Mr. Lee Douglas
Douglas Parking Company
1721 Webster Street
Oakland, California 94612

Ms. Barbara Jakub
Alameda County Environmental Health
Department of Environmental Health
1131 Harbor Bay Parkway, 2nd Floor
Alameda, CA 94502-6577

**RECEIVED**
*By Alameda County Environmental Health at 8:39 am, May 14, 2013*

**Re: Douglas Parking Company**
1721 Webster Street
Oakland, California
ACEH File No. 129

Dear Ms. Jakub:

I, Mr. Lee Douglas, have retained Pangea Environmental Services, Inc. (Pangea) as the environmental consultant for the project referenced above. Pangea is submitting the attached report on my behalf.

I declare, under penalty of perjury, that the information and/or recommendations contained in the attached report are true and correct to the best of my knowledge.

Sincerely,

Lee Douglas

April 4, 2013

***VIA ALAMEDA COUNTY FTP SITE***

Ms. Barbara Jakub
Alameda County Environmental Health
1131 Harbor Bay Parkway, 2nd Floor
Alameda, California 94502

Re: **Workplan for Additional Assessment and Soil Gas Sampling**
Douglas Parking Company
1721 Webster Street
Oakland, California
ACEH File No. 129

Dear Ms. Jakub:

On behalf of Douglas Parking Company, Pangea Environmental Services, Inc. (Pangea) has prepared this *Workplan for Additional Assessment and Soil Gas Sampling* (Workplan). This Workplan was requested by an Alameda County Environmental Health (ACEH) letter dated December 21, 2012. The Workplan was requested to address data gaps indentified in Pangea's *Sensitive Receptor Survey, Conduit Study and Site Conceptual Model* (SCM) dated March 26, 2012. Consistent with data gaps identified in the SCM, Pangea proposes soil gas sampling to evaluate potential vapor intrusion into indoor air for onsite and adjacent retail buildings, and for assessment of possible secondary source material downgradient of well MW-2.

If you have any questions or comments, please call me at (510) 435-8664.

Sincerely,
**Pangea Environmental Services, Inc.**

Bob Clark-Riddell, P.E.
Principal Engineer

Attachment: *Workplan for Additional Assessment and Soil Gas Sampling*

cc: Mr. Lee Douglas, Douglas Parking Company, 1721 Webster Street, Oakland, California 94612
SWRCB Geotracker Database (electronic copy)

# WORKPLAN FOR ADDITIONAL ASSESSMENT AND SOIL GAS SAMPLING

**Douglas Parking Company**
**1721 Webster Street**
**Oakland, California**
**ACEH File No. 129**

**April 4, 2013**

*Prepared for:*

Mr. Lee Douglas
1721 Webster Street
Oakland, California 94612

*Prepared by:*

Pangea Environmental Services, Inc.
1710 Franklin Street, Suite 200
Oakland, California 94612

*Written by:*

REGISTERED PROFESSIONAL ENGINEER
ROBERT G. CLARK-RIDDELL
No. C 049629
Exp. SEPT 2014
CIVIL
STATE OF CALIFORNIA


Tina de la Fuente
Project Scientist

Bob Clark-Riddell, P.E.
Principal Engineer

## INTRODUCTION

On behalf of Douglas Parking Company, Pangea Environmental Services, Inc. (Pangea) has prepared this *Workplan for Additional Assessment and Soil Gas Sampling* (Workplan). This Workplan was requested by an Alameda County Environmental Health (ACEH) letter dated December 21, 2012 (Appendix A). The Workplan was requested to address data gaps indentified in Pangea's *Sensitive Receptor Survey, Conduit Study and Site Conceptual Model* (SCM) dated March 26, 2012. Consistent with the ACEH letter, Pangea proposes soil gas sampling to evaluate potential vapor intrusion into indoor air for onsite and adjacent retail buildings, and for assessment of possible secondary source material downgradient of well MW-2.

## SITE BACKGROUND

### Site Description

The site is currently being utilized as a parking garage, and is located between 17th and 19th Streets in downtown Oakland, California, approximately four miles east of San Francisco Bay and one quarter mile west of Lake Merritt (Figure 1). The site is relatively flat with an elevation of approximately 30 feet (ft) above mean sea level (msl).

Several former underground storage tank (UST) sites are located close to the site, including Prentiss Properties to the northeast at 1750 Webster Street, a former gas station to the east at 1700 Webster, and a former Chevron service station which is located approximately 400 feet to the southwest on the corner of 17$^{th}$ Street and Harrison Street.

On August 3 and 6, 1992, Parker Environmental Services removed one 1,000-gallon and two 500-gallon gasoline underground storage tanks (USTs) from the site. Up to 1,500 milligrams per kilogram (mg/kg) total petroleum hydrocarbons as gasoline (TPHg) and up to 12 mg/kg benzene were detected in the soil samples collected from the UST excavation.

Several investigations have been completed at the site. On July 8 and September 8, 1994, Gen Tech/Piers Environmental, Inc. (Gen Tech) of San Jose, California drilled six exploratory borings and installed three groundwater monitoring wells (MW-1 through MW-3). In February and May 1996, Cambria Environmental Technology (Cambria) of Emeryville, California advanced seven geoprobe soil borings and installed two groundwater monitoring wells (MW-4 and MW-5). On August 8, 2000, *Conduit Study and File Review Report* was submitted by Cambria Environmental Technology. The report provided significant information about offsite hydrocarbon impact and offsite sources, and concluded that there were no identified conduits for contaminant migration in groundwater. On June 27, 2003 Cambria installed two additional offsite monitoring wells (MW-6 and MW-7) to facilitate additional plume delineation.

Limited site remediation has been conducted at the site. In January 1998, Cambria installed ORC socks in well MW-2 to enhance the natural attenuation of dissolved-phase hydrocarbons. Dissolved oxygen (DO) concentrations temporarily increased in well MW-2 following the ORC sock installation. In February and March 1999, a total of 120 gallons of 7.5% hydrogen peroxide solution was added into monitoring wells MW-2 and MW-3 to oxidize hydrocarbons and also increase DO levels to enhance biodegradation of dissolved-phase hydrocarbons. The hydrogen peroxide *temporarily* increased groundwater DO levels, but hydrocarbon concentrations remained at elevated levels.

On March 4, 2003, Cambria installed a co-axial air sparging/soil vapor extraction well (SV-1/AS-1) and two angled air sparging wells (AS-2 and AS-3) to approximately 30 ft below grade surface (bgs). The wells were installed to facilitate feasibility testing and future site remediation. Site remediation via soil vapor extraction and air sparging began in October 2007. To improve system performance and further evaluate site conditions, Pangea submitted an *Investigation and Remediation Workplan* dated March 5, 2009, which proposed additional investigation, remediation system expansion, and evaluation of groundwater geochemistry.

On November 19, 2010, ACEH issued a letter requesting a cross section, additional information regarding a potential offsite source and a preferential pathway survey. In December 2010, Pangea informed the ACEH that significant information about the offsite hydrocarbon impact was presented in the August 8, 2000 *Conduit Study and File Review Report* prepared by Cambria. In December 2010, the UST Cleanup Fund prepared a 5 Year Review that recommended a site conceptual model (SCM), risk assessment, and sensitive receptor survey to help facilitate selection of an enhanced remediation technique. In a letter dated June 17, 2011, ACEH requested a site conceptual model with a preferential pathway evaluation. Pangea submitted a *Sensitive Receptor Survey, Conduit Study and Site Conceptual Model* (SCM) dated March 26, 2012. In a letter dated December 21, 2012, ACEH requested a workplan for vapor intrusion evaluation and investigation of potential secondary source near well MW-2.

## Site Geology & Hydrogeology

Unconfined groundwater conditions exist at the site. A shallow water-bearing zone consisting of highly permeable sand is present from approximately 14 to 30 feet bgs, and is underlain by a silty clay layer. Groundwater beneath the site generally flows *northwards* to *north-northeastwards*, consistent with the local topography. Since 1994, the depth to groundwater beneath and surrounding the site has ranged from approximately 13.6 feet bgs (MW-5) to 23.4 feet bgs (MW-7), equivalent to a groundwater elevation range from 5 to 13 feet above msl over thirteen years of monitoring. For source area well MW-2, groundwater depth has fluctuated only three feet, from 17.8 to 20.8 ft bgs (hydrocarbon concentrations generally decrease during low groundwater depth in well MW-2).

### Contaminant Distribution in Soil

Based on previous site investigations, the extent of detected TPHg and benzene concentrations in soil is primarily limited to the area around the former site USTs. Generally, the highest concentrations of contaminants in soil were detected during tank removal activities in August 1992, when shallow soil samples were collected at depths ranging from 7 to 14 ft bgs. Additional soil samples were collected in July 1994 and February and May 1996 at depths ranging from 15.5 to 31 ft bgs. The deeper soil samples, collected in 1994 and 1996, contained very low to non-detect concentrations of contaminants in the immediate area around the former site USTs. Historical soil analytical results are included in Table 1.

### Contaminant Distribution in Groundwater

The lateral extent of contaminants in shallow groundwater appears to be fairly well defined by data from existing monitoring wells and historical grab groundwater sampling. The downgradient extent of TPHg and benzene contamination in groundwater is defined by monitoring well MW-5. Contaminant concentrations are generally highest in source wells MW-2 and MW-3, which are both located near the former USTs, and in offsite wells MW-4 and MW-6 located down/crossgradient from the source area. Hydrocabons in wells MW-4 and MW-6 located across the street may be from an offsite source. Groundwater analytical data indicates that the contaminant plume is stable.

Some vertical assessment of contamination in groundwater at 1721 Webster Street is provided by air sparge wells screened at approximately 27 to 30 ft bgs. Most site monitoring wells are screened between 15 and 30 feet bgs. There is a layer of clay at approximately 30 ft bgs near the former USTs. This clay layer may be preventing contaminants from migrating into deeper water-bearing zones. Groundwater analytical data from the deeper site wells (air sparge wells) suggests that hydrocarbons are mostly limited to shallower groundwater.

## PROPOSED INVESTIGATION

The objective of the proposed investigation is to evaluate the potential for vapor intrusion into the onsite and adjacent retail buildings, and to further assess the extent of residual contaminants near well MW-2. The proposed scope of work to accomplish the investigation objective is detailed below.

### Task 1 - Pre-Field Activities

Prior to initiating field activities, Pangea will conduct the following tasks:

- Obtain encroachment and excavation permits from the City of Oakland and drilling permits from Alameda County Public Works Agency (ACPWA) as necessary;

- Pre-mark the boring locations with white paint, notify Underground Service Alert (USA) of the drilling and sampling activities at least 72 hours before work begins, and conduct private line locating as merited;

- Prepare a site-specific health and safety plan to educate personnel and minimize their exposure to potential hazards related to site activities; and

- Coordinate with drilling and laboratory subcontractors and other involved parties.

### Task 2 – Soil Borings

To provide additional assessment downgradient of well MW-2, Pangea proposes to advance two offsite borings (B-1 and B-2) to approximately 30 ft bgs. As shown on Figure 2, these boring locations will provide additional secondary source assessment immediately downgradient of well MW-2 where contaminant concentrations remain elevated. These borings will also evaluate current conditions near boring SB-D that contained elevated contaminant concentrations in 1996. At each boring location, soil samples will be collected every four feet and a grab groundwater sample will be collected from first-encountered groundwater. The grab groundwater sample will be collected using either temporary PVC casing or a discrete-depth sampler.

Pangea will conduct site investigation using a direct-push sampling rig. The direct-push sampling rig will be equipped with a hydraulic hammer and steel drive rods to advance the borings to total depth. With hydraulic-push drilling, continuous soil collection is conducted using acetate liners and samples are typically collected on four foot intervals. Soil samples will be obtained by cutting 6-inch subsections, trimming the excess soil from the ends, and capping the ends with Teflon® tape and plastic caps. Additional soil samples may be collected near the water table and at lithologic changes. The soil samples will be classified according to the Unified Soil Classification System (USCS) and screened for field indications of petroleum hydrocarbons using visual and olfactory observations and a photo-ionization device (PID).

All site investigation activities will be performed under the supervision of a California Registered Civil Professional Engineer (P.E.). Additional soil and assessment procedures are presented in our Standard Operating Procedures (SOPs) in Appendix B.

Groundwater and select soil samples will be analyzed for total petroleum hydrocarbons as gasoline (TPHg), benzene, toluene, ethylbenzene, xylenes (BTEX), and methyl-tertiary butyl ether (MTBE) by EPA Method 8015Cm/8021B.

### Task 3 – Soil Gas/Subslab Sampling

Pangea proposes to install one (1) shallow soil gas sample probe and three (3) subslab probes to facilitate collection of soil gas/subslab gas samples. Pangea proposes both soil gas and subslab gas sampling to more thoroughly evaluate subsurface vapor conditions. Hydrocarbon vapors could migrate through underground conduits to below the onsite slab, without significantly impacting deeper soil near the soil gas sampling location. Semi-permanent probes will be used to allow subsequent collection if merited. Pangea anticipates collecting initial soil gas samples during the dry season. If requested by ACEH, additional soil gas samples will be collected during the wet season.

The proposed sampling locations were selected to minimize disruption to existing businesses. As shown on Figure 2, all three subslab probe locations (SS-1 through SS-3) are within the onsite and adjacent retail buildings. Soil gas probe (SG-1) is located on Webster Street near the source area. Soil gas/subslab gas samples will be collected within Summa canisters and submitted to a state-certified laboratory for analysis. Soil gas/subslab gas samples will be analyzed for total petroleum hydrocarbons as gasoline (TPHg), benzene, toluene, ethylbenzene, xylene(s) (BTEX), methyl-tertiary butyl ether (MTBE), and naphthalene by modified Total Organics Method 15 (TO-15); and for percent oxygen and helium (leak check compound) by Method ASTM D-1946. The oxygen analyses will help evaluate the potential for future degradation and attenuation of detected hydrocarbons, and will help assess soil column characteristics (>= 4% oxygen in soil gas is referenced in the SWRCB's Underground Storage Tank Low-Threat Site Closure Policy).

The semi-permanent *soil gas* probe will be constructed with a stainless steel geoprobe implant connected to new ¼-inch diameter Teflon tubing and capped with a Swagelok® type fitting. The implant will be placed in a 0.5 to 1 ft thick sand pack with 0.5 to 1 ft of dry granular bentonite above, followed by hydrated bentonite and a concrete surface seal. The probe will be installed using a hand auger.

The *subslab* gas probe installation procedure involves using a rotohammer to drill a 1 ½-inch diameter, 4-inch deep hole in the approximately 6-inch thick concrete slab of the building, drilling a ½-inch diameter hole through the remaining concrete, installing a rubber stopper with stainless steel tubing (capped on one end with a Swagelok fitting) and placing a bentonite seal from the top of the stopper to within an inch of the surface. A second rubber stopper will be placed over the subslab probe to protect it and the probes will be allowed to equilibrate for 48 hours, prior to sampling.

An analytical laboratory will provide sampling assemblies and certified Summa canisters for sampling. The Summa canisters will come under a complete vacuum of approximately 30 inches of mercury. Prior to sample collection a vacuum/leak test will be conducted on the sampling assembly with the purging Summa canister to confirm no leak and the maintenance of the initial vacuum in the sampling manifold system. After a minimum of 5 minutes of vacuum/leak testing, the sampling Summa canister will be opened for sample collection. The pre-set valve will regulate the vapor flow to approximately 150 milliliters of air per minute, which equates to approximately 5 to 7 minutes to fill the 1-liter canister. Sample collection is typically discontinued when the vacuum decreases to below 5 inches of mercury but not below 3 inches of mercury. To further evaluate potential leakage within the sampling system, a leak-check enclosure will be placed over the soil gas/subslab probe, and helium gas will be introduced into the leak-check enclosure. A helium detector will be used to monitor the concentration of helium within the enclosure during sample collection. Additionally, tedlar bag samples are collected before (during purging) and after sample collection to check for helium in the sampling assembly. This method allows Pangea to monitor for leaks from the sample probe during sample collection and correct problems before sending the samples to the laboratory. The subslab/soil gas sampling will be conducted in general accordance with procedures described in Pangea's Standard Operating Procedures (SOPs) for Soil Gas and Subslab Sampling (Appendix B).

### Task 4 – Waste Management and Disposal

Soil cuttings and other investigation-derived waste will be stored onsite in Department of Transportation (DOT)-approved 55-gallon drums. The drums and their contents will be held onsite pending laboratory analytical results. Upon receipt of the analytical reports, the waste will be transported to an appropriate disposal/recycling facility.

