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## TRANSMITTAL

DATE: May 14, 2010 REFERENCE NO.: 521000  
PROJECT NAME: 1137-1167 65<sup>th</sup> Street, Oakland

TO: Ms. Barbara Jakub  
Alameda County Health Care Services Agency  
Department of Environmental Health  
1131 Harbor Bay Parkway, Suite 250  
Alameda, California 94502

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Alameda County  
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QUANTITY	DESCRIPTION
1	Sub-Slab Vapor Probe Installation and Additional Site Assessment Workplan

As Requested  For Review and Comment  
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 \_\_\_\_\_

**COMMENTS:**  
Should you have any questions regarding the content of this document, please contact Bob Foss at (510) 420-3348.

Copy to: Mr. Frederic Schrag (electronic only)  
Mr. Dennis Parfitt

Completed by: Bob Foss [Please Print] Signed: Robert Foss

Filing: **Correspondence File**



# **SUB-SLAB VAPOR PROBE INSTALLATION AND ADDITIONAL SITE ASSESSMENT WORKPLAN**

**1137-1167 65<sup>th</sup> STREET  
OAKLAND, CALIFORNIA**

**AGENCY CASE NO. RO0000082**

**MAY 14, 2010**

**REF. NO. 521000 (8)**

This report is printed on recycled paper.

**Prepared by:  
Conestoga-Rovers  
& Associates**

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## 1.0 INTRODUCTION

On behalf of Mr. John Nady, Conestoga-Rovers & Associates (CRA) is pleased to submit this *Sub-slab Vapor Probe and Additional Site Assessment Workplan* (Workplan) for the site referenced above. This Workplan is in response to an Alameda County Environmental Health (ACEH) email dated March 18, 2010 regarding CRA's recommendation to proceed with additional characterization of conditions beneath the site. A copy of this email is included as Appendix A. ACEH is the lead agency for this site.

### 1.1 SITE INFORMATION

<b>Site Address</b>	1137-1167 65 <sup>th</sup> Street, Oakland, CA
<b>Site Use</b>	Commercial
<b>Client and Contact</b>	John Nady, Trustee of the Nady Trust Contact: Frederic Schrag
<b>Consultant and Contact Person</b>	CRA, Robert Foss, P.G.
<b>Lead Agency and Contact Person</b>	ACEH, Ms. Barbara Jakub
<b>Agency Case No.</b>	RO0000082

## 2.0 SITE BACKGROUND

### 2.1 SITE DESCRIPTION

The site currently comprises a group of buildings separated by narrow walkways and an outside parking area. The site includes the addresses 1137, 1145, 1147 and 1167 65<sup>th</sup> Street, in Oakland. Currently, various spaces are rented to artists and musicians. The surrounding area is comprised of mixed residential, commercial and light industrial uses. Historically, the facility was used for dry cleaning operations from approximately 1935 and terminating in 1978. Figure 1 is a site vicinity map. Figure 2 is an extended site map, illustrating the site buildings as well as surrounding roadways, residences and other structures.

### 2.2 HISTORICAL CHEMICAL USE

Six underground storage tanks (USTs) and associated conveyance piping (Figure 2) had been associated with dry cleaning chemical storage at the site. A liquid sample from

each tank was collected and analyzed in September 2001 to profile the residual fluids for removal and disposal. Five of the six tanks were removed in February 2002, while the sixth, UST #5, was abandoned in place with agency approval. Each sample contained varying concentrations of petroleum hydrocarbons, in the ranges of gasoline, naphtha and diesel, and probably was composed primarily of stoddard solvent, a common dry cleaning fluid. Two additional USTs had been in use on the site and were removed in 1982 and 1998. A gasoline UST and overlying dispenser was located beneath a paved area east of the buildings. This tank was removed in 1982. A heating oil tank was located beneath the sidewalk just north of the building at 1145 65<sup>th</sup> Street and removed in 1998.

### 3.0 ENVIRONMENTAL SETTING

**Regional and Local Geology:** Regionally, the site is located in the Coast Ranges Geomorphic Province of California. The origin of the local geology is apparently a prehistoric alluvial fan interfacing with marine estuarine deposits. Typical lithology of an alluvial fan consists of mixtures and interfingering lenses of gravel, sand, silt and clay. Distal alluvial fan deposits are typically comprised of smaller clastic sediments of finer sand, silt and clay, representing lower energy depositional conditions. These alluvial fan deposits may interface with marine estuarine sediments, predominantly comprised of silt and clay mixed with organic material and some discontinuous deposits of sand and gravel. Bedrock, well below these shallow sediments, is probably Mesozoic Franciscan Formation.

Beneath surface materials (concrete or asphalt) and fill, investigations to date have shown subsurface soils to generally consist of interbedded layers of low permeability silts and clays; moderately permeable mixtures of sandy silt and clay; and higher permeable silty sand. Elevation of the site is approximately 35 feet above mean sea level (ft msl) and local topography is generally flat.

**Local Hydrogeology:** Several water-bearing transmissive zones have been identified beneath the site. Within each zone, transmissive sediments may not be laterally continuous across the site. These zones are described, as follows:

- **A-Zone:** This zone is defined as shallow, discontinuous, water-bearing sediments found at depths between approximately 3.5 and 12 feet below grade (fbg). In localized areas, perched groundwater may exist within transmissive sediments ranging in thickness from 1.5 to 2 ft, and at depths between approximately 3.5 and 6 fbg. More extensive water-bearing transmissive sediments appear at depths of

approximately 6 to 12 fbg, ranging in thickness from 1 to 6 ft. Groundwater found between 3.5 and 12 fbg may be hydraulically connected and groundwater in this zone may be semi-confined to unconfined.

- **B-Zone:** Boring logs from across the site suggest that this zone is less easily recognized and defined than either the A- or C-zones. The B-zone consists of thin, discontinuous water-bearing strata of lower permeability than either the A- or C-zones. These strata consist of clayey silty sands and sandy silts, with varying amounts of gravels. This zone is located between 13 and 24 fbg, and exhibits semi-confined to confined conditions.
- **C-Zone:** The C-Zone consists of water-bearing, transmissive sediments found between 25 and 46 fbg, under semi-confined or confined conditions. Sediments at these depths appear to be discontinuous.

Groundwater flow is typically calculated toward the southwest, in the general direction of San Francisco Bay.

#### 4.0 PREVIOUS ACTIVITIES AND INVESTIGATIONS

The following provides a general overview of prior environmental activities and investigations:

**1982 Tank Removal:** A gasoline UST and associated gas pump were removed in 1982. Based on depressions in the site asphalt, the gasoline UST appears to have been located directly beneath the former gasoline pump (Figure 2).

**1998 Tank Removal:** In 1998, a 750-gallon heating oil UST was removed from beneath the sidewalk north and in front of the 1145 65th Street building (Figure 2). Approximately 18 cubic yards of impacted soil was removed from the UST cavity and transported under manifest for disposal. Additional information is present in the December 24, 1998 *UST Removal Report*, prepared by Artesian.

**2001 UST Liquid Contents Removal:** In September and October 2001, liquid samples were collected from the six remaining USTs at the site. These samples were analyzed to characterize each UST's contents for disposal. The liquid in the six USTs was removed and transported under chain of custody for disposal as hazardous waste in November 2001. Additional information is present in the May 17, 2002 *UST Removal Report*, prepared by SCI consultants.

**2002 Tank Removal and Abandonment:** In February 2002, five of the six USTs were excavated and removed. The remaining UST (Interior Tank #5) was filled with cement slurry and abandoned in place. Additional information is contained in the May 17, 2002 *UST Removal Report*, prepared by SCI consultants.

**2002 Soil Boring and Geophysical Survey:** In November 2002, Cambria Environmental Technology Inc (Cambria) advanced eleven soil borings (SB-1 through SB-11) to further define the extent of petroleum hydrocarbons and VOCs in soil and groundwater beneath the site. Temporary wells were installed in each boring to measure groundwater depth and to collect grab groundwater samples. Additional information is provided in Cambria's February 13, 2003 *Soil and Groundwater Investigation Report*.

**July 2003 Geophysical Survey:** On July 7, 2003, NorCal conducted a limited site geophysical survey to identify any additional subsurface piping. Subsurface piping identified by the geophysical survey is illustrated on Figure 2.

**January 2004 Soil Boring Investigation:** In January 2004, Cambria advanced numerous soil borings to further define the extent of petroleum hydrocarbons and VOCs in soil and groundwater beneath the site. Soil and groundwater samples were collected from A-Zone, B-Zone and C-Zone depths. Additional information is provided in Cambria's February 24, 2004 *Interim Investigation Data Report*.

**January 2004 Sensitive Receptor Survey:** In January 2004, Cambria conducted a sensitive receptor survey for beneficial use wells (e.g., municipal supply, domestic, irrigation, etc.) and surface water bodies within ½-mile of the site. While several environmental monitoring wells were located during the survey, Cambria did not locate any surface water bodies or beneficial use wells within ½-mile of the site. Cambria stated that local groundwater is not currently, nor reasonably considered as a potential future source of drinking water. Cambria also conducted a conduit study to evaluate if preferential migration pathways exist near the site and merit additional investigation. No preferential migration pathways were located adjacent to the site in Peabody Lane. Based on site concentrations in grab groundwater samples near 65<sup>th</sup> Street, it is unlikely that preferential migration is occurring via the underground utilities located in 65<sup>th</sup> Street. Additional information of the January 2004 Sensitive Receptor Survey and Conduit Study can be found in Cambria's February 24, 2004 *Interim Investigation Data Report*.

**May 2004 Soil Boring and Well Installation Investigation:** In May 2004, Cambria drilled 13 additional soil borings and constructed monitoring wells MW-1A through MW-4A, and MW-6A and MW-7A; wells MW-1B, MW-4B, MW-5B and MW-6B; and



MW-1C, MW-4C and MW-6C. Additional information is provided in Cambria's September 7, 2004 *Supplemental Soil and Groundwater Investigation Report*.

**August-September 2009 Additional Site Characterization:** Additional site characterization was conducted. This included three offsite borings, four additional monitoring wells, 15 borings logged with CPT and MIP, one deep groundwater sample; and the installation and sampling of nine soil vapor probes. Additional information is provided in CRA's *Additional Site Characterization Report*, dated February 25, 2010.

**Groundwater Monitoring:** Quarterly groundwater monitoring and sampling have been performed at the site since 2004. In response to State Water Resources Control Board Resolution No. 2009-0042, dated May 19, 2009, semi-annual groundwater monitoring and sampling was implemented during the second quarter of 2009. As a result, monitoring, sampling and reporting are now conducted during the first and third quarters of the calendar year. Groundwater Monitoring Reports have been submitted to the agency.

## 5.0 CHEMICAL DISTRIBUTION

### 5.1 CHEMICALS OF POTENTIAL CONCERN

Chemicals of potential concern at this site are primarily Stoddard Solvent and PCE, both common dry cleaning chemicals. Associated with stoddard solvent is ethylbenzene, xylenes and isomers of benzene. Also associated with PCE is Trichloroethene (TCE) and Dichloroethene (DCE) and vinyl chloride (VC). All three of these compounds may be present as sequential degradation products of PCE.

Gasoline-range and heating oil-range hydrocarbons are also present, but at much lower concentrations than the dry cleaning chemical compounds.

### 5.2 CHEMICAL DISTRIBUTION IN SOIL

- Elevated concentrations of TPHss have been identified in the vicinity of the former Exterior and Interior USTs and conveyance pipes; in an area east of the former Exterior USTs; at the southwest corner of the facility, and near the floor drain in the 1167 65<sup>th</sup> Street building. The deepest detected concentration of TPHss is at 17.5 fbg in a sample collected at the southwest corner of the facility. TPHss concentrations at

this location are non-detect (ND) at 20 fbg. Some elevated concentrations reported as TPHg and TPHd are likely to be Stoddard Solvent.

- Across the site, PCE was rarely identified in soil above frequently elevated detection limits. The highest concentration of PCE in soil was identified below Exterior Tank #3 at 310 µg/kg. Detected concentrations of PCE were all relatively shallow. TCE has not been detected in soil.
- Detected concentrations of BTEX are present downgradient of the former gasoline UST location in boring SB-14A at 7.5 fbg. A TPHg concentration of 210 mg/kg was also detected at this depth. The 11.5 fbg samples at this location was non-detected (ND) for these analytes.
- Slightly elevated concentrations of ethylbenzene and/or xylenes also exist southeast of the former Exterior USTs. Moderately elevated concentrations of ethylbenzene and xylenes also apparently occur at depth at the southeast corner of the facility, from borings in an alley apparently covered in vegetation. At this location are the deepest samples with ethylbenzene and xylenes, found at 17.5 fbg (SB-18B@17.5). No concentrations were found in a sample collected from 20 fbg at this location in the alley.
- Elevated concentrations of TPHmo-range hydrocarbons were detected in shallow soil adjacent to the former heating oil UST, under the sidewalk adjacent to 65<sup>th</sup> Street. An elevated concentration of TPHmo-range hydrocarbons also exist at 5.5 fbg under Peabody Lane, southwest of the facility, but decreases to ND at 11 fbg.

### 5.3 CHEMICAL DISTRIBUTION IN GROUNDWATER

#### *A-Zone Groundwater*

Significantly elevated concentrations of TPHss were found in the proximity of the former Exterior USTs; to the east of the Exterior USTs; at the northern defined extend of the conveyance pipe; at and beyond the southwest corner of the facility; and adjacent to the floor drain in the 1167 65<sup>th</sup> Street building in groundwater samples collected in the A-Zone. Elevated concentrations of TPHg and TPHd-range hydrocarbons also are typically found where TPHss is detected. PCE and TCE were detected in A-Zone groundwater only in the immediate vicinity of the former Exterior USTs. The highest concentration of PCE at 170 µg/l was detected just north of the Exterior USTs. Elevated concentrations of TPHmo-range hydrocarbons were detected adjacent to the former heating oil UST, and also adjacent to the Exterior USTs. TPHg-range hydrocarbons were only moderately elevated in groundwater near the former gasoline UST in well MW-2A.

No benzene was ever detected in well MW-, and only very low concentrations of BTEX have been detected in groundwater collected from the A-Zone.

### ***B-Zone Groundwater***

Elevated concentrations of TPHss have been detected near the southwest corner of the facility in MW-6B and SB-7. Elevated concentrations of TPHd and TPHg-range hydrocarbons have been also detected, although these results likely represent TPHss overlapping into the gas and diesel ranges and being reported as such. cis-DCE was detected in SB-17B at 1,100 µg/l, southwest and downgradient of the former Exterior USTs. No PCE or TCE were detected in groundwater collected from SB-17B. No other grab groundwater or B-Zone monitoring wells had detectable concentrations of PCE or TCE. Benzene was practically ND in grab groundwater samples collected from borings and groundwater samples from B-Zone monitoring wells.

### ***C-Zone Groundwater***

C-Zone TPH concentrations decrease significantly compared to A- and B-Zone results. Low levels of TPHss, along with TPHg-range hydrocarbons, were detected in C-Zone groundwater at the southwest corner of the facility. Very low concentrations of PCE, TCE, cis-DCE, and Vinyl Chloride were detected in groundwater from monitoring well MW-6C, located beyond the southwest corner of the facility. Significantly elevated concentrations of PCE, TCE, and cis-DCE were detected from C-Zone grab groundwater samples collected from SB-18B\*(C-Zone) and SB-18C, located below the alley at the southwest corner of the facility. Benzene has not been detected in any C-Zone monitoring wells and detected at low concentration in C-Zone soil boring SB-18.

## **6.0 PROPOSED SCOPE OF WORK**

Based on results of the August 2009 additional site characterization work, soil vapor sampling and groundwater monitoring well sampling, CRA proposes to install sub-slab vapor probes at various locations beneath the onsite buildings. Analytic results of soil vapor probe sampling at approximately 5.5 fbg suggest the potential for vapor intrusion into the buildings. Figure 3 shows proposed locations of these sub-slab probes. Sub-slab vapor probes will be installed and sampled in accordance with the California Dept of Toxic Substances (DTSC) *Advisory - Active Soil Gas Investigation* guidance document, dated March 2010 and *Guidance for Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air - Final Interim, Appendix G -Soil Gas Sampling Directly Under Building Foundations (Subslab Sampling)*, December 15, 2004 (revised February 7, 2005). CRA's Standard field procedures for this proposed scope of work is included in

Appendix A. In addition to installation and sampling of sub-slab vapor probes, CRA proposes to advance two soil borings along Ocean Avenue in another attempt to collect A-zone groundwater samples, and to determine the extent of dissolved hydrocarbon and VOC plumes in all three water-bearing zones. These proposed soil boring locations are also shown on Figure 3. A detailed description of proposed activities is discussed below.

## 6.1 SUBSLAB SOIL VAPOR INVESTIGATION

To evaluate the potential for vapor intrusion into buildings present on the site, CRA recommends the installation of sub-slab vapor probes and collection of sub-slab vapor samples from nine locations within the on-site buildings. CRA also recommends installation and sampling of three sub-slab vapor probes along Peabody Lane due to results of previously acquired vapor samples collected from depths of approximately 5 fbg. Analytic results of subsurface soil vapor samples collected previously at approximately 5 fbg are included in Table 1. Soil vapor samples will be analyzed for TPHss, TPHg, BTEX, PCE, TCE, 1,2-DCE and VC. Prior to sampling, the probes will be allowed at least 30 minutes for curing of cement and equilibration of subsurface conditions, per DTSC/Cal - EPA guidelines. CRA will collect samples in 1-liter summa canisters. Samples will be collected after pre-sampling preparations are complete.

The following Table 6-1 presents soil vapor analysis, sampling containers, preservation, detection limit, and holding time.

