September 18, 2009



Mr. Mark E. Detterman, PG, CEG
Alameda County Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502

Re: **Investigation Work Plan**
5925 Ocean View Drive
Oakland, CA 94618
ACEH Case No. RO0003003

Dear Mr. Detterman:

On behalf of Brian McCormack, Pangea Environmental Services, Inc. (Pangea) has prepared this *Investigation Work Plan* (workplan) for the subject site. This workplan was recently requested by your agency letter dated June 19, 2009 (Appendix A). The following sections describe the site background and the proposed investigation of subsurface conditions near the former underground storage tank (UST).

## SITE BACKGROUND

### Site Use

The subject site is a residential property located at 5925 Ocean View Drive approximately 200 ft east of Broadway in a residential area of Oakland, California (Figure 1). The local topography slopes to the south-southwest.

### Compliance Sampling and Tank Removal

During due diligence associated with sale of the property, Mr. McCormack became aware a heating oil underground storage tank. On April 23, 2009, Golden Gate Tank Removal (GGTR) removed one 250-gallon steel heating oil tank from beneath the driveway at the subject site. The tank was reportedly in good condition with no visible holes or pitting. However, hydrocarbon odors were noted in soil surrounding the tank. One soil sample was collected from beneath the former UST at a depth of approximately 8.5 ft below grade surface (bgs). The sample contained 448 milligrams per kilogram (mg/Kg) total petroleum hydrocarbons as heating oil (TPHho), 0.047 mg/Kg ethylbenzene, and 0.0396 total xylenes. Additionally, a four-point composite sample and hotspot sample were collected from the excavated soil. A concentration of 2,750 mg/Kg TPHho was detected in the hotspot sample (GGTR, 2009).

### Site Geology and Hydrogeology

Based on the tank removal report, shallow site soil consists of clay/rock  Groundwater was not observed during the excavation to approximately 8.5 ft bgs.

For the nearby Shell/Thrifty Oil LUST site located at 5755 Broadway, the depth to groundwater in site wells has ranged from approximately 0.5 to 5 ft bgs with a groundwater flow direction in the south-southwest direction.  Pangea understands that historically, during the winter rainy season, some site wells were artesian with site groundwater exiting the property (with a sheen). For another nearby LUFT site (5175 Broadway), groundwater was encountered both above and below fractured bedrock in select wells.  During drilling by Pangea at 5175 Broadway, grab groundwater sampling was effective in some locations but not others due to site conditions.

## INVESTIGATION WORK PLAN

The objective of the proposed investigation is to further evaluate the extent of petroleum hydrocarbons in soil and groundwater at the site.  The proposed investigation involves the completion of two soil borings, with soil and grab groundwater sampling planned from each boring. Additional assessment tasks are included as a contingency if the initial sampling is ineffective due to potentially rocky and dry site conditions. All field activities will be conducted in accordance with the Standard Operating Procedures (SOPs) detailed in Appendix B.

### Pre-Field Activities

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

- Obtain soil boring permits from the Alameda County Public Works Agency;
- Pre-mark the boring locations with white paint and notify Underground Service Alert (USA) of the drilling and sampling activities at least 48 hours before work begins; and
- Prepare a site-specific health and safety plan to educate personnel and minimize their exposure to potential hazards related to site activities.
- Coordinate with drilling and laboratory contractors and with involved parties.

### Proposed Boring Locations and Purpose

The proposed sampling will assess the extent of contaminants near the former site UST.  Pangea assumes that the groundwater flow direction is generally towards the south-southwest, based on the surface topography as well as the groundwater flow direction recorded at the nearby LUFT site at 5755 Broadway Terrace.  As shown on Figure 2, Pangea proposes to complete boring SB-1

approximately 5 ft south of the former UST excavation and boring SB-2 at the flatter location on the driveway, approximately 25 ft south of the former UST excavation. The former UST, driveway and two residences are shown in the photograph on Figure 3.

## Soil & Groundwater Assessment – Boring Installation

To facilitate soil and groundwater sampling, Pangea plans to contract a combination direct-push and hollow-stem auger drill rig. Initial sampling will be attempted using the direct-push features of the drill rig, with the hollow-stem augers used if necessary for deeper boring and attempted grab groundwater collection.

Initially, continuous soil samples will be collected from the surface to total depth of each boring using a Geoprobe or similar direct-push rig. Each boring will be advanced to first encountered groundwater, which is anticipated to be present between 15 and 20 ft bgs. Samples will be geologically logged and classified according to the Unified Soil Classification System by a trained geologist or engineer working under the supervision of a California Professional Engineer (PE) or a California Professional Geologist (PG). At each boring location, soil samples will be collected every four (4) feet and/or at changes in soil type. Field personnel will screen soil with a photo-ionization detector (PID) and will look for field indications (odor, discoloration) of petroleum hydrocarbons. Soil samples for analysis will be obtained by cutting an approximate six-inch length of the GeoProbe acetate liner and capping both ends with Teflon tape and end caps. Pangea anticipates submitting soil samples from approximately 4, 8, and 12 ft bgs for laboratory analysis. Deeper soil samples (if can be collected) will be held for analysis if elevated contaminant concentrations are detected for samples from 12 ft bgs in a given boring.

If water is encountered in the direct-push boring, a single grab groundwater sample will be collected from each sampling point using either a temporary PVC casing and a peristaltic pump or bailer, or a discrete-depth sampler (e.g. Screen-Point Sampler, Hydro-Punch, Simulprobe or similar). Completed borings will be tremmie-grouted from the bottom of the hole to the surface. Additional soil boring procedures are presented in our Standard Operating Procedures (Appendix B).