### Task 5 – Report Preparation

Upon completion of assessment activities, Pangea will prepare a technical report. The report will describe the investigation activities, present tabulated analytical data, and offer conclusions and recommendations.

## REFERENCES

Cambria Environmental Technology, Inc., 2004, *Feasibility Test Report*, Douglas Parking Company, 1721 Webster Street, Oakland, California, April 22.

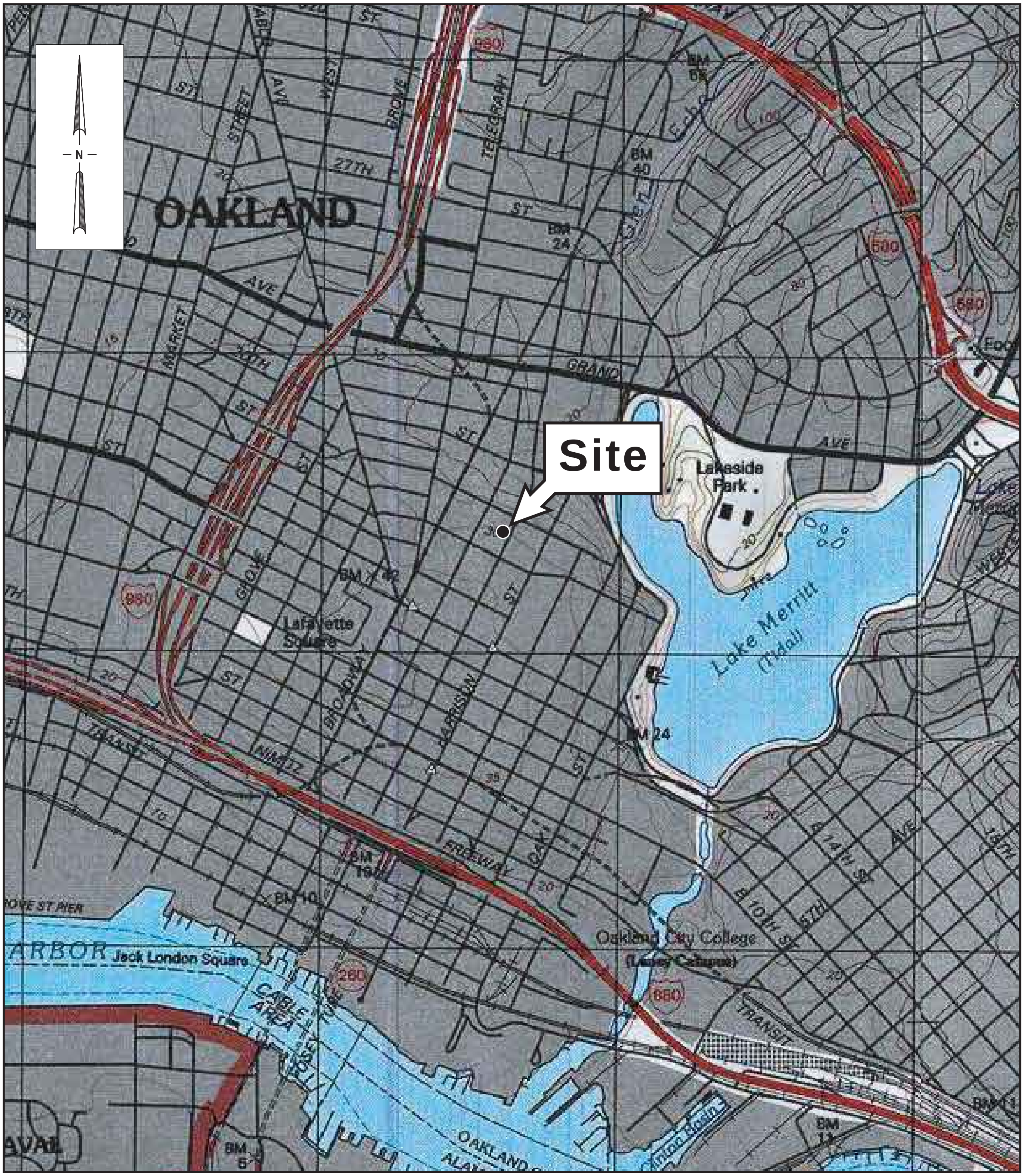
## ATTACHMENTS

Figure 1 – Vicinity Map
Figure 2 – Proposed Boring and Soil Gas/Subslab Probe Location Map

Table 1 – Soil Analytical Data
Table 2 – Groundwater Analytical Data

Appendix A – Regulatory Letter
Appendix B – Standard Operating Procedures

10/7/2006




SOURCE: TOPO! MAPS

0 1/8 1/4 1/2 1

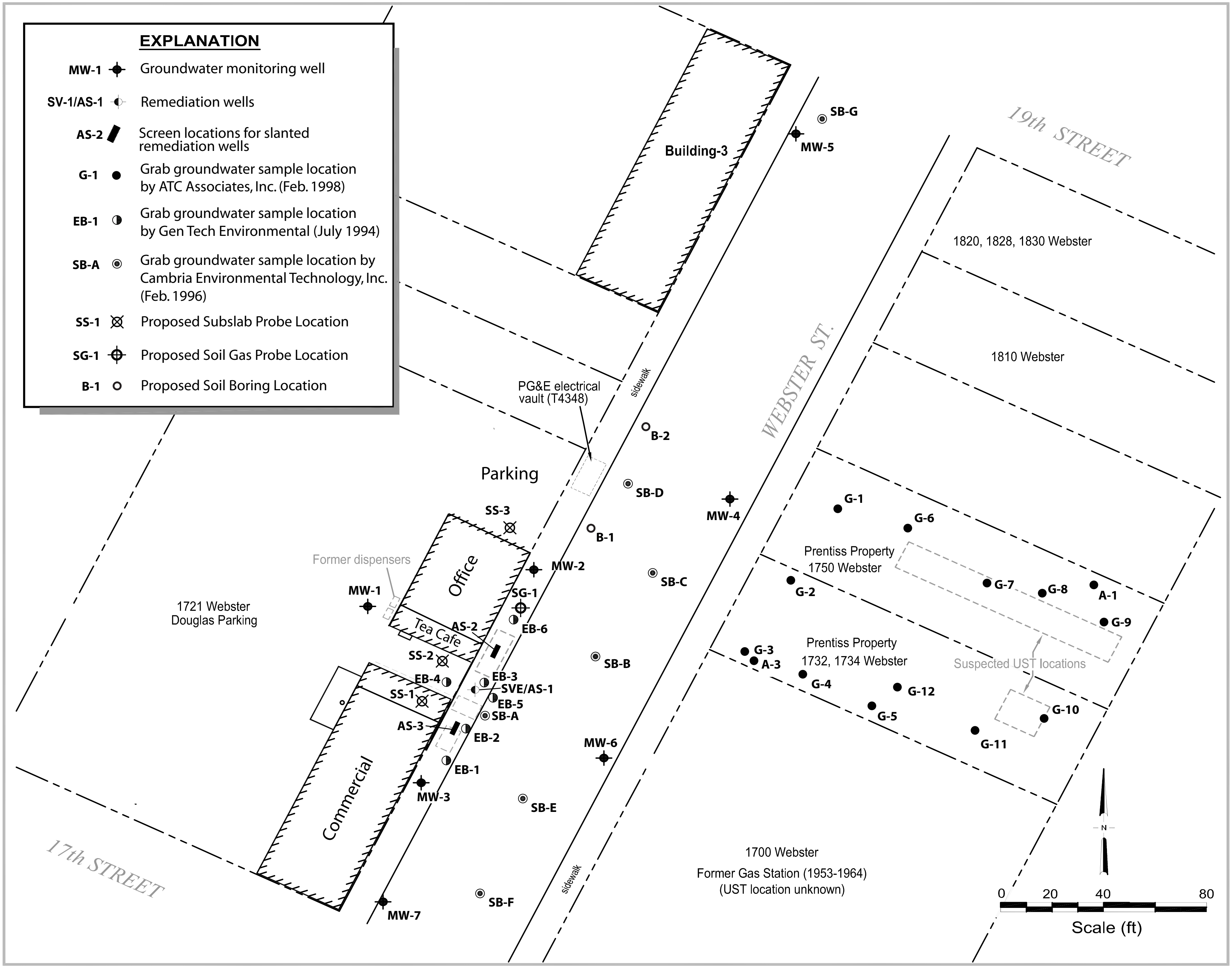
SCALE : 1" = 1/4 MILE

Figure
**1**

**Douglas Parking Facility**
**1721 Webster Street**
**Oakland, California**

PANGEA

**Vicinity Map**




**Douglas Parking**
1721 Webster Street
Oakland, California

PANGEA

**Proposed Boring & Soil Gas/ Subslab Probe Location Map**

FIGURE
**2**

# Pangea

**Table 1. Soil Analytical Data: Petroleum Hydrocarbons -** 1721 Webster Street, Oakland, California

| Sample ID | Date Sampled | Sample Depth (ft) | TPHg | Benzene | Toluene | Ethylbenzene | Xylenes | MTBE |
|---|---|---|---|---|---|---|---|---|
| | | | ← | | | mg/kg | | → |
| Comm. ESL - Indoor Air Impacts | | | Use soil gas | Use soil gas | Use soil gas | Use soil gas | Use soil gas | Use soil gas |
| Comm. ESL - Urban Ecotoxicity | | | -- | 25 | -- | -- | -- | -- |
| Comm. ESL - Ceiling Value | | | 500 | 870 | 650 | 400 | 420 | 500 |
| Comm. ESL - Direct Exposure | | | 450 | 0.27 | 210 | 5.0 | 100 | 65 |
| Comm. ESL - GW Protection (Leaching) | | | 83 | 0.044 | 2.9 | 3.3 | 2.3 | 0.023 |
| Final ESL - Commercial, Drinking Water Resource | | | **83** | **0.044** | **2.9** | **3.3** | **2.3** | **0.023** |
| **Cambria Environmental Technology, Inc. - 2003** | | | | | | | | |
| MW-6 | 6/27/2003 | 20.0 | **220** | <0.10 | 0.14 | <0.10 | 0.35 | <1.0 |
| **Cambria Environmental Technology, Inc. - 1996** | | | | | | | | |
| SB-A | 2/22/1996 | 19.5 | <1.0 | <0.005 | 0.007 | <0.005 | <0.005 | -- |
| SB-B | 2/22/1996 | 20.5 | **580** | <0.3 | 1.3 | 1.8 | **4.2** | -- |
| SB-C | 2/22/1996 | 19.5 | 1.4 | <0.005 | 0.013 | 0.027 | 0.12 | -- |
| SB-D | 2/22/1996 | 20.5 | **660** | <0.2 | 2.3 | <0.2 | **5.2** | -- |
| SB-E | 2/23/1996 | 20.5 | <1.0 | <0.005 | 0.009 | <0.005 | <0.005 | -- |
| SB-F | 2/23/1996 | 20.0 | <1.0 | <0.005 | 0.006 | <0.005 | <0.005 | -- |
| SB-G | 2/23/1996 | 20.0 | <1.0 | <0.005 | 0.009 | <0.005 | <0.005 | -- |
| SB-H | 5/3/1996 | 20.5 | 1.2 | <0.005 | 0.006 | 0.025 | 0.038 | -- |
| (MW-4) | 5/3/1996 | 31.0 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | -- |
| SB-I | 5/3/1996 | 15.5 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | -- |
| (MW-5) | 5/3/1996 | 26.0 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | -- |
| **Gen-Tech Environmental - 1994** | | | | | | | | |
| EB-1@20 | 7/8/1994 | 20.0 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | -- |
| EB-2@20 | 7/8/1994 | 20.0 | **300** | **0.2** | 1.7 | 0.26 | **3.0** | -- |
| EB-3@20 | 7/8/1994 | 20.0 | 51 | 0.039 | 0.56 | 0.32 | **2.9** | -- |
| EB-4@20 | 7/8/1994 | 20.0 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | -- |
| EB-5@20 | 7/8/1994 | 20.0 | **650** | **0.17** | **5.2** | **4.4** | **48** | -- |
| EB-6@20 | 7/8/1994 | 20.0 | 68 | <0.005 | **22** | **4.3** | **23** | -- |
| **Parker Environmental - 1992** | | | | | | | | |
| **Beneath UST Samples** | | | | | | | | |
| T-1 | 8/3/1992 | 9.0 | **150** | **2.2** | **2.9** | 1.8 | **13** | -- |
| T-2 | 8/3/1992 | 9.0 | **120** | **0.62** | 0.56 | 0.87 | 2.2 | -- |
| T-3 | 8/6/1992 | 8.0 | **580** | **1.7** | **5.9** | **5.6** | **43** | -- |
| T-4 | 8/6/1992 | 8.0 | **1,500** | **11** | **140** | **48** | **280** | -- |
| T-5 | 8/6/1992 | 8.0 | **410** | **6.7** | **22** | **6.2** | **35** | -- |
| T-6 | 8/6/1992 | 12.0 | **1,400** | **12** | **71** | **29** | **150** | -- |
| T-7 | 8/6/1992 | 14.0 | 2.3 | **0.11** | 0.19 | 0.05 | 0.31 | -- |

# Pangea

## Table 1. Soil Analytical Data: Petroleum Hydrocarbons - 1721 Webster Street, Oakland, California

| Sample ID | Date Sampled | Sample Depth (ft) | TPHg | Benzene | Toluene | Ethylbenzene | Xylenes | MTBE |
|---|---|---|---|---|---|---|---|---|
| | | | ← | | | mg/kg | | → |
| Comm. ESL - Indoor Air Impacts | | | Use soil gas | Use soil gas | Use soil gas | Use soil gas | Use soil gas | Use soil gas |
| Comm. ESL - Urban Ecotoxicity | | | -- | 25 | -- | -- | -- | -- |
| Comm. ESL - Ceiling Value | | | 500 | 870 | 650 | 400 | 420 | 500 |
| Comm. ESL - Direct Exposure | | | 450 | 0.27 | 210 | 5.0 | 100 | 65 |
| Comm. ESL - GW Protection (Leaching) | | | 83 | 0.044 | 2.9 | 3.3 | 2.3 | 0.023 |
| Final ESL - Commercial, Drinking Water Resource | | | **83** | **0.044** | **2.9** | **3.3** | **2.3** | **0.023** |
| **South Excavation Sidewall Samples** | | | | | | | | |
| SW1 | 8/6/1992 | 9.5 | **280** | **2.9** | **5.8** | 3.2 | **15** | -- |
| SW2 | 8/6/1992 | 7.0 | **1,500** | **5.7** | **40** | **18** | **150** | -- |
| SW3 | 8/6/1992 | 8.0 | **400** | **2.7** | **5.8** | **4.0** | **21** | -- |
| SW4 | 8/6/1992 | 9.0 | 2.3 | **0.42** | 0.028 | 0.077 | 0.18 | -- |
| **Piping and Dispenser Samples** | | | | | | | | |
| L-1 | 8/3/1992 | 1.5 | 2.6 | <0.005 | 0.01 | <0.005 | 0.03 | -- |
| L-2 | 8/3/1992 | 1.5 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | -- |
| L-3 | 8/3/1992 | 1.5 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | -- |
| L-4 | 8/3/1992 | 1.5 | <1.0 | <0.005 | <0.005 | <0.005 | <0.005 | -- |
| L-5 | 8/3/1992 | 2.0 | 8.2 | 0.01 | 0.02 | 0.012 | 0.092 | -- |
| L-6 | 8/3/1992 | 2.0 | <1.0 | <0.005 | 0.007 | <0.005 | 0.034 | -- |
| **Stockpile Samples** | | | | | | | | |
| C1 | 8/6/1992 | 1.5 | **560** | <0.1 | **5.0** | 3.1 | **24** | -- |

**Notes, Abbreviations and Methods:**

mg/kg = Milligrams per kilogram, approximately equivalent to parts per million (ppm).

TPHd = Total petroleum hydrocarbons as diesel by modified EPA Method 8015.

TPHg = Total petroleum hydrocarbons by EPA Method 8015.

BTEX = Benzen, toluene, ethylbenzene, xylenes by EPA Method 8020/8021.

MTBE = Methyl tertiary-butyl ether by EPA Method 8020.

ESL = Environmental Screening Levels for shallow soil with commercial/industrial land use where groundwater is a current or potential drinking water resource from Table A-2, established by the SFBRWQCB, Interim Final - November 2007 (Revised May 2008).