<b>TABLE 6-1 SOIL GAS ANALYSIS, SAMPLING CONTAINERS, PRESERVATIVES, DETECTION LIMITS, AND HOLDING TIMES</b>				
<i>Analysis and Method</i>	<i>Sampling Containers</i>	<i>Preservatives</i>	<i>Detection Limit (<math>\mu\text{g}/\text{m}^3</math>)</i>	<i>Holding Times</i>
TPHss and TPHg (Method TO-17)	Summa Canister	None	300, 100	30 days
Benzene, Ethylbenzene, Toluene, Xylenes (Method TO-15)	Summa Canister	None	2, 2, 2, 2	30 days
PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, VC (Method TO-15)	Summa Canister	None	varies	30 days
Oxygen, Methane, Carbon Dioxide (Method ASTM-D1946).	Summa Canister	None	0.22%, 0.000022%, 0.022%	30 days
Helium - Leak detection (Method ASTM-D1946).	Summa Canister	None	0.11%	30 days

## 6.2 SOIL BORING INVESTIGATION

In August 2009, CRA advanced soil borings SB-27 and SB-28 along Ocean Avenue to characterize shallow groundwater conditions beneath the residential area downgradient of the site. Grab groundwater samples were collected in the B- and C-zones, but water did not enter the borehole across the A-zone depths in either boring. In another attempt to complete characterization of groundwater in the residential area downgradient of the facility, CRA proposes drilling two additional borings along Ocean Avenue. Additionally, based on previous grab groundwater analyses from boring SB-20 along Peabody Lane, CRA proposes to advance one additional boring further west on Peabody Lane. CRA will advance the two borings on Ocean Avenue to approximately 40 fbg to collect groundwater samples from all three groundwater zone intervals. CRA will attempt to collect A-zone, B-zone and C-zone groundwater samples at depths ranging from 3.5-12 fbg, 13-24 fbg and 25-40 fbg, respectively, in these borings. CRA intends to advance the one additional boring along Peabody Lane to a depth of 24 fbg. This depth will allow soil and grab groundwater sampling of the A- and B-zones. Previous borings SB-7 and SB-17, also located along Peabody Lane, identified the B-zone as a silty sand/sandy silt layer approximately 0.5-3.5 feet thick at approximately 16-22 fbg. Previous boring SB-20 has already shown that no impacted groundwater is present in the C-zone at that distance downgradient of the subject site. Previous soil analytical results are included in Tables 2 and 3. Previous grab groundwater analytical results are included in Tables 4 and 5.

During the August 2009 investigation, no water entered the boreholes in the A-zone. CRA's staff geologist noted on the boring log that a 1-foot thick sandy gravel lens from 10 to 11 fbg in SB-28 was dry, as was the silty sandy clay directly underlying this gravel. Laterally discontinuous sediment lenses characterize soils beneath this entire area, and the lack of shallow groundwater may be due to an overall larger percentage of fines (clay and silt) in the formation near the locations of borings SB-27 and SB-28, decreasing soil permeability and groundwater flow. Due to permit restrictions, in August 2009, these borings could not remain open overnight, in the chance that a sufficient accumulation of groundwater would allow collection of a sample. For this additional investigation, CRA has acquired approval from the ACDPW to, if necessary, leave these two borings open overnight to allow additional time for shallow groundwater to enter the borehole if it is present within the A-zone depths.

CRA will collect soil samples from any interval with significant staining, odor or elevated photoionization detector (PID) readings. Grab groundwater and selected soil

samples will be analyzed for TPHss, TPHg, TPHd and TPHmo, using a Fuel Fingerprint technique in an attempt to identify the actual petroleum hydrocarbon product (i.e., possibly Stoddard Solvent), if present. BTEX and 8010-target list Halogenated Volatile Organic Compounds (HVOCs) will be analyzed to complete soil and groundwater characterization. After completion of pre-sampling preparations, a C-57 licensed drilling contractor will advance the borings and collect discrete soil and grab groundwater samples, using direct-push drilling technology. CRA will collect soil samples in 4 feet lengths of acetate tubing to log subsurface lithology and screen soil conditions for grab groundwater sampling. The maximum anticipated boring depth is 40 fbg. Table 6-2 presents soil sample analysis, sampling containers, preservation, detection limit, and holding time.

<b>TABLE 6-2 SOIL SAMPLE ANALYSIS, SAMPLING CONTAINERS, PRESERVATIVES, DETECTION LIMITS, AND HOLDING TIMES</b>				
<i>Analysis and Method</i>	<i>Sampling Containers</i>	<i>Preservatives</i>	<i>Detection Limit (mg/kg)</i>	<i>Holding Times</i>
TPHss, TPHg, TPHd and TPHmo (8015M) Fuel Fingerprint	Tube or Glass Containers	Ice	1.0, 1.0, 1.0 and 5.0	14 days
BTEX (8021M)	Tube or Glass Containers	Ice	0.005	14 days
HVOC 8010 Target List (by 8260b)	Tube or Glass Containers	Ice	varies	14 days

Table 6-3 presents grab groundwater sample analysis, sampling containers, preservation, detection limit, and holding time.

<b>TABLE 6-3 GRAB GROUNDWATER ANALYSIS, SAMPLING CONTAINERS, PRESERVATIVES, DETECTION LIMITS, AND HOLDING TIMES</b>				
<i>Analysis and Method</i>	<i>Sampling Containers</i>	<i>Preservatives</i>	<i>Detection Limit (µg/L)</i>	<i>Holding Times</i>
TPHss (8015M) Fuel Fingerprint	VOA	HCl	50	14 days
TPHg (8015M) Fuel Fingerprint	VOA	HCl	50	14 days
TPHd & TPHmo (8015M) Fuel Fingerprint, w/ Silica Gel Cleanup	Amber	HCl	50 & 250	14 days
BTEX (8021M)	VOA	HCl	0.5	14 days

<b>TABLE 6-3 GRAB GROUNDWATER ANALYSIS, SAMPLING CONTAINERS, PRESERVATIVES, DETECTION LIMITS, AND HOLDING TIMES</b>				
<i>Analysis and Method</i>	<i>Sampling Containers</i>	<i>Preservatives</i>	<i>Detection Limit (µg/L)</i>	<i>Holding Times</i>
HVOC 8010 Target List (by 8260b)	VOA	HCl	0.5	14 days

**7.0 PRE-SAMPLING PROCEDURES, DOCUMENTATION, AND WASTE MANAGEMENT**

**7.1 PRE-SAMPLING PREPARATIONS**

Prior to performing any field activities, the proposed scope of work will be approved, a site-specific Health and Safety Plan (HASP) will be prepared, utility clearance will be performed and a boring permit will be acquired.

**7.2 APPROVAL OF SAMPLING APPROACH**

This Workplan presents the proposed scope of work for the sampling approach. CRA will await ACEH written approval prior to initiating field activities.

**7.3 HEALTH AND SAFETY PLAN**

CRA will prepare a site-specific HASP for the proposed field activities. The HASP will be maintained on-site during field work and updated, as necessary, if conditions change.

**7.4 UTILITY CLEARANCE**

Prior to subsurface field activities, proposed sub-slab vapor probe and boring locations will be marked with white paint and Underground Service Alert (USA) will be notified to identify all known utilities in the proposed locations. Because of the limits of the USA survey, CRA will contract with a private utility locating service to perform an additional utility survey of the vapor probe locations beneath the buildings, the vapor probe locations in Peabody Lane and the proposed boring locations along Ocean Avenue. This will help to identify subsurface utilities at boring locations. In addition, initially a hand

auger or air knife may be used to clear the boreholes along Ocean Avenue to a reasonable depth and to collect soil samples.

#### **7.5 PERMIT**

A drilling permit will be obtained from Alameda County Public Works Agency. No permits are necessary for installation of the very shallow sub-slab vapor probes.

#### **7.6 SAMPLE DOCUMENTATION**

Sampling containers will be labeled in the field with the job number, sampling location, date and time of sample, and requested analysis. A chain-of-custody record will be initiated and updated throughout handling of the samples.

#### **7.7 SAMPLING LOCATIONS**

CRA will define boring and vapor probe locations by field measurements from existing structures. Borings and vapor probes will be identified on a scaled figure.

#### **7.8 INVESTIGATION DERIVED WASTE**

All investigation-derived waste (IDW) will be temporarily stored on-site in sealed Department of Transportation-approved drums. The drums will be labeled with the appropriate boring identification number(s), date of collection and nature of contents. On behalf of the client, CRA will coordinate the transportation and disposal of IDW.

### **8.0 REPORT**

CRA will prepare and submit the *Sub-Slab Vapor Probe and Additional Assessment Report* after receipt of all analytic data. The report will include the following:

- A summary of the site background and history,
- A description of sub-slab vapor probe installation methods,
- A description of soil boring drilling and sampling methods,
- Soil boring logs,

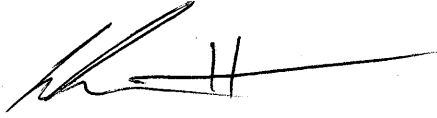


- Tabulated results,
- A site map showing the sub-slab vapor probe and boring locations,
- Analytic reports and chain-of-custody documentation,
- A description of hydrocarbon vapor conditions beneath the slab foundation,
- A description of sub-asphalt hydrocarbon vapor conditions along Peabody Lane,
- A discussion of hydrocarbon distribution at the site,
- Our conclusions and recommendations.

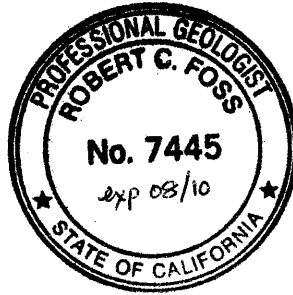

## 9.0 SCHEDULE

Upon written receipt from ACEH of workplan approval, CRA will proceed to permit the soil borings along Ocean Avenue. CRA will submit and uploaded the report to the ACEH website within 8 weeks of the receipt of all laboratory analytic data.

All of Which is Respectfully Submitted  
CONESTOGA-ROVERS & ASSOCIATES



Calvin Hee

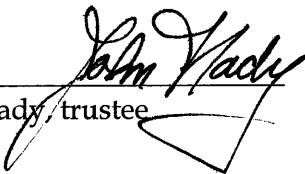


Robert Foss, P.G.,

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To the best of my knowledge, I have no argument or disagreement with the contents of this workplan.

