y	N	Y	Y	N	0.88	0.0003	ND	840	2,300	2	2.4	0.035	73	6,500	7,300	6
368 249TH ST	Yes	No	Edge	Y	11/29/10	Y,1/13	10	FY 26' wide x 12' deep front section and 16' wide x 27' deep rear section. Could test complex excav configuration.	Y	Y	N	Y	Y	Y	1.6	0.0024	1.2	1,300	3,500	2	63	0.58	1,800	16,000	20,000	3.5
24412 MARBELLA AVE	No	Yes	Y	Y	12/29/09 & 10/14/2010	Y,2/6	15	FY 17' wide x 26' deep; suitable for small excav.	N	Y	N	N	Y	Y	0.96	0.0057	0.71	1,900	3,400	2	11	0.24	3,000	20,000	21,000	5
24416 MARBELLA AVE	Yes	Yes	Y	Y	9/14/2010	Y, 7/10	10	FY 27' wide x 20' deep; suitable for med excav.	Y	Y	N	N	Y	Y	1.1	0.00071	0.61	480	1,000	2	51	0.50	4,000	17,000	16,000	10
24422 MARBELLA AVE	Yes	No	Y	Y	09/13/10	Y, 10/10	8.5	FY 18' wide x 20' deep; suitable for small excav.	Y	Y	N	N	Y	N	0.81	0.0014	0.17	2,400	3,800	2	15	0.24	950	13,000	17,000	7.5
24426 MARBELLA AVE	Yes	Yes	Y	N	09/17/09	Y, 2/2	5	FY 16' wide x 30' deep; suitable for small excav. May have fence.	N	N	N	N	Y	N	0.43	0.00027	ND	120	330	0.5	1.6	0.017	0.48	18,000	38,000	5
24432 MARBELLA AVE	Yes	No	Y	Y	10/27/10	Y, 13/13	8.5	FY 23' wide x 33' deep contiguous with FY to S. Good candidate for lg excav.	N	Y	N	N	Y	N	1.1	1.0E-02	230	2900	3500	2	8.6	1.00E-01	600	13000	16,000	7.5
24502 MARBELLA AVE	Yes	Yes	Y	Y	9/17/2010	Y, 10/10	8.5	FY 23' wide x 37' deep contiguous with FY to N; good candidate for lg excav.	N	Y	Y	N	Y	N	2.0	0.0059	0.89	2,100	3,500	2	4.5	0.10	760	7900	9,300	7
24516 MARBELLA AVE	Yes	Yes	Y	Y	05/25/10	Y, 5/8	10	FY 19' wide x 23' deep; suitable for med excav.	N	N	N	Y	Y	Y	3.2	0.0068	0.11	1,200	3,700	0.5	80	1.2	5,500	23,000	21,000	10
24522 MARBELLA AVE	Yes	Yes	Edge	Y	4/28/2010 & 9/21/2010	N/6	10	FY 16' wide x 38' deep. Suitable for slot trenching.	N	Y	N	Y	Y	N	0.76	0.0024	160	8,600	9,300	2	23	0.36	2,000	32,000	31,000	10
24606 MARBELLA AVE	Yes	Yes	Edge	Y	04/19/10, 8/25/10	N/14	10	FY 20' wide x 30' deep and is contiguous with FY to S. Const records show base may have been removed.	Y	Y	N	Y	Y	N	0.24	0.00039	0.26	980	1,900	2	49	0.94	2,700	25,000	28,000	10
24612 MARBELLA AVE	Yes	Yes	Y	Y	08/10/10	Y, 7/14	10	FY 20' wide x 36' deep and is contiguous with FY to N. Const records show base may have been removed.	Y	Y	Y	Y	Y	N	1.6	0.0043	0.082	7,200	9,500	2	43	0.90	5,700	27,000	26,000	5

**Table B-1
Potential Excavation Pilot Test Locations
Former Kast Property**

Property Information								Summary of Findings - Surface Soil (0 - 2 ft bgs)										Summary of Findings - Surface and Sub-Surface Soil (0 - 10 ft bgs)								
Property Address	Represented Party	Access Agreement Obtained	Within Reservoir Footprint?	Expanded Soil Sampling Conducted	Soil Sampling Date(s)	Refusal? # Borings w/ #Refusal/#Total	Max Boring Depth (ft)	Comments on Suitability for Pilot Testing or other Comments	Front Yard RI > 10?	Front Yard RI > 1?	Front Yard HI > 1?	Back Yard RI > 10?	Back Yard RI > 1?	Back Yard HI > 1?	Surface Soil RI	Surface Soil HI	Highest TPH as Gasoline	Highest TPH as Diesel	Highest TPH as Motor Oil	Depth with Max Surface TPH Concentration	Shallow & Deep Soil RI	Shallow & Deep Soil HI	Highest TPH as Gasoline	Highest TPH as Diesel	Highest TPH as Motor Oil	Depth with Max Surface and Sub-Surface TPH Concentration
24616 MARBELLA AVE	Yes	No	Y	Y	04/21/10, 8/23/10	Y, 7/12	10	FY 20' wide x 33' deep and contiguous with yard to S. Const records show base may have been removed.	Y	Y	N	Y	Y		2.4	0.039	0.49	8,600	8,700	2	51	0.95	3,300	39,000	39,000	10
24622 MARBELLA AVE	Yes	No	Y	Y	05/27/10	Y, 9/14	10	FY 31' wide x 14' deep and contiguous with yard to N. Const records show base may have been removed.	Y	Y	Y	Y	Y	N	0.54	0.00084	0.23	480	1,100	2	72	1.4	2,800	30,000	33,000	5
24628 MARBELLA AVE	No	No	Y	Y	12/02/10	Y, 12/17	10	FY 30' wide x 28' deep. Corner lot owned by S. Malchiewski; available for lease. Const records show base may have been removed. Suitable for lg excav.	N	Y	N	Y	Y	N	0.82	0.10	1	1,700	4,800	2	29	0.69	2,300	36,000	42,000	10
24700 MARBELLA AVE	Yes	Yes	Y	Y	06/07/10	Y, 8/11	10	FY 28' wide x 28' deep; corner lot. Large palm trees. Const records show base may have been removed. Suitable for lg excav.	Y	Y	N	N	Y	N	5.6	0.12	1,100	12,000	14,000	0	23	0.68	1,400	19,000	17,000	10
24706 MARBELLA AVE	Yes	No	Y	Y	11/05/10	Y, 7/9	10	FY 16' wide x 37' deep and heavily vegetated. Const records show base may have been removed.	Y	Y	N	Y	Y	N	0.61	0.0012	0.43	360	1300	2	25	0.55	2400	20000	17000	10
24716 MARBELLA AVE	Yes	Yes	Edge	Y	06/30/10	N/8	10	FY 16' wide x 38' deep. Const records show base may have been removed. Suitable for slot trench excav.	N	Y	N	Y	Y	N	Soil sampled, but not yet reported. Not a candidate.		160	1800	2200	2			3400	17000	14000	10
24406 NEPTUNE AVE	Yes	Yes	Y	Y	04/26/10	Y, 5/5	8	FY 31' wide x 15' deep. Suitable for med excav.	N	N	N	N	N	N	0.20	0.0033	0.059	520	1,100	2	1.2	0.041	270	2,400	2,600	8
24422 NEPTUNE AVE	Yes	Yes	Y	Y	09/17/09 & 7/7/10	Y, 1/9	10	FY 20' wide x 33' deep and contiguous with yard to S. Suitable for lg excav in combination w/adj property to S.	N	Y	N	N	Y	N	0.39	0.00054	ND	680	1700	2	2.4	0.011	210	3,200	4,500	10
24426 NEPTUNE AVE	Yes	Yes	Y	Y	09/16/09 & 6/25/10	N/6	10	FY 20' wide x 19' deep and contiguous with yard to N. Suitable for lg excav in combination w/adj property to N.	N	N	N	N	N	N	0.29	0.00041	0.22	110	530	0.5	1.1	0.0032	2.1	3,500	9,500	10
24502 NEPTUNE AVE	Yes	Yes	Y	Y	09/22/09	N/13	10	FY L-shaped 26' wide x 14' deep in front and 14' wide x 27' deep in rear. Good candidate for slot trench.	N	Y	N	N	N	N	0.19	0.000024	ND	850	2,300	0.5	0.43	0.0012	0.92	850	2,300	0.5
24518 NEPTUNE AVE	No	No	Y	Y	07/21/10	Y, 2/11	10	FY 14' wide x 40' deep. Has row of hedges(?). Suitable for slot trench.	N	Y	N	N	Y	N	0.92	0.00088	0.24	1,500	4,000	2	10	0.31	1,500	15,000	17,000	10
24522 NEPTUNE AVE	Yes	Yes	Y	Y	04/13/10	N/7	10	FY 22' wide x 20' deep. Suitable for med excav.	N	Y	N	N	Y	N	0.16	0.00029	0.1	150	740	-0.5	6.2	0.078	670	5800	9700	5
24602 NEPTUNE AVE	Yes	No	Edge	Y	07/22/10	Y, 1/9	10	FY 38' wide x 12' deep; suitable for sm excav or slot trench. BY 28' wde x 30' deep and accessible by driveway. Suitable for lg BY excav but RI<1.	N	N	N	N	N	N	0.12	0.00015	0.34	120	500	0.5	0.12	0.00015	0.34	120	500	0.5