**Bold** = Concentration equals or exceeds the Final ESL.

-- = Not available or not analyzed.

< n = Chemical not present at a concentration in excess of detection limit shown.

**Table 2 - Groundwater Elevation and Analytical Data.**
Douglas Parking Company, 1721 Webster Street, Oakland, California

| Boring / Well ID *TOC* | Date | Depth to Water (ft) | Groundwater Elevation (ft amsl) | TPHg | Benzene | Toluene | Ethylbenzene | Xylenes | MTBE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | ← | | (μg/L) | | | → |
| **Monitoring Wells** | | | | | | | | | |
| MW-1 | 12/2/1994 | 19.42 | 9.83 | ND | ND | ND | ND | ND | - |
| *29.25* | 3/6/1995 | 20.69 | 9.04 | ND | ND | ND | ND | ND | - |
| *29.73* | 7/11/1995 | 20.65 | 9.16 | ND | ND | ND | ND | ND | - |
| *29.81* | 5/10/1996 | 20.80 | 9.01 | ND | ND | ND | ND | ND | - |
| | 10/2/1996 | 21.35 | 8.46 | - | - | - | - | - | - |
| | 2/28/1997 | 20.57 | 9.24 | - | - | - | - | - | - |
| | 9/16/1997 | 21.50 | 8.31 | - | - | - | - | - | - |
| | 2/5/1998 | 20.91 | 8.90 | - | - | - | - | - | - |
| | 8/11/1998 | 20.50 | 9.31 | - | - | - | - | - | - |
| | 2/8/1999 | 21.42 | 8.39 | - | - | - | - | - | - |
| | 2/24/1999 | 22.99 | 6.82 | - | - | - | - | - | - |
| | 3/3/1999 | 20.84 | 8.97 | - | - | - | - | - | - |
| | 3/10/1999 | 20.89 | 8.92 | - | - | - | - | - | - |
| | 3/17/1999 | 20.84 | 8.97 | - | - | - | - | - | - |
| | 5/4/1999 | 20.80 | 9.01 | - | - | - | - | - | - |
| | 7/20/1999 | 21.25 | 8.56 | - | - | - | - | - | - |
| | 10/5/1999 | 21.37 | 8.44 | - | - | - | - | - | - |
| | 1/7/2000 | 21.65 | 8.16 | - | - | - | - | - | - |
| | 4/6/2000 | 21.05 | 8.76 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/31/2000 | 21.13 | 8.68 | - | - | - | - | - | - |
| | 10/3/2000 | 21.69 | 8.12 | - | - | - | - | - | - |
| | 1/12/2001 | 22.00 | 7.81 | - | - | - | - | - | - |
| | 4/11/2001 | 22.16 | 7.65 | - | - | - | - | - | - |
| | 7/6/2001 | 22.57 | 7.24 | - | - | - | - | - | - |
| | 10/25/2001 | 22.71 | 7.10 | - | - | - | - | - | - |
| | 3/4/2002 | 22.53 | 7.28 | - | - | - | - | - | - |
| | 4/18/2002 | 22.81 | 7.00 | - | - | - | - | - | - |
| | 7/9/2002 | 22.95 | 6.86 | - | - | - | - | - | - |
| | 10/4/2002 | 23.13 | 6.68 | - | - | - | - | - | - |
| | 1/12/2003 | 22.05 | 7.76 | - | - | - | - | - | - |
| | 4/21/2003 | 21.17 | 8.64 | - | - | - | - | - | - |
| *32.75* | 7/21/2003 | 21.39 | 11.36 | - | - | - | - | - | - |
| | 10/2/2003 | 21.64 | 11.11 | - | - | - | - | - | - |
| | 1/15/2004 | 21.10 | 11.65 | - | - | - | - | - | - |
| | 4/5/2004 | 21.20 | 11.55 | - | - | - | - | - | - |
| | 8/9/2004 | 22.97 | 9.78 | - | - | - | - | - | - |
| | 10/7/2004 | 23.55 | 9.20 | - | - | - | - | - | - |
| | 2/7/2005 | 20.90 | 11.85 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/5/2005 | 20.60 | 12.15 | - | - | - | - | - | - |
| | 7/6/2005 | 20.66 | 12.09 | - | - | - | - | - | - |
| | 10/10/2005 | 21.16 | 11.59 | - | - | - | - | - | - |
| | 1/26/2006 | 20.73 | 12.02 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/10/2006 | 20.05 | 12.70 | - | - | - | - | - | - |
| | 7/6/2006 | 20.90 | 11.85 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/26/2006 | 21.80 | 10.95 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 1/19/2007 | 22.02 | 10.73 | -- | -- | -- | -- | -- | -- |
| | 4/17/2007 | 22.13 | 10.62 | -- | -- | -- | -- | -- | -- |
| | 7/6/2007 | 21.83 | 10.92 | -- | -- | -- | -- | -- | -- |
| | 10/15/2007 | 22.28 | 10.47 | -- | -- | -- | -- | -- | -- |
| | 1/17/2008 | 22.33 | 10.42 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/9/2008 | 22.11 | 10.64 | -- | -- | -- | -- | -- | -- |
| | 7/17/2008 | 22.50 | 10.25 | -- | -- | -- | -- | -- | -- |
| | 10/27/2008 | 22.75 | 10.00 | -- | -- | -- | -- | -- | -- |
| | 1/9/2009 | 22.89 | 9.86 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/27/2009 | 22.40 | 10.35 | -- | -- | -- | -- | -- | -- |
| | 7/9/2009 | 22.55 | 10.20 | -- | -- | -- | -- | -- | -- |
| | 2/3/2010 | 22.08 | 10.67 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/13/2010 | 21.20 | 11.55 | --- | --- | --- | --- | --- | --- |
| | 1/17/2011 | | | | | Well Inaccessible | | | |
| | 7/12/2011 | 20.72 | 12.03 | -- | -- | -- | -- | -- | -- |
| | 1/11/2012 | 21.33 | 11.42 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/25/2012 | 20.94 | 11.81 | -- | -- | -- | -- | -- | -- |
| | **1/25/2013** | **21.41** | **11.34** | **<50** | **<0.5** | **<0.5** | **<0.5** | **<0.5** | **<5.0** |

PANGEA

**Table 2 - Groundwater Elevation and Analytical Data.**
Douglas Parking Company, 1721 Webster Street, Oakland, California

| Boring / Well ID | Date | Depth to Water | Groundwater Elevation | TPHg | Benzene | Toluene | Ethylbenzene | Xylenes | MTBE |
|---|---|---|---|---|---|---|---|---|---|
| *TOC* | | (ft) | (ft amsl) | (µg/L) | | | | | |
| MW-2 | 12/2/1994 | 19.50 | 7.60 | 61,300 | 3,000 | 3,900 | 160 | 4,500 | - |
| *27.10* | 3/6/1995 | 18.49 | 8.61 | 98,000 | 8,400 | 16,000 | 2,000 | 2,600 | - |
| *27.40* | 7/11/1995 | 18.45 | 8.95 | 38,000 | 3,100 | 7,500 | 940 | 3,700 | - |
| | 5/10/1996 | 18.56 | 8.84 | 63,000 | 7,400 | 16,000 | 1,500 | 6,000 | - |
| | 10/2/1996 | 19.15 | 8.25 | 21,000 | 2,200 | 3,400 | 430 | 1,600 | - |
| | 2/28/1997 | 18.43 | 8.97 | 39,000 | 4,700 | 9,600 | 950 | 4,200 | ND |
| | 9/16/1997 | 19.26 | 8.14 | 29,000 | 3,300 | 5,800 | 690 | 2,900 | <620 |
| | 2/5/1998 | 18.66 | 8.74 | 10,000 | 1,000 | 2,000 | 170 | 860 | <330 |
| | 8/11/1998 | 18.41 | 8.99 | 12,000 | 1,200 | 2,300 | 260 | 1,400 | 300 |
| | 2/8/1999 | 19.84 | 7.56 | 5,500 | 740 | 1,200 | 150 | 780 | 60 |
| | 2/17/1999 | 18.94 | 8.46 | - | - | - | - | - | - |
| | 2/24/1999 | 20.76 | 6.64 | - | - | - | - | - | - |
| | 3/3/1999 | 18.55 | 8.85 | - | - | - | - | - | - |
| | 3/10/1999 | 20.74 | 6.66 | - | - | - | - | - | - |
| | 3/17/1999 | 18.57 | 8.83 | - | - | - | - | - | - |
| | 5/4/1999 | 18.55 | 8.85 | 90,000 | 9,200 | 21,000 | 1,600 | 10,000 | 560 |
| | 7/20/1999 | 18.98 | 8.42 | 28,000 | 2,100 | 3,700 | 900 | 4,200 | <860 |
| | 10/5/1999 | 19.10 | 8.30 | 11,000 | 870 | 180 | 30 | 1,400 | <110 |
| | 1/7/2000 | 19.41 | 7.99 | 15,000 | 1,300 | 2,100 | 440 | 1,800 | <14 |
| | 4/6/2000 | 18.80 | 8.60 | 17,000 | 1,800 | 3,100 | 500 | 2,200 | <50 |
| | 7/31/2000 | 18.87 | 8.53 | 17,000 | 1,500 | 2,700 | 430 | 2,100 | <200 |
| | 10/3/2000 | 19.45 | 7.95 | 27,000 | 2,500 | 4,000 | 660 | 2,900 | <50 |
| | 1/12/2001 | 19.80 | 7.60 | 25,000 | 2,700 | 4,100 | 670 | 3,000 | <200 |
| | 4/11/2001 | 20.03 | 7.37 | 97,000 | 9,500 | 21,000 | 2,200 | 7,900 | <200 |
| | 7/6/2001 | 20.19 | 7.21 | 3,500 | 500 | 150 | 11 | 420 | <5.0 |
| | 10/25/2001 | 20.35 | 7.05 | 3,800 | 620 | 230 | 70 | 400 | <50 |
| | 3/4/2002 | 20.37 | 7.03 | 46,000 | 7,300 | 12,000 | 870 | 3,200 | <500 |
| | 4/18/2002 | 20.15 | 7.25 | 68,000 | 5,100 | 8,900 | 1,100 | 4,000 | <1,000 |
| | 7/9/2002 | 21.09 | 6.31 | 1,000 | 200 | 8.9 | 0.67 | 82 | <10 |
| | 10/4/2002 | 21.28 | 6.12 | 270 | 100 | 3.4 | 0.53 | 10 | <5.0 |
| | 1/12/2003 | 20.59 | 6.81 | 67,000 | 7,600 | 13,000 | 1,400 | 5,600 | <500 |
| | 4/21/2003 | 19.98 | 7.42 | 78,000 | 7,700 | 12,000 | 1,900 | 6,900 | <500 |
| *30.40* | 7/21/2003 | 20.08 | 10.32 | 1,800 | 360 | 16 | <5.0 | 190 | <50 |
| | 10/2/2003 | 20.41 | 9.99 | 4,000 | 790 | 110 | 60 | 350 | <50 |
| | 1/15/2004 | 19.93 | 10.47 | 8,100 | 6.1 | 23 | 44 | 530 | <50 |
| | 4/5/2004 | 18.99 | 11.41 | 14,000 | 1,600 | 2,100 | 550 | 2,500 | <500 |
| | 8/9/2004 | 19.79 | 10.61 | 1,200 | 210 | 16 | 14 | 100 | <20 |
| | 10/7/2004 | 20.26 | 10.14 | 1,100 | 2.3 | 9.8 | 2.9 | 36 | <5.0 |
| | 2/7/2005 | 18.80 | 11.60 | 45,000 | 4,400 | 4,800 | 1,400 | 5,800 | <200 |
| | 4/5/2005 | 18.40 | 12.00 | 34,000 | 3,700 | 3,600 | 1,200 | 5,300 | <500 (<5.0) |
| | 7/6/2005 | 18.48 | 11.92 | 24,000 | 1,600 | 1,700 | 570 | 2,800 | <500 |
| | 10/10/2005 | 19.00 | 11.40 | 25,000 | 1,700 | 2,100 | 710 | 3,200 | <500 |
| | 1/26/2006 | 18.58 | 11.82 | 60,000 | 4,600 | 7,200 | 1,600 | 6,900 | <1,000 |
| | 4/10/2006 | 17.84 | 12.56 | 56,000 | 4,900 | 7,500 | 1,200 | 7,400 | <500 |
| | 7/6/2006 | 18.76 | 11.64 | 28,000 | 1,900 | 1,700 | 720 | 2,900 | <500 |
| | 10/26/2006 | 19.60 | 10.80 | 43,000 | 2,800 | 2,500 | 1,700 | 7,600 | <500 |
| | 1/19/2007 | 19.84 | 10.56 | 31,000 | 2,700 | 2,400 | 1,400 | 5,800 | <150 |
| | 4/17/2007 | 19.90 | 10.50 | 37,000 | 3,200 | 2,900 | 1,600 | 6,400 | <400 |
| | 7/6/2007 | 19.63 | 10.77 | 30,000 | 3,200 | 2,000 | 1,500 | 5,200 | <250 |
| | 10/15/2007 | 20.11 | 10.29 | 20,000 | 1,200 | 990 | 650 | 2,300 | <500 |
| | 1/17/2008 | 20.10 | 10.30 | 38,000 | 2,900 | 5,100 | 1,200 | 5,000 | <210 |
| | 4/9/2008 | 20.12 | 10.28 | 51,000 | 3,000 | 6,400 | 1,700 | 6,500 | <250 |
| | 7/17/2008 | 20.01 | 10.39 | 22,000 | 180 | 500 | 660 | 2,100 | <250 |
| | 10/27/2008 | 20.61 | 9.79 | 26,000 | 570 | 2,100 | 670 | 3,400 | <50 |
| | 1/9/2009 | 20.80 | 9.60 | 16,000 | 240 | 680 | 460 | 3,000 | <100 |
| | 4/27/2009 | 20.17 | 10.23 | 16,000 | 130 | 660 | 570 | 3,600 | <500 |
| | 7/9/2009 | 20.36 | 10.04 | 8,500 | 30 | 110 | 250 | 1,400 | <100 |
| | 2/3/2010 | 19.84 | 10.56 | 22,000 | 47 | 140 | 500 | 3,000 | <100 |
| | 7/13/2010 | 19.08 | 11.32 | 1,900 | 3.5 | 5.8 | 38 | 110 | <5.0 |
| | 1/17/2011 | 19.02 | 11.38 | 17,000 | 23 | 100 | 330 | 2,200 | <100 |
| | 7/12/2011 | 18.52 | 11.88 | 15,000 | 22 | 30 | 190 | 740 | <50 |
| | 1/12/2011 | 19.18 | 11.22 | 20,000 | 17 | 47 | 250 | 2,100 | <84 |
| | 7/25/2012 | 18.83 | 11.57 | 440 | <0.5 | 2.2 | 1.0 | 39 | <5.0 |
| | **1/25/2013** | **19.21** | **11.19** | **8,300** | **17** | **11** | **140** | **510** | **<50** |