Nady Trust U/D/T dated 1/21/1997

  
\_\_\_\_\_  
John Nady, trustee

## FIGURES



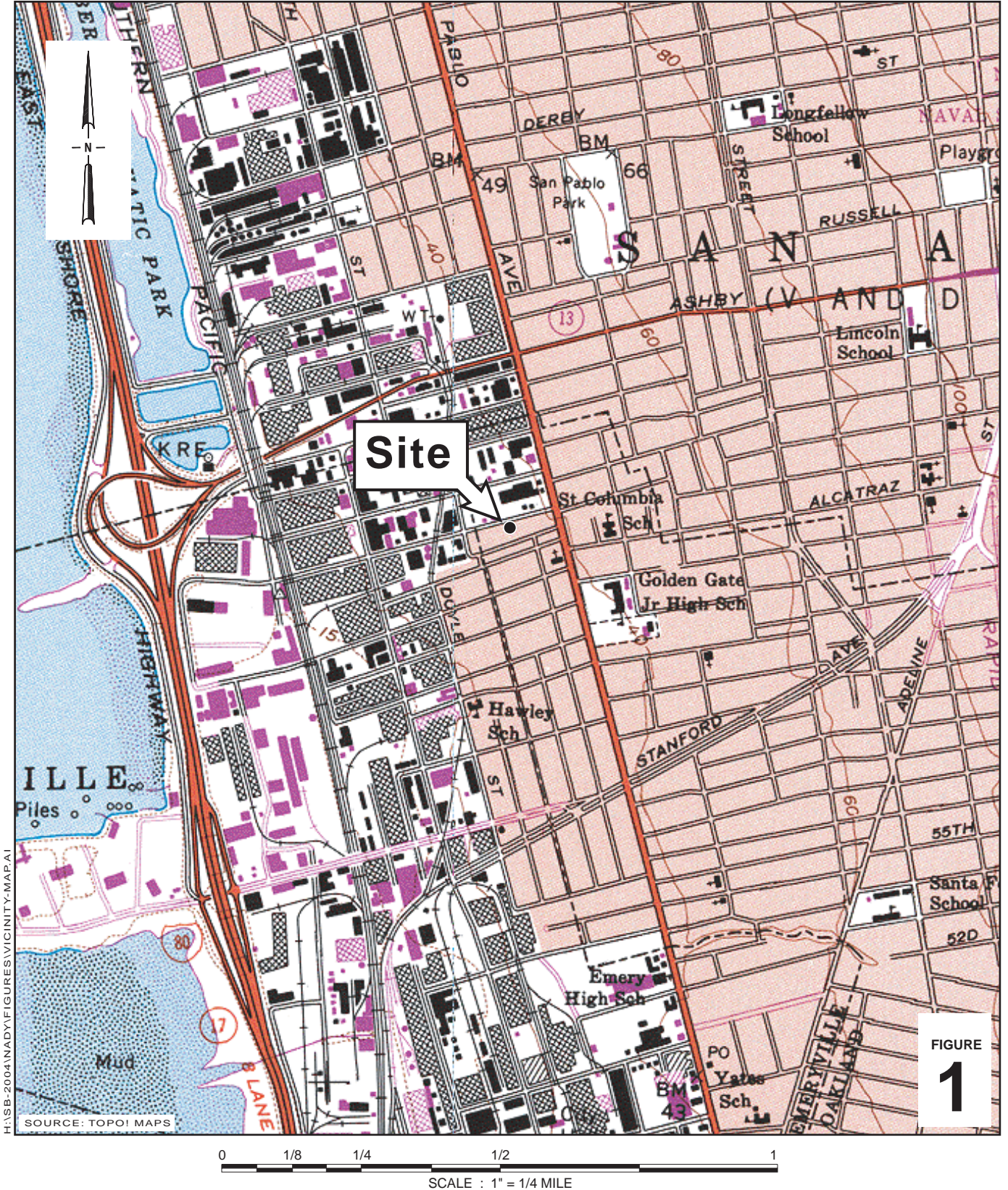


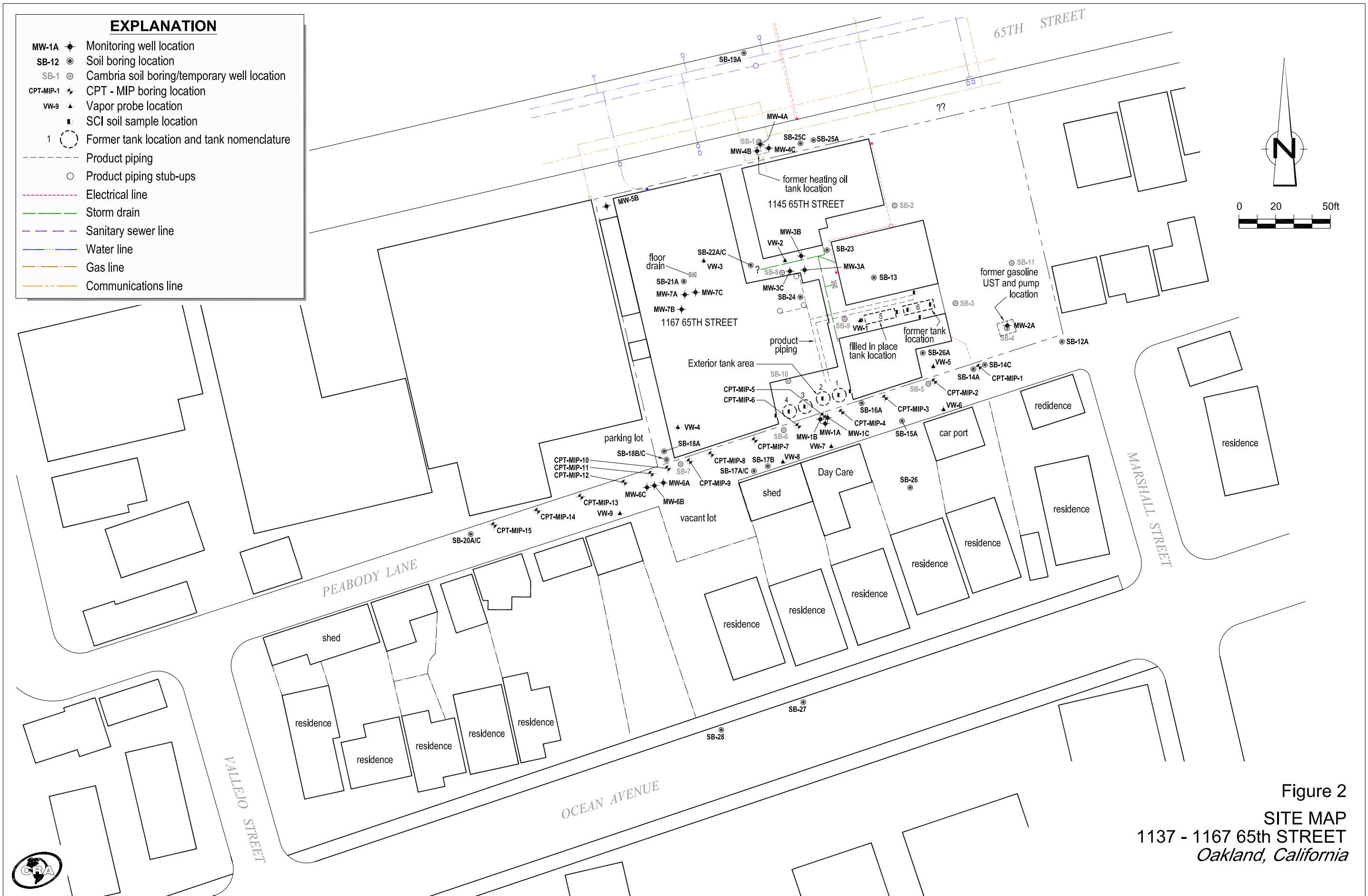
FIGURE  
**1**

1137 - 1167 65th Street  
Oakland, California



Vicinity Map





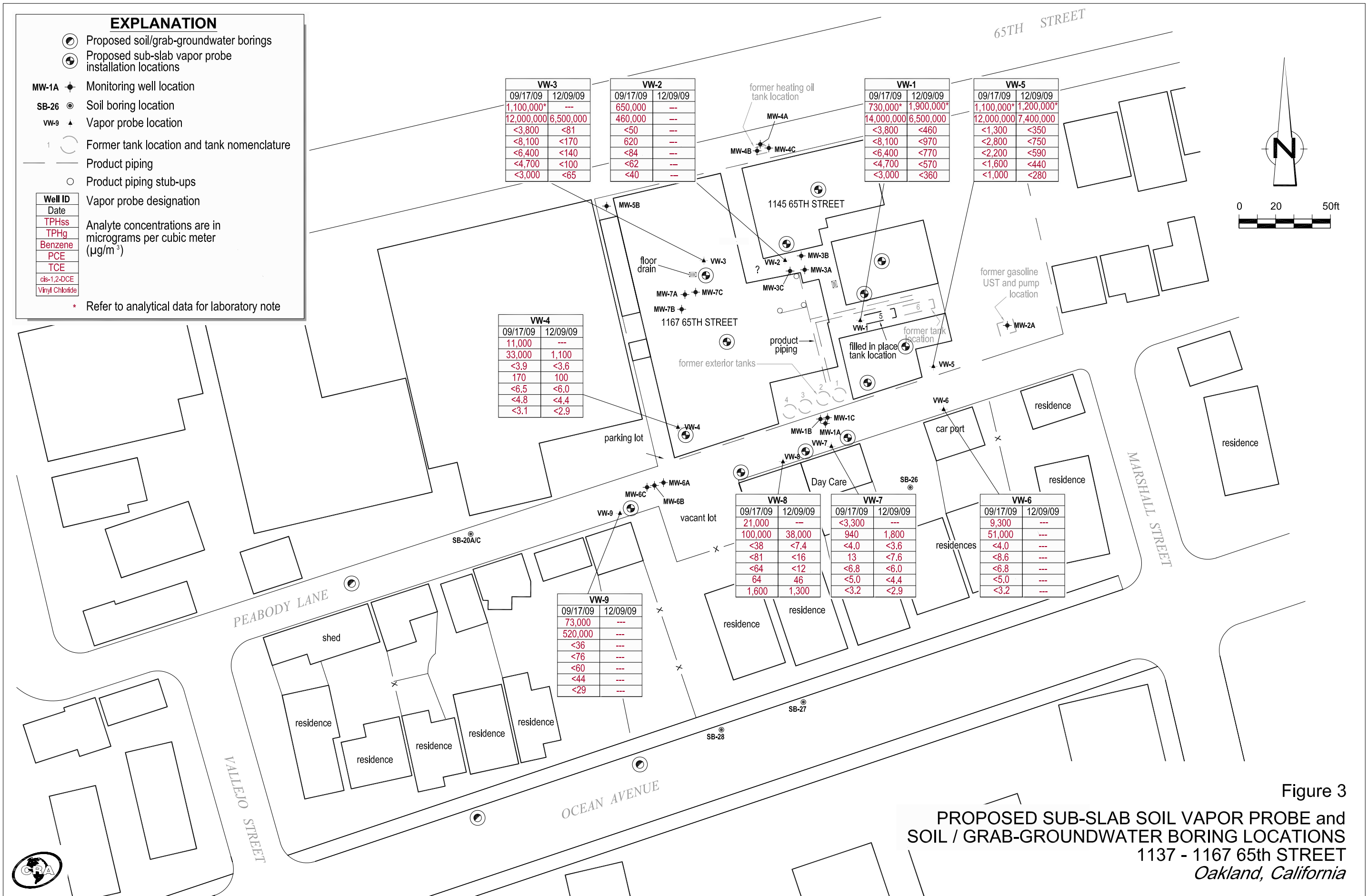


Figure 3  
 PROPOSED SUB-SLAB SOIL VAPOR PROBE and  
 SOIL / GRAB-GROUNDWATER BORING LOCATIONS  
 1137 - 1167 65th STREET  
 Oakland, California

## TABLES

TABLE 1

SOIL VAPOR ANALYTICAL DATA  
JOHN NADY  
1137-1167 65TH STREET  
OAKLAND, CALIFORNIA

Sample ID	Date Sampled	Depth (ft)	PCE (ug/m <sup>3</sup> )	TCE (ug/m <sup>3</sup> )	TPHss (ug/m <sup>3</sup> )	TPHg (ug/m <sup>3</sup> )	Benzene (ug/m <sup>3</sup> )	Toluene (ug/m <sup>3</sup> )	Ethylbenzene (ug/m <sup>3</sup> )	m,p-Xylene (ug/m <sup>3</sup> )	o-Xylene (ug/m <sup>3</sup> )	cis-1,2-DCE (ug/m <sup>3</sup> )	trans-1,2-DCE (ug/m <sup>3</sup> )	Vinyl Chloride (ug/m <sup>3</sup> )	Oxygen (%)	Methane (%)	Carbon Dioxide (%)	Helium (%)
VW-1	9/17/2009	5	<8,100	<6,400	>730,000	14,000,000	<3,800	<4,500	<5,200	<5,200	<5,200	<4,700	<4,700	<3,000	1.3	0.39	16	<0.12
	12/9/2009	5	<970	<770	>1,900,000	6,500,000	<460	<540	<620	<620	<620	<570	<570	<360	1.3	0.1	15	<0.022
VW-2	9/17/2009	5	620	<84	650,000	460,000	<50	<58	<68	<68	<68	<62	<62	<40	11	0.089	8.8	<0.12
	12/9/2009	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
VW-3	9/17/2009	5	<8,100	<6,400	>1,100,000	12,000,000	<3,800	<4,500	<5,200	<5,200	<5,200	<4,700	<4,700	<3,000	1.2	3.2	17	<0.12
	12/9/2009	5	<170	<140	--	6,500,000	<81	<95	<110	<110	110	<100	<100	<65	1.4	2.1	15	<0.13
VW-4	9/17/2009	5	170	<6.5	11,000	3,300	<3.9	<4.6	<5.2	<5.2	<5.2	<4.8	<4.8	<3.1	16	0.0015	5.2	<0.12
	12/9/2009	5	100	<6.0	--	1,100	<3.6	<4.2	<4.9	<4.9	<4.9	<4.4	<4.4	<2.9	16	<0.00022	4.9	<0.11
VW-5	9/17/2009	4.5	<2,800	<2,200	>1,100,000	12,000,000	<1,300	<1,600	<1,800	<1,800	<1,800	<1,600	<1,600	<1,000	1.3	10	11	<0.12
	12/9/2009	4.5	<750	<590	>1,200,000	7,400,000	<350	<410	<480	<480	<480	<440	<440	<280	1.2	8.3	8	<0.11
VW-6	9/17/2009	5	<8.6	<6.8	9,300	51,000	<4.0	<4.8	<5.5	<5.5	<5.5	<5.0	<5.0	<3.2	4.6	0.013	17	<0.13
	12/9/2009	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
VW-7	9/17/2009	4.3	13	<6.8	<3,300	940	<4.0	<4.8	<5.5	<5.5	<5.5	<5.0	<5.0	<3.2	3.8	<0.00025	13	<0.13
	12/9/2009	4.3	<7.6	<6.0	--	1,800	<3.6	<4.2	<4.9	<4.9	<4.9	<4.4	<4.4	<2.9	1.3	2.1	10	<0.11
VW-8	9/17/2009	5	<81	<64	21,000	100,000	<38	<45	<52	<52	<52	64	<47	1,600	1.2	1.5	17	<0.12
	12/9/2009	5	<16	<12	--	38,000	<7.4	<8.8	<10	<10	<10	46	<9.2	1,300	1.4	0.79	11	<0.12
VW-9	9/17/2009	5	<76	<60	73,000	520,000	<36	54	<49	51	<49	<44	<44	<29	2.5	9.5	7.5	<0.11
	12/9/2009	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
<i>Duplicate Samples</i>																		
VW-4-Dup (lab)	9/24/2009	--	--	--	--	--	--	--	--	--	--	--	--	--	16	0.0015	5.2	<0.12
VW-7-Dup (field)	9/17/2009	5	12	<6.8	<3,300	940	<4.0	<4.8	<5.5	<5.5	<5.5	<5.0	<5.0	<3.2	4.0	<0.00025	13	<0.13
VW-8-Dup (lab)	9/17/2009	--	<160	<130	--	110,000	<76	<90	<100	<100	<100	<94	<94	1,800	--	--	--	--
VW-9-Dup (lab)	9/24/2009	--	--	--	--	--	--	--	--	--	--	--	--	--	2.5	9.6	7.5	<0.11

**Abbreviations and Analyses:**

&lt;n = Not detected (ND) above laboratory detection limit, n.

&gt;n = Compound present at concentrations exceeding instrument calibration range, n.

ug/m<sup>3</sup> = Microgram per cubic meter.

% = Percent

-- = Not Analyzed, Not Available

ft = Measured in feet

TPHss by EPA Method TO-17

TPHg by EPA Method TO-15 GC/MS

Benzene, Toluene, Ethylbenzene, m,p&amp;o-Xylenes and five HVOCs by modified EPA Method TO-15 GC/MS

Oxygen, Methane, Carbon Dioxide, Helium by ASTM D-1946



TABLE 2

**SOIL ANALYTICAL RESULTS: PETROLEUM HYDROCARBONS AND LEAD**  
**JOHN NADY**  
**1137-1167 65TH STREET**  
**OAKLAND, CALIFORNIA**

Sample ID	Date Sampled	Sample Depth (ft)	TPHs			TPHnap	TPHg	Lead	Notes
			←	TPHd	TPHmo mg/kg				
MW-1C @6.5	5/10/2004	6.5	<1.0	<1.0	<5.0	--	<1.0	--	
MW-1C @9.5	5/10/2004	9.5	340	60	<5.0	--	160	--	
MW-1C @14.5	5/10/2004	14.5	--	10	<5.0	--	6	--	
MW-1C @20	5/10/2004	20	<1.0	<1.0	<5.0	--	<1.0	--	
MW-3A @15	5/7/2004	15	26	180	9.2	--	11	--	
MW-3B-5	8/10/2009	5	<1.0	<1.0	<5.0	--	<1.0	--	
MW-3C-10	8/13/2009	10	<1.0	<1.0	<5.0	--	<1.0	--	
MW-3C-15	8/13/2009	15	<1.0	2.4	13	--	<1.0	--	
MW-5B @5	5/18/2004	5	<1.0	<1.0	<5.0	--	<1.0	--	
MW-5B @10	5/18/2004	10	<1.0	<1.0	<5.0	--	<1.0	--	
MW-5B @15	5/18/2004	15	390	42	<5.0	--	410	--	
MW-5B @20	5/18/2004	20	<1.0	<1.0	<5.0	--	<1.0	--	
MW-5B @24	5/18/2004	24	<1.0	<1.0	<5.0	--	<1.0	--	
MW-6C @5.5	5/11/2004	5.5	11	810	1800	--	6	--	
MW-6C @11	5/11/2004	11	68	18	<5.0	--	29	--	
MW-6C @16	5/11/2004	16	230	16	<5.0	--	100	--	
MW-6C @21	5/11/2004	21	<1.0	<1.0	<5.0	--	<1.0	--	
MW-7C-7	8/14/2009	7	360	22	<5.0	--	200	--	c
MW-7C-8.5	8/14/2009	8.5	590	440	<5.0	--	330	--	c
MW-7C-10	8/14/2009	10	140	25	<5.0	--	74	--	c
SB-1-3.5	11/25/2002	3.5	1.7	170	860	--	2.6a,b	37	
SB-1-7.5	11/25/2002	7.5	<1.0	32	140	--	<1.0	5.8	
SB-2-3.5	11/25/2002	3.5	<1.0	<1.0	<5.0	--	<1.0	3.9	
SB-2-11.5	11/25/2002	11.5	<1.0	<1.0	<5.0	--	<1.0	6.8	

TABLE 2

**SOIL ANALYTICAL RESULTS: PETROLEUM HYDROCARBONS AND LEAD**  
**JOHN NADY**  
**1137-1167 65TH STREET**  
**OAKLAND, CALIFORNIA**

Sample ID	Date Sampled	Sample Depth (ft)	TPHs			TPHnap	TPHg	Lead	Notes
			←	TPHd	TPHmo mg/kg				
SB-3-7.5	11/25/2002	7.5	180	20	<5.0	--	190a	<3.0	
SB-3-11.5	11/25/2002	11.5	<1.0	<1.0	<5.0	--	<1.0	9.7	
SB-4-3.5	11/25/2002	3.5	<1.0	<1.0	<5.0	--	<1.0	3.1	
SB-4-7.5	11/25/2002	7.5	<1.0	2.1	15	--	<1.0	21	
SB-4-11.5	11/25/2002	11.5	3.6	4.8	5.9	--	4.0	3.9	
SB-5-7.5	11/25/2002	7.5	1,300	190	5	--	1,200a	4.2	
SB-5-11.5	11/25/2002	11.5	<1.0	<1.0	<5.0	--	<1.0	<3.0	
SB-7-3.5	11/25/2002	3.5	750	250	16	--	810a	8.5	
SB-7-7.5	11/25/2002	7.5	350	79	13	--	380a	6.1	
SB-7-17.5	11/25/2002	17.5	830	470	18	--	890a	6.6	
SB-8-3	11/25/2002	3.0	3,600	2,500	<500	--	3,500a	6.1	
SB-8-6	11/25/2002	6.0	6,600	2,900	<500	--	6,400a	7.5	
SB-8-9	11/25/2002	9.0	380	58	6.3	--	380a	7.5	
SB-9-6	11/25/2002	6.0	9.4	2.8	<5.0	--	9.5a	6.4	
SB-9-9	11/25/2002	9.0	<1.0	<1.0	<5.0	--	<1.0	6.0	
SB-10-3	11/25/2002	3.0	<1.0	<1.0	<5.0	--	<1.0	5.0	
SB-10-6	11/25/2002	6.0	140	70	<5.0	--	140a	6.4	
SB-10-9	11/25/2002	9.0	140	96	<5.0	--	180a	<3.0	
SB-10-12	11/25/2002	12.0	<1.0	<1.0	<5.0	--	<1.0	<3.0	
SB-11-7.5	11/25/2002	7.5	<1.0	<1.0	<5.0	--	<1.0	9.1	
SB-13 @6.0	1/5/2004	6	150	21	<5.0	--	140	--	
SB-13 @11.5	1/5/2004	11.5	260	41	<5.0	--	260	--	
SB-14A @7.5	1/9/2004	7.5	100	64	<5.0	--	210	--	
SB-14A @11.5	1/9/2004	11.5	<1.0	<1.0	<5.0	--	<1.0	--	
SB-15A @7.5	1/12/2004	7.5	820	190	9.3	--	1,500	--	

TABLE 2

**SOIL ANALYTICAL RESULTS: PETROLEUM HYDROCARBONS AND LEAD**  
**JOHN NADY**  
**1137-1167 65TH STREET**  
**OAKLAND, CALIFORNIA**

<i>Sample ID</i>	<i>Date Sampled</i>	<i>Sample Depth (ft)</i>	<i>TPHs</i> ← →						<i>Lead</i>	<i>Notes</i>
			<i>TPHd</i>	<i>TPHmo</i> mg/kg	<i>TPHnap</i>	<i>TPHg</i>				
SB-15A @11.5	1/12/2004	11.5	<1.0	<1.0	<5.0	--	<1.0	--		
SB-16A @7.5	1/12/2004	7.5	49	59	<5.0	--	90	--		
SB-16A @11.5	1/12/2004	11.5	<1.0	<1.0	<5.0	--	<1.0	--		
SB-17B @3.5	1/8/2004	3.5	<1.0	110	210	--	<1.0	--		
SB-17B @7.5	1/8/2004	7.5	<1.0	<1.0	<5.0	--	<1.0	--		
SB-17B @11.5	1/8/2004	11.5	<1.0	<1.0	<5.0	--	<1.0	--		
SB-17B @17.0	1/8/2004	17.5	<1.0	<1.0	<5.0	--	<1.0	--		
SB-17B @20	1/8/2004	20	<1.0	1	5.5	--	<1.0	--		
SB-18A @3.5	1/6/2004	3.5	<1.0	<1.0	<5.0	--	<1.0	--		
SB-18A @7.5	1/6/2004	7.5	310	230	<50	--	340	--		
SB-18A @11.5	1/6/2004	11.5	6	9	<5.0	--	6	--		
SB-18A @17	1/6/2004	17	1,600	850	<100	--	2,600	--		
SB-18B @17.5	1/6/2004	17.5	990	660	<50	--	1,000	--		
SB-18B @20	1/9/2004	20	<1.0	<1.0	<5.0	--	<1.0	--		
SB-21A @3	1/20/2004	3.0	<1.0	<1.0	<5.0	--	<1.0	--		
SB-21A @6	1/20/2004	6.0	590.0	220.0	<25	--	590.0	--		
SB-21A @9	1/20/2004	9.0	450.0	270.0	<25	--	470.0	--		
SB-22A/C @3	1/7/2004	3.0	<1.0	1.1	<5.0	--	<1.0	--		
SB-22A/C @6	1/7/2004	6.0	220.0	230.0	11.0	--	410.0	--		
SB-22A/C @9	1/7/2004	9.0	220.0	150.0	6.7	--	400.0	--		
SB-23 @3	1/6/2004	3.0	<1.0	<1.0	<5.0	--	<1.0	--		
SB-23 @6	1/6/2004	6.0	<1.0	<1.0	<5.0	--	<1.0	--		
SB-23 @9	1/6/2004	9.0	<1.0	<1.0	<5.0	--	<1.0	--		

**SOIL ANALYTICAL RESULTS: PETROLEUM HYDROCARBONS AND LEAD**  
**JOHN NADY**  
**1137-1167 65TH STREET**  
**OAKLAND, CALIFORNIA**