**Table B-1
Potential Excavation Pilot Test Locations
Former Kast Property**

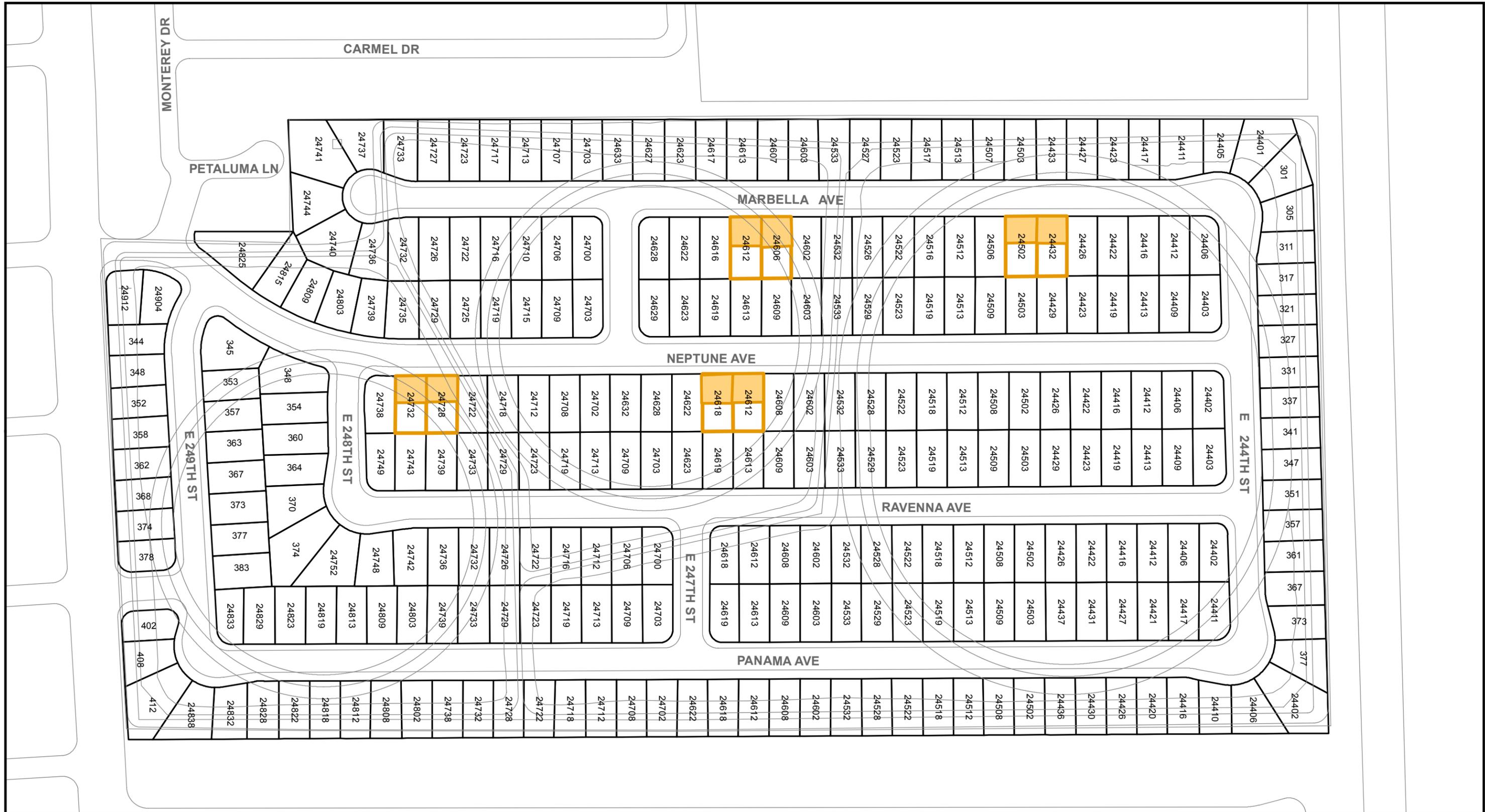
Property Information														Summary of Findings - Surface Soil (0 - 2 ft bgs)						Summary of Findings - Surface and Sub-Surface Soil (0 - 10 ft bgs)						
Property Address	Represented Party	Access Agreement Obtained	Within Reservoir Footprint?	Expanded Soil Sampling Conducted	Soil Sampling Date(s)	Refusal? # Borings w/ #Refusa/#Total	Max Boring Depth (ft)	Comments on Suitability for Pilot Testing or other Comments	Front Yard RI > 10?	Front Yard RI > 1?	Front Yard HI > 1?	Back Yard RI > 10?	Back Yard RI > 1?	Back Yard HI > 1?	Surface Soil RI	Surface Soil HI	Highest TPH as Gasoline	Highest TPH as Diesel	Highest TPH as Motor Oil	Depth with Max Surface TPH Concentration	Shallow & Deep Soil RI	Shallow & Deep Soil HI	Highest TPH as Gasoline	Highest TPH as Diesel	Highest TPH as Motor Oil	Depth with Max Surface and Sub-Surface TPH Concentration
24608 NEPTUNE AVE	Yes	Yes	Y	Y	04/01/10 & 7/7/10	N/7	10	FY 16' wide x 32' deep; suitable for med excav or slot trenching.	N	Y	N	N	Y	N	1.6	0.062	430	13,000	13,000	0.5	9.0	0.33	1,100	13,000	13,000	0.5
24612 NEPTUNE AVE	Yes	Yes	Y	Y	11/09/10	Y, 6/9	10	FY 19' wide x 36' deep and contiguous w/prop to S. Suitable for med excav or slot trench, or lg excav in combination w/adj property to S	Y	Y	N	Y	Y	N	0.3	0.0012	0.29	160	570	0.5	16	0.46	1600	20000	19000	10
24618 NEPTUNE AVE	Yes	Yes	Y	Y	05/17/10, 9/3/10	Y, 7/7	7	FY 27' wide x 21' deep and contiguous w/prop to N. Suitable for lg excav individually or in combination w/adj property to N.	Y	Y	N	N	Y	N	0.84	0.0014	0.19	690	1,800	2	16	0.43	460	13,000	11,000	6.5
24622 NEPTUNE AVE	Yes	Yes	Y	Y	04/14/10	Y, 3/8	8	FY 17' wide x 36' deep and contiguous w/prop to S. Suitable for lg excav or slot trench individually or in combination w/adj property to S.	Y	Y	N	Y	Y	N	0.80	0.00097	0.057	38	190	0.5	37	0.29	800	11,000	14,000	7
24628 NEPTUNE AVE	Yes	No	Y	Y	10/25/10	Y, 4/4	8	FY 28' wide x 20' deep and contiguous w/prop to N. Suitable for lg excav or slot trench individually or in combination w/adj property to N.	N	Y	N	N	N	N	0.35	0.00043	ND	250	970	2	7.0	0.096	680	13,000	13,000	7.5