**Table 2 - Groundwater Elevation and Analytical Data.**
Douglas Parking Company, 1721 Webster Street, Oakland, California

| Boring / Well ID *TOC* | Date | Depth to Water (ft) | Groundwater Elevation (ft amsl) | TPHg | Benzene | Toluene | Ethylbenzene | Xylenes | MTBE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | (µg/L) | | | | | |
| MW-3 | 12/2/1994 | 22.15 | 7.35 | 394,000 | 1,200 | ND | 1,800 | 4,000 | - |
| *29.50* | 3/6/1995 | 20.09 | 9.16 | 21,000 | 400 | 150 | 24 | 62 | - |
| *29.25* | 7/11/1995 | 19.99 | 9.57 | 12,000 | ND | 10 | 16 | 99 | - |
| *29.56* | 5/10/1996 | 20.24 | 9.32 | 8,600 | ND | 7.6 | 16 | 84 | - |
| | 10/2/1996 | 20.90 | 8.66 | 11,000 | ND | 7.4 | 19 | 92 | - |
| | 2/28/1997 | 20.12 | 9.44 | 6,000 | ND | 4.4 | 17 | 88 | 50 |
| | 9/16/1997 | 20.97 | 8.59 | 6,500 | <0.5 | 0.69 | 1.2 | 6.7 | <5.0 |
| | 2/5/1998 | 20.39 | 9.17 | 5,400 | <0.5 | 6.3 | 15 | 86 | <63 |
| | 8/11/1998 | 19.95 | 9.61 | 2,700 | <0.5 | 3.5 | 3.2 | 12 | <10 |
| | 2/8/1999 | 20.58 | 8.98 | 6,100 | <0.5 | 8.1 | 18 | 80 | <140 |
| | 2/17/1999 | 20.53 | 9.03 | - | - | - | - | - | - |
| | 2/24/1999 | 22.53 | 7.03 | - | - | - | - | - | - |
| | 3/3/1999 | 20.28 | 9.28 | - | - | - | - | - | - |
| | 3/10/1999 | 22.45 | 7.11 | - | - | - | - | - | - |
| | 3/17/1999 | 20.26 | 9.30 | - | - | - | - | - | - |
| | 5/4/1999 | 20.24 | 9.32 | 11,000 | <2 | <2 | 9.8 | 140 | <10 |
| | 7/20/1999 | 20.68 | 8.88 | 11,000 | <0.5 | 3.1 | 13 | 88 | <80 |
| | 10/5/1999 | 20.81 | 8.75 | 31,000 | 62 | <0.5 | 21 | 170 | <90 |
| | 1/7/2000 | 21.09 | 8.47 | 13,000 | <0.5 | <2 | 21 | 140 | <80 |
| | 4/6/2000 | 20.48 | 9.08 | 5,300 | 1.5 | 1.4 | 9.8 | 60 | <30 |
| | 7/31/2000 | 20.62 | 8.94 | 7,100 | 3.5 | 1.0 | 12 | 66 | <5.0 |
| | 10/3/2000 | 21.13 | 8.43 | 8,000 | <0.5 | 3.3 | 11 | 70 | <40 |
| | 1/12/2001 | 21.45 | 8.11 | 11,000 | 4.3 | 6.7 | 11 | 73 | <70 |
| | 4/11/2001 | 21.69 | 7.87 | 10,000 | <0.5 | <0.5 | 11 | 65 | <10 |
| | 7/6/2001 | 21.60 | 7.96 | 13,000 | 5.3 | 1.6 | 11 | 58 | <5.0 |
| | 10/25/2001 | 21.70 | 7.86 | 11,000 | <0.5 | 3.0 | 15 | 70 | <10 |
| | 3/4/2002 | 21.65 | 7.91 | 1,900 | 1.3 | 0.8 | <0.5 | 15 | <5.0 |
| | 4/18/2002 | 21.77 | 7.79 | 1,500 | 1.0 | 0.97 | 1.3 | 5.8 | <5 |
| | 7/9/2002 | 22.03 | 7.53 | 13,000 | 6.8 | 5.7 | 13 | 59 | <90 |
| | 10/4/2002 | 22.15 | 7.41 | 8,400 | <10 | <10 | <10 | 42 | <100 |
| | 1/12/2003 | 21.13 | 8.43 | 9,000 | 9.5 | 5.1 | 8.5 | 46 | <90 |
| | 4/21/2003 | 20.63 | 8.93 | 10,000 | <5.0 | <5.0 | 8.5 | 32 | <50 |
| *32.56* | 7/21/2003 | 20.68 | 11.88 | 9,600 | <2.5 | <2.5 | 7.4 | 39 | 48 (<1.0) |
| | 10/2/2003 | 20.99 | 11.57 | 12,000 | <5.0 | <5.0 | 10 | 40 | <90 |
| | 1/15/2004 | 20.74 | 11.82 | 13,000 | 37 | 41 | 78 | 930 | <50 |
| | 4/5/2004 | 20.59 | 11.97 | 4,500 | <1.7 | <1.7 | <1.7 | 12 | <17 |
| | 8/9/2004 | 22.18 | 10.38 | 2,100 | <1.0 | 3.7 | <1.0 | 8.1 | <10 |
| | 10/7/2004 | 22.79 | 9.77 | 2,400 | 6.5 | 26 | 7.5 | 89 | <15 |
| | 2/7/2005 | 20.35 | 12.21 | 6,800 | 2.2 | 5.6 | 2.0 | 12 | <30 |
| | 4/5/2005 | 19.95 | 12.61 | 6,100 | 2.3 | 2.6 | 1.3 | 8.3 | <45 (<0.5) |
| | 7/6/2005 | 19.93 | 12.63 | 4,500 | <1.0 | 1.5 | 1.0 | 8.3 | <10 |
| | 10/10/2005 | 20.45 | 12.11 | 3,800 | 0.73 | <0.5 | 0.98 | 5.7 | <15 |
| | 1/26/2006 | 20.05 | 12.51 | 5,100 | <0.5 | 1.1 | <0.5 | 6.6 | <15 |
| | 4/10/2006 | 19.39 | 13.17 | 1,900 | 0.55 | 1.6 | 0.51 | 4.1 | <10 |
| | 7/6/2006 | 20.25 | 12.31 | 5,600 | <1.0 | 2.3 | <1.0 | 6.4 | <20 |
| | 10/26/2006 | 21.07 | 11.49 | 8,000 | 2.5 | 1.0 | 2.3 | 12 | <35 |
| | 1/19/2007 | 21.38 | 11.18 | 77,000 | 19 | 40 | 9.5 | 130 | <300 |
| | 4/17/2007 | 21.45 | 11.11 | 7,400 | 2.7 | 6.6 | 1.1 | 12 | <40 |
| | 7/6/2007 | 21.29 | 11.27 | 7,100 | 2.4 | 5.6 | 0.85 | 10 | <30 |
| | 10/15/2007 | 21.62 | 10.94 | 10,000 | <5.0 | <5.0 | <5.0 | 14 | <50 |
| | 1/17/2008 | 21.68 | 10.88 | 6,400 | 1.8 | <0.5 | 1.0 | 8.4 | 23 |
| | 4/9/2008 | 21.42 | 11.14 | 4,700 | 1.7 | 2.2 | <0.5 | 3.8 | <18 |
| | 7/17/2008 | 22.10 | 10.46 | 7,700 | 2.9 | 3.1 | 1.4 | 11 | <60 |
| | 10/27/2008 | 22.13 | 10.43 | 9,700 | <1.7 | 1.8 | 2.3 | 11 | <17 |
| | 1/9/2009 | 22.27 | 10.29 | 9,800 | 1.7 | 2.0 | 3.0 | 14 | <17 |
| | 4/27/2009 | 21.74 | 10.82 | 8,700 | 1.9 | 3.3 | <1.7 | 11 | <50 |
| | 7/9/2009 | 21.92 | 10.64 | 10,000 | <2.5 | 4.1 | 2.6 | 11 | <60 |
| | 2/3/2010 | 21.55 | 11.01 | 5,300 | 1.5 | 2.3 | <0.5 | 2.7 | <25 |
| | 7/13/2010 | 21.31 | 11.25 | 4,400 | <2.5 | 9.0 | <2.5 | 4.6 | <25 |
| | 1/17/2011 | 20.75 | 11.81 | 4,100 | 1.2 | 1.8 | <0.5 | 2.7 | <20 |
| | 7/12/2011 | 20.14 | 12.42 | 4,500 | 2.4 | 2.8 | <0.5 | 5.0 | <25 |
| | 1/11/2012 | 20.80 | 11.76 | 3,000 | 1.1 | 1.6 | <0.5 | 1.9 | <15 |
| | 7/25/2012 | 20.44 | 12.12 | 5,400 | <1.7 | <1.7 | <1.7 | 4.1 | <17 |
| | **1/25/2013** | **20.84** | **11.72** | **4,900** | **<1.7** | **2.7** | **<1.7** | **3.5** | **<17** |

**Table 2 - Groundwater Elevation and Analytical Data.**
Douglas Parking Company, 1721 Webster Street, Oakland, California

| Boring / Well ID *TOC* | Date | Depth to Water (ft) | Groundwater Elevation (ft amsl) | TPHg | Benzene | Toluene | Ethylbenzene | Xylenes | MTBE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | ← | | (μg/L) | | | → |
| MW-4 | 5/10/1996 | 16.98 | 8.31 | 14,000 | ND | 1,200 | 720 | 3,100 | - |
| *25.29* | 10/2/1996 | 17.65 | 7.64 | 12,000 | ND | 650 | 580 | 2,200 | - |
| | 2/28/1997 | 16.80 | 8.49 | 13,000 | ND | 1,100 | 750 | 2,700 | 110 |
| | 9/17/1997 | 17.93 | 7.36 | 13,000 | <2.5 | 820 | 750 | 2,900 | <190 |
| | 2/5/1998 | 16.78 | 8.51 | 13,000 | <1.0 | 690 | 690 | 2,900 | <170 |
| | 8/11/1998 | 16.59 | 8.70 | 15,000 | <5 | 360 | 520 | 1,900 | 280 |
| | 2/8/1999 | 17.10 | 8.19 | 9,800 | <5 | 680 | 770 | 2,200 | 300 |
| | 2/24/1999 | 18.95 | 6.34 | - | - | - | - | - | - |
| | 3/3/1999 | 16.80 | 8.49 | - | - | - | - | - | - |
| | 3/10/1999 | 16.86 | 8.43 | - | - | - | - | - | - |
| | 3/17/1999 | 16.82 | 8.47 | - | - | - | - | - | - |
| | 5/4/1999 | 16.86 | 8.43 | 11,000 | 46 | 600 | 620 | 1,900 | <100 |
| | 7/20/1999 | 17.30 | 7.99 | 13,000 | <0.5 | 470 | 7.0 | 2,000 | <150 |
| | 10/5/1999 | 17.43 | 7.86 | 18,000 | 4.4 | 720 | 800 | 2,100 | <120 |
| | 1/7/2000 | 17.78 | 7.51 | 18,000 | <2 | 930 | 990 | 2,700 | <30 |
| | 4/6/2000 | 17.17 | 8.12 | 8,000 | 31 | 390 | 530 | 1,300 | <10 |
| | 7/31/2000 | 17.21 | 8.08 | 6,200 | 13 | 170 | 460 | 850 | <10 |
| | 10/3/2000 | 18.00 | 7.29 | 14,000 | 42 | 820 | 730 | 2,000 | <50 |
| | 1/12/2001 | 18.20 | 7.09 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/11/2001 | 18.31 | 6.98 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/6/2001 | 18.35 | 6.94 | 470 | 2.3 | 1.6 | 0.81 | 43 | <5.0 |
| | 10/25/2001 | 18.47 | 6.82 | 110 | 0.70 | <0.5 | <0.5 | 3.3 | <5.0 |
| | 3/4/2002 | 18.43 | 6.86 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/18/2002 | 18.61 | 6.68 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/9/2002 | 19.50 | 5.79 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/4/2002 | 19.83 | 5.46 | 310 | 2.0 | 2.9 | 13 | 16 | <0.5 |
| | 1/12/2003 | 19.07 | 6.22 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/21/2003 | 18.71 | 6.58 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| *28.29* | 7/21/2003 | 18.81 | 9.48 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/2/2003 | 19.02 | 9.27 | 59 | 0.78 | <0.5 | 1.1 | 0.91 | <5.0 |
| | 1/15/2004 | 18.68 | 9.61 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/5/2004 | 17.41 | 10.88 | 6,200 | 29 | 250 | 450 | 730 | <100 |
| | 8/9/2004 | 19.07 | 9.22 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/7/2004 | 19.65 | 8.64 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 2/7/2005 | 17.21 | 11.08 | 8,700 | 48 | 340 | 550 | 720 | <100 |
| | 4/5/2005 | 16.78 | 11.51 | 6,900 | 27 | 290 | 520 | 660 | <170 (<0.5) |
| | 7/6/2005 | 16.98 | 11.31 | 5,600 | <5.0 | 130 | 470 | 480 | <50 |
| | 10/10/2005 | 17.59 | 10.70 | 6,300 | 23 | 78 | 530 | 430 | <50 |
| | 1/26/2006 | 17.08 | 11.21 | 5,600 | 41 | 68 | 400 | 290 | <120 |
| | 4/10/2006 | 16.27 | 12.02 | 2,900 | 39 | 32 | 200 | 140 | <60 |
| | 7/6/2006 | 17.20 | 11.09 | 5,400 | 65 | 59 | 340 | 150 | <120 |
| | 10/26/2006 | 18.06 | 10.23 | 7,200 | 72 | 46 | 460 | 200 | <150 |
| | 1/19/2007 | 18.29 | 10.00 | 7,100 | 140 | 35 | 520 | 150 | <200 |
| | 4/17/2007 | 18.30 | 9.99 | 4,900 | 90 | 32 | 290 | 89 | <110 |
| | 7/6/2007 | 18.00 | 10.29 | 4,600 | 91 | 30 | 210 | 55 | <90 |
| | 10/15/2007 | 18.52 | 9.77 | 8,600 | 200 | 62 | 480 | 110 | <210 |
| | 1/17/2008 | 18.46 | 9.83 | 820 | 15 | 3.7 | 25 | 9.3 | <10 |
| | 4/9/2008 | 18.23 | 10.06 | 3,600 | 55 | 20 | 160 | 64 | <60 |
| | 7/17/2008 | 18.72 | 9.57 | 6,500 | 210 | 47 | 510 | 180 | <180 |
| | 10/27/2008 | 19.07 | 9.22 | 7,700 | 200 | 28 | 450 | 87 | <150 |
| | 1/9/2009 | 19.12 | 9.17 | 4,400 | 180 | 34 | 180 | 93 | <150 |
| | 4/27/2009 | 18.52 | 9.77 | 2,500 | 110 | 24 | 190 | 69 | <150 |
| | 7/9/2009 | 18.78 | 9.51 | 5,600 | 150 | 34 | 270 | 83 | <250 |
| | 2/3/2010 | 18.24 | 10.05 | 2,900 | 38 | 20 | 69 | 54 | <50 |
| | 7/13/2010 | 17.59 | 10.70 | 1,100 | 20 | 7.6 | 43 | 26 | <60 |
| | 1/17/2011 | 17.42 | 10.87 | 2,900 | 16 | 43 | 60 | 99 | <15 |
| | 7/12/2011 | 17.01 | 11.28 | <50 | <0.5 | 0.56 | 0.52 | 0.93 | <5.0 |
| | 1/11/2012 | 17.68 | 10.61 | 4,100 | 52 | 52 | 49 | 130 | <90 |
| | 7/25/2012 | 17.26 | 11.03 | 100 | 1.2 | <0.5 | <0.5 | <0.5 | <5.0 |
| | **1/25/2013** | **17.58** | **10.71** | **3,500** | **33.0** | **20** | **23** | **65** | **<35** |