Sample ID	Date Sampled	Sample Depth (ft)	TPHs			TPHnap	TPHg	Lead	Notes
			←	TPHd	TPHmo mg/kg				
SB-23 @6	1/6/2004	6.0	<1.0	<1.0	<5.0	--	<1.0	--	
SB-23 @9	1/6/2004	9.0	<1.0	<1.0	<5.0	--	<1.0	--	
SB-24 @3	1/5/2004	3.0	1000	1300	<250	--	980	--	
SB-24 @6	1/5/2004	6.0	420	220	8.9	--	430	--	
SB-24 @9	1/5/2004	9.0	43	54	<5.0	--	43	--	
SB-26A @7.5	1/7/2004	7.5	220	150	6.8	--	240	--	
SB-26A @11.5	1/7/2004	11.5	98	67	<5.0	--	180	--	
SB-26-10	8/12/2009	10	360	78	<5.0	--	220		
SB-26-16	8/12/2009	16	1.4	<1.0	<5.0	--	<1.0		
SB-27-20	8/12/2009	20	<1.0	<1.0	<5.0	--	<1.0		
SB-27-24	8/12/2009	24	<1.0	<1.0	<5.0	--	<1.0		
<i>Previous SCI Samples</i>									
Tank 1 Bottom	2/25/2002	--	74	69	--	58	110	--	
Tank 2 Bottom	2/25/2002	--	280	34	--	230	440	--	
Tank 3 Bottom	2/25/2002	--	940	220	--	750	1,500	--	
Tank 4 Bottom	2/25/2002	--	1,000	12	--	830	1,600	--	
E End @ 6'	2/26/2002	6.0	1,400	220	--	1,100	2,200	--	
W End @ 6'	2/26/2002	6.0	1,800	390	--	1,500	2,900	--	
Pipe #1	2/26/2002	--	<0.99	68	--	<0.99	<0.99	--	
Pipe #2	2/26/2002	--	<0.95	6.8	--	<0.95	<0.95	--	
Tank 5 E End	2/13/2002	--	11,000	1,000	--	8,400	17,000	--	
Tank 5 W End	2/13/2002	--	8,400	1,800	--	6,200	13,000	--	
Tank 6 N Wall	3/7/2002	2.0	<0.98	53	--	<0.98	<0.98	--	
Tank 6 S Wall	3/7/2002	5.0	270	260	--	140	310	--	

**SOIL ANALYTICAL RESULTS: PETROLEUM HYDROCARBONS AND LEAD  
JOHN NADY  
1137-1167 65TH STREET  
OAKLAND, CALIFORNIA**

<i>Sample ID</i>	<i>Date Sampled</i>	<i>Sample Depth (ft)</i>	<i>TPHss</i>	<i>TPHd</i>	<i>TPHmo</i> <i>mg/kg</i>	<i>TPHnap</i>	<i>TPHg</i>	<i>Lead</i>	<i>Notes</i>
Tank 6 E End	2/13/2002	--	300	670	--	240	470	--	
Tank 6 W End	2/13/2002	--	17,000	1,500	--	12,000	26,000	--	

**Abbreviations and Methods:**

mg/kg = Milligrams per kilogram

-- = Not sampled or not analyzed.

< n = Not Detected (ND) - Chemical not present at a concentration in excess of detection limit shown

TPHmo = Total petroleum hydrocarbons as motor oil by EPA Method 8015C with silica gel cleanup (C18-C36)

TPHd = Total petroleum hydrocarbons as diesel by EPA Method 8015C with silica gel cleanup (C10-C23)

TPHss = Total petroleum hydrocarbons as Stoddard solvent by EPA Method 8021B/8015Cm (C9-C12).

TPHg = Total petroleum hydrocarbons as gasoline by EPA Method 8021B/8015Cm (C6-C12).

TPHnap = Total petroleum hydrocarbons as naphtha by EPA Method 8015m/8020

Lead by EPA Method 6010C

a = Laboratory note: TPH pattern that does not appear to be derived from gasoline

b = Laboratory note: heavier gasoline range compounds are significant

c = Laboratory note: TPH pattern that does not appear to be derived from gaslone (stoddard solvent/mineral spirits)

TABLE 3

SOIL ANALYTICAL RESULTS: VOLATILE ORGANIC COMPOUNDS  
 JOHN NADY  
 1137-1167 65TH STREET  
 OAKLAND, CALIFORNIA

Sample ID	Date Sampled	Depth (ft)	ug/kg																		Notes				
			Benzene	Toluene	Ethylbenzene	Xylenes	MTBE	Tetrachloroethene	cis-1,2-Dichloroethene	Trichloroethene	Isopropylbenzene (Cumene)	n-Propylbenzene	1,3,5-Trimethylbenzene	1,2,4-Trimethylbenzene	sec-Butylbenzene	4-Isopropyl Toluene	n-Butylbenzene	Naphthalene	Styrene	Methylene Chloride		Acetone	2-Butanone (MEK)	4-methyl-2-pentanone (MIBK)	Vinyl Chloride
MW-1C @6.5	5/10/2004	6.5	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	
MW-1C @9.5	5/10/2004	9.5	<0.2	<0.2	<0.2	<0.2		<20	<20	<20	--	--	--	--	--	--	--	--	<20	--	--	--	<20	<20	
MW-1C @14.5	5/10/2004	14.5	<5.0	<5.0	<5.0	5.3		<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	
MW-1C @20	5/10/2004	20	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	
MW-3A @15	5/7/2004	15	<5.0	<5.0	<5.0	<5.0		<100	<100	<100	--	--	--	--	--	--	--	--	<100	--	--	--	<100	<100	
MW-3B-5	8/10/2009	5	<5.0	<5.0	<5.0	<5.0	<50		<5.0	<5.0	<5.0	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	Other VOCs ND
MW-3C-10	8/13/2009	10	<5.0	<5.0	<5.0	<5.0	<50		<5.0	<5.0	<5.0	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	Other VOCs ND
MW-3C-15	8/13/2009	15	<5.0	<5.0	<5.0	<5.0	<50		<5.0	<5.0	<5.0	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	Other VOCs ND
MW-5B @5	5/18/2004	5	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	
MW-5B @10	5/18/2004	10	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	
MW-5B @15	5/18/2004	15	<100	<100	<100	1400		<20	<20	<20	--	--	--	--	--	--	--	--	<20	--	--	--	<20	<20	
MW-5B @20	5/18/2004	20	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	
MW-5B @24	5/18/2004	24	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	
MW-6C @5.5	5/11/2004	5.5	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	
MW-6C @11	5/11/2004	11	<25	<25	<25	<25		<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	
MW-6C @16	5/11/2004	16	<50	<50	<50	<50		<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	
MW-6C @21	5/11/2004	21	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	
MW-7C-7	8/14/2009	7	<170	<170	<170	<170	<1,700		<5.0	<5.0	<5.0	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	Other VOCs ND
MW-7C-8.5	8/14/2009	8.5	<100	<100	<100	1000	<1,000		<5.0	<5.0	<5.0	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	Other VOCs ND
MW-7C-10	8/14/2009	10	<100	<100	<100	<100	<1,000		<5.0	<5.0	<5.0	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	Other VOCs ND
SB-1-3.5	11/25/2002	3.5	<5.0	37	16	120		44	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	9.6	36	<5.0	<5.0	<50	<10	<5.0	<5.0	ND	
SB-1-7.5	11/25/2002	7.5	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	150	<5.0	<5.0	<50	<10	<5.0	<5.0	ND	
SB-2-3.5	11/25/2002	3.5	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<50	<10	<5.0	<5.0	ND	
SB-2-11.5	11/25/2002	11.5	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<50	<10	<5.0	<5.0	ND	
SB-3-7.5	11/25/2002	7.5	<100	<100	<100	<100		<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<1,000	<200	<100	<100	<100	ND	
SB-3-11.5	11/25/2002	11.5	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<50	<10	<5.0	<5.0	ND	
SB-4-3.5	11/25/2002	3.5	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<50	<10	<5.0	<5.0	ND	
SB-4-7.5	11/25/2002	7.5	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<50	<10	<5.0	<5.0	ND	
SB-4-11.5	11/25/2002	11.5	<5.0	<5.0	7.4	11		<5.0	<5.0	<5.0	7.8	33	79	160	9.5	<5.0	59	<5.0	<5.0	<50	<10	<5.0	<5.0	ND	
SB-5-7.5	11/25/2002	7.5	<200	<200	<200	<200		<200	<200	<200	360	970	300	<200	1,700	260	1,600	<200	<200	<200	<2,000	<400	<200	ND	
SB-5-11.5	11/25/2002	11.5	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<50	<10	<5.0	<5.0	ND	
SB-7-3.5	11/25/2002	3.5	<100	<100	<100	<100		<100	<100	<100	<100	<100	<100	<100	<100	<100	200	<100	<100	<1,000	<200	<100	<100	ND	
SB-7-7.5	11/25/2002	7.5	<100	<100	<100	<100		<100	<100	<100	<100	<100	<100	<100	130	<100	<100	<100	<100	<1,000	<200	<100	<100	ND	
SB-7-17.5	11/25/2002	17.5	<100	<100	<100	<100		<100	<100	<100	<100	<100	<100	<100	470	<100	<100	<100	<100	<1,000	<200	<100	<100	ND	
SB-8-3	11/25/2002	3.0	<500	<500	<500	<500		<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<5,000	<1,000	<500	<500	ND	
SB-8-6	11/25/2002	6.0	<1,000	<1,000	<1,000	<1,000		<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<10,000	<2,000	<1,000	<1,000	ND	
SB-8-9	11/25/2002	9.0	<100	<100	<100	<100		<100	<100	<100	<100	<100	<100	<100	470	<100	<100	<100	<100	<1,000	<200	<100	<100	ND	
SB-9-6	11/25/2002	6.0	<10	<10	<10	<10		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<100	<20	<10	<10	<10	ND	

TABLE 3

SOIL ANALYTICAL RESULTS: VOLATILE ORGANIC COMPOUNDS  
 JOHN NADY  
 1137-1167 65TH STREET  
 OAKLAND, CALIFORNIA

Sample ID	Date Sampled	Depth (ft)	ug/kg																		Notes			
			Benzene	Toluene	Ethylbenzene	Xylenes	MTBE	Tetrachloroethene	cis-1,2-Dichloroethene	Trichloroethene	Isopropylbenzene (Cumene)	n-Propylbenzene	1,3,5-Trimethylbenzene	1,2,4-Trimethylbenzene	sec-Butylbenzene	4-Isopropyl Toluene	n-Butylbenzene	Naphthalene	Styrene	Methylene Chloride		Acetone	2-Butanone (MEK)	4-methyl-2-pentanone (MIBK)
SB-9-9	11/25/2002	9.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<5.0	ND	
SB-10-3	11/25/2002	3.0	<5.0	<5.0	<5.0	<5.0	56	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<5.0	ND	
SB-10-6	11/25/2002	6.0	<50	<50	<50	<50	<50	<50	<50	100	<50	<50	260	71	260	<50	<50	<50	<500	<100	<50	ND		
SB-10-9	11/25/2002	9.0	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<5,000	<1,000	<500	ND	
SB-10-12	11/25/2002	12.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<5.0	18	
SB-11-7.5	11/25/2002	7.5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<5.0	ND	
SB-13 @6.0	1/5/2004	6	<50	<50	<50	<50	<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0
SB-13 @11.5	1/5/2004	11.5	<100	<100	<100	<100	<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0
SB-14A @7.5	1/9/2004	7.5	640	390	1800	5000	<400	<400	<400	--	--	--	--	--	--	--	--	--	<400	--	--	--	<400	<400
SB-14A @11.5	1/9/2004	11.5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0
SB-15A @7.5	1/12/2004	7.5	<1000	<1000	<1000	2400	<400	<400	<400	--	--	--	--	--	--	--	--	--	<400	--	--	--	<400	<400
SB-15A @11.5	1/12/2004	11.5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0
SB-16A @7.5	1/12/2004	7.5	<50	<50	69	110	<100	<100	<100	--	--	--	--	--	--	--	--	--	<100	--	--	--	<100	<100
SB-16A @11.5	1/12/2004	11.5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0
SB-17B @3.5	1/8/2004	3.5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0
SB-17B @7.5	1/8/2004	7.5	<5.0	<5.0	<5.0	<5.0	<5.0	8.3	<5.0	--	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0
SB-17B @11.5	1/8/2004	11.5	<5.0	<5.0	<5.0	<5.0	<5.0	180	<5.0	--	--	--	--	--	--	--	--	--	<5.0	--	--	--	8.3	7.4
SB-17B @17.0	1/8/2004	17.5	<5.0	<5.0	<5.0	<5.0	<5.0	170	<10	--	--	--	--	--	--	--	--	--	<10	--	--	--	<10	<10
SB-17B @20	1/8/2004	20	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0
SB-18A @3.5	1/6/2004	3.5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0
SB-18A @7.5	1/6/2004	7.5	<200	<200	310	1600	<400	<400	<400	--	--	--	--	--	--	--	--	--	<400	--	--	--	<400	<400
SB-18A @11.5	1/6/2004	11.5	<5.0	<5.0	<5.0	15	<50	<50	<50	--	--	--	--	--	--	--	--	--	<50	--	--	--	<50	<50
SB-18A @17	1/6/2004	17	<200	<200	1100	6500	<400	<400	<400	--	--	--	--	--	--	--	--	--	<400	--	--	--	<400	<400
SB-18B @17.5	1/6/2004	17.5	<250	<250	570	2900	<400	<400	<400	--	--	--	--	--	--	--	--	--	<400	--	--	--	<400	<400
SB-18B @20	1/9/2004	20	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0
SB-21A @3	1/20/2004	3.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0
SB-21A @6	1/20/2004	6.0	<100	<100	<100	<100	<100	<100	<100	--	--	--	--	--	--	--	--	--	<100	--	--	--	<100	<100
SB-21A @9	1/20/2004	9.0	<200	<200	230	<200	<200	<200	<200	--	--	--	--	--	--	--	--	--	<200	--	--	--	<200	<200
SB-22A/C @3	1/7/2004	3.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0
SB-22A/C @6	1/7/2004	6.0	<200	<200	<200	670	<400	<400	<400	--	--	--	--	--	--	--	--	--	<400	--	--	--	<400	<400
SB-22A/C @9	1/7/2004	9.0	<200	<200	<200	770	<100	<100	<100	--	--	--	--	--	--	--	--	--	<100	--	--	--	<100	<100
SB-23 @3	1/6/2004	3.0	<5.0	<5.0	<5.0	<5.0	13	<5.0	<5.0	--	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0
SB-23 @6	1/6/2004	6.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0
SB-23 @9	1/6/2004	9.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0
SB-24 @3	1/5/2004	3.0	<500	<500	<500	<500	<400	<400	<400	--	--	--	--	--	--	--	--	--	<400	--	--	--	<400	<400
SB-24 @6	1/5/2004	6.0	<200	<200	240	<200	<400	<400	<400	--	--	--	--	--	--	--	--	--	<400	--	--	--	<400	<400

TABLE 3

SOIL ANALYTICAL RESULTS: VOLATILE ORGANIC COMPOUNDS  
 JOHN NADY  
 1137-1167 65TH STREET  
 OAKLAND, CALIFORNIA

Sample ID	Date Sampled	Depth (ft)	ug/kg																		Notes						
			Benzene	Toluene	Ethylbenzene	Xylenes	MTBE	Tetrachloroethene	cis-1,2-Dichloroethene	Trichloroethene	Isopropylbenzene (Cumene)	n-Propylbenzene	1,3,5-Trimethylbenzene	1,2,4-Trimethylbenzene	sec-Butylbenzene	4-Isopropyl Toluene	n-Butylbenzene	Naphthalene	Styrene	Methylene Chloride		Acetone	2-Butanone (MEK)	4-methyl-2-pentanone (MIBK)	Vinyl Chloride	1,2-Dichloropropane	
SB-24 @9	1/5/2004	9.0	<50	<50	<50	<50		<50	<50	<50	--	--	--	--	--	--	--	--	<50	--	--	--	<50	<50			
SB-26A @7.5	1/7/2004	7.5	<200	<200	<200	<200		<100	<100	<100	--	--	--	--	--	--	--	--	<100	--	--	--	<100	<100			
SB-26A @11.5	1/7/2004	11.5	<200	<200	<200	330		<50	<50	<50	--	--	--	--	--	--	--	--	<50	--	--	--	<50	<50			
SB-26-10	8/12/2009	10	<250	<250	<250	<250	<250	<20	<20	<20	--	--	--	--	--	--	--	--	<20	--	--	--	<20	<20	Other VOCs ND		
SB-26-16	8/12/2009	16	<5.0	<5.0	<5.0	<5.0	<50	<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	Other VOCs ND		
SB-27-20	8/12/2009	20	<5.0	<5.0	<5.0	<5.0	<50	<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	Other VOCs ND		
SB-27-24	8/12/2009	24	<5.0	<5.0	<5.0	<5.0	<50	<5.0	<5.0	<5.0	--	--	--	--	--	--	--	--	<5.0	--	--	--	<5.0	<5.0	Other VOCs ND		
<i>Previous SCI Samples</i>																											
Tank 1 Bottom	2/25/2002	--	<130	<130	<130	<130		<130	<130	<130	<130	<130	<130	230	<130	<130	<130	<130	<130	<130	<130	<130	<130	<130	<130		
Tank 2 Bottom	2/25/2002	--	<250	<250	<250	<250		<250	<250	<250	<250	<250	300	680	290	370	550	<250	<250	<250	<250	<250	<250	<250	<250		
Tank 3 Bottom	2/25/2002	--	<250	<250	<250	<250		310	<250	<250	<250	570	680	1,600	960	930	1,500	<250	<250	<250	<250	<250	<250	<250	<250		
Tank 4 Bottom	2/25/2002	--	<250	<250	<250	<250		<250	<250	<250	740	1,700	<250	840	2,100	940	1,900	660	<250	<250	<250	<250	<250	<250	<250		
E End @ 6'	2/25/2002	6.0	<250	<250	<250	950		<250	<250	<250	1,300	3,200	<250	<250	1,700	920	2,400	<250	<250	<250	<250	<250	<250	<250	<250		
W End @ 6'	2/25/2002	6.0	<250	<250	<250	<250		<250	<250	<250	520	1,300	1,100	<250	1,700	890	1,700	<250	<250	<250	<250	<250	<250	<250	<250		
Pipe #1	2/25/2002	--	<5.0	<5.0	<5.0	<5.0		<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0		
Pipe #2	2/25/2002	--	<4.9	<4.9	<4.9	<4.9		<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9		
Tank 5 E End	3/7/2002	--	<2,000	<2,000	8,600	<2,000		<2,000	<2,000	<2,000	5,600	16,000	25,000	63,000	13,000	9,900	14,000	<2,000	<2,000	<2,000	<2,000	<2,000	<2,000	<2,000	<2,000		
Tank 5 W End	3/7/2002	--	<1,700	<1,700	5,900	<1,700		<1,700	<1,700	<1,700	4,100	11,000	17,000	47,000	9,600	8,500	1,000	<1,700	<1,700	<1,700	<1,700	<1,700	<1,700	<1,700	<1,700		
Tank 6 N Wall	3/7/2002	2.0	<4.7	<4.7	<4.7	<4.7		<4.7	<4.7	<4.7	<4.7	<4.7	<4.7	<4.7	<4.7	<4.7	<4.7	<4.7	<4.7	<4.7	<4.7	<4.7	<4.7	<4.7	<4.7		
Tank 6 S Wall	3/7/2002	5.0	<4.8	<4.8	<4.8	<4.8		<4.8	<4.8	<4.8	<4.8	<4.8	<4.8	<4.8	<4.8	<4.8	<4.8	<4.8	<4.8	<4.8	<4.8	<4.8	<4.8	<4.8	<4.8		
Tank 6 E End	3/7/2002	--	<420	<420	<420	<420		<420	<420	<420	<420	<420	<420	1,600	2,100	<420	510	<420	<420	<420	<420	<420	<420	<420	<420		
Tank 6 W End	3/7/2002	--	<3,100	<3,100	<3,100	<3,100		<3,100	<3,100	<3,100	8,500	24,000	46,000	100,000	30,000	27,000	<3,100	<3,100	<3,100	<3,100	<3,100	<3,100	<3,100	<3,100	<3,100		

**Abbreviations and Methods:**

ug/kg = Micrograms per kilogram

-- = Not sampled or not analyzed.