### Contingent Deeper Sampling and Temporary Monitoring Well Installation

Pangea anticipates that shallow bedrock in the area of the site may prevent advancement of direct-push equipment to groundwater depth. If direct-push refusal is encountered prior to reaching groundwater, Pangea proposes to attempt to drill the boring deeper using the hollow-stem augers on the combination rig. If groundwater is still not encountered and if required by your agency, Pangea will construct a temporary ¾-inch diameter monitoring well at the

maximum depth reached to help facilitate collection of a groundwater sample during the rainy season. Monitoring well procedures are presented in our Standard Operating Procedures (Appendix B).

### Contingent Soil Gas Sampling

If temporary well construction is not required and/or does not facilitate successful collection of a groundwater sample, Pangea proposes to conduct soil gas sampling at two locations (SGP-1 and SGP-2) adjacent to the two closest residential structures. The contingent soil gas sampling locations are shown on Figure 2. Contingent soil gas sampling would help evaluate the potential risk to indoor air since volatile hydrocarbons (ethylbenzene and xylenes) were detected in site soil during the tank removal. Soil gas sampling procedures are presented in our Standard Operating Procedures (Appendix B).

## Sample Analysis

Select soil samples and grab groundwater samples collected during this investigation will be analyzed for total petroleum hydrocarbons as heating oil (TPHho) by U.S. Environmental Protection Agency (EPA) modified Method 8015C, and for benzene, toluene, ethylbenzene, xylenes (BTEX) by EPA Method 8021B. All samples will be analyzed by a laboratory certified by the California Department of Health Services.

## Investigation Derived Waste

Soil cuttings and other investigation-derived waste will be stored onsite in appropriate containers pending laboratory analytical results. Upon receipt of the analytical reports, the waste will be transported to an appropriate disposal/recycling facility.

## Report Preparation

Upon completion of field activities, Pangea will prepare a site assessment report. The report will discuss field activities and analytical results, and will provide recommendations for further action, if needed.

## CLOSING

If you have any questions or comments, please contact me at (510) 435-8664 or briddell@pangeaenv.com.

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

Bob Clark-Riddell, P.E.
Principal Engineer


## REFERENCES

Golden Gate Tank Removal, Inc., 2009, *Tank Closure Report*, 5925 Ocean View Drive, Oakland, California, May 1.

## ATTACHMENTS

Figure 1 – Vicinity Map
Figure 2 – Proposed Boring Locations
Figure 3 – Photograph of Former UST Location