**Table 2 - Groundwater Elevation and Analytical Data.**
Douglas Parking Company, 1721 Webster Street, Oakland, California

| Boring / Well ID *TOC* | Date | Depth to Water (ft) | Groundwater Elevation (ft amsl) | TPHg | Benzene | Toluene | Ethylbenzene | Xylenes | MTBE |
|---|---|---|---|---|---|---|---|---|---|
| | | | | ← | | (µg/L) | | | → |
| MW-5 | 5/10/1996 | 14.60 | 7.37 | ND | ND | ND | ND | ND | - |
| *21.97* | 10/2/1996 | 15.25 | 6.72 | ND | ND | ND | ND | ND | - |
| | 2/28/1997 | 14.31 | 7.66 | ND | ND | ND | ND | ND | ND |
| | 9/17/1997 | 15.18 | 6.79 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 2/5/1998 | 13.64 | 8.33 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 8/11/1998 | 13.92 | 8.05 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 2/8/1999 | 14.19 | 7.78 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 2/24/1999 | 16.18 | 5.79 | - | - | - | - | - | - |
| | 3/3/1999 | 14.23 | 7.74 | - | - | - | - | - | - |
| | 3/10/1999 | 14.32 | 7.65 | - | - | - | - | - | - |
| | 3/17/1999 | 14.25 | 7.72 | - | - | - | - | - | - |
| | 5/4/1999 | 14.41 | 7.56 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/20/1999 | 14.44 | 7.53 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/5/1999 | 14.79 | 7.18 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 1/7/2000* | 15.23 | 6.74 | - | - | - | - | - | - |
| | 4/6/2000 | 14.74 | 7.23 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/31/2000 | 14.52 | 7.45 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/3/2000 | 15.37 | 6.60 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 1/12/2001 | 15.70 | 6.27 | 6,400 | 13 | 290 | 450 | 1,100 | <40 |
| | 4/11/2001 | 15.78 | 6.19 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/6/2001 | 15.97 | 6.00 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/25/2001 | 16.05 | 5.92 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 3/4/2002 | 16.21 | 5.76 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/18/2002 | 16.59 | 5.38 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/9/2002 | 16.94 | 5.03 | 170 | 1.0 | 0.65 | 2.1 | 4.0 | <15 |
| | 10/4/2002 | 17.14 | 4.83 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 1/12/2003 | 16.58 | 5.39 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/21/2003 | 15.90 | 6.07 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/21/2003 | 16.03 | 8.96 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| *24.99* | 10/2/2003 | 16.33 | 8.66 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 1/15/2004 | 16.21 | 8.78 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/5/2004 | 15.01 | 9.98 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 8/9/2004 | 16.85 | 8.14 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/7/2004 | 17.48 | 7.51 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 2/7/2005 | 16.52 | 8.47 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/5/2005 | 14.45 | 10.54 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 (<0.5) |
| | 7/6/2005 | 14.85 | 10.14 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/10/2005 | 15.44 | 9.55 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 1/26/2006 | 14.96 | 10.03 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/10/2006 | 14.01 | 10.98 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/6/2006 | 15.17 | 9.82 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/26/2006 | 15.94 | 9.05 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 1/19/2007 | 16.05 | 8.94 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/17/2007 | 15.99 | 9.00 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/6/2007 | 15.50 | 9.49 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/15/2007 | 16.27 | 8.72 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 1/17/2008 | 15.10 | 9.89 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/9/2008 | 15.96 | 9.03 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/17/2008 | 16.44 | 8.55 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/27/2008 | 16.78 | 8.21 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 1/9/2009 | 16.75 | 8.24 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/27/2009 | 16.21 | 8.78 | -- | -- | -- | -- | -- | -- |
| | 7/9/2009 | 16.48 | 8.51 | -- | -- | -- | -- | -- | -- |
| | 2/3/2010 | 15.77 | 9.22 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/13/2010 | 15.34 | 9.65 | --- | --- | --- | --- | --- | --- |
| | 1/17/2011 | 14.93 | 10.06 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/12/2011 | 14.81 | 10.18 | -- | -- | -- | -- | -- | -- |
| | 1/11/2012 | 15.44 | 9.55 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/25/2012 | 14.79 | 10.20 | -- | -- | -- | -- | -- | -- |
| | **1/25/2013** | **15.21** | **9.78** | **<50** | **<0.5** | **<0.5** | **<0.5** | **<0.5** | **<5.0** |

**Table 2 - Groundwater Elevation and Analytical Data.**
Douglas Parking Company, 1721 Webster Street, Oakland, California

| Boring / Well ID *TOC* | Date | Depth to Water (ft) | Groundwater Elevation (ft amsl) | TPHg (µg/L) | Benzene (µg/L) | Toluene (µg/L) | Ethylbenzene (µg/L) | Xylenes (µg/L) | MTBE (µg/L) |
|---|---|---|---|---|---|---|---|---|---|
| MW-6 | 6/30/2003 | 19.60 | 11.39 | 68,000 | 950 | 6,000 | 2,400 | 10,000 | <1,000 |
| *30.99* | 7/21/2003 | 19.67 | 11.32 | 120,000 | 170 | 1,400 | 1,100 | 10,000 | <1,000 |
| | 10/2/2003 | 19.97 | 11.02 | 16,000 | 7.6 | 200 | 38 | 1,800 | <100 |
| | 1/15/2004 | 19.55 | 11.44 | 14,000 | 48 | 51 | 94 | 1,100 | <50 |
| | 4/5/2004 | 19.17 | 11.82 | 24,000 | 180 | 900 | 430 | 1,800 | <500 |
| | 8/9/2004 | 20.98 | 10.01 | 5,300 | 6.4 | 25 | 5.3 | 69 | <17 (<0.5) |
| | 10/7/2004 | 21.52 | 9.47 | 5,600 | 11 | 58 | 18 | 210 | <50 (<0.5) |
| | 2/7/2005 | 19.00 | 11.99 | 31,000 | 120 | 620 | 310 | 1,200 | <500 |
| | 4/5/2005 | 18.60 | 12.39 | 21,000 | 170 | 1,100 | 350 | 1,300 | <500 (<5.0) |
| | 7/6/2005 | 18.56 | 12.43 | 26,000 | 130 | 920 | 320 | 1,200 | <500 |
| | 10/10/2005 | 19.99 | 11.00 | 19,000 | 140 | 840 | 250 | 980 | <500 |
| | 1/26/2006 | 18.70 | 12.29 | 10,000 | 140 | 1,100 | 270 | 1,200 | <170 |
| | 4/10/2006 | 18.04 | 12.95 | 13,000 | 140 | 1,000 | 280 | 1,000 | <250 |
| | 7/6/2006 | 18.80 | 12.19 | 17,000 | 150 | 1,000 | 290 | 1,000 | <250 |
| | 10/26/2006 | 19.62 | 11.37 | 23,000 | 230 | 660 | 470 | 1,500 | <500 |
| | 1/19/2007 | 19.92 | 11.07 | 18,000 | 190 | 620 | 350 | 1,100 | <150 |
| | 4/17/2007 | 19.97 | 11.02 | 23,000 | 380 | 1,400 | 590 | 2,000 | <450 |
| | 7/6/2007 | 19.81 | 11.18 | 28,000 | 600 | 3,000 | 900 | 2,700 | <500 |
| | 10/15/2007 | 20.15 | 10.84 | 25,000 | 290 | 680 | 410 | 1,100 | <250 |
| | 10/15/2007 | 20.15 | 10.84 | 25,000 | 290 | 680 | 410 | 1,100 | <250 |
| | 1/17/2007 | 20.22 | 10.77 | 16,000 | 200 | 130 | 130 | 460 | <150 |
| | 4/9/2008 | 19.86 | 11.13 | 18,000 | 320 | 870 | 480 | 1,500 | <250 |
| | 7/17/2008 | 20.36 | 10.63 | 18,000 | 320 | 510 | 420 | 1,200 | <500 |
| | 10/27/2008 | 20.69 | 10.30 | 31,000 | 320 | 320 | 410 | 990 | <350 |
| | 1/9/2009 | 20.83 | 10.16 | 22,000 | 340 | 390 | 560 | 1,400 | <250 |
| | 4/27/2009 | 20.27 | 10.72 | 13,000 | 110 | 97 | 380 | 1,100 | <350 |
| | 7/9/2009 | 20.43 | 10.56 | 18,000 | 250 | 520 | 470 | 1,300 | <450 |
| | 2/3/2010 | 20.14 | 10.85 | 6,200 | 82 | 180 | 190 | 550 | <150 |
| | 7/13/2010 | 19.29 | 11.70 | 12,000 | 260 | 420 | 480 | 1,600 | <450 |
| | 1/17/2011 | 19.31 | 11.68 | 4,900 | 70 | 52 | 210 | 500 | <50 |
| | 7/12/2011 | 18.73 | 12.26 | 1,400 | 20 | 8.5 | 64 | 130 | <30 |
| | 1/11/2012 | 19.39 | 11.60 | 6,000 | 100 | 38 | 310 | 700 | <210 |
| | 7/25/2012 | 19.02 | 11.97 | 2,800 | 31 | 13 | 140 | 240 | <75 |
| | **1/25/2013** | **19.35** | **11.64** | **5,400** | **86** | **34** | **310** | **620** | **<100** |
| MW-7 | 6/30/2003 | 21.40 | 11.71 | 170 | <0.5 | 2.1 | 2.0 | 8.7 | <5.0 |
| *33.11* | 7/21/2003 | 21.44 | 11.67 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/2/2003 | 21.73 | 11.38 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 1/15/2004 | 21.57 | 11.54 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/5/2004 | 20.84 | 12.27 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 8/9/2004 | 22.68 | 10.43 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/7/2004 | 23.27 | 9.84 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 2/7/2005 | 20.60 | 12.51 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/5/2005 | 20.22 | 12.89 | <50 | <0.5 | 0.75 | <0.5 | <0.5 | <5.0 (<0.5) |
| | 7/6/2005 | 20.25 | 12.86 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/10/2005 | 20.70 | 12.41 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 1/26/2006 | 20.32 | 12.79 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/10/2006 | 19.62 | 13.49 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/6/2006 | 20.47 | 12.64 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/26/2006 | 21.30 | 11.81 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 1/19/2007 | 21.62 | 11.49 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/17/2007 | | 11.49 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/6/2007 | 21.59 | 11.52 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/15/2007 | 21.85 | 11.26 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 1/17/2007 | 21.90 | 11.21 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/9/2008 | 21.61 | 11.50 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/17/2008 | 22.09 | 11.02 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/27/2008 | 22.39 | 10.72 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 1/9/2009 | 22.52 | 10.59 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/27/2009 | 21.98 | 11.13 | -- | -- | -- | -- | -- | -- |
| | 7/9/2009 | 22.18 | 10.93 | -- | -- | -- | -- | -- | -- |
| | 2/3/2010 | 21.87 | 11.24 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/13/2010 | 21.01 | 12.10 | --- | --- | --- | --- | --- | --- |
| | 1/17/2011 | 21.07 | 12.04 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/12/2011 | 20.72 | 12.39 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 1/11/2012 | 21.13 | 11.98 | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/25/2012 | 20.75 | 12.36 | -- | -- | -- | -- | -- | -- |
| | **1/25/2013** | **21.10** | **12.01** | **<50** | **<0.5** | **<0.5** | **<0.5** | **<0.5** | **<5.0** |

**Table 2 - Groundwater Elevation and Analytical Data.**
Douglas Parking Company, 1721 Webster Street, Oakland, California

| Boring / Well ID *TOC* | Date | Depth to Water (ft) | Groundwater Elevation (ft amsl) | TPHg | Benzene | Toluene | Ethylbenzene (µg/L) | Xylenes | MTBE |
|---|---|---|---|---|---|---|---|---|---|
| AS-1 | 7/6/2006 | 19.53 | -- | 18,000 | 2,700 | 570 | 700 | 1,900 | <500 |
| | 10/26/2006 | 20.33 | -- | 15,000 | 1,900 | 340 | 360 | 1,400 | <250 |
| | 1/19/2007 | 20.64 | -- | 5,700 | 1,100 | 110 | 88 | 630 | <50 |
| | 1/19/2007 | 20.64 | -- | 5,700 | 1,100 | 110 | 88 | 630 | <50 |
| | 4/17/2007 | 20.71 | -- | -- | -- | -- | -- | -- | -- |
| | 7/16/2007 | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10/15/2007 | -- | -- | -- | -- | -- | -- | -- | -- |
| | 1/17/2008 | -- | -- | -- | -- | -- | -- | -- | -- |
| | 4/9/2008 | -- | -- | -- | -- | -- | -- | -- | -- |
| | **1/25/2013** | **--** | **--** | **70** | **10** | **<0.5** | **<0.5** | **<0.5** | **<5.0** |
| AS-2 | 7/6/2006 | 22.26 | -- | 2,100 | 6.1 | <0.5 | 33 | 200 | <20 |
| | 10/26/2006 | 23.25 | -- | 280 | 1.1 | <0.5 | <0.5 | 6.0 | <15 |
| | 1/19/2007 | 23.61 | -- | 2,100 | 2.3 | <0.5 | 96 | 310 | <35 |
| | 4/17/2007 | 23.70 | -- | -- | -- | -- | -- | -- | -- |
| | 7/16/2007 | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10/15/2007 | -- | -- | -- | -- | -- | -- | -- | -- |
| | 1/17/2008 | -- | -- | -- | -- | -- | -- | -- | -- |
| | 4/9/2008 | -- | -- | -- | -- | -- | -- | -- | -- |
| | **1/25/2013** | **22.02** | **--** | **<50** | **<0.5** | **<0.5** | **<0.5** | **<0.5** | **<5.0** |
| AS-3 | 7/6/2006 | 21.77 | -- | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/26/2006 | 22.66 | -- | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 1/19/2007 | 22.97 | -- | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/17/2007 | 23.06 | -- | -- | -- | -- | -- | -- | -- |
| | 7/16/2007 | -- | -- | -- | -- | -- | -- | -- | -- |
| | 10/15/2007 | -- | -- | -- | -- | -- | -- | -- | -- |
| | 1/17/2008 | -- | -- | -- | -- | -- | -- | -- | -- |
| | 4/9/2008 | -- | -- | -- | -- | -- | -- | -- | -- |
| | **1/25/2013** | **22.60** | **--** | **<50** | **<0.5** | **<0.5** | **0.55** | **<0.5** | **<5.0** |
| Trip Blank | 01/12/01 | - | - | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 4/11/2001 | - | - | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 7/6/2001 | - | - | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 3/4/2002 | - | - | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/2/2003 | - | - | <50 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 |
| | 10/15/2007 | -- | -- | -- | -- | -- | -- | -- | -- |
| **Grab Groundwater** | | | | | | | | | |
| SB-A | 2/22/1996 | -- | -- | 16,000 | 38 | 16 | 180 | 620 | -- |
| SB-B | 2/22/1996 | -- | -- | 20,000 | 100 | 29 | 320 | 590 | -- |
| SB-C | 2/22/1996 | -- | -- | 1,200 | 130 | 100 | 68 | 230 | -- |
| SB-D | 2/22/1996 | -- | -- | 7,400 | 550 | 110 | 160 | 89 | -- |
| SB-E | 2/23/1996 | -- | -- | 16,000 | 31 | 160 | 390 | 1,400 | -- |
| SB-F | 2/23/1996 | -- | -- | <50 | <0.5 | 1.4 | <0.5 | 2.3 | -- |
| SB-G | 2/23/1996 | -- | -- | 5,200 | 1.3 | <0.5 | 0.7 | <0.5 | -- |
| EB-1GWS | 7/8/1994 | -- | -- | 62,000 | <0.5 | 26 | 850.0 | 8,900 | -- |
| EB-2GWS | 7/8/1994 | -- | -- | 160,000 | 5,300 | 20,000 | 2,100 | 17,000 | -- |
| EB-3GWS | 7/8/1994 | -- | -- | 87,000 | 1,400 | 21,000 | 1,700 | 19,000 | -- |
| EB-4GWS | 7/8/1994 | -- | -- | 350,000 | 290 | 1,300 | 3,200 | 31,000 | -- |
| EB-5GWS | 7/8/1994 | -- | -- | 120,000 | 2,100.0 | 13,000 | 1,300.0 | 16,000 | -- |
| EB-6GWS | 7/8/1994 | -- | -- | 230,000 | 10,000 | 34,000 | 2,300 | 16,000 | -- |

**Notes and Abbreviations:**

TOC = Top of casing elevations in feet above mean sea level.
ft amsl = Measured in feet above mean sea level
µg/L = Micrograms per liter.
TPHg = Total petroleum hydrocarbons as gasoline by modified EPA Method 8015C.
BTEX = Benzene, toluene, ethylbenzene, and xylenes by EPA Method 8021B.
MTBE = Methyl tertiary butyl ether by EPA Method 8021B, and by EPA Method 8260 in parenthesis.
<0.5 = Concentration not detected above specific laboratory reporting limit.
-- = Not analyzed, not sampled, or not applicable.
ND = Not detected.
Data prior to 7/11/95 from Gen Tech and Piers Environmental Quarterly Groundwater Monitoring Reports dated December 2, 1994 and March 6, 1995, respectively.

On July 31, 2003, Virgil Chavez Land Surveying of Vallejo, California surveyed monitoring wells using a benchmark in the top of the curb near the SW return of the NW corner of 34th and Broadway.

# APPENDIX A

Regulatory Letter

ALAMEDA COUNTY
**HEALTH CARE SERVICES**
AGENCY
ALEX BRISCOE, Director

ENVIRONMENTAL HEALTH DEPARTMENT
ENVIRONMENTAL PROTECTION
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577
(510) 567-6700
FAX (510) 337-9335

December 21, 2012

Mr. Leland Douglas (Sent via E-mail to: lee@douglasparking.com)
Douglas Parking
1721 Webster St.
Oakland, CA 94612

Subject: Fuel Leak Case No. RO0000129 and Geotracker Global ID T0600100140, Douglas Parking Company, 1721 Webster Street, Oakland, CA 94612 – Groundwater Monitoring Requirements

Dear Mr. Douglas:

Alameda County Environmental Health (ACEH) staff has reviewed case file for the site including the most recently submitted document *Sensitive Receptor Survey, Conduit Study and Site Conceptual Model* dated March 26, 2012 and prepared by Pangea. The SCM identifies data gaps needing potential evaluation. ACEH requests that you address the following technical comments, and send us the technical reports described below by the due dates requested below.