< n = Not Detected (ND) - Chemical not present at a concentration in excess of detection limit shown

ND = None detected above laboratory reporting limit, see laboratory report for individual reporting limits.

Volatile organic compounds by EPA Method 8260B (8010)



TABLE 4

**GRAB GROUNDWATER ANALYTICAL RESULTS: PETROLEUM HYDROCARBONS**  
**JOHN NADY**  
**1137-1167 65TH STREET**  
**OAKLAND, CALIFORNIA**

Boring ID (TOC)	Date Sampled	Groundwater Zone	Sample Collection Depth (ft bgs)	Groundwater Elevation (ft msl)	Depth to Water (ft, TOC)	TPH				Notes
						TPH <sub>ss</sub>	TPH <sub>d</sub> ug/L	TPH <sub>mo</sub>	TPH <sub>g</sub>	
SB-1	11/25/2002	A-Zone	---	35.39	3.45	---	---	---	---	
(38.84)	11/26/2002	A-Zone	---	35.44	3.40	ND<50	2,000	7,500	58	
SB-2	11/25/2002	C-Zone	---	11.61	29.50	---	---	---	---	
(41.11)	11/26/2002	C-Zone	---	29.46	11.65	ND<50	ND<50	ND<250	ND<50	
SB-4	11/25/2002	A-Zone	---	34.02	6.90	---	---	---	---	
(40.92)	11/26/2002	A-Zone	---	34.82	6.10	---	---	---	---	SPH
SB-6	11/25/2002	A-Zone	---	28.24	11.25	---	---	---	---	
(39.49)	11/26/2002	A-Zone	---	32.19	7.30	7,800	23,000	620	8,700	a,b,c
SB-7	11/25/2002	B-Zone	---	28.20	10.30	---	---	---	---	
(38.50)	11/26/2002	B-Zone	---	30.10	8.40	5,800	120,000	<25,000	6,100	a,b,c
SB-8	11/25/2002	A-Zone	---	36.30	4.70	---	---	---	---	
(41.00)	11/26/2002	A-Zone	---	36.55	4.65	100,000	1,200,000	ND<250,000	110,000	a,b,c
SB-9	11/25/2002	C-Zone	---	16.02	25.00	---	---	---	---	
(41.02)	11/26/2002	C-Zone	---	17.07	23.95	ND<50	50	300	ND<50c	
SB-10	11/25/2002	A-Zone	---	29.27	11.60	---	---	---	---	
(40.87)	11/26/2002	A-Zone	---	31.12	9.75	200	350	ND<250	260a,c	
SB-11	11/25/2002	C-Zone	---	12.15	29.30	---	---	---	---	
(41.45)	11/26/2002	C-Zone	---	19.55	21.90	ND<50	ND<50	ND<250	ND<50	
SB-12A	1/13/2004	A-Zone	---	---	4.5	ND<50	130	300	230	h,c,e,d,f
SB-14A	1/9/2004	A-Zone	---	---	4.0	ND<50	ND<50	ND<250	ND<50	c
SB-14C	1/9/2004	C-Zone	---	---	NW	---	---	---	---	

TABLE 4

**GRAB GROUNDWATER ANALYTICAL RESULTS: PETROLEUM HYDROCARBONS**  
**JOHN NADY**  
**1137-1167 65TH STREET**  
**OAKLAND, CALIFORNIA**

Boring ID (TOC)	Date Sampled	Groundwater Zone	Sample Collection Depth (ft bgs)	Groundwater Elevation (ft msl)	Depth to Water (ft, TOC)	TPH <sub>ss</sub>	TPH <sub>d</sub>		TPH <sub>mo</sub>	TPH <sub>g</sub>	Notes
							←————— ug/L —————→				
SB-15A	1/12/2004	A-Zone	---	---	4.0	2,500	2,400	290	2,700	a,c,d	
SB-16A	1/12/2004	A-Zone	---	---	4.0	1,500	23,000	9,800	1,700	a,b,c,d,e,i	
SB-17A	1/13/2004	A-Zone	---	---	NW	---	---	---	---		
SB-17B	1/8/2004	B-Zone	---	---	16.5	ND<50	95	ND<250	120	c,d,f,g	
SB-17C	1/13/2004	C-Zone	---	---	NW	---	---	---	---		
SB-18A	1/6/2004	A-Zone	---	---	1.5	2,100	11,000	ND<2,500	3,900	d,b	
SB-18B*	1/9/2004	C-Zone	---	---	25.0	ND<50	92	ND<250	250	g,h	
SB-18C	1/9/2004	C-Zone	---	---	34.0	170	---	---	300	c,g,h	
SB-19A	1/13/2004	A-Zone	---	---	NW	---	---	---	---		
SB-20A	1/13/2004	A-Zone	---	---	8.0	610	1400	ND<250	680	b,d,j	
SB-20C	1/13/2004	C-Zone	---	---	31.0	ND<50	ND<50	ND<250	ND<50	c	
SB-21A	1/20/2004	A-Zone	---	---	8.5	5,600	110000	<25,000	6,100	a,b,i,k	
SB-22A	1/7/2004	A-Zone	---	---	NW	---	---	---	---		
SB-22C	1/7/2004	C-Zone	---	---	--	ND<50	110	ND<250	ND<50	c,f	
SB-25A	1/8/2004	A-Zone	---	---	5.0	ND<50	64	ND<250	ND<50	c,f,g	
SB-25C	1/8/2004	C-Zone	---	---	29.0	ND<50	ND<50	ND<250	ND<50	c	
SB-26A	1/7/2004	A-Zone	---	---	4.0	2,600	5300	1000	3,000	c,d,e	
SB-26-12-W	8/17/2009	A-Zone	12	---	---	75	NA	ND<250	65	j	
SB-26-24-W	8/17/2009	B-Zone	24	---	---	ND<50	ND<50	ND<250	ND<50		
SB-26-40-W	8/17/2009	C-Zone	40	---	---	ND<50	ND<50	ND<250	ND<50		

## GRAB GROUNDWATER ANALYTICAL RESULTS: PETROLEUM HYDROCARBONS

JOHN NADY  
1137-1167 65TH STREET  
OAKLAND, CALIFORNIA

Boring ID (TOC)	Date Sampled	Groundwater Zone	Sample Collection Depth (ft bgs)	Groundwater Elevation (ft msl)	Depth to Water (ft, TOC)	TPH		TPH <sub>mo</sub>	TPH <sub>g</sub>	Notes
						← TPH <sub>ss</sub>	TPH <sub>d</sub> → ug/L			
SB-26-40-W	8/14/2009	C-Zone	40	---	---	ND<50	**	**	ND<50	
SB-27-12-W	8/12/2009	A-Zone	---	---	---	Dry, No Sample				
SB-27-24-W	8/12/2009	B-Zone	24	---	---	ND<50	ND<50	ND<250	ND<50	
SB-27-40-W	8/12/2009	C-Zone	40	---	---	ND<50	57	250	ND<50	e,f
SB-28-12-W	8/17/2009	A-Zone	---	---	---	Dry, No Sample				
SB-28-24-W	8/17/2009	B-Zone	24	---	---	760	ND<50	ND<250	530	a
SB-28-35-W	8/17/2009	C-Zone	35	---	---	ND<50	ND<50	ND<250	ND<50	
CPT-11-W	8/17/2009	"D-Zone"	56-60	---	---	ND<50	ND<50	ND<250	ND<50	
<i>Previous SCI Samples</i>										
Interior	2/20/2002		---	---	---	13,000	94000	---	21,000	
Exterior	2/25/2002		---	---	---	42,000	82000	---	66,000	

**Abbreviations and Notes:**

mg/L = micrograms per liter

(TOC) = Top of temporary casing in feet above mean seal level.

ft msl = Feet above mean sea level.

ft bgs = feet below ground surface

ND&lt;n = Not Detected above detection limit cited (n represents the reported detection limit)

--- = Not available, not analyzed, or does not apply.

NW = No groundwater for sample.

TPH<sub>mo</sub> = Total petroleum hydrocarbons as motor oil by EPA Method 8015C with silica gel cleanup (C18-C36)TPH<sub>d</sub> = Total petroleum hydrocarbons as diesel by EPA Method 8015C with silica gel cleanup (C10-C23)TPH<sub>ss</sub> = Total petroleum hydrocarbons as Stoddard solvent by EPA Method 8021B/8015Cm (C9-C12)TPH<sub>g</sub> = Total petroleum hydrocarbons as gasoline by EPA Method 8021B/8015Cm (C6-C12)

**GRAB GROUNDWATER ANALYTICAL RESULTS: PETROLEUM HYDROCARBONS  
JOHN NADY  
1137-1167 65TH STREET  
OAKLAND, CALIFORNIA**

<i>Boring ID</i> (TOC)	<i>Date</i> <i>Sampled</i>	<i>Groundwater Zone</i>	<i>Sample</i> <i>Collection</i> <i>Depth</i> (ft bgs)	<i>Groundwater</i> <i>Elevation</i> (ft msl)	<i>Depth to</i> <i>Water</i> (ft, TOC)	<i>TPH<sub>ss</sub></i>	<i>TPH<sub>d</sub></i> ←————— ug/L	<i>TPH<sub>mo</sub></i>	<i>TPH<sub>g</sub></i> —————→	<i>Notes</i>
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Grab groundwater samples may have been collected without protection against cross contamination between groundwater zones; may not be discrete.

A-Zone ~3.5 to 12 ft below grade (bg)

B-Zone ~13 to 24 ft bg

C-Zone ~25 to 40 ft bg

\* = Sample SB-18B collected in the C-zone

\*\* = Insufficient volume of groundwater to sample for analysis.

a = Laboratory note: TPH pattern that does not appear to be derived from gasoline (Stoddard solvent/mineral spirit?)

b = Laboratory note: lighter than water immiscible sheen/product is present

c = Laboratory note: liquid sample that contains greater than ~2 vol. % sediment

d = Laboratory note: gasoline range compounds are significant

e = Laboratory note: oil range compounds are significant

f = Laboratory note: diesel range compounds are significant; no recognizable pattern

g = Laboratory note: one to a few isolated non-target peaks present

h = Laboratory note: unmodified or weakly modified gasoline is significant

i = Laboratory note: sample diluted due to high organic content

j = Laboratory note: strongly aged gasoline or diesel range compounds are significant

k = Laboratory note: stoddard solvent/mineral spirit

TABLE 5

GRAB GROUNDWATER ANALYTICAL RESULTS: VOLATILE ORGANIC COMPOUNDS  
 JOHN NADY  
 1137-1167 65TH STREET  
 OAKLAND, CALIFORNIA

Boring ID (TOC)	Date Sampled	Groundwater Zone	Groundwater Elevation (ft msl)	Depth to Water (ft)	Benzene	Toluene	Ethylbenzene	Xylenes	MTBE	Chloroethane	1,1,2,2-Tetrachloroethane	Tetrachloroethene	Trichloroethene	1,2-Dichlorobenzene	cis-1,2-Dichloroethene	1,1-Dichloroethane	1,2-Dichloroethane	Vinyl Chloride	Notes
					ug/L														
Soil Boring Grab Groundwater Samples																			
SB-1	11/25/2002	A-Zone	35.39	3.45	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
(38.84)	11/26/2002	A-Zone	35.44	3.40	1.7	3.2	0.55	3.6		ND<0.5	ND<0.5	1.2	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	j,o
SB-2	11/25/2002	C-Zone	11.61	29.50	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
(41.11)	11/26/2002	C-Zone	29.46	11.65	ND<0.5	ND<0.5	ND<0.5	ND<0.5		ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	o
SB-4	11/25/2002	A-Zone	34.02	6.90	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
(40.92)	11/26/2002	A-Zone	34.82	6.10	---	---	---	---	---	---	---	---	---	---	---	---	---	---	SPH
SB-6	11/25/2002	A-Zone	28.24	11.25	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
(39.49)	11/26/2002	A-Zone	32.19	7.30	2.1	1.2	ND<0.5	0.55		3.8	ND<0.5	ND<0.5	ND<0.5	ND<0.5	1.2	1.4	ND<0.5	0.90	a,n,o
SB-7	11/25/2002	B-Zone	28.20	10.30	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
(38.50)	11/26/2002	B-Zone	30.10	8.40	ND<0.5	0.74	ND<0.5	3		16	16	ND<0.5	ND<0.5	ND<0.5	ND<0.5	1.7	ND<0.5	1.3	a,n,o
SB-8	11/25/2002	A-Zone	36.30	4.70	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
(41.00)	11/26/2002	A-Zone	36.55	4.65	ND<10	ND<10	ND<10	ND<10		ND<10	ND<10	ND<10	ND<10	20	ND<10	ND<10	ND<10	ND<10	a,n,o
SB-9	11/25/2002	C-Zone	16.02	25.00	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
(41.02)	11/26/2002	C-Zone	17.07	23.95	ND<0.5	0.88	ND<0.5	ND<0.5		ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	o
SB-10	11/25/2002	A-Zone	29.27	11.60	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
(40.87)	11/26/2002	A-Zone	31.12	9.75	ND<2.5	3.4	ND<2.5	ND<2.5		ND<2.5	ND<2.5	ND<2.5	ND<2.5	ND<2.5	170	19	ND<2.5	45	a,o
SB-11	11/25/2002	C-Zone	12.15	29.30	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
(41.45)	11/26/2002	C-Zone	---	21.90	ND<0.5	ND<0.5	ND<0.5	ND<0.5		ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	
Trip Blank	11/26/2002		---	---	ND<0.5	ND<0.5	ND<0.5	ND<0.5		ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	
SB-12A	1/13/2004	A-Zone	---	4.5	ND<0.5	2.0	ND<0.5	ND<0.5		ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	a,i,o
SB-14A	1/9/2004	A-Zone	---	4.0	0.58	ND<0.5	ND<0.5	ND<0.5		ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	i,o
SB-14C	1/9/2004	C-Zone	---	NW	---	---	---	---		---	---	---	---	---	---	---	---	---	
SB-15A	1/12/2004	A-Zone	---	4.0	ND<0.5	ND<0.5	ND<0.5	17		ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	e,i,o
SB-16A	1/12/2004	A-Zone	---	4.0	0.65	0.51	1.3	7.7		ND<2.5	ND<2.5	ND<2.5	ND<2.5	ND<2.5	ND<2.5	ND<2.5	ND<2.5	ND<2.5	e, h,i,p,n,o
SB-17A	1/13/2004	A-Zone	---	NW	---	---	---	---		---	---	---	---	---	---	---	---	---	
SB-17B	1/8/2004	B-Zone	---	16.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5		<50	<50	<50	<50	<50	1,100	<50	<50	<50	f,i,o
SB-17C	1/13/2004	C-Zone	---	NW	---	---	---	---		---	---	---	---	---	---	---	---	---	

TABLE 5

GRAB GROUNDWATER ANALYTICAL RESULTS: VOLATILE ORGANIC COMPOUNDS  
 JOHN NADY  
 1137-1167 65TH STREET  
 OAKLAND, CALIFORNIA