24632 NEPTUNE AVE	Yes	Yes	Y	Y	10/01/09 & 7/15/10	Y, 5/5	8.5	FY 16' wide x 32' deep; suitable for med excav or slot trench.	Y	Y	N	Y	Y	N	0.29	0.00016	0.36	260	700	2	27	0.52	520	14,000	14,000	8.5
24702 NEPTUNE AVE	No	No	Y	Y	10/05/10	Y, 11/11	8.5	FY 18' wide x 20' deep and contiguous w/prop to S. Suitable for med excav or lg excav in combination w/adj property to S (not investigated).	Y	Y	N	Y	Y	N	0.75	0.00072	0.13	360	1,100	2	21	0.34	830	25,000	30,000	5
24715 NEPTUNE AVE	Yes	No	Y	Y	04/23/10, 9/7/10	Y, 8/8	10	Water main in FY. Detached garage in rear. BY lawn area 18' by 24'. Would be suitable for BY excav by slot trench or slide-rail shored excav.				Y	Y		4.8	0.0063	0.087	340	1,500	0.5	59	0.73	2,200	18,000	19,000	10
24718 NEPTUNE AVE	Yes	Yes	Edge	Y	09/02/10	N/14	10	FY L-shaped 22' wide x 12' deep in front and 11' wide x 25' deep in rear. Good candidate for slot trench.	Y	Y	Y	N	N	N	1.2	1.2E-03	0.54	5100	8600	2	21	1.30E+00	3400	20000	20,000	5
24722 NEPTUNE AVE	Yes	No	Edge	Y	07/21/10	N/10	10	FY 17' wide x 37' deep. Good candidate for slot trench.	N	N	N	N	N	N	0.25	0.00059	0.11	140	440	0.5	0.29	0.00067	0.11	140	440	0.5
24728 NEPTUNE AVE	Yes	No	Edge	Y	05/12/10	N/8	10	FY 27' wide x 21' deep and contiguous w/prop to S. Suitable for lg excav individually or in combination w/adj property to S.	N	N	N	Y	Y	N	4.3	0.049	660	8,100	11,000	0.5	22	0.21	1,400	10,000	12,000	5
24732 NEPTUNE AVE	Yes	No	Edge	Y	09/16/10	N/10	10	FY 23' wide x 32' deep and contiguous w/prop to N. Suitable for lg excav individually or in combination w/adj property to N.	Y	Y	Y	Y	Y		1.3	0.0031	0.51	1,200	3,000	2	110	1.5	3600	31,000	40,000	10
24738 NEPTUNE AVE	Yes	Yes	Y	Y	09/21/09	N/14	10	Corner lot; FY 26' wide x 24' deep. Side yard along 248th 8' wide x 50' deep. Suitable for lg excav or slot trench.	Y	Y	Y	Y	Y	Y	1.3	0.0076	ND	1,000	3,700	0.5	16	0.36	3,200	21,000	12,000	15
24406 RAVENNA AVE	No	No	Y	Y	12/06/10	Y, 6/7	10	FY 35' wide x only 14' deep. Has detached garage; BY accessible and is ~20x20'. Suitable for med excav in FY or BY.	N	N	N	N	N	N	0.49	0.00044	0.14	1,200	3,200	0.5	1.2	0.020	16	5,300	7,300	10
24412 RAVENNA AVE	Yes	No	Y	Y	07/13/10	Y, 5/13	10	Front portion of FY is 26' wide x 14' deep; rear portion of FY is 16' wide x 18' deep. Suitable for med excav or L-shaped excav.	N	Y	N	N	Y	N	4.7	0.069	750	7200	6500	2	9.1	0.23	1400	12000	18,000	9.5