**TECHNICAL COMMENTS**

1. **Data Gap Work Plan –** The SCM identified a number of data gaps that remain at the site including vapor intrusion, possible secondary source that remains near MW-2 and defining the vertical extent of total petroleum hydrocarbons as gasoline (TPHg) below 30 feet. ACEH requests that you submit a work plan to evaluate vapor intrusion and the secondary source remaining near MW-2. It does not appear that further vertical delineation of TPHg in groundwater is needed. However, since the air-sparge wells have not been analyzed since 2008, please perform a round of sampling the air-sparge wells, as recommended in the SCM. Report the results of the air-sparge well sampling in the groundwater monitoring report requested below and reevaluate the need for additional vertical characterization. If determined appropriate, propose additional sampling in the work plan requested below. Please submit your work plan by the date specified below.

2. **Preferential Pathway Survey** – Thank you for including the results of the well survey and utility survey in your SCM. Please submit the confidential DWR well logs and a table summarizing the results as an addendum to the report, mark as confidential and upload the addendum to our ftp site (not to Geotracker). The report will be placed in our confidential file and available only to internal staff for review. .

**TECHNICAL REPORT REQUEST**

Please submit technical reports to ACEH (Attention: Barbara Jakub), according to the following schedule:

- **January 31, 2013** – SCM Addendum
  (File to be named: SCM_ADD_R_yyyy-mm-dd)

- **February 20, 2013** – Semi-annual Monitoring Report (1st Half 2013)
  (File to be named: GWM_R_yyyy-mm-dd)

- **March 20, 2013** – Work Plan
  (File to be named: WP_R_yyyy-mm-dd)

Should you have any questions or concerns regarding this correspondence or your case, please call me at (510) 639-1287 or send me an electronic mail message at barbara.jakub@acgov.org.

Sincerely,

Barbara J Jakub

Digitally signed by Barbara Jakub
DN: cn=Barbara Jakub, o=Local Oversight Program, ou=Alameda County Environmental Health, email=barbara.jakub@acgov.org, c=US
Date: 2012.12.21 10:19:18 -08'00'

Barbara J. Jakub, P.G.
Hazardous Materials Specialist

Enclosure: Responsible Party(ies) Legal Requirements/Obligations
ACEH Electronic Report Upload (ftp) Instructions

cc: Bob Clark-Riddell, Pangea, 1710 Franklin Street, Suite 200, Oakland, CA 94612 (*Sent via E-mail to: briddell@pangeaenv.com*)
Leroy Griffin, Oakland Fire Department, 250 Frank H. Ogawa Plaza, Ste. 3341, Oakland, CA 94612-2032 (*Sent via E-mail to:* lgriffin@oaklandnet.com)
Donna Drogos, ACEH (*Sent via E-mail to: donna.drogos@acgov.org*)
Barbara Jakub, ACEH (*Sent via E-mail to: barbara.jakub@acgov.org*)
GeoTracker, e-file

# APPENDIX B

Standard Operating Procedures

# STANDARD FIELD PROCEDURES FOR SOIL BORINGS

This document describes Pangea Environmental Services' 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, scientist or engineer working under the supervision of a California Registered Engineer, California Registered Geologist (RG) 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. 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. With hollow-stem drilling, samples are collected using lined split-barrel or equivalent samplers driven into undisturbed sediments beyond the bottom of the borehole. With hydraulic-push drilling, samples are typically collected using acetate liners. 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 or the acetate tube. All sample depths use the ground surface immediately adjacent to the boring as a datum. The horizontal 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 or cut acetate liners 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

Soil samples collected during drilling will be analyzed in the field for ionizable organic compounds using a photo-ionization detector (PID) with a 10.2 eV lamp. The screening procedure will involve placing an undisturbed soil sample in a sealed container (either a zip-lock bag, glass jar, or a capped soil tube). The container will be set aside, preferably in the sun or warm location. After approximately fifteen minutes, the head space within the container will be tested for total organic vapor, measured in parts per million on a volume to volume basis (ppmv) by the PID. The PID instrument will be calibrated prior to boring using hexane or isobutylene. 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 collected from borings are either collected from the open borehole, from within screened PVC inserted into the borehole, or from a driven Hydropunch-type sampler. Groundwater is typically extracted using a bailer, check valve and/or a peristaltic pump. 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.

Pangea often performs electrical conductivity (EC) logging and/or continuous coring to identify potential water-bearing zones. Hydropunch-type sampling is then performed to provide discrete-depth grab groundwater sampling within potential water-bearing zones for vertical contaminant delineation. Hydropunch-type sampling typically involves driving a cylindrical sheath of hardened steel with an expendable drive point to the desired depth within undisturbed soil. The sheath is retracted to expose a stainless steel or PVC screen that is sealed inside the sheath with Neoprene O-rings to prevent infiltration of formation fluids until the desired depth is attained. The groundwater is extracted using tubing inserted down the center of the rods into the screened sampler.

## 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 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.

# STANDARD OPERATING PROCEDURE FOR SOIL VAPOR SAMPLING

## 1.0 PURPOSE

This standard operating procedure (SOP) describes the procedures for collecting soil vapor samples using temporary and semi-permanent soil gas probes/wells and evacuated stainless-steel Summa canisters. The SOP is modified from procedures and information presented in Cal/EPA 2012 (*Advisory-Active Soil Investigations)*; Cal/EPA 2011; Cal/EPA 2010; U.S. EPA, 2006; and DiGiulio, 2003. This SOP includes (a) real-time leak-check procedures to evaluate integrity of the soil gas probe and sampling assembly during probe purging and post sampling, and (b) real-time field screening of soil gas concentrations during probe purging and post sampling.

## 2.0 REQUIRED EQUIPMENT

- Hammer drill with fittings for installing and removing vapor probes (for direct push vapor probes)
- Vapor probes with retractable or dedicated drop-off tips (e.g. AMS SGVP) (for direct push vapor probes).
- Hand auger (for soil vapor wells)
- Tubing with Swagelok or similar threaded compression-fittings, vapor-tight caps, valves
- Screens (for soil vapor wells)
- Filter-pack sand (for dedicated tips and soil vapor wells)
- Granular bentonite (for vapor well construction)
- VOA vials
- Vacuum pump with rotameter for purging and leak testing
- 1-Liter Summa canister with vacuum gauge for each sample
- Tedlar bags (for helium measurement and vapor screening)
- Stainless-steel sampling manifold
- Leak-check compound (e.g., helium)
- Calibrated photoionization detector (PID) or other organic vapor analyzer
- Isobutylene for PID calibration
- Vacuum chamber (iron lung) for pre- and post-sampling leak-check
- Leak-check enclosure(s) (small bucket [or similar] with openings for sample tubing, helium introduction and sampling enclosure atmosphere)
- Weather stripping or bentonite (for leak check enclosure seal)
- Record-keeping materials
- Latex or nitrile gloves

## 3.0 PROCEDURES

### 3.1 Boring Clearance

Prior to installing soil vapor probes, ensure that a utility clearance has been conducted.

### 3.2 Probe Depths

This SOP describes procedures for installing soil gas probes/wells at sufficient depth to provide a minimum of 5 feet between the ground surface and the top of the dry bentonite overlying the sand pack that surrounds the soil gas screen interval. This is because soil gas samples collected shallower than 5 ft depth may be subject to barometric pressure effects and prone to breakthrough of ambient air through the soil column.

In some cases shallower probe installation may be required to provide soil gas characterization immediately above the contaminant impact zone, to avoid shallow groundwater/capillary fringe, or to provide additional vertical characterization. Variation of sample depths and the need for deeper sample locations should be evaluated based on site specific characteristics and data quality objectives. If vertical characterization to groundwater is needed, the deepest soil gas sample should be collected near the top of the capillary fringe. Soil gas probes/wells should not be installed within or below the capillary fringe.

Collecting soil gas sampling near contaminant sources is recommended when performing vapor intrusion modeling. Risk estimates may be biased low if quantified with shallow soil gas measurements (five feet below grade) using the Johnson & Ettinger 1991 model. Vertical soil gas sampling should be conducted to determine the source of subsurface contamination, ideally using numerous vertical profiles of soil gas to accurately locate subsurface sources. Once located, soil gas can be targeted at these depths site wide.

### 3.3 Semi-permanent Direct-Push Vapor Probe Installation

1. Use a rotary hammer drill or concrete-coring equipment to core any paved surfaces.
2. The drive rod is driven to a predetermined depth and then partially or fully removed (depending on soil type), leaving a disposable drop-off tip in the hole. The hole should be sufficiently deep that there is a minimum of 5 feet between the surface and the top of the dry bentonite overlying the sand pack (see below for details). If possible, remove the drive rod and place 3” of sand in the hole before placing the drop-off tip.
3. The inner soil gas pathway from probe tip to the surface should be continuously sealed (e.g., a sampling tube attached to the probe tip with a barbed fitting or a screw adapter with an o-ring) to prevent leakage. If a screw adapter with o-ring is used, inspect the o-ring to ensure that it is not flawed and use rigid tubing that can be tightened from the surface. Tightly cap the top end of the sampling tube. The volume of the sampling apparatus should be minimized. DTSC guidance requires that tubing should be no greater than ¼” nominal diameter.
4. Cover the probe tip with at least 3”of sand (resulting in a minimum 6” sand pack), followed by at least 6” of dry granular bentonite (see **Figure 1**). Fill the remainder of the boring with hydrated bentonite slurry. For multiple depth soil gas probes, separate vapor probe sand packs with hydrated bentonite as shown on **Figure 2**. VOA vials are useful for measuring and placing these materials because they have approximately the same inside diameter as the AMS SGVP drive rod outer diameter. Check the annular space for bridging and construction material depths using a narrow rod.
5. **Equilibration Time:** Record probe installation time/date, and wait at least **2 hours** before conducting purge volume tests, leak tests, or soil gas sampling -- if there is a minimum of 5

feet between the surface and the top of the dry bentonite overlying the sand pack. If there is less than 5 feet between the surface and the top of the dry bentonite overlying the sand pack or the borehole was hand augered, wait at least **48 hours** after probe installation and capping before conducting purge volume tests, leak tests, or soil gas sampling. If the probe was installed with a combination of hand augering and direct-push drilling methods and there is less than 5 feet between the bottom of the hand auger depth and the top of the dry bentonite overlying the sand pack, wait at least **48 hours** after probe installation and capping before conducting purge volume tests, leak tests, or soil gas sampling.

6. Decontamination: Decontaminate drive rods and other reusable components between sample locations by washing equipment with Alconox or Liquinox soap and rinsing with tap water and/or by steam-cleaning. Use new flexible tubing for each sample point (do not reuse).

### 3.4 Semi-permanent Augered Vapor Well Installation

1. Use a rotary hammer drill or concrete-coring equipment to core any paved surfaces.
2. Auger to a depth sufficient to allow a minimum of 5 feet between the surface and the top of the dry bentonite overlying the sand pack (see below for details). It is recommended to use the smallest diameter auger feasible to minimize future purging volumes and optimize representativeness of soil gas data.
3. Install small diameter tubing with a short (<6" long) screened section close to the bottom of the hole. The soil gas pathway from screen to the surface should be continuously sealed (e.g., a sampling tube attached to the probe tip with a barbed fitting or a screw adapter with an o-ring) to prevent leakage. If a screw adapter with o-ring is used, inspect the o-ring to ensure that it is now flawed and use rigid tubing that can be tightened from the surface. The volume of the sampling apparatus should be minimized. DTSC guidance specifies that tubing should be no greater than ¼" nominal diameter.
4. For deep wells (>10 feet), install a down-hole rod or other support to ensure that the screened section remains at the proper depth.
5. Cover the screened section with at least 6" of sand, followed by at least 6" of dry granular bentonite. Ensure that the screened section is near the center of the sand pack. Fill the remainder of the boring with hydrated bentonite. The bentonite should be hydrated at the surface and poured into the borehole.
6. **Equilibration Time:** After probe installation, tightly cap the tubing, record probe installation time/date, and wait at least **48 hours** before conducting purge volume tests, leak tests, or soil gas sampling:
7. Decontamination: Decontaminate drive rods and other reusable components between sample locations by washing equipment with Alconox or Liquinox soap and rinsing with tap water and/or by steam-cleaning. Use new flexible tubing for each sample point (do not reuse).

### 3.5 Temporary Vapor Probe Installation Using Tubing and Expendable Tip

1. This method should only be used for qualitative assessments due to the possibility of vapor leaks along the drive rods. This method should not be used when sampling in coarse granular materials due to potential leakage along the probe.
2. Use a rotary hammer drill or concrete-coring equipment to core any paved surfaces.
3. The drive rod is driven to a predetermined depth (generally 6 feet minimum) and then pulled back (approximately 1") to expose the short screened section of the probe (typically an expendable tip, **Figure 3**).

4. The probe tip should be attached to the sampling tube with either a barbed fitting or a screw adapter with an o-ring to prevent leakage. If a screw adapter with o-ring is used, replace o-rings daily and inspect them for flaws before installing each probe. Use rigid tubing that can be tightened from the surface to ensure that the o-ring is properly sealed. The volume of the sampling apparatus should be minimized. DTSC guidance requires that tubing should be no greater than ¼" nominal diameter.
5. Hydrated bentonite should be used to seal around the drive rod at the ground surface to prevent ambient air intrusion
6. **Equilibration Time:** After probe installation, tightly cap the tubing, record probe installation time/date, wait at least **2 hours** before conducting purge volume tests, leak tests, or soil gas sampling.

### 3.6 Vapor Sample Collection

During vapor sampling, record all valve open/close times and canister/manifold vacuum readings at each step. Do not conduct sampling within **5 days following a significant rain event** (0.5 inches of rainfall during any 24-hour period) or after significant nearby irrigation.

<u>Setup</u>

1. Calculate and record the volume of the sampling assembly, tubing, vapor probe, and any *permeable* air-, sand-, or dry bentonite-filled annular space around the vapor probe tip.

   One Purge Volume = $\pi * r^2 * L$ = 3.14 x (1/2*ID) x (1/2*ID) * L,

   where ID = tubing or manifold inside diameter and L = length of tubing/manifold/borehole segment.

- 1/8" ID tubing volume = 2.4 ml/ft,
- 1/4" ID tubing volume = 9.7 ml/ft,
- 1/4" OD (0.17" ID) tubing volume = 4.5 ml/ft
- 2-1/8" auger boring volume = 697 ml/ft * 0.4 = 278 ml/ft (sand) minus tubing volume
- 2-1/8" auger boring volume = 697 ml/ft * 0.5 = 349 ml/ft (dry bentonite) minus tubing volume
- 3-1/4" auger boring volume = 1631 ml/ft * 0.4 = 652 ml/ft (sand) minus tubing volume
- 3-1/4" auger boring volume = 1631 ml/ft * 0.5 = 816 ml/ft (dry bentonite) minus tubing volume

**Sample Purge Volumes**

| Item | One (1) Purge Volume (approx) | Three (3) Purge Volumes | Ten (10) Purge Volumes |
|---|---|---|---|
| ¼" ID tubing (10 ft) | 100 ml | 300 ml | 1,000 ml |
| ¼" ID tubing (10 ft) with 6" dry bentonite and 6" sand, inside 3-1/4" diameter auger boring | 830 ml | 2,500 ml | 8,300 ml |
| ¼" ID tubing (10 ft) with 1 ft dry bentonite and 1 ft sand, inside 3-1/4" diameter auger boring | 1,550 ml | 4,650 ml | 15,550 ml |

2. Wear latex or nitrile gloves while handling sampling equipment. Change gloves whenever a new sample is collected and after handling leak-check compound.
3. Replace the vapor probe cap with a closed Swagelok valve. Connect the sampling manifold to the vapor probe, sample Summa canister and vacuum pump using Swagelok fittings and stainless-steel, nylon, or Teflon tubing. Check all fittings for tightness (do not over-tighten).
4. Close all valves. Record pre-test vacuum reading on the Summa canister.

Shut-In Check

1. Open valve on vapor sampling manifold and open 3-way valve #1 so the vacuum pump of the purging assembly can evacuate the vapor sampling manifold assembly (keep valves #2 and #3 closed to the Tedlar bag/vacuum chamber of the vapor screening assembly) (**Figure 4**). Start the vacuum pump. Do *not* open #1 valve to the probe assembly, or the valve on the sample Summa canister. Allow manifold/tubing vacuum to stabilize at approximately 10" Hg.
2. Stop the vacuum pump, close 3-way valves #2 and #3 (to allow shut-in testing of vapor sampling manifold), and conduct a shut-in test by waiting at least **5 minutes** (if using 150 inches of water gauge) or **10 minutes** (if using 30 inches of mercury gauge). Monitor manifold vacuum gauge to test for leaks. If the vacuum decreases, rectify the leak before proceeding.