Boring ID (TOC)	Date Sampled	Groundwater Zone	Groundwater Elevation (ft msl)	Depth to Water (ft)	Benzene	Toluene	Ethylbenzene	Xylenes	MTBE	Chloroethane	1,1,2,2-Tetrachloroethane	Tetrachloroethene	Trichloroethene	1,2-Dichlorobenzene	cis-1,2-Dichloroethene	1,1-Dichloroethane	1,2-Dichloroethane	Vinyl Chloride	Notes
					ug/L														
SB-18A	1/6/2004	A-Zone	---	1.5	ND<5.0	ND<5.0	ND<5.0	<b>11</b>		ND<2.5	ND<2.5	ND<2.5	ND<2.5	ND<2.5	ND<2.5	ND<2.5	ND<2.5	ND<2.5	e,h,p,n
SB-18B*	1/9/2004	C-Zone	---	25.0	<b>0.54</b>	ND<0.5	ND<0.5	<b>0.64</b>		ND<100	ND<100	<b>630</b>	<b>430</b>	ND<100	1,800	ND<100	ND<100	ND<100	a,f
SB-18C	1/9/2004	C-Zone	---	34.0	<b>0.82</b>	ND<0.5	ND<0.5	<b>1.3</b>		<50	<50	<b>300</b>	<b>250</b>	<50	1,200	<50	<50	<50	a,f,i,o
SB-19A	1/13/2004	B-Zone	---	NW	---	---	---	---		---	---	---	---	---	---	---	---	---	
SB-20A	1/13/2004	A-Zone	---	8.0	ND<0.5	ND<0.5	ND<0.5	<b>3.3</b>		ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	g,h,n
SB-20C	1/13/2004	C-Zone	---	31.0	ND<0.5	ND<0.5	ND<0.5	ND<0.5		ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	i,o
SB-21A	1/20/2004	A-Zone	---	8.5	ND<5.0	ND<5.0	ND<5.0	ND<5.0		<50	<50	<50	<50	<50	<50	<50	<50	<50	e,h,p,n
SB-22A	1/7/2004	A-Zone	---	NW	---	---	---	---		---	---	---	---	---	---	---	---	---	
SB-22C	1/7/2004	C-Zone	---	--	ND<0.5	ND<0.5	ND<0.5	ND<0.5		ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	i, o
SB-25A	1/8/2004	A-Zone	---	5.0	ND<0.5	ND<0.5	ND<0.5	ND<0.5		ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	i, o
SB-25C	1/8/2004	C-Zone	---	29.0	ND<0.5	ND<0.5	ND<0.5	ND<0.5		ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	i, o
SB-26A	1/7/2004	A-Zone	---	4.0	<b>6.2</b>	ND<5.0	ND<5.0	<b>13</b>		ND<0.5	ND<0.5	ND<5.0	ND<5.0	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5.0	i,e,o,p
SB-26-12-W	8/17/2009	A-Zone	---	---	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5.0	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	
SB-26-24-W	8/17/2009	B-Zone	---	---	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5.0	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	
SB-26-40-W	8/17/2009	C-Zone	---	---	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5.0	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	
SB-26-40-W	8/14/2009	C-Zone	---	---	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5.0	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	
SB-27-12-W	8/12/2009	A-Zone	---	NW	---	---	---	---		---	---	---	---	---	---	---	---	---	
SB-27-24-W	8/12/2009	B-Zone	---	---	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5.0	ND<0.5	ND<0.5	ND<0.5	<b>7.5</b>	ND<0.5	ND<0.5	<b>0.97</b>	ND<0.5	ND<0.5	Carbon Tetrachloride = 0.59
SB-27-40-W	8/12/2009	C-Zone	---	---	ND<0.5	<b>2.6</b>	ND<0.5	ND<0.5	ND<5.0	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	Carbon Tetrachloride = 0.56
SB-28-12-W	8/17/2009	A-Zone	---	NW	---	---	---	---		---	---	---	---	---	---	---	---	---	
SB-28-24-W	8/17/2009	B-Zone	---	---	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5.0	ND<0.5	ND<0.5	ND<0.5	<b>5.0</b>	ND<0.5	<b>0.56</b>	ND<0.5	ND<0.5	ND<0.5	
SB-28-35-W	8/17/2009	C-Zone	---	---	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5.0	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	
CPT-11-W	8/17/2009	56-60 fbg "D-Zone"	---	---	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<5.0	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	ND<0.5	
Previous SCI Samples																			
Interior	2/20/2002		---	---	<b>47</b>	ND<5.0	<b>9.4</b>	<b>114</b>			ND<5.0	ND<5.0		ND<5.0				ND<5.0	

TABLE 5

GRAB GROUNDWATER ANALYTICAL RESULTS: VOLATILE ORGANIC COMPOUNDS  
 JOHN NADY  
 1137-1167 65TH STREET  
 OAKLAND, CALIFORNIA

Boring ID (TOC)	Date Sampled	Groundwater Zone	Groundwater Elevation (ft msl)	Depth to Water (ft)	Benzene	Toluene	Ethylbenzene	Xylenes	MTBE	Chloroethane	1,1,2,2-Tetrachloroethane	Tetrachloroethene	Trichloroethene	1,2-Dichlorobenzene	cis-1,2-Dichloroethene	1,1-Dichloroethane	1,2-Dichloroethane	Vinyl Chloride	Notes
Exterior	2/20/2002		---	---	ND<7.1	ND<7.1	ND<7.1	24			83	ND<7.1		9.6				ND<7.1	

**Abbreviations and Notes:**

mg/L = micrograms per liter

(TOC) = Top of temporary casing in feet above mean seal level.

ft msl = Feet above mean sea level.

ftb = feet below grade (surface).

ND<0.5 = Not Detected above detection limit cited.

--- = Not available, not analyzed, or does not apply

NW = No groundwater for sample.

Volatile organic compounds by EPA Method 8260B

Grab groundwater samples may have been collected without protection against cross contamination between groundwater zones; may not be discrete.

A-Zone ~3.5 to 12 ft below grade (bg)

B-Zone ~13 to 24 ft bg

C-Zone ~25 to 40 ft bg

\* = Sample 18B collected in the C-zone

a = TPH pattern that does not appear to be derived from gasoline

b = No recognizable pattern.

c = Stoddard solvent/mineral spirit.

d = Diesel range compounds are significant; no recognizable pattern.

e = Gasoline range compounds are significant.

f = One to a few isolated peaks present

g = Oil range compounds are significant.

h = Lighter than water immiscible sheen/product is present.

i = Liquid sample contains greater than ~1 vol. % sediment.

j = Unmodified or weakly modified gasoline is significant

k = TPHg range non-target isolated peaks subtracted out of the TPHg concentration

APPENDIX A

REGULATORY CORRESPONDENCE



**Foss, Bob (Robert)**

---

**From:** Jakub, Barbara, Env. Health [barbara.jakub@acgov.org]  
**Sent:** Thursday, March 18, 2010 3:32 PM  
**To:** Foss, Bob (Robert)  
**Cc:** schrag@nady.com  
**Subject:** RE: Nady Property, 1137-1167 65th St, Oakland

Dear Mr. Schrag and Mr. Foss,

You may prepare a work plan for the site. However, since we have not reviewed the previous work including the Investigation plan that we received on March 1, 2010, we have not agreed with the recommendations in that report. Modifications to the work plan may be required after the investigation report and work plan are reviewed.

Regards,

Barbara Jakub, P.G.  
Alameda County Environmental Health  
(510) 639-1287 (direct)  
(510) 337-9335 (fax)  
[barbara.jakub@acgov.org](mailto:barbara.jakub@acgov.org)

Online case files are available at the website below  
<http://www.acgov.org/aceh/lop/resources.htm>

---

**From:** Foss, Bob (Robert) [mailto:bfoss@croworld.com]  
**Sent:** Thursday, March 18, 2010 11:52 AM  
**To:** Jakub, Barbara, Env. Health  
**Cc:** schrag@nady.com  
**Subject:** Nady Property, 1137-1167 65th St, Oakland

Ms. Jakub:

In your February 25 email responding to our request for your concurrence to conduct ambient air sampling within the building(s) at the subject site you had stated that, in several respects, the DTSC guidelines had not been fully addressed. As you are aware, the specific objective of that intended sampling event was to collect baseline sample data prior to occupancy by a new tenant whose business would compromise indoor air quality due to the materials they use. As a result of your workload and consequent inability to grant approval of this "fast track" plan to collect these samples, the client decided to hold off on the sampling.

I know that you are very busy with conducting case reviews as mandated by the SWRCB at this time, but I would like to propose that CRA, on behalf of Mr. Nady, generate and submit a workplan that follows, with minor modification, the recommendations proposed in the *Additional Site Characterization Report* submitted to you on February 25, 2010. The modification to the recommendation consists of proceeding in the customary sequence of installing sub-slab vapor probes and collecting sub-slab vapor samples prior to collecting indoor ambient air samples. Evaluation of sample results will determine the next sequential step. But this will be elaborated on in a more formal and detailed workplan than was presented in the rushed attempt collect samples in late February.

Additionally, this workplan will include a planned scope of work to conduct additional soil borings along Ocean Avenue in another attempt to collect A-zone water samples since no A-zone water was present during the August 2009 drilling of borings SB-27 and SB-28.

5/12/2010

We at CRA and Mr. Nady wish to continue moving this project forward and request your concurrence with the proposed workplan. While we do not want to be bothersome to you as we know you are currently engaged in the State-mandated case reviews, we encourage you to review the submitted *Additional Site Characterization Report* at your earliest convenience. Thank you for your consideration.

Bob Foss

**Robert C. Foss, P.G.**  
**Conestoga-Rovers & Associates (CRA)**  
**5900 Hollis Street, Suite A**  
**Emeryville, CA 94608**  
**(510) 420-3348 office**  
**(925) 413-8707 cell**  
**(510) 420-9170 fax**

5/12/2010

APPENDIX B

STANDARD FIELD PROCEDURES

# CONESTOGA-ROVERS & ASSOCIATES

## STANDARD FIELD PROCEDURES FOR SOIL BORINGS

This document describes Conestoga-Rovers & Associates, Inc. (CRA) standard field methods for drilling and sampling soil borings. These procedures are designed to comply with Federal, State and local regulatory guidelines. Specific field procedures are summarized below.

### Objectives

Soil samples are collected to characterize subsurface lithology, assess whether the soils exhibit obvious hydrocarbon or other compound vapor odor or staining, estimate ground water depth and quality and to submit samples for chemical analysis.

### Soil Classification/Logging

All soil samples are classified according to the Unified Soil Classification System by a trained geologist or engineer working under the supervision of a California Professional Geologist (PG) or a Certified Engineering Geologist (CEG). The following soil properties are noted for each soil sample:

- Principal and secondary grain size category (i.e. sand, silt, clay or gravel)
- Approximate percentage of each grain size category,
- Color,
- Approximate water or product saturation percentage,
- Observed odor and/or discoloration,
- Other significant observations (i.e. cementation, presence of marker horizons, mineralogy), and
- Estimated permeability.

### Soil Boring and Sampling

Soil borings are typically drilled using hollow-stem augers or hydraulic push technologies. Prior to drilling, the first 8 ft of the boring are cleared using an air or water knife and vacuum extraction. This minimizes the potential for impacting utilities.

At least one and one half ft of the soil column is collected for every five ft of drilled depth. Additional soil samples are collected near the water table and at lithologic changes. Samples are collected using lined split-barrel or equivalent samplers driven into undisturbed sediments beyond the bottom of the borehole. The vertical location of each soil sample is determined by measuring the distance from the middle of the soil sample tube to the end of the drive rod used to advance the split barrel sampler. All sample depths use the ground surface immediately adjacent to the boring as a datum. The horizontal

## CONESTOGA-ROVERS & ASSOCIATES

location of each boring is measured in the field from an onsite permanent reference using a measuring wheel or tape measure.

Drilling and sampling equipment is steam-cleaned prior to drilling and between borings to prevent cross-contamination. Sampling equipment is washed between samples with trisodium phosphate or an equivalent EPA-approved detergent.

### **Sample Storage, Handling and Transport**

Sampling tubes chosen for analysis are trimmed of excess soil and capped with Teflon tape and plastic end caps. Soil samples are labeled and stored at or below 4° C on either crushed or dry ice, depending upon local regulations. Samples are transported under chain-of-custody to a State-certified analytic laboratory.

### **Field Screening**

One of the remaining tubes is partially emptied leaving about one-third of the soil in the tube. The tube is capped with plastic end caps and set aside to allow hydrocarbons to volatilize from the soil. After ten to fifteen minutes, a portable photoionization detector (PID) measures volatile hydrocarbon vapor concentrations in the tube headspace, extracting the vapor through a slit in the cap. PID measurements are used along with the field observations, odors, stratigraphy and ground water depth to select soil samples for analysis.

### **Water Sampling**

Water samples, if they are collected from the boring, are either collected using a driven Hydropunch type sampler or are collected from the open borehole using bailers. The ground water samples are decanted into the appropriate containers supplied by the analytic laboratory. Samples are labeled, placed in protective foam sleeves, stored on crushed ice at or below 4°C, and transported under chain-of-custody to the laboratory.

### **Duplicates and Blanks**

Blind duplicate water samples are collected usually collected only for monitoring well sampling programs, at a rate of one blind sample for every 10 wells sampled. Laboratory-supplied trip blanks accompany samples collected for all sampling programs to check for cross-contamination caused by sample handling and transport. These trip blanks are analyzed if the internal laboratory QA/QC

## CONESTOGA-ROVERS & ASSOCIATES

blanks contain the suspected field contaminants. An equipment blank may also be analyzed if non-dedicated sampling equipment is used.

### **Grouting**

If the borings are not completed as wells, the borings are filled to the ground surface with cement grout poured or pumped through a tremie pipe.

### **Waste Handling and Disposal**

Soil cuttings from drilling activities are usually stockpiled onsite on top of and covered by plastic sheeting. At least four individual soil samples are collected from the stockpiles for later compositing at the analytic laboratory. The composite sample is analyzed for the same constituents analyzed in the borehole samples. Soil cuttings are transported by licensed waste haulers and disposed in secure, licensed facilities based on the composite analytic results.

Ground water removed during sampling and/or rinsate generated during decontamination procedures are stored onsite in sealed 55 gallon drums. Each drum is labeled with the drum number, date of generation, suspected contents, generator identification and consultant contact. Disposal of the water is based on the analytic results for the well samples. The water is either pumped out using a vacuum truck for transport to a licensed waste treatment/disposal facility or the individual drums are picked up and transported to the waste facility where the drum contents are removed and appropriately disposed.

I:\misc\Templates\SOPs\Boring with Air Knife Clearance.doc

## APPENDIX G - SOIL GAS SAMPLING DIRECTLY UNDER BUILDING FOUNDATIONS (SUBSLAB SAMPLING)

For sites that fail a preliminary evaluation pursuant to Step 5, a site-specific evaluation of vapor intrusion can be done, which may include the sampling of soil gas beneath a building's foundation. The number and locations of subslab samples should be determined based on information collected during the building survey, an understanding of the building foundation, and the results from nearby soil gas sampling. At least two subslab samples should be taken at a minimum, with one sample taken in the center of the building's foundation, if possible. The subslab data will determine if vapors are collecting directly under the building's foundation and will demonstrate which contaminants potentially represent a threat to human health. If a building is determined to have a vapor barrier and/or a tension slab, special care should be given when hand-drilling through the concrete slab. In particular, for a tension foundation slab, the tension cables within the slab should be located prior to drilling either through visual observation or through remote-sensing with either a metal detector or ground penetrating radar. The cutting of a tension cable within a slab during drilling could disrupt the integrity of the slab and potentially cause injury to the field crew.

When evaluating subslab soil gas concentrations for a building, DTSC recommends that permanent sampling points be installed so that repeated sampling can be conducted, as necessary, to evaluate seasonal or temporal variations.

The following guidelines for subslab testing are derived, with modifications, from the state of Massachusetts' Indoor Air Sampling and Evaluation Guide, WSC Policy #02-430 (Massachusetts Department of Environmental Protection, 2002).

- 1) After removal of the floor covering, small-diameter holes should be drilled through the concrete of the foundation slab. Typically, holes are 1.0 to 1.25 inches in diameter. Either an electric hand drill or concrete corer is used to drill the holes. All subslab utilities should be located and clearly marked on the slab prior to drilling. Subslab holes should be advanced 3 to 4 inches into the subslab material. The sampling probe should be constructed with the following specifications:
  - Vapor probes are typically constructed of 1/8 inch or 1/4 inch diameter brass or stainless steel pipe, with a permeable probe tip. A Teflon™ sealing disk should be placed between the probe tip and the blank pipe.
  - Bentonite chips should be used to fill the borehole annular space between the probe pipe and subslab gravel from the Teflon sealing disk to the base of the concrete foundation. Sufficient water should be added to hydrate the bentonite to insure proper sealing, and care should be used in placement of the bentonite to prevent post-emplacment expansion which might compromise both the probe and cement seal. If needed, the vapor probe tip can be covered with sand.
  - The probe pipe should be tightly sealed to the foundation slab with quick-setting contaminant-free Portland cement.

- Each probe should be constructed with a recessed threaded cap with a brass or stainless steel threaded fitting or compression fitting so the probe completion is flush with the foundation slab to reduce the tripping hazard.
- At least 30 minutes of time should elapse following installation of a probe to allow the cement to cure and allow for the subsurface conditions to equilibrate prior to sampling.

An example of a sampling probe is shown in the attached schematic diagram.

- 2) The collection of subslab samples should follow the procedures in Cal-EPA (2003), which recommends purge volume testing, leak testing, and the use of surface seals to insure sample integrity, as appropriate for field conditions. Samples should be collected in gas-tight, opaque/dark containers so that light-sensitive or halogenated VOCs will not degrade. The use of Tedlar bags for collection of soil gas samples is not recommended. If a Summa™ canister is used, a flow regulator should be placed between the probe and the canister to ensure that the canister is filled at the appropriate flow rate. Flow rates should not exceed 200 ml/min. Care should be taken during sampling to avoid sample break-through from the surface of the slab.
- 3) Subslab soil gas sampling should be performed using analytical methods in Cal-EPA (2003). These methods include USEPA Methods 8260B, 8021B, and 8015B. Other methods that may be used include USEPA Methods TO-14A, TO-15, and other methods that meet the site-specific data quality objectives and the analytical method detection limits for risk determination.
- 4) A sufficient number of subslab sampling events should be conducted to account for seasonal and temporal transience. Therefore, a minimum of two subslab sampling events are warranted before a final risk determination is made.
- 5) Upon completion of all the sampling, the foundation probes should be properly decommissioned. The probe tip, probe piping, bentonite, and grout should be removed by redrilling. The borehole should be filled with grout and concrete patch material. Surface restoration should include a follow-up visit for final sanding and finish work to restore the floor slab to its original condition.