Table 1 – Soil Analytical Data

Appendix A –Regulatory Correspondence
Appendix B – Standard Operating Procedures

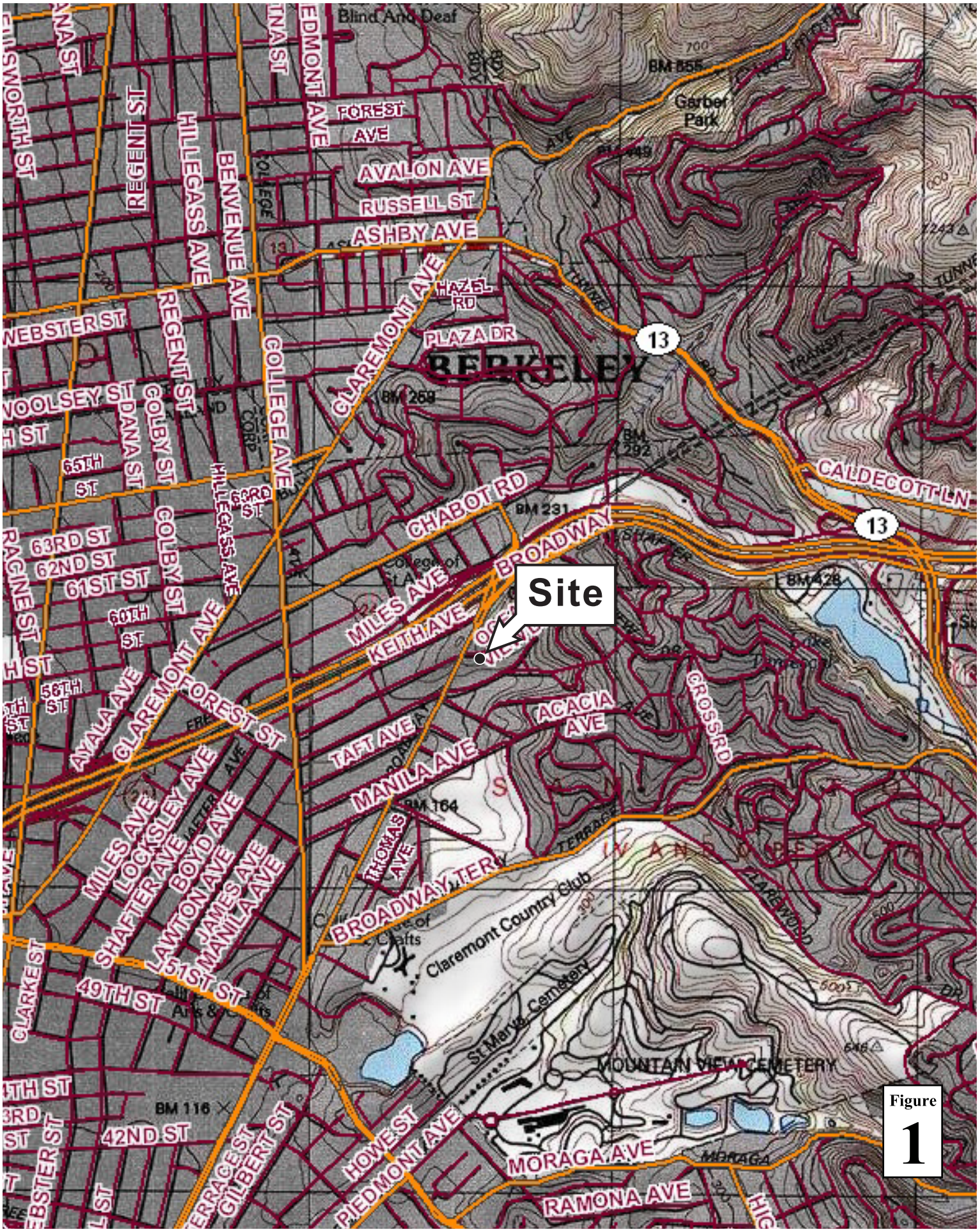


Figure 1

**Morehouse**
5925 Ocean View Drive
Oakland, California

PANGEA

**Vicinity Map**

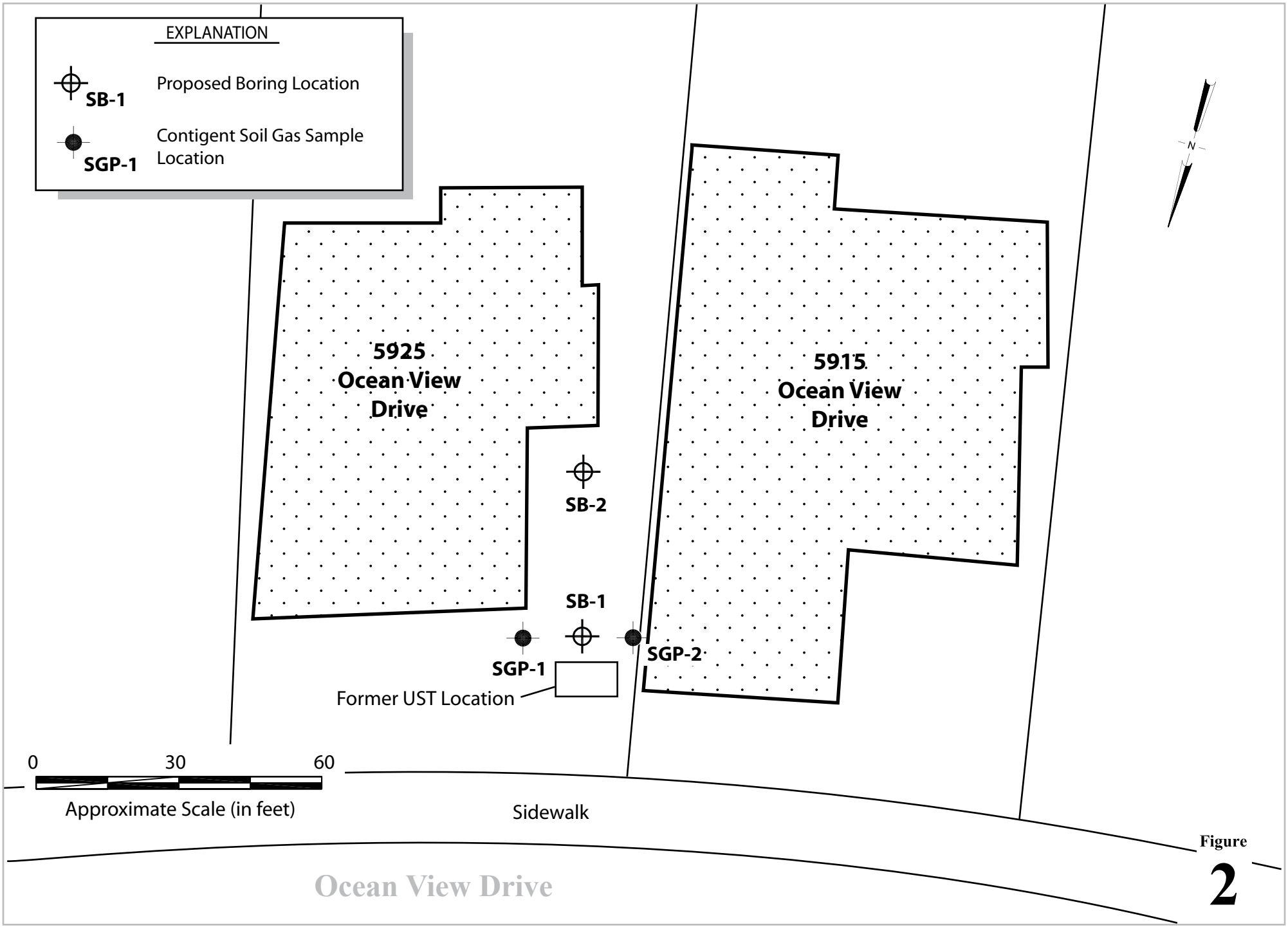


Figure
**2**

5925 Ocean View Drive
Oakland, California

PANGEA

**Proposed Boring Location Map**

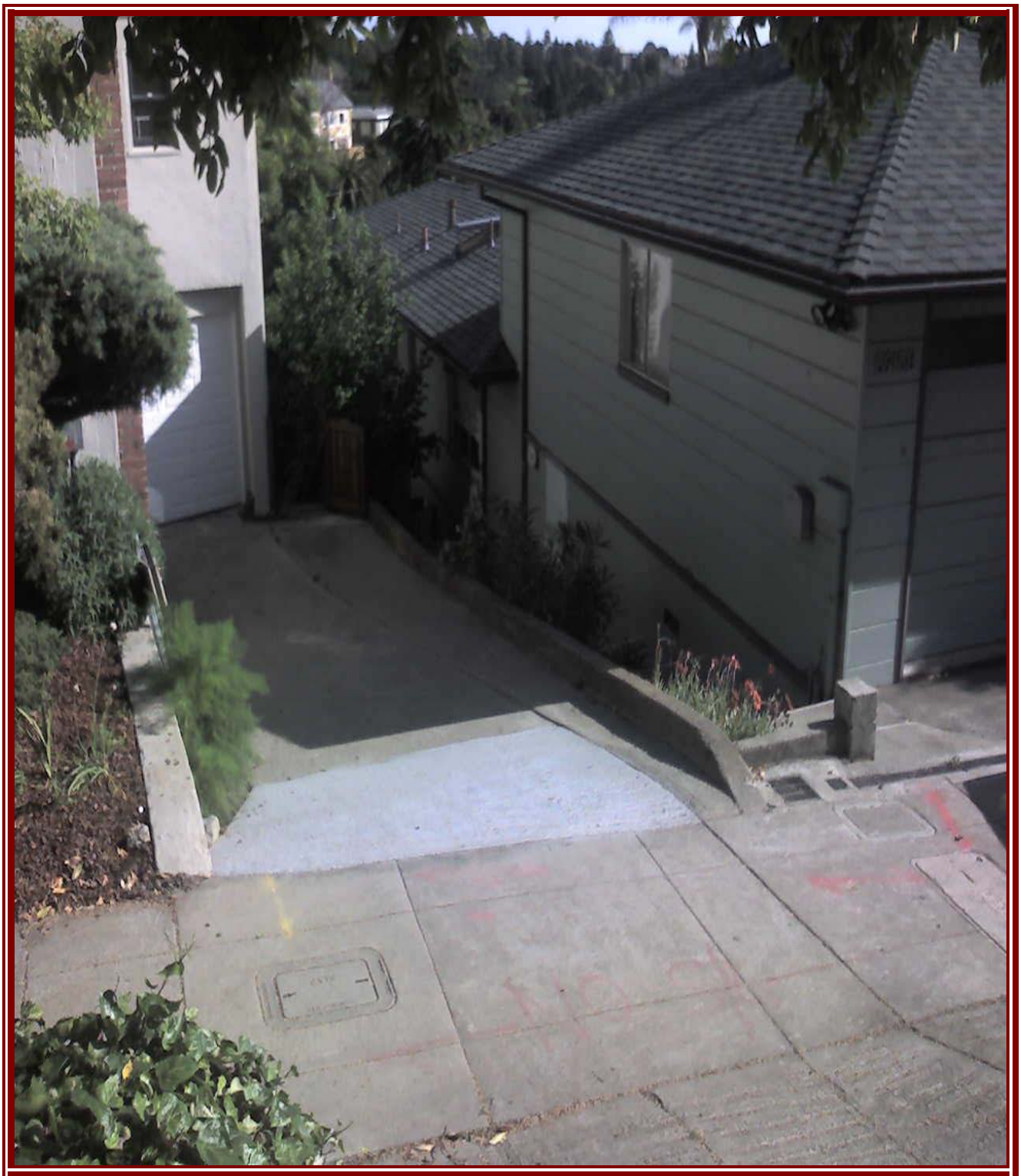

Figure 3 - Photograph of Former UST Location

Pangea

**Table 1. Soil Analytical Data: Petroleum Hydrocarbons -** 5925 Ocean View Drive, Oakland, California

| Sample ID | Date Sampled | Sample Depth (ft) | TPHho | TPHmo | Benzene | Toluene | Ethylbenzene | Xylenes | MTBE | Lead |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | ← mg/kg → | | | | | | | |
| Residential ESL - Indoor Air Impacts | | | Use soil gas | Use soil gas | Use soil gas | Use soil gas | Use soil gas | Use soil gas | Use soil gas | -- |
| Residential ESL - Urban Ecotoxicity | | | -- | -- | 25 | -- | -- | -- | -- | 200 |