**Table B-1
Potential Excavation Pilot Test Locations
Former Kast Property**

Property Information								Summary of Findings - Surface Soil (0 - 2 ft bgs)										Summary of Findings - Surface and Sub-Surface Soil (0 - 10 ft bgs)								
Property Address	Represented Party	Access Agreement Obtained	Within Reservoir Footprint?	Expanded Soil Sampling Conducted	Soil Sampling Date(s)	Refusal? # Borings w/ #Refusa/#Total	Max Boring Depth (ft)	Comments on Suitability for Pilot Testing or other Comments	Front Yard RI > 10?	Front Yard RI > 1?	Front Yard HI > 1?	Back Yard RI > 10?	Back Yard RI > 1?	Back Yard HI > 1?	Surface Soil RI	Surface Soil HI	Highest TPH as Gasoline	Highest TPH as Diesel	Highest TPH as Motor Oil	Depth with Max Surface TPH Concentration	Shallow & Deep Soil RI	Shallow & Deep Soil HI	Highest TPH as Gasoline	Highest TPH as Diesel	Highest TPH as Motor Oil	Depth with Max Surface and Sub-Surface TPH Concentration
24416 RAVENNA AVE	Yes	Yes	Y	Y	09/18/09 and 7/22/10	Y, 8/11	10	FY 15' wide x 38' deep; has a block wall fence separating front & rear portions. Suitable for slot trench.	N	Y	N	Y	Y	N	18	0.28	550	23,000	29,000	1.5	18	0.29	550	23,000	29,000	1.5
24422 RAVENNA AVE	Yes	No	Y	Y	01/12/11	N/7	10	FY 19' wide by 10' deep. Suitable for small excav only.	N	Y	N	Y	Y	N	13	4.70E-01	800	18000	19000	2	13	4.70E-01	800	18000	19,000	2
24502 RAVENNA AVE	Yes	Yes	Y	Y	04/08/10 & 10/7/2010	Y, 1/10	10	Front portion of FY is 26' wide x 15' deep; rear portion of FY is 14' wide x 26' deep. Has fence separating. Suitable for med excav or L-shaped excav.	N	N	N	Y	Y	N	1.1	0.00071	0.47	1,100	2,500	2	15	0.46	1,700	17,000	16,000	5
24512 RAVENNA AVE	Yes	No	Y	Y	1/7/2011 & 1/11/11	Y, 1/12	10	FY 20' wide x 32' deep; contiguous w/ FY in prop to S. Suitable for med excav or slot trench individually or lg excav in combination w/ prop to S.	Y	Y	N	N	Y	N	0.43	3.00E-03	0.28	210	620	2	25	5.30E-01	3100	11000	15,000	4.5
24518 RAVENNA AVE	Yes	No	Y	Y	04/22/10, 8/23/10	N/6	10	FY 19' wide x 20' deep; contiguous w/ FY in prop to N. Suitable for med excav or slot trench individually or lg excav in combination w/ prop to N.	N	Y	N	N	Y	N	0.34	0.00038	0.12	200	610	2	7.7	0.23	1,000	10,000	9,900	3.5
24522 RAVENNA AVE	Yes	No	Y	Y	10/29/10	N/8	10	FY 19' wide x 20' deep. Suitable for sm excav or slot trench.	N	Y	N	N	Y	N	0.45	0.00079	0.12	270	680	0.5	8.6	0.18	2,200	8,800	8,400	10
24533 RAVENNA AVE	Yes	No	Edge	Y	9/1/2010 10/20/10	N/15	10	Water main in FY. BY 28' wide x 21' deep. Conduct small excav in BY to remove impacted soil as IRM at boring SBC and eval small, BY surgical excav.	N	N	N	Y	Y	Y	260	0.15	0.098	3600	9800	2	260	0.15	0.16	3600	9,800	5
24619 RAVENNA AVE	Yes	No	Y	Y	08/26/10	N/8	10	Water main in FY. Has detached rear garage and BY lawn area 21' x 28'. Would be suitable for slot trench or slide-rail excav in BY.				Y	Y		0.61	0.00094	1.2	170	520	0.5	30	0.43	1,100	18,000	20,000	10
24732 RAVENNA AVE	Yes	No	Edge	Y	10/07/10	Y, 3/11	10	FY 22' wide x 33' deep. Suitable for med excav or slot trenching.	N	Y	N	N	N	N	1.6	0.0021	1.9	2,600	3,600	0.5	2.3	0.049	190	4,300	6,200	5
24736 RAVENNA AVE	Yes	No	Y	Y	04/27/10, 9/10/10	Y, 4/8	10	FY L-shaped. Front portion 27' wide x 14' deep; rear portion 19' wide x 16' deep. Suitable for med excav or L-shaped excav.	Y	Y	N	N	Y	N	9.8	0.11	270	10,000	13,000	0.5	19	0.49	700	23,000	21,000	3
24752 RAVENNA AVE	Yes	Yes	Y	Y	03/31/10 & 1/28/11	N/9	10	FY irregular, 10-25' wide x max 42' deep. EEC prev. excav trench in FY. Suitable for med excav or lg slot trenching.	Y	Y	N	N	Y	Y	1.7	0.00059	1.9	1,200	2,800	2	21	0.48	950	14,000	16,000	3
															unitless	unitless	mg/kg	mg/kg	mg/kg	ft	unitless	unitless	mg/kg	mg/kg	mg/kg	ft

No soil boring data in database; not sampled or data not received.
 Sampled but not reported; not a candidate.
 Property potentially suitable for pilot test excavation in front yard.
 Property potentially suitable for pilot test excavation in back yard.
 Property available for pilot testing but does not meet RI criteria for front yard samples
 40-yr old 6" CWSC water main located in front yard 3-4' from curb line. No planned pilot test excavation in yards with water main due to concern over breaking water main and resulting impacts on water distribution system for community.

RI ≥ 1 to 9.9
 RI ≥ 10 to 99
 RI ≥ 100 to 999
 RI and HI in front vs back yard of property.