Purge, Flow and Leak Check

1. **Calculate purge volume and duration.** Do *not* over-purge. Purge volumes should be determined in one of the following ways:

   a) For vapor sampling in support of sensitive human health risk assessments for regulatory review, a step-purge test should be conducted at a "worst case" sampling point, **using 1, 3 and 10 purge volumes** (including tubing, sampling assembly and annular space) to determine the appropriate volume that yields the highest target compound concentration.

   b) For collecting samples from depths of 5 feet or less, or if step purge tests yield no detectable target compounds, use a default purge of approximately **3 purge volumes** (including tubing, sampling assembly and annular space).

   c) For semi-permanent wells subject to frequent sampling, **purge 1 volume** only of the tubing and manifold volume (not including the dry bentonite or sand pack section) after waiting at least **2 weeks** following the previous sampling event.
2. Place leak-check enclosure over vapor probe and seal to ground using hydrated bentonite or weather stripping.
3. Introduce helium gas into the leak-check enclosure and monitor with the helium gas analyzer until it reads between 20% and 30% helium.
4. **Conduct purging.** Start vacuum pump and open 3-way valve #1 (and 3-way valves #2 and #3) so the vacuum pump can evacuate the probe. Do *not* over-purge. Closely monitor the flow on the rotameter and the vacuum on the vacuum gauge. For most samples flow should be limited to 150mL/min or 200 mL/min maximum. Flow rates greater than 200 mL/min may be used when purging times are excessive, such as for deep wells with larger-diameter tubing. However, a vacuum of 100" of water or less must be maintained during sampling whenever a higher flow rate is used. If the vacuum remains below approximately 7" Hg, then sufficient flow is present to collect a representative sample (Cal/EPA 2012) and continue purging for the planned purge duration.

5. If the probe-side vacuum exceeds approximately 7” Hg, then insufficient flow may be present to collect a representative sample and this condition should be noted. (Evaluate probe integrity or consider re-installation of probe, especially if probe installed in coarse-grain material). **To sample soil gas under low flow conditions, follow this alternate sampling method** derived from Appendix D, Cal/EPA 2012. Make a reasonable attempt to purge one purge volume (as defined above), but as a minimum purge one volume of the sampling assembly, tubing, and probe. After purging, open sample Summa canister until sampling manifold vacuum threshold is achieved, then close Summa sample valve until probe vacuum dissipates. Repeat this sampling procedure as necessary to sufficiently fill the sample Summa canister. Alternatively, consider installing a soil gas probe with a larger probe annulus space, or employing passive soil gas sampling methods.
6. **Pre-Sample Vapor Screening.** To pre-screen soil vapor, open valves #2 and #3 of the vapor screening assembly to route vapor into the Tedlar bag within a vacuum chamber (iron lung). Partially fill the Tedlar bag (and return valves #2 and #3 to purging position). Monitor the rotameter for changes in flow while filling the Tedlar bag. Check bag with the helium gas analyzer to screen probe vapors for leakage (indicated by presence of helium). If helium concentration in bag is below 1% then continue sampling. If helium concentration in bag is above 1%, then discontinue sampling and check for leaks around the probe. The probe may need to be repaired or re-installed. Additionally, check the Tedlar bag for contaminants using the PID for qualitative contaminant assessment (optional). For tight soil formations, consider skipping the pre-sample vapor screening or conducting screening as initial probe purging.
7. When purge duration complete and ready to discontinue purging, close 3-way valve #1 so that the probe is connected to the sampling manifold, and then stop the vacuum pump.
8. Record helium reading for leak-check enclosure about each minute during purging and sampling.

<u>Sample Collection</u>

1. **Opening Sample Canister.** Once a helium reading of at least 20% has been reached, open sample canister valve. **Sampling takes approximately 5 minutes for a 1-liter Summa canister** (at 150 ml/min sampling flow rate).
2. Close sampling canister valve when vacuum decreases to 5” mercury. Do *not* allow vacuum to fall below this range.
3. **Post-Sample Vapor Screening.** After sampling, open 3-way valve #1 so that the vapor screening assembly is connected to the probe, turn on the vacuum pump, and open 3-way valves #2 and #3 to partially fill the Tedlar bag within the vacuum chamber (iron lung). When Tedlar bag is sufficiently filled, return valves #2 and #3 to purging position. Check Tedlar bag for indication of sampling leakage using the helium gas analyzer. If helium concentration is below 1% then sample is sufficiently representative. If helium concentration is above 1%, then the sample may not be sufficiently representative; the probe may need to be repaired or re-installed and re-sampled. Additionally, check the Tedlar bag for contaminants using the PID for qualitative contaminant assessment (optional).
4. **Shroud Sample.** To confirm helium meter readings, collect one shroud sample per day to analyze for percent helium. Connect the shroud sample Summa canister and manifold to a port near the bottom of the shroud and open the canister valve at the beginning of sampling. Close sampling canister valve when vacuum decreases to 5” mercury. Do *not* allow vacuum to fall below this range. Disassemble sampling assembly, and cap (or remove and restore) vapor sampling point.

5. **Analyses.** Fill out chain-of-custody form for analysis for **chemicals of concern (i.e. TO-15)**, and for **leak-check compound** for at least 10% of samples. Analyze all samples for **percent oxygen** by ASTM D1946-90**.** Additionally, samples may be analyzed for **percent methane and carbon dioxide** by ASTM D1946-90 when in support of sensitive human health risk assessments for regulatory review. Include final vacuum reading and serial numbers of canister and flow restrictor on chain-of-custody form.
6. For vapor sampling in support of sensitive human health risk assessments for regulatory review, collect at least one *duplicate* sample per site per sampling event from the sampling point with the anticipated highest vapor concentrations. The duplicate sample should be collected by attaching a fresh sample canister following collection of the initial sample. If a new manifold is used, follow the same purging and sampling procedures used for the original sample. If the same manifold is used, collect a sample without further purging, using the same sampling procedures used for the original sample.

<u>Decontamination and Decommissioning</u>

1. Use a decontaminated sampling manifold and new tubing for each sample location. Return equipment to laboratory for decontamination.
2. Backfill any open soil vapor probe holes with bentonite slurry or Portland cement and cap with concrete or other surface material to match the area.
3. To retain the soil gas probe for future sampling, cap the Swagelock fitting and cover the probe with a small vault or other protective device.

## REFERENCES

Cal/EPA, 2012, Advisory-Active Soil Gas Investigation, California Environmental Protection Agency, Department of Toxic Substances Control, Los Angeles Regional Water Quality Control Board, San Francisco Regional Water Quality Control Board, April.

Cal/EPA, 2011, Guidance for the evaluation and mitigation of subsurface vapor intrusion to indoor air (vapor intrusion guidance), California Environmental Protection Agency, Department of Toxic Substances Control, October.

Cal/EPA, 2010, Advisory – Active Soil Gas Investigation, California Environmental Protection Agency, Department of Toxic Substances Control, March.

U.S. EPA, 2006,Office Of Research and Development, National Risk Management Research Laboratory, Cincinnati, OH, Assessment of vapor intrusion in homes near the Raymark Superfund Site using basement and sub-slab air samples, March.

Dominic DiGiulio, 2003, Standard Operating Procedure (SOP) for installation of sub-slab vapor probes and sampling using EPA Method TO-15 to support vapor intrusion investigations, U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory, Ground-Water and Ecosystem Restoration Division, Ada, Oklahoma (included as Appendix C of Colorado Department of Public Health and Environment, 2004, Draft Indoor Air Guidance, Hazardous Materials and Waste Division), September.

**Figure 1 – Permanent/Semi-permanent Gas Vapor well Construction Diagram**

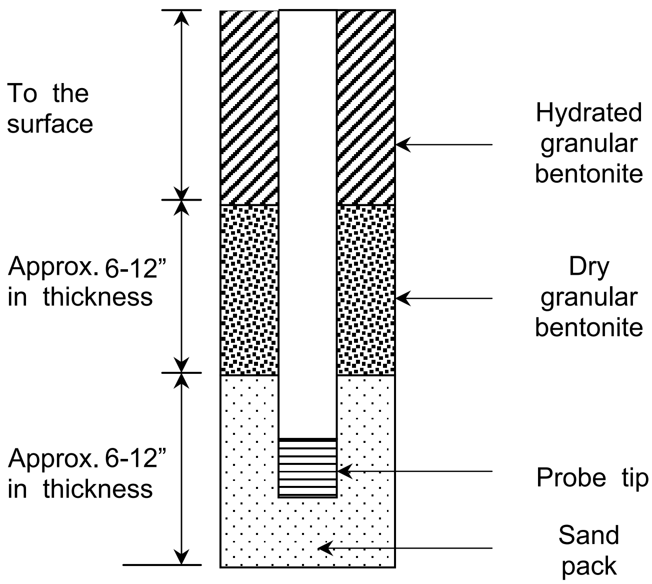



**Figure 2 – Multi-depth Gas Vapor Well Construction Diagram**

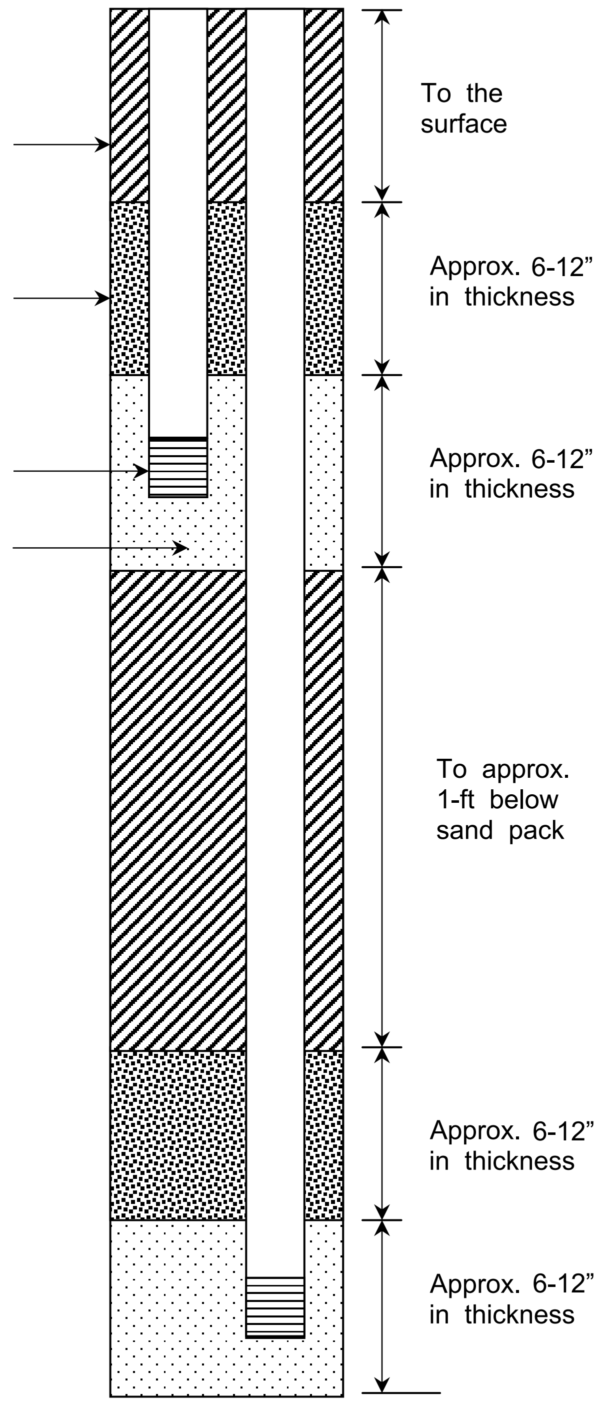
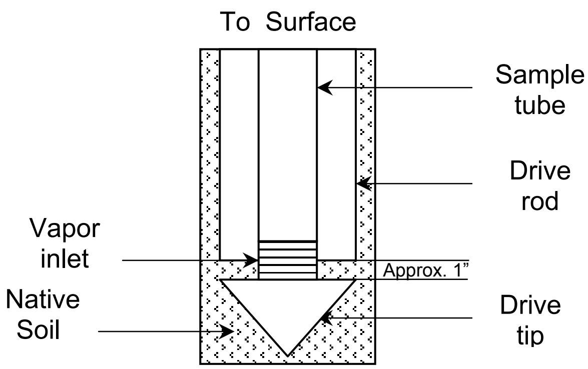



**Figure 3 - Temporary Soil Gas Probe (with Expendible Tip)**



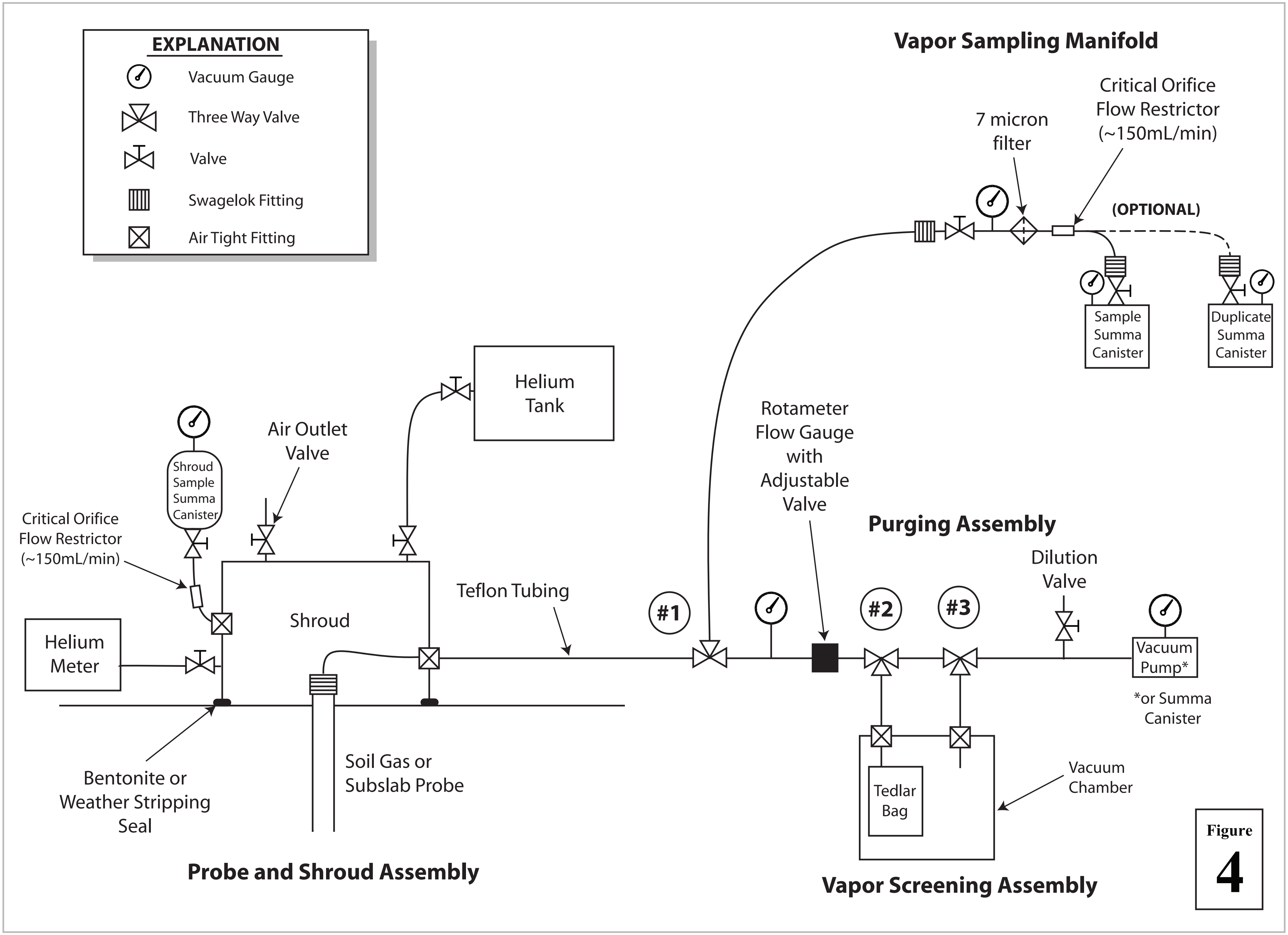



Figure 4

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Soil Vapor Sampling Manifold Schematic

# STANDARD OPERATING PROCEDURE FOR SUBSLAB VAPOR SAMPLING

## 1.0 PURPOSE

This standard operating procedure (SOP) describes the procedures for collecting subslab vapor samples using evacuated stainless-steel Summa canisters for the purpose of assessing risk to building occupants. The SOP is modified from procedures and information presented in Cal/EPA 2012 (*Advisory-Active Soil Investigations)*; Cal/EPA 2011; Cal/EPA 2010; U.S. EPA, 2006; and DiGiulio, 2003. This SOP includes (a) real-time leak-check procedures to evaluate integrity of the soil gas probe and sampling assembly during probe purging and post sampling, and (b) real-time field screening of soil gas concentrations during probe purging and post sampling.