| Residential ESL - Ceiling Value | | | 500 | 500 | 500 | 500 | 400 | 420 | 100 | 1,000 |
| Residential ESL - Direct Exposure | | | 370 | 370 | 0.12 | 63 | 2.3 | 31 | 30 | 260 |
| Residential ESL - GW Protection (Leaching) | | | -- | -- | 0.044 | 2.9 | 3.3 | 2.3 | 0.023 | -- |
| Final ESL - Shallow soil, Res., Drinking Water Resource | | | 370 | 370 | 0.044 | 2.9 | 2.3 | 2.3 | 0.023 | 200 |
| Final ESL - Shallow Soil, Res., *Non* Drinking Water Resource | | | **370** | **370** | **0.12** | **9.3** | **2.3** | **11** | **8.4** | **200** |
| **2009 Samples by Golden Gate Tank Removal** | | | | | | | | | | |
| 9081-SP(A-D) | 4/23/2009 | -- | 29.2 | 10.6 | <0.250 | 0.0568 | <0.250 | <0.500 | <1.2 | 35.6 |
| 9081-VC(A-D) | 4/23/2009 | -- | **2,750** | <1,000 | <0.240 | 0.0562 | 0.453 | 0.545 | <1.2 | 8.8 |
| 9081-C-8.5 | 4/23/2009 | 8.5 | **448** | <100 | <0.022 | <0.022 | 0.0447 | 0.04 | <0.110 | -- |

**Notes, Abbreviations and Methods:**

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

TPHho = Total petroleum hydrocarbons as heating oil by EPA Method 8015.