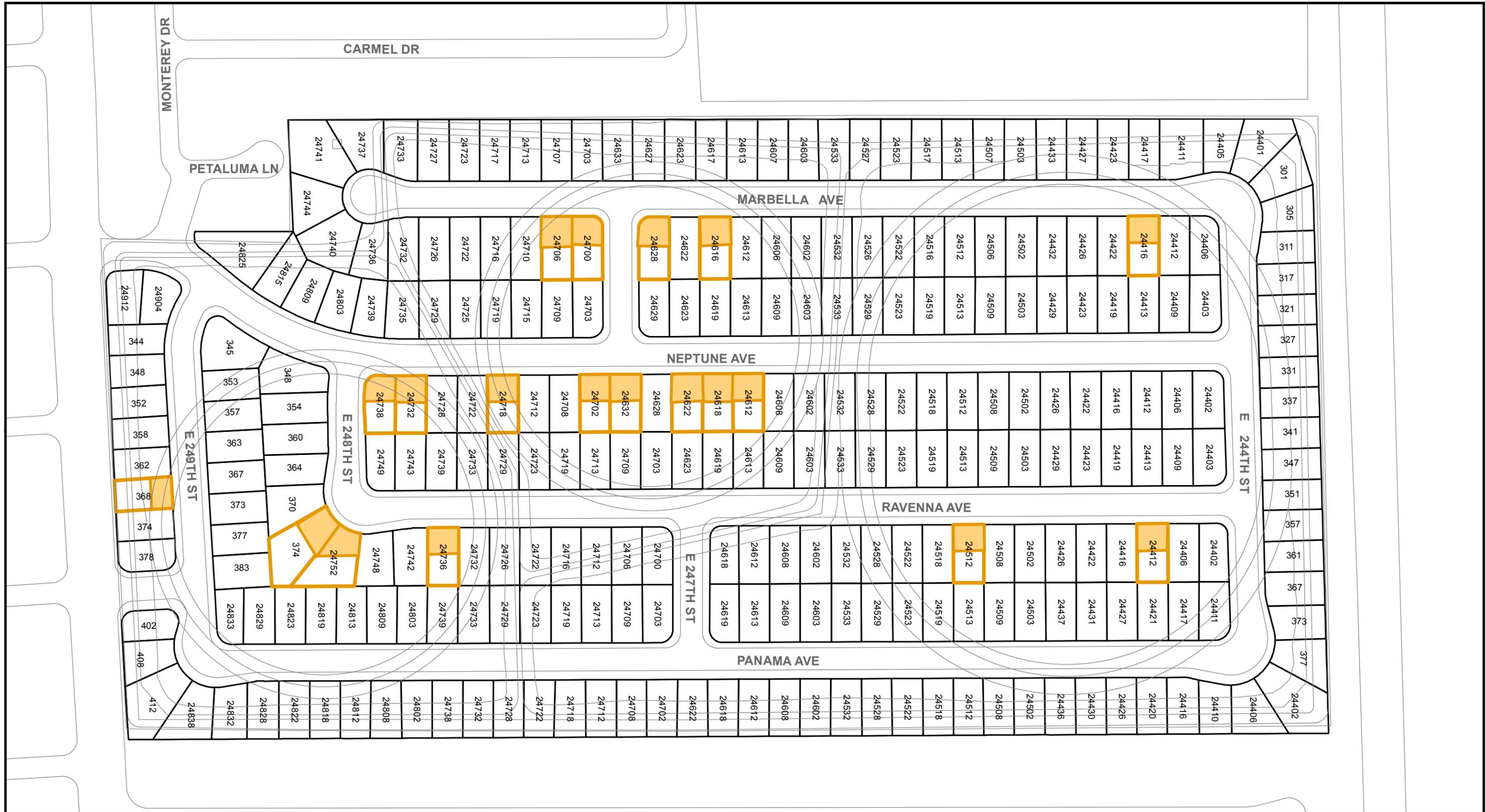


EXPLANATION
 [Black Outline] Kast Property [Orange Outline] Pilot Test Locations



**B-1 Potential Pilot Test Locations
 Large Unshored Excavation with Sloped Sidewalls**

May 10, 2011



EXPLANATION

- Kast Property
- Pilot Test Locations

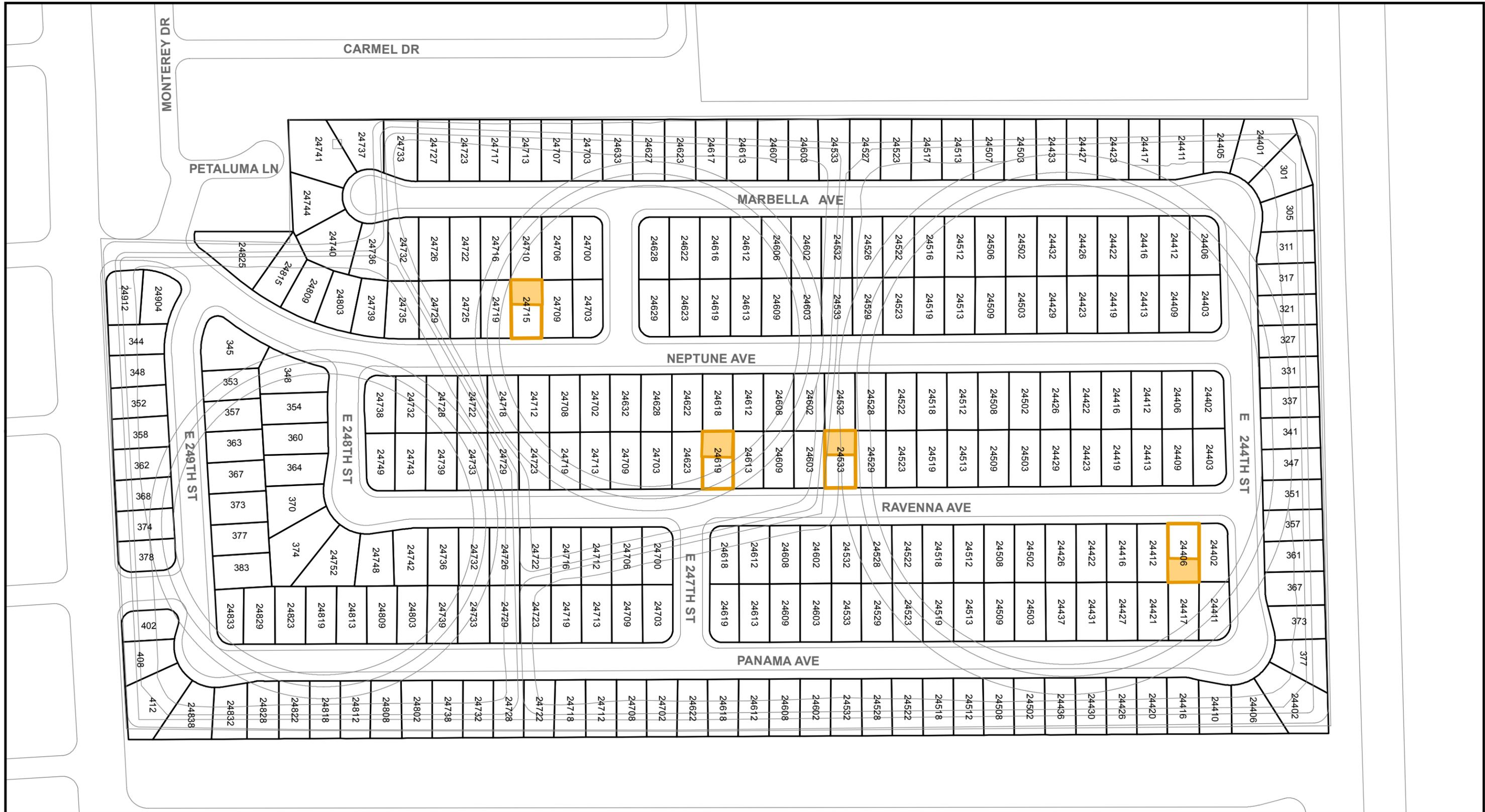


100 50 0 100 Feet

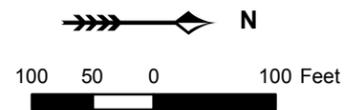


**B-2 Potential Pilot Test Locations
Unshored Slot-Trench Excavations**

May 10, 2011



EXPLANATION
 □ Kast Property □ Pilot Test Locations



**B-4 Potential Pilot Test Excavation
 in Rear Yards of Properties**

May 10, 2011

APPENDIX C

ISCO BACKGROUND

AND

SITE SPECIFIC FEASIBILITY EVALUATION

APPENDIX C

ISCO BACKGROUND AND SITE-SPECIFIC FEASIBILITY EVALUATION

C.1 IN-SITU CHEMICAL OXIDATION BACKGROUND

ISCO has the potential advantages in suitable site conditions of achieving relatively rapid and complete treatment of site COCs and has been shown to destroy TPH and VOCs (ITRC, 2005). General feasibility and design challenges relate to: 1) ensuring that the oxidation reactions will achieve an adequate level of treatment; and 2) that the oxidant can be effectively distributed across the entire target treatment zone. An evaluation of the applicability of various oxidant and delivery alternatives is provided herein.