## 2.0 REQUIRED EQUIPMENT

- Hammer drill with 1” bit and smaller bits (slightly larger than vapor probe tubing)
- Tubing for cleaning boring
- Stainless-steel or Teflon vapor probe tubing with Swagelok threaded compression fitting, vapor-tight cap, and valves.
- Rubber stopper or Teflon disk
- Granulated bentonite, bentonite pellets and cement
- Vacuum pump with adjustable rotameter for purging and leak testing
- 1-Liter Summa canister for each sample
- Stainless-steel sampling manifold with vacuum gauges and critical orifice flow restrictor (request that laboratory leak-check sampling manifold prior to mobilization)
- Leak-check compound (e.g. helium)
- Helium gas analyzer (calibrated)
- Calibrated photoionization detector (PID) or other organic vapor analyzer
- Isobutylene for PID calibration
- Tedlar bags (for helium measurement and vapor screening)
- Vacuum chamber (iron lung) for pre- and post-sampling leak-check
- Leak-check enclosure (bucket with hydrated bentonite pellets [or weather stripping] for sealing enclosure to surface and openings for vapor probe tubing, helium and for sampling enclosure atmosphere)
- Recordkeeping materials
- Latex or nitrile gloves

## 3.0 PROCEDURES

### 3.1 Boring Clearance

Prior to installing subslab vapor probes, ensure that a utility clearance has been conducted to ensure that potential subsurface utility and rebar locations have been identified and marked.

### 3.2 Vapor Probe Construction

1. To protect interior surfaces, lay plastic sheeting around the probe location.
2. Use a rotary hammer drill to create an approximately 3-inch deep, 1 1/2 -inch diameter hole that *partially* penetrates the slab. Use a piece of flexible tubing to blow or vacuum concrete debris and dust from the hole. Do not blow or vacuum after the slab has been completely penetrated.
3. Drill a smaller diameter *inner hole* in the center of the outer hole, periodically blowing dust and debris from the hole until the slab is penetrated. The diameter of the inner hole should exceed the diameter of the vapor probe tubing by the minimum amount practicable. The inner hole should be drilled completely through the slab and 3 to 4 inches into the subslab material (baserock or soil) to form a cavity (**Figure 1**).
4. Insert the capped vapor probe tubing through a tightly fitting rubber stopper or a Teflon disk and insert the stopper or disk into the bottom of the outer hole. The purpose of the stopper is to stop moisture from the annular seal from leaking into subslab materials. The fitting may either be constructed flush, or may protrude above the slab, depending on location and susceptibility to damage. If a lubricant is needed, use only high-vacuum silicone grease.
5. Clean the concrete surfaces in the borehole with a dampened towel to increase the potential of a good seal. Fill the remainder of the hole with hydrated bentonite (temporary probe) or hydrated bentonite topped with expanding cement (semi-permanent probe). Place a protective cap (temporary probe) or flush mounted well box (semi-permanent probe) over the probe to protect it from damage.

## 3.3 Vapor Sampling

During vapor sampling, record all valve open/close times and canister/manifold vacuum readings at each step. Do not conduct sampling within **5 days following a significant rain event** (0.5 inches of rainfall during any 24-hour period) or signficant irrigation adjacent to the building.

<u>Setup</u>

1. Calculate and record the volume of the sampling assembly, tubing, vapor probe and void space created in subslab material.

   Volume = $\pi * r^2 * L = 3.14 \times (1/2*ID) \times (1/2*ID) *L$,

   where ID = cavity, tubing or manifold inside diameter and L = length of cavity or tubing/manifold segment.
2. Wear latex or nitrile gloves while handling sampling equipment. Change gloves whenever a new sample is collected and after handling leak-check compound.
3. Replace the vapor probe cap with a closed Swagelok valve. Connect the sampling manifold to the vapor probe, sample Summa canister and vacuum pump using Swagelok fittings and stainless-steel, Teflon or Tygon tubing. Check all fittings for tightness (do not overtighten).
4. Close all valves. Record pre-test vacuum readings on summa canister.

<u>Manifold Shut-In Check</u>

1. Open valve on vapor sampling manifold and open 3-way valve #1 so the vacuum pump of the purging assembly can evacuate the vapor sampling manifold assembly (keep valves #2 and #3 closed to the Tedlar bag/vacuum chamber of the vapor screening

assembly) (**Figure 2**). Start the vacuum pump. Do *not* open #1 valve to the probe assembly, or the valve on the sample Summa canister. Allow manifold/tubing vacuum to stabilize at approximately 10" Hg.

2. Stop the vacuum pump, close 3-way valves #2 and #3 (to allow shut-in testing of vapor sampling manifold), and conduct a shut-in test by waiting at least **5 minutes** (if using 150 inches of water gauge) or **10 minutes** (if using 30 inches of mercury gauge). Monitor manifold vacuum gauge to test for leaks. If the vacuum decreases, rectify the leak before proceeding.

Purge, Flow and Leak Check

1. **Calculate purge volume and duration**. Determine the desired total purge volume and purging duration for the equipment setup. A critical orifice flow restrictor is intended to limit the maximum purge and sampling flow rate (approximately 150 ml/min). If step testing is not required to better determine optimal purge volume, **purge approximately 3 times** the volume of the sampling assembly, tubing, vapor probe and void space or any probe/filter pack material below the concrete slab.
2. **Leak-check enclosure.** Place leak-check enclosure over vapor probe and seal to floor using hydrated bentonite or weather stripping. Introduce helium gas into the leak-check enclosure and monitor with the helium gas analyzer until it reads between 20% and 30% helium.
3. **Conduct purging.** Start vacuum pump and open 3-way valve #1 (and 3-way valves #2 and #3) so the vacuum pump can evacuate the probe. Do *not* over-purge. Closely monitor the flow on the rotameter and the vacuum on the vacuum gauge. For most samples flow should be limited to 150mL/min or less. If the vacuum remains below approximately 7" Hg, then sufficient flow is present to collect a representative sample (Cal/EPA 2012) and continue purging for the planned purge duration.
4. If the probe-side vacuum exceeds approximately 7" Hg, then insufficient flow may be present to collect a representative sample and this condition should be noted. Evaluate probe integrity or consider re-installation of probe, especially if probe installed in coarse-grain material. If no significant flow is attained, the sampling line may be plugged or the vapor probe may be positioned in a low permeability or saturated layer. If the probe cap is opened for probe inspection, record the inspection procedures and duration. If purging and sampling is resumed after opening the probe cap, this information will help determine the representativeness of the sample. **To sample subslab gas under low flow conditions, follow this alternate sampling method** derived from Appendix D, Cal/EPA 2012. Make a reasonable attempt to purge one purge volume. After purging, open sample Summa canister until sampling manifold vacuum threshold is achieved, then close Summa sample valve until probe vacuum dissipates. Repeat this sampling procedure as necessary to sufficiently fill the sample Summa canister. Alternatively, consider installing a subslab gas probe with a larger probe annulus space, or employing passive soil gas sampling methods.
5. When purge duration complete and ready to discontinue purging, close 3-way valve #1 so that the probe is connected to the sampling manifold, and then stop the vacuum pump.
6. Record helium reading for leak-check enclosure at least once every minute during purging and sampling.

Sample Collection

1. **Opening Sample Canister.** Once a helium reading of at least 20% has been reached, open sample canister valve. **Sampling takes approximately 5 minutes for a 1-liter Summa canister** (at 150 ml/min sampling flow rate).
2. Close sampling canister valve when vacuum decreases to 5" mercury. Do *not* allow vacuum to fall below this range.
3. **Post-Sample Vapor Screening.** After sampling, open 3-way valve #1 so that the vapor screening assembly is connected to the probe, turn on the vacuum pump, and open 3-way valves #2 and #3 to partially fill the Tedlar bag within the vacuum chamber (iron lung). When Tedlar bag is sufficiently filled, return valves #2 and #3 to purging position. Check Tedlar bag for indication of sampling leakage using the helium gas analyzer. If helium concentration is below 1% then sample is sufficiently representative. If helium concentration is above 1%, then the sample may not be sufficiently representative; the probe may need to be repaired or re-installed and re-sampled. Additionally, check the Tedlar bag for contaminants using the PID for qualitative contaminant assessment (optional).
4. **Shroud Sample.** To confirm helium meter readings collect one shroud sample per day to analyze for percent helium. Connect the shroud sample summa canister and manifold to a port near the bottom of the shroud and open the canister valve at the beginning of sampling. Close sampling canister valve when vacuum decreases to 5" mercury. Do *not* allow vacuum to fall below this range. Disassemble sampling assembly, and cap (or remove and restore) vapor sampling point.
5. **Analyses.** Fill out chain-of-custody form for analysis for **chemicals of concern (i.e. TO-15)**, and for **leak-check compound** for at least 10% of samples. Analyze all samples for **percent oxygen** by ASTM D1946-90**.** Additionally, samples may be analyzed for **percent methane and carbon dioxide** by ASTM D1946-90 when in support of sensitive human health risk assessments for regulatory review. Include final vacuum reading and serial numbers of canister and flow restrictor on chain-of-custody form.
6. For vapor sampling in support of sensitive human health risk assessments for regulatory review, collect at least one *duplicate* sample per site per sampling event from the sampling point with the anticipated highest vapor concentrations. The duplicate sample should be collected by attaching a fresh sample canister following collection of the initial sample. If a new manifold is used, follow the same purging and sampling procedures used for the original sample. If the same manifold is used, collect a sample without further purging, using the same sampling procedures used for the original sample.

Decontamination and Decommissioning

1. Use a decontaminated sampling manifold and new tubing for each sample location. Return equipment to laboratory for decontamination.
2. Backfill any open soil vapor probe holes with bentonite slurry or Portland cement and cap with concrete or other surface material to match the area.
3. To retain the subslab probe for future sampling, cap the Swagelock fitting and cover the probe with a small vault or other protective device.

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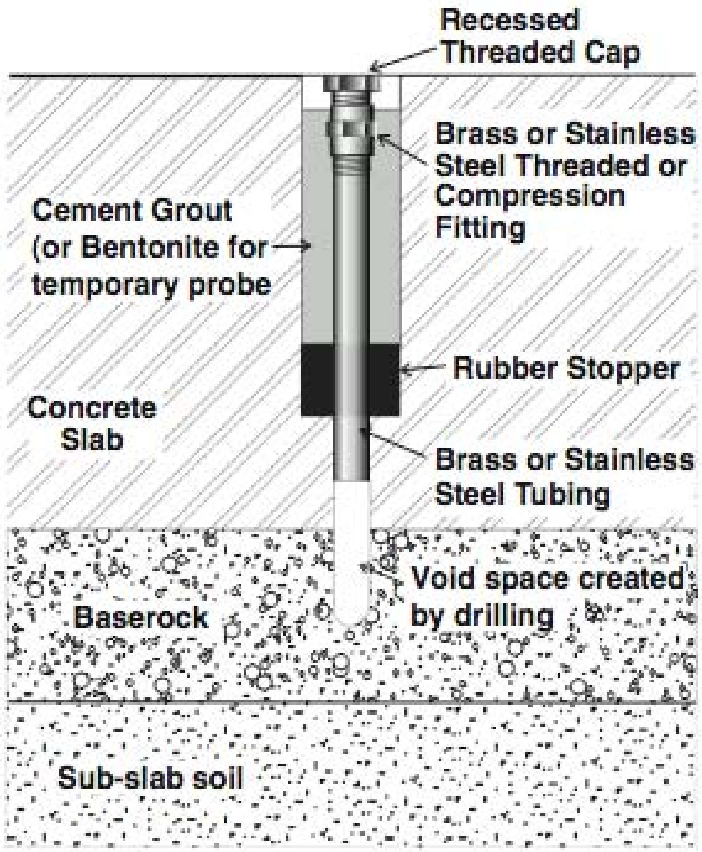


Figure

1

Subslab Vapor Probe Schematic

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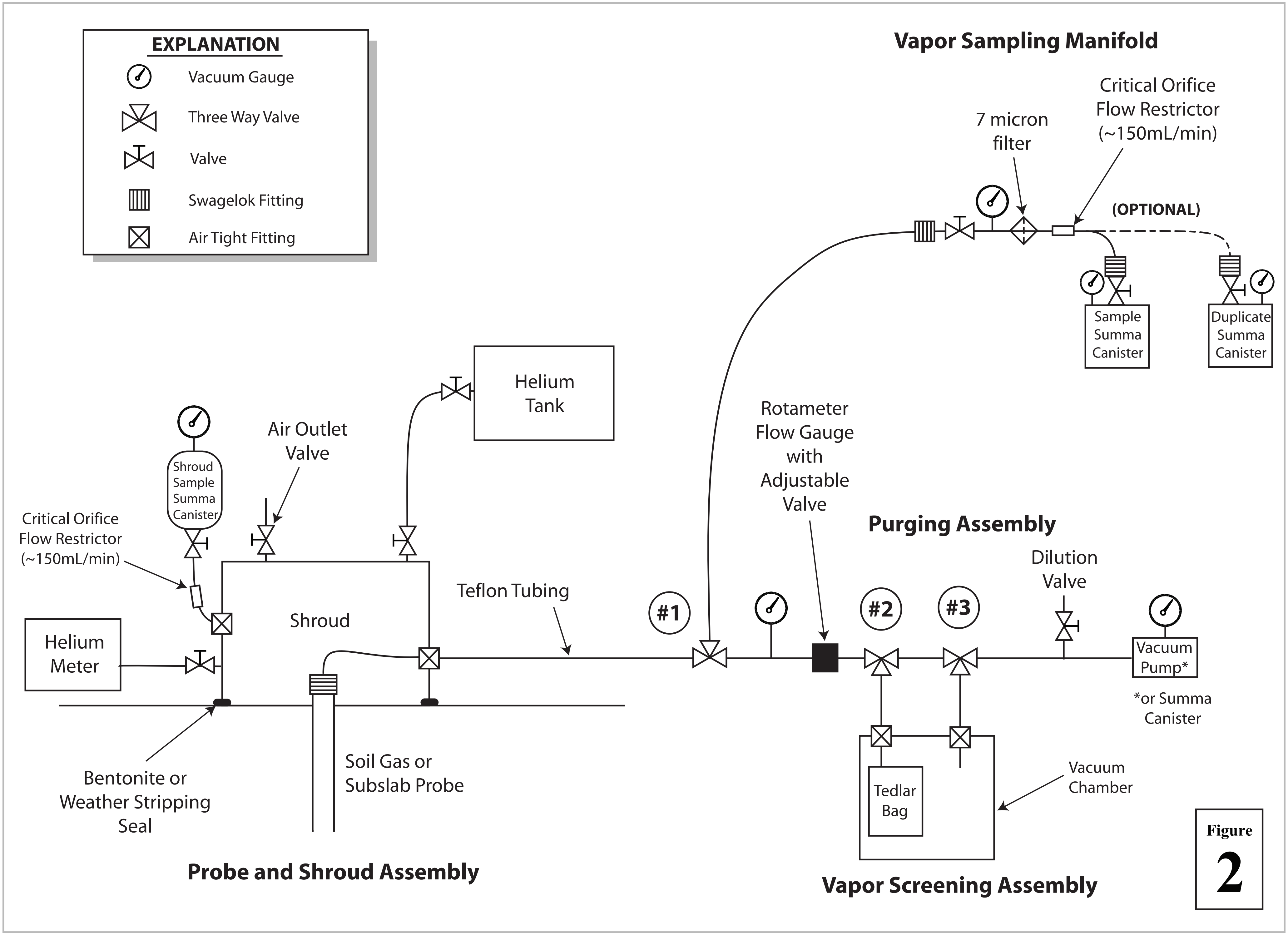


**Figure 2**

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**Subslab Vapor Sampling Manifold Schematic**