TPHmo = Total petroleum hydrocarbons as motor oil by modified EPA Method 8015.

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

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

Lead = Total lead by EPA Method 6010.

ESL = Environmental Screening Levels for shallow soil with residential land use where groundwater *is/is not* a current or potential drinking water resource from Table A-1/B-1, established by the SFBRWQCB, Interim Final - November 2007 (Revised May 2008).

**Bold** = Concentration equals or exceeds the Final ESL where groundwater *is not* considered a current or potential drinking water resource.

-- = Not available or not analyzed.

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

# APPENDIX A

# Regulatory Correspondence

ALAMEDA COUNTY
HEALTH CARE SERVICES
AGENCY
DAVID J. KEARS, Agency Director

ENVIRONMENTAL HEALTH SERVICES
ENVIRONMENTAL PROTECTION
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577
(510) 567-6700
FAX (510) 337-93

June 19, 2009

Mr. Brian McCormack and Ms Cynthia Chackerian
c/o McCormack. Law Firm
120 Montgomery Street, #1600
San Francisco, CA 94104

Mr. John Morehouse and Ms Katrina Rapa
5925 Ocean View Dr.
Oakland, CA 94618

Subject: Fuel Leak Case No. RO0003003 and Geotracker Global ID T10000001165, McCormack / Chackerian Property, 5925 Ocean View Dr., Oakland, CA 94618

Dear Mr. McCormack and Ms Chackerian; and Mr. Morehouse and Ms Rapa:

Alameda County Environmental Health (ACEH) staff has reviewed the fuel leak case file for the above referenced site. Mr. McCormack and Ms. Chackerian are the former owners of the subject property and arranged for the recent removal of the underground storage tank (UST), while Mr. Morehouse and Ms. Rapa are the current owners due to a recent property transaction.

## WORKPLAN REQUIRED TO CONDUCT INVESTIGATION

According to the recently submitted document entitled, *Tank Closure Report* dated May 1, 2009, which was prepared by Golden Gate Tank Removal, Inc, an approximately 250-gallon UST was removed from beneath the driveway at 5925 Ocean View Drive, Oakland, CA on April 21, 2009. The age or history of the UST was not known by the owners. The UST was in good condition with no noticeable holes; however, hydrocarbon odors were noted in the overburden soil and within the UST pit. A removal confirmation soil sample collected beneath the UST at a depth of approximately 8.5 feet contained 448 milligrams per kilogram (mg/Kg) Total Petroleum Hydrocarbons (TPH) as heating oil, non-detectable concentrations of TPH as motor oil, benzene, toluene, and methyl-tert-butyl ether at elevated detection limits, and 0.047 mg/Kg and 0.0396 mg/Kg ethylbenzene and total xylenes, respectively. Total lead was detected at a concentration of 35.6 mg/Kg. Two stockpile samples were analyzed, a four-point composite and a hotspot sample. Both contained multiple detectable concentrations; however, the hotspot contained up to 2,750 mg/kg TPH heating oil. Based on the results of soil sampling an unauthorized release occurred from the UST.

Please investigate the extent of soil contamination and determine if groundwater contamination is present beneath your site. This type of investigation usually involves drilling one or more soil borings and collecting soil and groundwater samples for analysis. We request that you prepare and submit a Work Plan to ACEH to conduct this work at the site by the date specified below.

## CLAIM SITE IN GEOTRACKER

Please also claim the site in Geotracker, the State Water Resources Control Board's (SWRCB) database website, upload all environmental reports and data for your site. Pursuant to California Code of Regulations, Title 23, Division 3, Chapter 16, Article 12, Sections 2729 and 2729.1, beginning September 1, 2001, all analytical data, including monitoring well samples, submitted in a report to a regulatory agency as part of the UST or LUST program, must be transmitted electronically to the SWRCB GeoTracker system via the internet. Also, beginning January 1, 2002, all permanent monitoring points utilized to collect groundwater samples (i.e. monitoring wells) and submitted in a report to a regulatory agency, must be surveyed (top of casing) to mean sea level and latitude and longitude to sub-meter accuracy using NAD 83. A California licensed surveyor may be required to perform this work. Additionally, pursuant to California Code of Regulations, Title 23, Division 3, Chapter 30, Articles 1 and 2, Sections 3893, 3894, and 3895, beginning July 1, 2005, the successful submittal of electronic information (i.e. report in PDF format) shall replace the requirement for the submittal of a paper copy. Please claim your site and upload all future submittals to GeoTracker and ACEH's ftp server by the date schedule specified below. Electronic reporting is described further below.

## SUBMIT SIGNED UNAUTHORIZED RELEASE FORM

Please submit a signed copy of the *Unauthorized Release Form* by the date specified below. An unsigned copy was included in the previously referenced *Tank Closure Report*.