C.2 FINDINGS FROM THE SVE PILOT TEST RELATIVE TO EVALUATION OF ISCO TECHNOLOGY

Soil properties including effective permeability, hydraulic conductivity and soil moisture content were reviewed and are summarized below. In addition, soil vapor extraction rates and observed vacuum influence away from the extraction wells were also evaluated and are discussed below.

Soil physical properties were measured for the Addendum to the Interim Remedial Action Plan (IRAP) Further Site Characterization Report and SVE Pilot Test Work Plan, and the SVE Pilot Test Report (URS, 2010b and 2010c). Measured soil properties were similar in both the IRAP and SVE pilot testing. Soils in the target depth interval (zero to 10 feet bgs) generally consist of sandy silts with grain size ranging from 0.012 mm to 0.207 mm. Total silt and clay content varies widely (10-90%). Soil grain sizes tend to increase with depth although variation in soil texture is observed throughout the target depth interval. The relatively fine-grained nature of the shallow site soils may limit the effectiveness of ISCO, particularly liquid oxidants; thus there is a need for pilot testing. The following table summarizes soil parameters from samples collected during IRAP and SVE pilot test activities.

Shallow Soil Properties (0 to 14 ft bgs) ¹

Soil Property	Unit	Range of Values
Median Grain Size	Millimeters	0.012 to 0.207
Effective Permeability to Water	Millidarcy	0.30 to 631
Hydraulic Conductivity	centimeters per second	3.03E-07 to 7.17E-04
Total organic carbon	milligrams per kilogram	870 to 33,700
Moisture content	percent by weight	9.6 to 29.7
Total Porosity	percent bulk volume	32.9 to 50.0
Air-Filled Porosity	percent bulk volume	3.6 to 31.1
Pore Fluid Saturation (Water)	percent pore volume	26.3 to 82.8
Pore Fluid Saturation (NAPL)	percent pore volume	0.5 to 21.4

¹ From Addendum to the IRAP Further Site Characterization Report and SVE Pilot Test Work Plan and SVE Pilot Test Report (Section 4.1.4) (URS, 2010b & 2010c).

Soil vapor extraction tests were performed at various levels of applied vacuum to estimate the approximate radius of influence (ROI) that can be expected from this technology as a future remedy. Soil permeability to air flow estimates were reviewed to evaluate if gas (e.g. ozone) injection may be viable (Section 7.1.8). Extraction rates and vacuums were also reviewed and are summarized in the table below.

Vacuum extraction testing was conducted in the vapor extraction wells (VEWs) along the western, northern and eastern portions of the Site. The estimated effective ROI in the shallow zone (wells screened from 5 to 10 feet bgs, Zone A) ranged from 24 to 78 feet with an average ROI of 50 feet. Deeper depth intervals were generally more permeable. In general, soil permeability greater than 1.0 darcy was associated with SVE viability. Soil permeability ranged from 0.99 to 8.7 darcy in the ISCO target zone (depth zone A – shallow soils).

Shallow Soil Properties (0 to 14 ft bgs) ²

Applied Vacuum (in of WC)	Flow rate (SCFM)	Effective ROI (ft)	Soil Permeability to Air Flow (darcy)
163	22	24	1.0
136	121	78	8.7
218	29	46	0.99

Pilot testing concluded that SVE extraction rates of up to 58 scfm may be achieved in the ISCO target depth interval (zone A). As a result, gas injection and distribution may be viable under pressure (Section 7.1.8). This Work Plan will describe additional pilot testing to evaluate the effectiveness of a gas phase oxidant such as ozone.

C.3 PRELIMINARY TECHNOLOGY ASSESSMENT

The key factors for the evaluation of ISCO at a particular site include:

- Geologic conditions that control the delivery of the oxidant to the impacted media;
- Rate of consumption of oxidant in the subsurface; and
- Oxidant dosage needed to achieve the remedial objectives.

In-situ remediation typically requires that an amendment, in this case an oxidant, is delivered to the impacted media. The efficiency and uniformity of the delivery of the amendment strongly affects the performance of in-situ remediation technologies. Geologic conditions, such as the permeability of the soil relative to the fluid injected and the variability in soil texture, are important variables that influence effectiveness and costs. Geologic conditions influence ISCO design variables including: well spacing, injection rates and pressure.

Oxidant consumption rates in the presence of soils can have half-lives ranging from seconds to weeks. Oxidants react with a broad range of soil constituents including soil humic matter and reduced metals

² From Addendum to the IRAP Further Site Characterization Report and SVE Pilot Test Work Plan and SVE Pilot Test Report (Section 4.1.4) (URS, 2010b & 2010c).

such as iron and manganese, in addition to target COCs. As a result, oxidant consumption rates are highly site-specific and difficult to estimate by indirect methods. Oxidant reaction rates are typically second order, meaning the observed oxidant consumption rate is dependent on the concentration of oxidant. This implies that as oxidant is consumed, the reaction rate decreases and therefore oxidant reaction rates vary with time. However, in practice oxidant is typically delivered in excess as compared to the target compounds to be treated such that pseudo-first order rates are typically estimated at the bench-scale to support ISCO designs.

Successful ISCO requires delivery of an adequate dose of oxidant to the impacted interval. Dose is typically expressed as a soil oxidant demand (SOD) with units of grams of oxidant per kilogram of soil. An SOD value is associated with a time interval, such as five days. For some oxidants, such as hydrogen peroxide, the SOD may essentially be infinite, i.e., the SOD equals the applied oxidant dose. Because oxidant reactivity is second order, the SOD measured is not a fixed value for a geologic media or site. In the unsaturated zone, the surface area of the soil and the water saturation also influence the observed SOD. To address these issues, bench-scale testing is typically performed to support design and multiple injection events or continuous injection of oxidant is usually performed to sustain the ISCO process until remedial goals are achieved.

The ideal oxidant and oxidant activation/propagation method will: (1) persist for a relatively long time period to enable transport to and contact with contaminants; (2) completely destroy contaminants of concern; and (3) have predictable behavior under given site conditions. An optimized ISCO process involves the slow consumption of an oxidant, an activator that reacts with the oxidant to generate free radicals, and is conserved, forming a range of free radicals that treat a broad array of contaminants. In practice it is difficult to achieve this balance because the activator often reacts with the oxidant generating free radicals and becomes depleted (e.g. Fe^{2+} cycling to Fe^{3+}), or the free radicals are scavenged by the activator before they can react with the target contaminants (e.g., sulfate free radicals in persulfate oxidation will compete with persulfate for reaction with the activator Fe^{2+}). This competition is well described by Liang et al. (2004a).