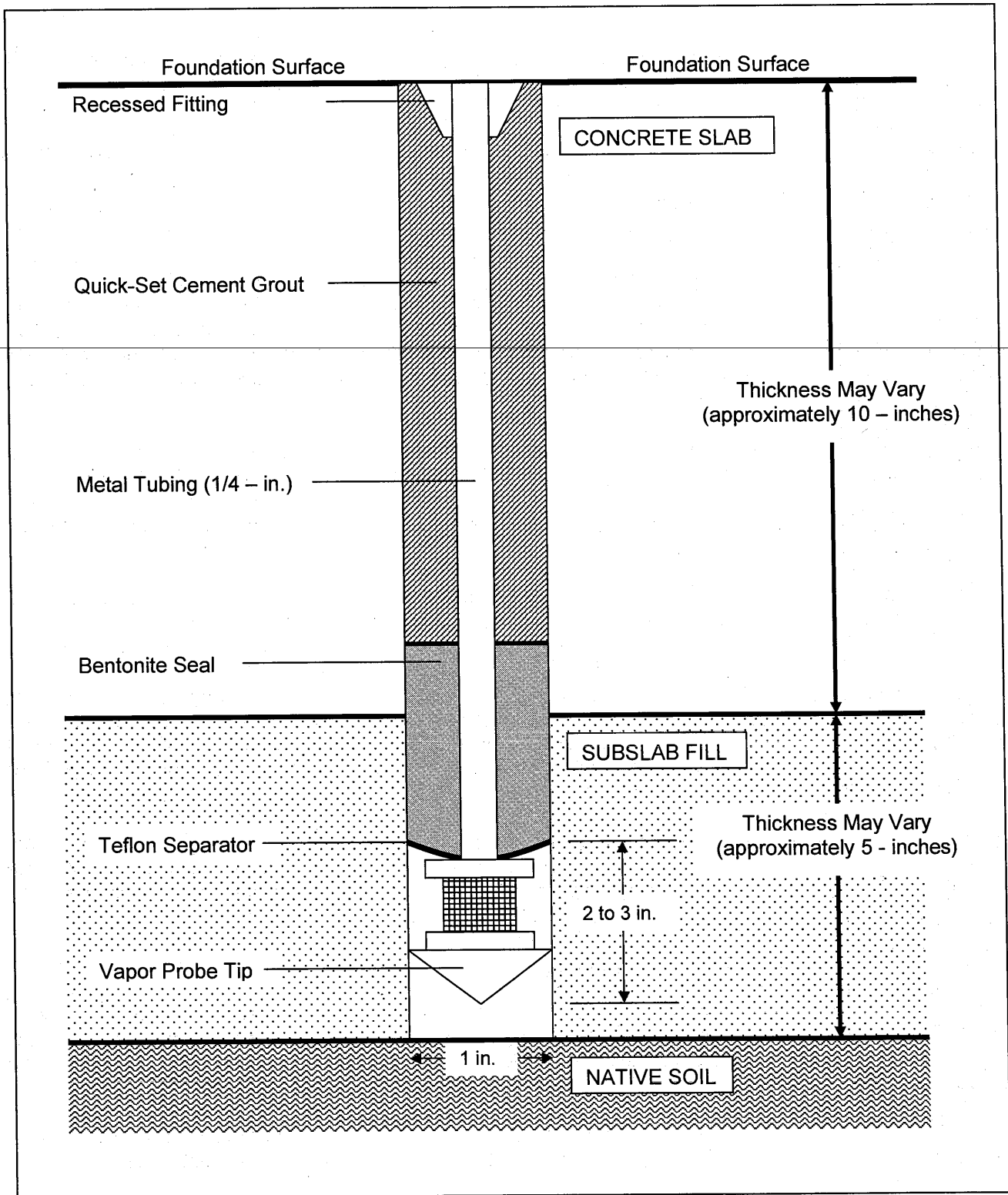
The use of passive soil gas methods for subslab sampling are not recommended for risk determination. Passive soil gas sampling should only be considered to identify subsurface contaminants, preferential pathways for vapor movement, and to reduce uncertainty caused by temporal variations.

## REFERENCES

- California Environmental Protection Agency. 2003. Advisory – Active Soil Gas Investigation. Jointly issued by the Regional Water Quality Control Board, Los Angeles Region and the Department of Toxic Substances Control. January 28, 2003. [[www.dtsc.ca.gov/Publications/Forms/index.html](http://www.dtsc.ca.gov/Publications/Forms/index.html)]
- Massachusetts Department of Environmental Protection. April 2002. Indoor Air Sampling and Evaluation Guide, WSC Policy #02-430. Massachusetts Department of Environmental Protection.



### SCHEMATIC DIAGRAM OF A SUBSLAB SAMPLING PROBE



## **ADVISORY – ACTIVE SOIL GAS INVESTIGATION**

Comment period open until April 15, 2010. Submit comments to:

Theo Johnson  
Department of Toxic Substances Control  
5796 Corporate Avenue  
Cypress, CA 90630

[tjohnson@dtsc.ca.gov](mailto:tjohnson@dtsc.ca.gov)

**California Environmental Protection Agency**



**March 2010**

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## LIST OF ACRONYMS

AGSI	Active Soil Gas Investigation
ASAP	As soon as possible
AST	Aboveground Storage Tank
ASTM	American Society of Testing and Materials
BFB	Bromofluorobenzene
Cal/EPA	California Environmental Protection Agency
CHHSLs	California Human Health Screening Levels
COPC	Chemical of Potential Concern
CSM	Conceptual Site Model
1,1-DFE	1,1-Difluoroethane, Freon 152A
DFTPP	Decafluorotriphenylphosphine
DL	Detection Limit
DQO	Data Quality Objective
DTSC	Department of Toxic Substances Control
ECD	Electron Capture Detector
ECL	Environmental Chemistry Laboratory, DTSC
ELAP	Environmental Laboratory Accreditation Program
EPA	Environmental Protection Agency
ETBE	Ethyl tertiary butyl ether
FID	Flame Ionization Detector
Freon 11	Trichlorofluoromethane
Freon 12	Dichlorodifluoromethane
Freon 113	1,1,2-Trichloro-1,2,2-trifluoroethane
GC	Gas Chromatograph
GC/MS	Gas Chromatograph/Mass Spectrometer
CRWQCB	California Regional Water Quality Control Board
GEM	Gas Emission Monitor
HECD	Hall electrolytic conductivity detector
IDW	Investigation Derived Waste
ITRC	Interstate Technology & Regulatory Council
LARWQCB	Los Angeles Regional Water Quality Control Board
LCS	Laboratory Control Samples
L-D PE	Low Density Polyethylene
µg/L	Microgram per liter
µg/m <sup>3</sup>	Microgram per cubic meter
MS	Mass Spectrometer
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MTBE	Methyl tertiary butyl ether
ND	Non-detect
NELAP	National Environmental Laboratory Accreditation Program
NIST	National Institute of Standard and Technology
OEHHA	Office of Environmental Health Hazard Assessment
PAHs	Polycyclic Aromatic Hydrocarbons



8. An assessment of the adequacy of the current CSM and a subsequently revised CSM;
9. Data gaps identified based on revised CSM; and
10. Conclusions and recommendations:

All engineering or geologic work (e.g., logging continuous soil cores, soil description) should be performed or supervised by a California Registered Professional in accordance with the Business and Professions Code, Chapters 7 and 12.5, and the California Code of Regulations, Title 16, Chapters 5 and 29.

### **2.3 Soil Gas Sampling Location and Sampling Wells/Probes Installation**

#### **Lithology**

Use site soil or lithologic information to select appropriate locations and depths for soil vapor monitoring wells. If on-site lithologic information is not available prior to conducting the soil gas investigation, at least one (1) continuously cored boring to the proposed greatest depth of the soil gas investigation should be installed at the first sampling location, unless specifically waived or deferred by the regulating agency. Depending on site conditions, additional continuously cored borings may be necessary. If the soil gas data are to be used for human health risk assessment or vapor intrusion assessment, the lithology/geology should be understood and documented in an appropriate level of detail. Geotechnical information required to be collected for vapor intrusion risk assessment purposes can be found in the DTSC Vapor Intrusion Guidance (Cal/EPA, 2005, Appendix H). A statistically sufficient number of geotechnical samples should be collected for vapor intrusion (i.e., Johnson & Ettinger) modeling used for the risk assessment.

Prepare lithologic logs prepared for all borings, soil matrix sampling, and geotechnical sampling. Information gathered from the continuously cored borings may include soil physical parameters, geotechnical data and contaminant data. Use information collected from borings to modify the CSM. Provide all boring logs to the agency.

#### **Sample Spacing**

Sample spacing should be in accordance with the study design rationale provided in the workplan, and may be modified based on site-specific conditions



with regulatory agency approval. The sampling locations should include biased sampling locations to optimize detecting and delineating VOCs. Selection of appropriate number, locations and sampling depths are site-specific, and should be based on the CSM and the project DQOs.

### **Sample Depth**

Soil gas sample depths should be chosen to minimize the effects of changes in barometric pressure, temperature, or breakthrough of ambient air from the surface and to ensure that representative samples are collected. Consideration should be given to source location, types of chemicals of concern, and the lithology encountered.

Vapor monitoring wells should be installed at a minimum of two sample depths, at approximately five (5) feet below ground surface (bgs) and 10 to 15 ft bgs. Variation of sample depths and the need for deeper sample locations will be evaluated based on site specific characteristics.

For shallow contaminant sources of less than 10 feet bgs, collect soil gas samples immediately above the source. Samples collected at less than 5 feet bgs may be subject to barometric pressure effects and are more prone to ambient air breakthrough. For deep contaminant sources, collect soil gas samples starting at 10-15 feet bgs.

When evaluating vapor intrusion, obtain soil gas samples at appropriate depths so that risk to human exposure can be adequately quantified. Empirical studies indicate that shallow soil gas measurements at 5 feet bgs may not be indicative of soil gas concentrations under buildings (Hers et al., 2006; DiGiulio and Cody, 2006). These studies suggest that soil gas samples collected at depth of 10 to 15 feet are a better indicator of vapor intrusion risk than samples collected at 5 feet bgs when the source depth is greater than 15 feet bgs. Numerical modeling also suggests this relationship (Abreu and Johnson, 2005; Abreu et al, 2006). Hence, risk quantified with shallow soil gas measurements (5 feet bgs) using the Johnson and Ettinger (1991) model may yield estimates that are biased low if the soil gas is from a deep source.

For vapor intrusion evaluations, soil gas sample depth is dependent on the depth of the contaminants. Deeper sampling would be needed when evaluating buildings with basements (Abreu et al., 2006).

### **Vertical Profiling**

Vertical profiling is achieved by collecting soil gas samples at varying depths in a single location, or by using closely spaced vapor monitoring wells installed at varying depths. Use vertical profiling in areas where significant contaminant concentrations are identified. The objectives of vertical profiling are to:



- (1) Assess the vertical distribution of contaminants in the vapor phase within the unsaturated zone;
- (2) Identify migration pathways at depth along which contaminants may have migrated from sources; and
- (3) Serve as discrete monitoring points to evaluate the efficiency of a cleanup action.

Vertical profiling depends on DQOs and the CSM. Vertical profiling may or may not be appropriate at any given site. Describe the rationale for vertical profiling in the workplan for regulatory review prior to commencement of field work. Vertical profiling is appropriate for any of the following locations:

- Sites identified with subsurface structures such as USTs, sumps, clarifiers, waste or chemical management units
- Sites with subsurface sources such as oil fields, artificial fill, or buried animal waste
- Sites with heterogeneous lithology
- Sites with contaminated groundwater
- Areas with significantly elevated VOC concentrations detected during previous sampling
- Areas where elevated field instrument readings are encountered from soil matrix cuttings, cores or samples
- In the annular space of groundwater monitoring wells during construction where and assessment of the vertical extent of soil gas contamination is necessary.

All available information such as geologic logs and field instrument readings from soil cuttings or cores should be used to select appropriate depths to collect soil gas samples. Probes should be installed at depths with elevated vapor readings and/or slightly above fine-grained soils. If vertical characterization to groundwater is required, the deepest soil gas sample should be collected near the top of the capillary fringe. Soil gas probes should not be installed within or below the capillary fringe. Where deeper soil gas sampling is necessary and no lithologic change or technical basis is observed, then default sampling depths of 10 to 15 foot intervals may be selected for multi-depth sampling, until either groundwater is encountered or VOCs are not detected. Nested vapor wells may be installed in the annular space of groundwater monitoring wells to serve as a dual-purpose well if both vapor and groundwater monitoring are required.

### **Sampling Tubing**

Small diameter (1/8 to 1/4 inch) sampling tubes made of material, which will not react or interact with site contaminants should be used. Use small-diameter continuous tubing attached from the vapor probe to the ground surface to minimize



purge volume.

1. Clean, dry tubing should be used at all times. If any moisture, water, or an unknown material is present in the probe prior to insertion, decontaminate or replace the tubing.
2. The bottom-end of the tubing should be attached to an appropriate vapor probe tip. The probe tip design should allow for optimum air flow and prevent air flow restriction. Ensure the connection between the tubing and the vapor probe tip is air-tight to prevent leakage.
3. Metal tubes should not be used for collection of hydrogen sulfide samples. Nylaflow<sup>®</sup>, polyetheretherketone (PEEK), and Teflon<sup>®</sup> are recommended for use in the soil vapor sampling train. Use of low-density polyethylene (L-D PE) is discouraged due to decreased performance relative to other tubing types in both introduction of background analytes and sample recovery. Reduced recovery of naphthalene was reported when using Nylaflow<sup>®</sup> tubing with small sample sizes (see Appendix B).

### Soil Vapor Well Installation

Vapor well installation procedures are described below. The probe tip, probe and probe connectors should all have the same diameter to provide a good seal between the formation and the sampling assembly. Seal all holes and spaces with bentonite slurry to prevent ambient air intrusion.

**Installation Methods and Design:** Soil vapor wells may be installed using a variety of drilling methods, such as direct push methods, hollow stem auger, or other techniques, as appropriate. Certain types of drilling methods, such as air rotary and rotosonic, are not recommended because they can adversely affect soil gas data during and after drilling. However, for deeper soil gas wells or for drilling in denser/coarser formations, alternate drilling methods (e.g., air rotary and rotosonic methods) may be employed with longer equilibration times prior to sampling. The mud rotary drilling method is not acceptable for soil gas probe emplacement under any circumstances. When additional sampling is not anticipated, properly remove or decommission vapor wells with concurrence from the regulatory agency and in accordance with State and local requirements.

- A. Place the probe tip midway in the sand pack, as shown on Figure 1. The sand pack should be a minimum of one (1) foot thick. Install the sand pack to minimize disruption of airflow to the sampling tip.
- B. Emplace at least one (1) foot of dry granular bentonite on top of each sand pack, as shown on Figure 1. Following the dry bentonite, grout the borehole to the surface with hydrated bentonite. The purpose of the dry granular



bentonite between the sand pack and the hydrated bentonite is to preclude the hydrated bentonite grout from infiltrating the sand pack. Follow a similar procedure for deep well construction with multiple probe depths, in that one foot of dry granular bentonite should be emplaced on top of the sand pack encasing each probe, followed by hydrated bentonite grout. The hydrated bentonite grout should continue until the next sand pack, as shown on Figure 2. A cement/bentonite mixture in accordance with California well construction standards may also be used above the dry bentonite layer to seal the borehole annulus.

- C. A tremie pipe should be used for soil vapor wells deeper than 15 feet, to avoid bridging or segregation during placement of the sand pack and bentonite seal.
- D. The use of a down-hole probe support may be required for vapor wells in excess of 40 feet bgs. The probe support may be constructed from a one-inch diameter bentonite/cement grouted PVC pipe or other solid rod, or equivalent, allowing probes to be positioned at measured intervals prior to installation. The support should be solid or properly sealed to avoid possible cross contamination or ambient air intrusion. Alternative probe support designs with accompanying descriptions may be proposed in the project workplan. Justification should be included in the project workplan if the project proponent chooses not to use probe support for deep vapor wells.

**Tubing Protection:** Tubing should be protected from damage or clogging from subsurface soil materials by placing the tubing inside a flush-mount casing. For deep vapor wells ensure the probe tip and tubing are properly placed and tubing is not damaged or kinked. Properly mark tubing at the surface to identify the probe location and depth.

**Soil Gas Well Completion:** Soil gas wells should be properly secured, capped and completed to prevent infiltration of water or ambient air into the subsurface and to prevent accidental damage or vandalism. For surface completions, the following components may be installed:

- a. Gas-tight valve or fitting for capping the sampling tube;
- b. Utility vault or meter box with ventilation holes and lock;
- c. Surface seal; and
- d. Guard posts.



**Temporary Soil Vapor Wells:** Post-run tubing and drive point methods<sup>1</sup> used to create temporary soil vapor wells are not recommended for soil gas sampling (McAlary, et al, 2009). The tubing used to create temporary soil vapor wells for the post-run method is prone to sealing issues associated with connecting the tubing to the drive point. Additionally, the drive point probes may be deflected by cobbles, which can create gaps between the outer wall of the casing and the geologic materials that are difficult to observe and equally difficult to seal. A hydrated bentonite plug at ground surface does not stop communication along the outer wall of the casing between different depth intervals. Samples collected under these circumstances will draw soil gas primarily from the most permeable layer above the tip of the probe which may introduce a significant bias. Moreover, this condition cannot be identified by any tracer applied at or near ground surface. Temporary soil vapor wells may also yield questionable results in moderate to low permeability soils such as clay and/or silt clay lenses, where the flow of gas through the geologic materials is low. In such case, soil gas will be collected from the path of least resistance at any depth along the drive shaft.