## LANDOWNER NOTIFICATION REQUIREMENTS

Pursuant to California Health & Safety Code Section 25297.15, the active or primary responsible party for a fuel leak case must inform all current property owners of the site of cleanup actions or requests for closure. Furthermore, ACEH may not consider any cleanup proposals or requests for case closure without assurance that this notification requirement has been met. Additionally, the active or primary responsible party is required to forward to ACEH a complete mailing list of all record fee title holders to the site.

At this time we require that you submit a complete mailing list of all record fee title owners of the site by the schedule listed below that states, at a minimum, the following:

> *A. In accordance with section 25297.15(a) of Chapter 6.7 of the Health & Safety Code, I, (name of primary responsible party), certify that the following is a complete list of current record fee title owners and their mailing addresses for the above site:*
>
> *- OR -*
>
> *B. In accordance with section 25297.15(a) of Chapter 6.7 of the Health & Safety Code, I, (name of primary responsible party), certify that I am the sole landowner for the above site.*

*(Note: Complete item A if there are multiple site landowners. If you are the sole site landowner, skip item A and complete item B.)*

In the future, for you to meet these requirements when submitting cleanup proposals or requests for case closure, ACEH requires that you:

1. Notify all current record owners of fee title to the site of any cleanup proposals or requests for case closure;
2. Submit a letter to ACEH which certifies that the notification requirement in 25297.15(a) of the Health and Safety Code has been met;
3. Forward to ACEH a copy of your complete mailing list of all record fee title holders to the site; and
4. Update your mailing list of all record fee title holders, and repeat the process outlined above prior to submittal of any additional *Corrective Action Plan* or your *Request for Case Closure.*

Your written certification to ACEH (Item 2 above) must state, at a minimum, the following:

*A. In accordance with Section 25297.15(a) of the Health & Safety Code, I, (name of primary responsible party), certify that I have notified all responsible landowners of the enclosed proposed action. (Check space for applicable proposed action(s)):*
*___ cleanup proposal (Corrective Action Plan)*
*___ request for case closure*
*___ local agency intention to make a determination that no further action is required*
*___ local agency intention to issue a closure letter*

*- OR -*

*B. In accordance with section 25297.15(a) of Chapter 6.7 of the Health & Safety Code, I, (name of primary responsible party), certify that I am the sole landowner for the above site.*

*(Note: Complete item A if there are multiple site landowners. If you are the sole site landowner, skip item A and complete item B.)*

***(Note: Complete item A if there are multiple site landowners. If you are the sole site landowner, skip item A and complete item B.)***

## TECHNICAL REPORT REQUEST

Please submit technical reports to Alameda County Environmental Health (Attention: Mark Detterman), according to the following schedule:

- **July 20, 2009** – Claim Site in Geotracker
- **July 20, 2009** – Signed Unauthorized Release Form
- **July 20, 2009** – Signed Landowner Certification
- **September 18, 2009** – Work Plan

These reports are being requested pursuant to California Health and Safety Code Section 25296.10. 23 CCR Sections 2652 through 2654, and 2721 through 2728 outline the responsibilities of a responsible party in response to an unauthorized release from a petroleum UST system, and require your compliance with this request.

## UNDERGROUND STORAGE TANK CLEANUP FUND

Site investigation/site cleanup costs may be reimbursable from the California Underground Storage Tank Cleanup Fund. The application and additional information is available at the State Water Resources Control Board's website at http://www.waterboards.ca.gov/water_issues/programs/ustcf/. Please be aware that reimbursement monies are contingent upon maintaining compliance with directives from ACEH. Delays in investigation, later reports, or enforcement actions may result in your becoming ineligible to receive money from the Underground Storage Tank Cleanup Fund. We strongly encourage you to contact the Fund for an application.

## ELECTRONIC SUBMITTAL OF REPORTS

ACEH's Environmental Cleanup Oversight Programs (LOP and SLIC) require submission of reports in electronic form. The electronic copy replaces paper copies and is expected to be used for all public information requests, regulatory review, and compliance/enforcement activities. Instructions for submission of electronic documents to the Alameda County Environmental Cleanup Oversight Program FTP site are provided on the attached "Electronic Report Upload Instructions." Submission of reports to the Alameda County FTP site is an addition to existing requirements for electronic submittal of information to the State Water Resources Control Board (SWRCB) Geotracker website. In September 2004, the SWRCB adopted regulations that require electronic submittal of information for all groundwater cleanup programs. For several years, responsible parties for cleanup of leaks from underground storage tanks (USTs) have been required to submit groundwater analytical data, surveyed locations of monitoring wells, and other data to the Geotracker database over the Internet. Beginning July 1, 2005, these same reporting requirements were added to Spills, Leaks, Investigations, and Cleanup (SLIC) sites. Beginning July 1, 2005, electronic submittal of a complete copy of all reports for all sites is required in Geotracker (in PDF format). Please visit the SWRCB website for more information on these requirements (http://www.swrcb.ca.gov/ust/electronic_submittal/index.shtml).

## PERJURY STATEMENT

All work plans, technical reports, or technical documents submitted to ACEH must be accompanied by a cover letter from the responsible party that states, at a minimum, the following: "I declare, under penalty of perjury, that the information and/or recommendations contained in the attached document or report is true and correct to the best of my knowledge." This letter must be signed by an officer or legally authorized representative of your company. Please include a cover letter satisfying these requirements with all future reports and technical documents submitted for this fuel leak case.