ISCO offers several benefits as an in-situ remediation amendment in suitable site conditions. As noted, ISCO can destroy TPH and VOCs (ITRC, 2005). Oxidation reactions proceed in a number of intermediate steps, where the hydrocarbon rings and chains are broken into smaller molecules that are susceptible to further oxidation. Ultimately, hydrocarbons are oxidized to carbon dioxide (CO_2) and hydrogen ions (H^+). Oxygen addition to hydrocarbons generates aldehyde and ketone intermediates that are less stable in the environment and more biodegradable than the highly reduced parent compounds (Glaze, 1986; Kooij et al., 1989; and Calvosa et al., 1991). Oxygen addition to a benzene ring can lead to ring destabilization and cleavage. Biodegradation of long-chain alkanes, alkenes and waxes generally proceeds from the end of carbon chains or branches. Partial oxidation of long-chain hydrocarbons breaks the hydrocarbon into pieces that effectively increases the number of chain ends that are readily biodegradable increasing the overall biodegradability of TPH.

ISCO treatment of hydrocarbons requires a relatively high dose of oxidants as compared to other compounds such as chlorinated ethenes. This is a result of the relatively high molecular weight and reduced structure of hydrocarbons. In order to oxidize hydrocarbons completely to CO_2 dosages up to 50 pounds of oxidant per pound of hydrocarbon may be required. However, remedial goals may be achieved without complete oxidation to CO_2 because as hydrocarbons are partially oxidized, the biodegradability of the products increases and toxicity tends to decrease. Therefore, ISCO may be implemented for treatment

of hydrocarbons as a pre-treatment supported by monitored natural attenuation or bioventing. ISCO is known to reduce the population of microorganisms during the ISCO process and microbial activity typically recovers after the oxidant is consumed (Sahl and Munakata-Marr, 2006). By-products of oxidants, such as oxygen or sulfate and lower molecular weight organics, can stimulate post-ISCO recovery of microbial populations. Both oxygen and sulfate residuals may promote post-ISCO microbial activity facilitating secondary treatment of residual hydrocarbons and/or partial oxidation products.

C.4 SCREENING OF OXIDANTS

Persulfate and O₃ were retained while permanganate and catalyzed hydrogen peroxide were not retained for further evaluation in the pilot study. Permanganate was not retained because it does not typically treat hydrocarbons such as benzene (ITRC, 2005). Catalyzed hydrogen peroxide (CHP) was not retained for two reasons. First the combination of the shallow depth to the target zone and soil texture increase the likelihood of short-circuiting of vapors or foams from a CHP process to the ground surface (RWQCB, 2009) given the very reactive nature of hydrogen peroxide which can quickly release between 5 to 50 times more oxygen gas than the volume of hydrogen peroxide injected into soils. Second, along with significant oxygen release potential in a short time period, CHP also releases heat leading to safety concerns when applied under structures and impervious surfaces (Marvin et al., 2002).

C.4.1 SODIUM PERSULFATE

An overview of SP for ISCO is provided in Tsitonaki et al., 2010. SP is the most recent oxidant developed for ISCO. SP is manufactured as a solid, although it is most typically injected as a liquid solution in the concentration range of 10 to 30 percent by weight. Persulfate slowly disassociates into the persulfate anion, a mild oxidant, and acidity in water. Under acidic conditions persulfate reactivity with hydrocarbons decreases and hydrogen peroxide (H₂O₂) may be produced. SP decomposition produces 2 moles of acid for each mole of SP consumed. Oxidation of hydrocarbons produces additional acidity (up to 8 moles of acid per mole of carbon oxidized). Therefore the acid/base buffering capacity of soil is an important consideration for persulfate-based ISCO.

SP is typically activated by using ferric iron, heat, or sodium hydroxide (base). Base activated persulfate was selected for two reasons. First, base activated persulfate treats hydrocarbons effectively as a result of a diversity of radical species over the pH range (hydroxyl radicals when pH >10.5 and superoxide radicals when below pH <10). Mechanisms of base activated persulfate are continuing to be investigated, yet this is the most common activation approach (Telesz, 2011). Base is consumed and pH decreases as persulfate consumed leading the pH to decrease over time. Combinations of SP and H₂O₂ also produce a diversity of radical species, the decomposition of H₂O₂ releases heat and large volumes of off-gas that can lead to foaming (ITRC, 2005). As result, it can be difficult to deliver an adequate dose of H₂O₂ to activate SP. Iron activated SP does not produce as broad of spectrum of radicals as base and heat activation (FMC, 2008).

C.4.2 OZONE

Ozone (O₃) oxidation of petroleum hydrocarbons is well documented in the literature (ITRC, 2005 and Siegrist et al., 2011). O₃ has been used for groundwater remediation since the mid-1990s. An overview of O₃ for ISCO is provided in Seigrist et al. (2011). Direct oxidation by O₃ proceeds in a number of intermediate steps, where the hydrocarbon rings and chains are broken into smaller molecules that are

highly susceptible to further oxidation by O₃ or by microbial processes. Ozone also can be activated by soil transition metals, such as iron and manganese, to form radical species. The radical species are more powerful oxidizers of organic compounds than O₃, and promote aggressive treatment. Ozone decomposition in unsaturated soils has been linked to the iron and manganese content of the soil and the specific surface area of the soil (Trapido et al., 2005; Kim and Choi, 2002). The specific surface area of the soil is influenced by the soil moisture, mineralogy and depositional history (Jung et al., 2004).

In-situ ozone treatment is well established; however, the site-specific feasibility and cost of in-situ ozone treatment often depends on subsurface ozone delivery. Ozone delivery relates to the ability to effectively move the oxidant through the target zone so that the contaminants are contacted and treatment is achieved. In most settings, this is a function of the oxidant reaction rate with the formation materials, subsurface heterogeneity and the treatment system operational configurations. Ozone is produced onsite and injected at concentrations that pose a potential inhalation hazard. As a result, ozone equipment and operations is relatively expensive as compared to other oxidants typically used for ISCO.

Bench-scale testing is planned in addition to field testing to provide a site-specific measurement of oxidant consumption kinetics, effects of oxidant dose and initial concentration, and overall treatment of TPH and VOCs. As noted in Section 7.1.3, previous SVE pilot testing at the Site indicates the permeability of site soils may be sufficient for ozone delivery.

C.5 SCREENING OF DELIVERY METHODS

Heterogeneity in soil texture and properties in the shallow Site soils may limit the ability to deliver in-situ remediation amendments uniformly to the subsurface. Variations in soil permeability, organic carbon content and COC distribution (dissolved, adsorbed, and non-aqueous phase) can lead to amendment bypassing and less than ideal subsurface contact. Hydrocarbon impacts have been observed to vary greatly over small distances at the Site. SVE pilot test results suggest that soil permeability and response to vapor extraction increases with increasing depth (greater below 10 feet). Thus, evaluating the uniformity and adequacy of delivery of injected fluids (oxidants or tracers) in the upper 10 feet of soil is a key objective of pilot testing.