### **Equilibration Time**

Subsurface conditions are disturbed during probe placement. To allow for subsurface conditions to equilibrate and vapor concentrations to stabilize, the following procedures are recommended:

1. For soil vapor wells installed with the direct push method, do not conduct the purge volume test, leak test, and soil gas sampling for at least 30 minutes following vapor probe installation.
2. For soil vapor wells installed with hollow stem or hand auger drilling methods, do not conduct the purge volume test, leak test, and soil gas sampling for at least 48 hours after vapor probe installation.
3. For soil vapor wells installed with the roto sonic or air rotary method, do not conduct the purge volume test, leak test, and soil gas sampling until it can be empirically demonstrated that the subsurface equilibrium time is sufficient for representative sample collection.

Vapor well installation method and equilibration time should be recorded in the field log book or field form.

### **Decontamination**

Decontaminate all reusable equipment to prevent cross contamination.

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<sup>1</sup> Drive point methods may be appropriate for certain site conditions or circumstances depending on DQOs. The use of post-run tubing should be discussed with the Agency prior to inclusion in the workplan.



Decontamination may consist of steam cleaning or a three-stage wash and rinse consisting of a wash with a non-phosphate detergent, a rinse with tap water, and a final rinse with distilled water. Collect one equipment blank at the beginning of sampling, and at least one each day after decontamination. Air dry equipment prior to re-use. Use new or unused sample tubing for each probe location. Reuse of tubing is not recommended.

### **Sub-Slab Investigation Methods**

The procedure for collecting sub-slab soil gas samples are the same as for collecting sub-surface soil gas samples except that a slower flow rate and lower vacuum should be utilized. Using a flow rate of less than or equal to 50 milliliters per minute (mL/min) and maintaining a low vacuum of less than 100 inches of water should prevent ambient air breakthrough into samples (McAlary et al., 2009). Methods and procedures for installing sub-slab vapor wells are described in the DTSC Vapor Intrusion Guidance (Cal/EPA, 2005, Page G-1)

## **2.4 Soil Gas Sampling**

Before obtaining soil gas samples, leak and purge volume tests are necessary.

### **Leak Test**

A leak test is used to evaluate whether a good seal was established in the sampling train, ground surface, and probe interface. A leak test should be conducted at every vapor monitoring well each time a soil gas sample is collected because a poor seal may result in soil gas samples that are diluted by ambient air. This may result in an underestimation of actual site contaminant concentrations or, alternatively, introduce external contaminant into samples from ambient air.

**Shut-In Test:** Prior to purging or sampling soil gas, a shut-in test should be conducted to check for leaks in the above ground fittings. The shut-in test consist of assembling the above-ground apparatus (e.g., valves, lines and fittings downstream from the top of the probe), and evacuating the lines to a measured vacuum of about 100 inches of water column (in-H<sub>2</sub>O), then shutting the vacuum in with closed valves on opposite ends of the sampling train. The vacuum gauge connected to the line via "T"-fitting is observed for at least one minute, and if there is any observable loss of vacuum, the fittings are adjusted as needed until the vacuum in the above-ground portion of the sample train does not noticeably dissipate (McAlary et al., 2009).

**Leak Check Compounds:** Liquid tracer compounds, such as hexane, pentane, and n-propanol, can be used to evaluate the sample integrity. Typically, liquid



tracer compounds are applied to towels or clean rags and placed around all connections in the sampling train in order to evaluate potential leaks of ambient air into the sampling train. The leak check compound selected should not be a suspected site-specific contaminant.

Seal integrity is confirmed by analyzing subsequent soil gas samples for the tracer compound. Alternatively, gaseous tracer compounds, such as helium, isobutene, propane, and butane, can be used along with a shroud or tent over the sampling equipment. Procedures for conducting a quantitative leak test using helium as a tracer compound are described in Appendix C.

Leak check compounds (i.e., liquid tracer compounds) should be included in the method analyte list. The laboratory reports should quantify and annotate all detections of the leak check compound at the reporting limit of the target analytes. If the concentration of the leak check compound is greater than or equal to ten times the reporting limit for the target analyte(s), then corrective action is necessary as discussed below.

If a leak check compound (i.e., liquid tracer compounds) is detected in the sample, the cause of the leak should be determined, evaluated, and corrected through retesting. If a leak is confirmed and the problem cannot be corrected, the ambient air leak may be quantified using a gaseous tracer with a shroud, as described in Appendix C. An ambient air leak up to five (5) percent is acceptable if quantitative tracer testing is performed by shrouding. Otherwise, the soil gas vapor well should be decommissioned if the leak cannot be corrected. Replacement vapor wells should be installed at least five (5) feet from location where the original vapor well was decommissioned due to a confirmed leak. Include the leak check compound concentrations detected in the soil gas samples in the laboratory report and discussed in the site characterization report.

Note that if sampling is done exclusively from a SUMMA<sup>®</sup> canister at a stationary laboratory and there is a significant leak, it will not be identified until after the sample has been collected and analyzed. Therefore, field screening prior to laboratory confirmation is recommended.

## **2.5 Purge Volume Test**

The purpose of a purge volume test is to ensure stagnant or ambient air is removed from the sampling system and to ensure samples collected are representative of subsurface conditions. The purge volume test should be the first soil gas sampling activity at the selected purge volume test point, and should be located as near as possible to the anticipated or confirmed contaminant source, and in an area where soil gas concentrations are expected to be elevated, based on lithology. The purge volume test is conducted by collecting and analyzing a sample for target compounds after removing one, three, and ten



purge volumes.

The purge volume (also referred to as the "dead space volume") can be estimated by summation of the following components: (a) the internal volume of tubing used; (b) the void space of the sand pack around the probe tip; and (c) the dry bentonite in the annular space. Sample containers are not included in the purge volume calculation, except when non-evacuated glass bulbs are used. In those instances, the volume occupied by the non-evacuated glass bulbs should be added to the purge volume to account for mixing and dilution of gasses inside the glass bulb. The step purge tests of one (1), three (3), and ten (10) purge volumes should be conducted to determine the purge volume to be applied at all sampling locations. Select the appropriate purge volume based on the highest concentration of the compound(s) of concern detected during the step purge volume test. Optimize the purge volume for the compound(s) of greatest concern. Avoid extensive purging for soil gas samples collected at less than five (5) feet bgs. Conduct the step purge test and purging at the same flow rate and applied vacuum as soil gas samples. If the pump is battery operated, check the batteries before and during operation to insure a proper charge is maintained.

A default of three (3) purge volumes should be extracted prior to sampling in the following cases:

- If VOCs are not detected in any of the step purge tests
- If a SUMMA<sup>®</sup> canister is used for sampling soil gas
- For shallow soil gas samples (collected at less than five feet bgs)

Include the purge test data in the report to support the purge volume selection. The data set should include the purge volume test as well as the flow rate, vacuum exerted on the formation, and duration of each purge step.

#### **Additional Purge Volume Tests**

Additional purge volume tests may be necessary when warranted by site-specific situations. For example if widely variable or different site soil types are encountered during continuous coring conducted prior to the soil gas survey, or if the default purge volume of (3) is used and another VOC of concern not detected previously is subsequently detected.

If a new purge volume is selected in areas of similar lithology after additional step purge volume tests are conducted, then ten percent of the previously-completed vapor wells should be re-sampled using the new purge volume. Re-sampling may be necessary for all previously sampled vapor wells depending on site conditions. The soil gas investigation may then be continued with the revised purge volume in the remaining areas.



If a new purge volume is selected in areas of different lithology, then the soil gas investigation may be continued with the revised purge volume in the remaining areas with the same lithology.

## 2.6 Purge/Sample Flow Rate and Applied Vacuum

Purge/sample flow rates between 100 to 200 mL/min and vacuums less than 100 inches of water for standard small diameter (1/8 to 1/4 inch) tubing should be maintained to minimize partitioning of vapors from pore water to soil gas (i.e., stripping), prevent ambient air from diluting the soil gas samples, and to reduce the variability of purging rates from contractor to contractor. Low flow purge/sample rates and vacuums of less than 100 inches of water increases the likelihood that representative samples will be collected. The purge/sample rate may be modified based on conditions encountered in individual vapor wells. These modified rates should be documented in the soil gas report. A flow rate greater than 200 mL/min may be used in certain cases, such as when larger diameter tubing are used with deeper vapor wells that are greater than 40 feet bgs. However, a vacuum of 100 inches of water or less must be maintained during sampling whenever a higher flow rate is used. Large volume sample containers, such as the 6L-SUMMA<sup>®</sup> canisters should be avoided for shallow samples collected at less than five feet bgs.

Evaluate lithologic conditions adjacent to the vapor well to determine if the purge/sample flow rate is attainable. A vacuum gauge or similar device should be used between the soil gas sample tubing and the soil gas extraction devices, such as a vacuum pump, or SUMMA<sup>®</sup> canister. Gas tight syringes may also be used to qualitatively determine if a high vacuum soil condition is present. If a high vacuum condition due to tight or low permeability soil is present, the sampling technician will have a feeling of suction while the plunger on the syringe is being withdrawn. Conduct soil gas permeability testing at an optimal vacuum to determine the gas permeability of the soil surrounding the probe tip (McAlary, et al., 2009) (See Appendix D).

## 2.7 Sample Containers

Collect samples in gas-tight containers and handle in a manner that will prevent photo degradation of the target analytes. Sample containers should not compromise the integrity of the samples.

1. If a syringe is used, it should be leak-checked before each use by closing the exit valve and attempting to force ambient air through the needle. The use of gas-tight glass syringes with Teflon<sup>®</sup> seals is preferred. The use of plastic syringes is discouraged because of the interaction between the plastic (or rubber) of syringes and some target analytes.



2. If a SUMMA<sup>®</sup> canister is used, place a flow regulator and vacuum gauge between the vapor well and the SUMMA<sup>®</sup> canister. Perform near surface (e.g., less than five (5) feet bgs) sampling using 1L-SUMMA<sup>®</sup> or smaller containers.
3. If the Tedlar<sup>®</sup> bags or glass bulbs are used, add surrogates within 15 minutes of collection and analyze the samples as soon as possible after collection and within 6 hours after collection (see Appendix B).
4. Sorbent Tube sampling procedures: Details concerning selection of tube and sorbent, conditioning of tube, sampling apparatus, sampling rates, preparation of sample collection, set flow rates, and other sampling procedures are provided in the Compendium Method TO-17 (USEPA, 1999).
5. Specific recommendations for methane and hydrogen sulfide sample containers are specified in Section 3.9
6. Alternate Sample Containers (see Appendices B) are also available for sampling soil gas. Add surrogates in samples collected in glass containers within 15 minutes and analyze the samples within 6 hours of collection. MiniCans, smaller and lighter versions of the passivated SUMMA<sup>®</sup> canisters, can be used with the same limitations as the regular SUMMA<sup>®</sup> canisters. The use of alternate size or type of container should seek prior approval by the agency.

#### **Sample Handling for All Sample Containers and Sorbent Tubes:**

Soil gas samples should be analyzed as soon as possible after sampling. Ideally, samples are collected and analyzed immediately by a mobile laboratory; however, if samples need to be shipped to a fixed laboratory, then follow special handling procedures.

Samples collected in syringes should never be transported; however, samples collected in sorbent tubes and SUMMA<sup>®</sup> canisters may be shipped for analysis at a fixed laboratory. The precautions noted below should be followed.

Sample handling procedures cited in the analytical methods being used should be followed; however, since those methods are not designed for soil gas, additional safeguards should be implemented to maintain the integrity of the soil gas samples.

#### **Syringes and Glass Bulbs:**

1. Do not expose samples to light. Keep syringes and glass bulbs in a cool dark location at all times. Cover or wrap samples with foil and place into an insulated container (cooler but without ice) until the samples are analyzed.



Samples collected in syringes and glass bulbs should be analyzed as soon as possible after collection.

2. Do not subject samples to extreme in temperatures. Heat can cause compound degradation and leakage from the syringe or glass bulb. Cold can cause moisture condensation which can affect the recovery of target analytes. If condensation is observed, the sample should be discarded and a new sample should be collected.

Sorbent tubes:

1. Samples tubes should be recapped with metal, Swagelok<sup>®</sup>-type caps and combined PTFE ferrules, rewrapped in aluminum foil (if appropriate) and replaced in the storage container immediately after sampling.
2. Samples collected on tubes should be stored at less than or equal to 4°C and analyzed as soon as possible within 30 days after collection. For certain labile compounds, analysis should be done within one week (USEPA, 1999; Compendium Method TO-17, Section 10.10).
3. Samples collected on tubes containing multiple sorbent beds should be analyzed as soon as possible after collection unless it can be verified that storage will not affect the recovery of analytes (USEPA, 1999; Compendium Method TO-17, Section 10.10).

Tedlar<sup>®</sup> Bags:

If there is an absolute necessity to transport samples in Tedlar<sup>®</sup> bags, the following should be noted:

1. Do not expose soil gas samples in Tedlar<sup>®</sup> bags to light and extreme temperatures. Photodegradation of target analytes is possible with light exposure. Heat can cause expansion of the bag and possibly result in leakage. Cold can cause condensation of the sample.
2. Do not subject soil gas samples in Tedlar<sup>®</sup> bags to changes in ambient pressure. Changes in ambient pressure can adversely affect the integrity of the bags. Increases in pressure may collapse the bag and decreases in pressure may expand the bag. These changes in pressures coupled with possible flaws in the bag may cause sample loss due to leakage. Ambient pressure can change during the transport of samples. Samples traveling from the mountain area (lower pressure) to the lower desert area (such as Death Valley with higher pressure) can be subjected to significant pressure changes that may affect sample integrity. Alternate sample containers should be selected when pressure changes are anticipated.



## 2.8 Sample Container Cleanliness and Decontamination

1. New containers should be shown to be free of contaminants by providing data from either the supplier or the analytical laboratory.
2. After each use, reusable sample containers should be decontaminated as follows:
  - A. Glass syringes or bulbs should be disassembled and baked at 240° C for a minimum of 15 minutes or at 120° C for a minimum of 30 minutes, or be decontaminated by an equivalent method. If a syringe is re-used, it should be blank tested, and tested for adsorptive losses via spike testing. Blank testing frequency (or certification frequency) of syringes should also be included in the workplan.
  - B. SUMMA® canisters should be properly decontaminated as specified in US EPA Method TO-15, and/or should be certified according to project DQOs, either be batch or individually certified.
  - C. Tedlar® bags may be reused if data are provided to show the bags are free of contaminants.
  - D. Equipment blanks should be analyzed to verify and evaluate the effectiveness of decontamination procedures for recycled or reused containers. At a minimum, one equipment blank should be run per 20 sample containers cleaned, or at least one per day.

## 2.9 Sample Collection

1. **Vacuum Pump:** When a vacuum pump is used, collect samples on the intake side to prevent potential contamination from the pump. Use a lung box when collecting samples using Tedlar® bag (see Appendix C, Figure C-1). Record vacuum readings and corresponding flow rates on field data sheets for each sample. If the pump is battery operated, the batteries should be checked before and during operation to insure a proper charge is maintained.
2. **Soil Gas Sampling in Low-Permeability Soil:** Soil gas sampling from low permeability material (i.e., silt and clay-rich soils) is feasible and high quality data can be produced with: (1) good annular seals; (2) careful monitoring of flow and vacuum during purging and sample collection; and (3) using tracer gas (i.e., helium) for leak-testing. If the soil gas permeability is too low to allow sustainable purging at appreciable flow rates without applying excessive vacuum, follow the protocols as described in Appendix D. An "appreciable flow rate" is defined as flow of 100 mL/min or greater, and an "excessive vacuum" is defined as any vacuum greater than about 100 inches of water



column. A low-flow or low-permeability probe is defined as a condition where the minimum flow rate (100 mL/min) could not be sustained at the maximum applied vacuum level (100 inches water). See Appendix D for sampling protocols for low-permeability soils.

- 3. Soil Gas Sample Collection using Sorbents for Method TO-17:** Soil gas sampling for analysis by Method TO-17 is described in Appendix E and F. Low permeability materials may result in a lower flow rate. Use of vacuum gage is recommended between the sorbent and extraction device. Permeability testing of soil is recommended to determine the optimal flow rate at a vacuum of less than 100-inches of water (McAlary et al, 2009). TO-17 is currently recommended only for naphthalene analysis; however, TO-17 may also be used for other volatile constituents depending on the DQOs for the project. The regulatory agency should be notified and concurrence is required prior to implementation of sorbent/TO-17 for other volatile constituents other than naphthalene.

### 3.0 Field Conditions

Field conditions, such as rainfall, irrigation, fine-grained sediments, or drilling conditions may affect the ability to collect soil gas samples.

- 1. Rainfall and Barometric Pressure (see Appendix G):** Rainfall decreases the air-filled porosity of the shallow soil, thereby limiting diffusion transport of volatile contaminants and potentially biasing soil gas sampling results. Hence, do not conduct soil gas sampling during or within five days of a significant rain event (1/2 inch or greater). Stop irrigation or watering of soil at least five days prior to the soil gas sampling event. Likewise, areas subject to soil gas sampling should be free of standing or ponded water for at least five days prior to sampling. Do not perform soil gas sampling in swales or depressions where large volumes of water can potentially accumulate.

Barometric pressure fluctuations associated with the passage of frontal systems can introduce atmospheric air into the shallow vadose zone. Therefore, soil gas sampling should be delayed until frontal systems have passed the area. Alternatively, soil gas sampling times and depths may be chosen to minimize the effects of changes in barometric pressure.

- 2. Wet Conditions:** If no-flow or low-flow conditions are caused by wet soils due to a rain event or irrigation or water is drawn into a probe, cease the soil gas sampling. Low or no-flow condition corresponds to cases where the minimum flow rate of 100 mL/min cannot be sustained at the maximum applied vacuum of 100 inches of water (McAlary et al., 2009). If the low-flow condition is due to wet conditions or shallow groundwater, then passive samplers may be deployed to detect VOCs.