## PROFESSIONAL CERTIFICATION & CONCLUSIONS/RECOMMENDATIONS

The California Business and Professions Code (Sections 6735, 6835, and 7835.1) requires that work plans and technical or implementation reports containing geologic or engineering evaluations and/or judgments

be performed under the direction of an appropriately registered or certified professional. For your submittal to be considered a valid technical report, you are to present site specific data, data interpretations, and recommendations prepared by an appropriately licensed professional and include the professional registration stamp, signature, and statement of professional certification. Please ensure all that all technical reports submitted for this fuel leak case meet this requirement.

**AGENCY OVERSIGHT**

You should be made aware that if it appears as though significant delays are occurring or reports are not submitted as requested, we may consider referring your case to the Regional Board or other appropriate agency, including the County District Attorney, for possible enforcement actions. California Health and Safety Code, Section 25299.76 authorizes enforcement including administrative action or monetary penalties of up to $10,000 per day for each day of violation.

If you have any questions, please call me at (510) 567-6791 or send me an electronic mail message at mark.detterman@acgov.org.

Sincerely,

Mark E. Detterman, PG, CEG
Hazardous Materials Specialist

Enclosure: ACEH Electronic Report Upload (ftp) Instructions

cc: Leroy Griffin, Oakland Fire Department, 250 Frank H. Ogawa Plaza, Ste. 3341, Oakland, CA 94612-2032

Donna Drogos, ACEH
Mark Detterman, ACEH
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. 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 FIELD PROCEDURES FOR MONITORING WELLS

This document describes Pangea Environmental Services' standard field methods for drilling, installing, developing and sampling groundwater monitoring wells. These procedures are designed to comply with Federal, State and local regulatory guidelines. Specific field procedures are summarized below.

## Well Construction and Surveying

Groundwater monitoring wells are installed in soil borings to monitor groundwater quality and determine the groundwater elevation, flow direction and gradient. Well depths and screen lengths are based on groundwater depth, occurrence of hydrocarbons or other compounds in the borehole, stratigraphy and State and local regulatory guidelines. Well screens typically extend 10 to 15 feet below and 5 feet above the static water level at the time of drilling. However, the well screen will generally not extend into or through a clay layer that is at least three feet thick.

Well casing and screen are flush-threaded, Schedule 40 PVC. Screen slot size varies according to the sediments screened, but slots are generally 0.010 or 0.020 inches wide. A rinsed and graded sand occupies the annular space between the boring and the well screen to about one to two ft above the well screen. A two feet thick hydrated bentonite seal separates the sand from the overlying sanitary surface seal composed of Portland type I, II cement.

Well-heads are secured by locking well-caps inside traffic-rated vaults finished flush with the ground surface. A stovepipe may be installed between the well-head and the vault cap for additional security. The well top-of-casing elevation is surveyed with respect to mean sea level and the well is surveyed for horizontal location with respect to an onsite or nearby offsite landmark.

## Well Development

Wells are generally developed using a combination of groundwater surging and extraction. Surging agitates the groundwater and dislodges fine sediments from the sand pack. Wells may be surged prior to installation of the well seal to ensure that there are no voids in the sand pack. Development occurs 24 to 72 hours after seal installation to ensure that the Portland cement has set up correctly. After about ten minutes of surging, groundwater is extracted from the well using bailing, pumping and/or reverse air-lifting through an eductor pipe to remove the sediments from the well. Surging and extraction continue until at least ten well-casing volumes of groundwater are extracted and the sediment volume in the groundwater is negligible.

All equipment is steam-cleaned prior to use and air used for air-lifting is filtered to prevent oil entrained in the compressed air from entering the well. Wells that are developed using air-lift evacuation are not sampled until at least 24 hours after they are developed.

## Groundwater Sampling

Depending on local regulatory guidelines, three to four well-casing volumes of groundwater are purged prior to sampling. Purging continues until groundwater pH, conductivity, and temperature have stabilized. Groundwater samples are collected using bailers or pumps and 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. Laboratory-supplied trip blanks accompany the samples and are analyzed to check for cross-contamination. An equipment blank may be analyzed if non-dedicated sampling equipment is used.

# STANDARD OPERATING PROCEDURES FOR SOIL GAS SAMPLING

## 1.0 PURPOSE

This standard operating procedure (SOP) describes the procedures for collecting shallow soil gas vapor samples using temporary vapor probes and evacuated, stainless-steel Summa canisters. The SOP is modified from procedures and information presented in California Regional Water Quality Control Board – Los Angeles Region (LARWQCB), 1997, Cal/EPA 2004, and discussions (September 2006) with K Prime (Santa Rosa, California) laboratory staff.