The application of ISCO to areas at the Site including beneath structures and impervious surfaces influenced the screening of delivery methods. Most ISCO applications use vertical wells or temporary borings to inject oxidant into the target interval for groundwater treatment. Treatment of shallow soils with relatively low water content makes most common delivery approaches not viable. Typical soil delivery techniques include large-diameter auger mixing, emplacement of oxidant after excavation, and injection of slurries or liquids on closely spaced grid (typically less than 10 feet apart). These technologies may be applicable to open areas of the site, but would not be relevant for shallow soils under paved areas or structures. As the current pilot test will evaluate the general applicability and effectiveness of ISCO to treat Site soils, including under paved areas or structures, the following delivery approaches, while ultimately potentially applicable to the Site, were not retained for pilot testing at this time:

- Surface irrigation;
- Surface flooding;
- Soil mixing; and
- Slurry injections.

Should pilot testing indicate that ISCO is a viable treatment option at the site, these delivery approaches could be re-visited in the future.

Vertical wells were retained for ozone. Vertical wells were not retained for SP because gravity-driven flow will limit the lateral delivery from a vertical well. However, injection of ozone gas due to its low density is not as limited by gravity-driven flow from a vertical well. In addition, ozone gas can be applied to a vertical well at a higher volumetric flow rate, at standard conditions, than an SP solution due to the compressibility of gases as compared to liquids. Ozone distribution distances of over 30 feet in unsaturated soil injected via from vertical wells has been reported (Marvin et al., 1998). As a result, ozone pilot testing using vertical wells was retained.

Horizontal wells are the most viable delivery method for liquid oxidants. Horizontal wells can be installed beneath structures and thereby provide access to obstructed areas. Horizontal wells 50 to 300 feet in length may be required and are not uncommon. Horizontal wells are relatively expensive to install. Most horizontal wells are drilled from the ground surface and require a set-back from the edge of the target zones to angle downward from the ground surface and then back up. Drilled horizontal wells may pose a risk to slab foundations and utilities when installed at shallow depths. Drill pressure and bit alignment can cause foundation cracking or bit break-out. As a result, pipe jacking or micro-drilling methods in an orientation perpendicular to the long axis of structures or roads are more viable, although typically higher cost, as compared to conventional horizontal drilling.

Horizontal wells were retained for SP pilot testing. Delivery of liquid oxidant into unsaturated soil leads to filling of soil pores as oxidant slowly moves outward as a wetting front. Most of the injected liquid moves downward as a result of gravitational forces. As a result, the lateral distribution of SP solution from a horizontal well will be more uniform as compared to a line of vertical injection wells. Vertical distribution of SP solution below a horizontal well is expected to be relatively uniform as compared to the lateral delivery. Flow modeling will be used to further evaluate SP injection using a horizontal well and the sensitivity of lateral delivery to the injection volume, pressure and the range of estimated soil properties identified in the IRAP Further Site Characterization and SVE pilot test prior to constructing pilot test wells.

C.5.1 BENCH TESTING

Persulfate bench-scale testing will be conducted using slurries of Site soil and distilled water. The base demand of the Site soils will be measured before persulfate testing to identify the base dosage to be used. Preliminary estimates of the initial persulfate concentrations are: 35, 20 and 10 percent by weight in the aqueous phase of the slurries. The soil to water ratio will be maintained at approximately 1 to 2.

Ozone bench-scale testing will be conducted using unsaturated soil columns. Ozone gas will be humidified prior to the soil columns to maintain consistent water content in the soil columns during bench-scale testing. Ozone concentrations will be applied to the soil columns at approximately 2 percent by weight in the gas phase and three dosages will be evaluated based variations in exposure period. The longest duration test will be conducted in duplicate to provide two data sets on ozone consumption over 15 days. A control column will be tested with nitrogen to assess losses to volatilization.

Soils from the bench-scale tests will be composited and sampled after 15 days. These samples will be analyzed in triplicate for TPHg, TPHd, and TPHmo. Triplicate analysis will support and evaluation of variability in treatment effectiveness under idealized conditions.

Discrete masses of hydrocarbons have been observed at the Site and pose challenges for ISCO. Bench testing will be conducted to assess the effect of persulfate and ozone on discrete masses of hydrocarbons. Discrete masses of hydrocarbons may vary in size and surface area over a period of exposure to an oxidant. Oxidants may affect the surface of discrete masses of hydrocarbons causing changes in availability of the hydrocarbon to the oxidant and the behavior of hydrocarbons after oxidant has been consumed. For example, hydrocarbon droplets have been shown to form skins after prolonged exposure to the environment (Nelson et al., 1996). Depending on the observed characteristics of impacted soils in the excavations conducted during the pilot tests, additional bench-scale testing may be developed to evaluate the ability of oxidants to penetrate into discrete masses of hydrocarbons.

C.5.2 FLOW AND TRANSPORT MODELING

Flow modeling will be used to evaluate the SP injection volume and pressure. A hydraulic evaluation of SP injection into a horizontal well will be based on site-specific hydraulic data to evaluate the potential range of injection pressures and flow rates for SP pilot testing. This evaluation will be performed in cross section using VS2DTI (Variably Saturated Two-Dimensional Transport Interface) to simulate a series of injection configurations based on a simplified version of the site geology. VS2DTI is a variably saturated flow and transport finite difference code that solves the Richard's equation for fluid flow and the advection-dispersion equation for solute transport in two-dimensions (vertical plane). Solute transport processes simulated with VS2DTI can include advection, dispersion, and first-order reaction (USGS, 2007). The model domain can be discretized at a variable spacing, with grid spacing such as approximately 0.1 meter (m) near the injection well to 1 m at the vertical boundary farthest from the injection well. The domain size will be selected to minimize the effect of boundary conditions on simulations.

Transport and reaction of SP and O₃ at steady state will be evaluated using a pseudo first-order reactive transport spreadsheet-based model. Oxidant consumption rates will be estimated from the bench-scale test results. Pseudo first order reactive transport is conservative with respect to oxidant transport (Siegrist et al., 2011). This assumption implies that after some period of time the outward movement of oxidant is balanced by oxidant consumption and a steady-state distribution is achieved. A lower concentration threshold will be assigned that defines the limits of the steady state distribution. Reactive transport modeling evaluates the influence of the decomposition rate on the estimated delivery distance away from the injection well under idealized conditions. Pseudo first order one-dimensional reactive transport modeling is based on radial flow geometry and assumes a uniform homogeneous flow field. Inputs include the injection rate, duration, initial amendment concentration, water saturation, amendment half-life (from the pseudo first order decay coefficient), bulk porosity, and the soil density.