## 2.0 REQUIRED EQUIPMENT

- Drill rig or hammer drill with 1" bit and smaller bits (slightly larger than vapor probe tip)
- Tubing for cleaning boring
- Vapor probes and tubing with Swagelok threaded compression fitting and vapor-tight cap.
- Rubber stopper or Teflon disk
- Powdered bentonite or expanding Portland cement
- 6-Liter Summa canister (evacuated with approximately 30" Hg vacuum) with vacuum gauge for purging and leak testing
- 6-Liter Summa canister with vacuum gauge for each sample (including duplicates)
- 1-Liter Summa canister for leak-check compound
- K Prime Inc. stainless-steel sampling manifold (see Figure 2) (request that laboratory leak-check manifold prior to mobilization)
- Leak-check compound (e.g. isopropyl alcohol) and absorbent material (e.g. gauze)
- Photoionization detector (PID)
- Isobutylene for PID calibration
- Tedlar bags for sampling leak-check compound
- Leak-check enclosure (plastic container with flexible weatherstripping and openings for vapor probe tubing and for sampling enclosure atmosphere)
- Record-keeping materials
- Latex or nitrile gloves

## 3.0 PROCEDURES

### 3.1 Boring Clearance

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

### 3.2 Vapor Probe Installation

1. To protect surfaces, lay plastic sheeting around the probe location.
2. Use a rotary hammer drill or concrete-coring equipment to create an approximately 1-inch or greater diameter hole that penetrates the slab.
3. In general, the drive rod is driven to a predetermined depth and then pulled back to expose the inlets of the soil gas probe either by exposing a short screened section or by leaving a disposable drop-off tip in the hole. After sample collection, both the drive rod and tubing are removed.

4. During installation of the probe, hydrated bentonite should be used to seal around the drive rod at ground surface to prevent ambient air intrusion from occurring.
5. The inner soil gas pathway from probe tip to the surface should be continuously sealed (e.g., a sampling tube attached to a screw adapter fitted with an o-ring and connected to the probe tip) to prevent infiltration.
6. Equilibration Time: During probe emplacement, subsurface conditions are disturbed. To allow for subsurface conditions to equilibrate, the following equilibration times are recommended:

   For probes installed with the direct push method where the drive rod remains in the ground, purge volume test, leak test, and soil gas sampling should not be conducted for at least 20 minutes following probe installation.

   For probes installed with the direct push method where the drive rod does not remain in the ground, purge volume test, leak test, and soil gas sampling should not be conducted for at least 30 minutes following probe installation.

   For probes installed with hollow stem drilling methods, purge volume test, leak test, and soil gas sampling should not be conducted for at least 48 hours (depending on site lithologic or drilling conditions) after the soil gas probe installation.
7. Probe installation time should be recorded in the field log book.
8. Decontamination: After each use, drive rods and other reusable components should be properly decontaminated to prevent cross contamination. These methods include:

   3-stage wash and rinse (e.g., wash equipment with a non-phosphate detergent, rinse with tap water, and finally rinse with distilled water); and/or

   Steam-cleaning.

## 3.3 Vapor Sampling

**During vapor sampling, record all valve open/close times and canister/manifold vacuum readings at each step.**

**Setup**

1. Calculate and record the volume of the sampling assembly, tubing vapor probe, and any permeable annular space around the vapor probe tip.

   Volume =3.14 x (1/2*ID) x (1/2*ID) *L,

   where ID = tubing or manifold inside diameter and L = length of 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 purge Summa canister 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 both canisters.

**Flow and Leak Check**

1. Open both manifold valves and valve on purge Summa canister. Do *not* open valve on sample port. Allow manifold/tubing vacuum to stabilize at approximately 30” Hg.

2. Close purge canister valve and wait at least 10 minutes. Monitor manifold vacuum gauge to test for leaks. If the vacuum decreases, rectify the leak before proceeding.

3. If vacuum is stable, open purge canister valve and open vapor probe valve. After approximately *5 seconds*, close the canister valve and estimate flow rate by recording the elapsed time after valve closure for manifold vacuum to drop to 5" vacuum, as indicated on the following chart (specific to K-Prime sampling manifold)

**K PRIME, INC. SOIL GAS MANIFOLD FLOW RATE AND VACUUM LEVEL ESTIMATES**

| T (seconds) | PV | F (ml/minute) |
|---|---|---|
| 5 | 0 | 135 |
| 10 | 5 | 115 |
| 15 | 10 | 90 |
| 30 | 15 | 60 |
| 120 | 20 | 40 |
| 480 | 25 | 20 |

Source: K Prime, Inc. – July 24, 2006

NOTES:
T = Time duration from full vacuum to less than 5" vacuum after closing purge canister.
PV = Approximate vapor probe vacuum level based on measured T
F = Approximate sampling flow rate based on measured T

4. This procedure should also be conducted several times at the beginning of sampling to ensure that flow rate is sufficient. If no significant flow is attained, either the sampling line is plugged or the vapor probe is positioned in an impermeable or saturated layer. Such a situation should be rectified before sample collection.

5. Place absorbent materials (e.g., gauze) *lightly* moistened (e.g., five drops) with leak-check compound (isopropyl alcohol) inside the leak-check enclosure. Do not allow liquid to come in direct contact with tubing or sampling assembly.

6. Place leak-check enclosure over vapor probe and seal to floor using weatherstripping or duct tape. Ensure that PID has been calibrated with isobutylene gas. Note that the isopropyl alcohol response factor is approximately 5.6 (i.e. a reading of 2 ppm on the PID indicates 5.6 x 2 = 11.2 ppm of isopropyl alcohol in the sample). Record both the observed PID reading and the calculated isopropyl alcohol concentration. If the PID reading is below 10 ppm, slowly reapply leak-check compound.

7. Record PID reading for leak-check enclosure at least once every 5 minutes during purging and sampling. Slowly reapply leak-check compound if PID reading drops more than 20% below initial readings in an attempt to return to the initial readings.

**Purge and Sample**

1. Open purge canister valve and vapor probe valve and purge the appropriate number of purge volumes. For vapor sampling in support of risk-assessments for regulatory review, a step-purge test should be conducted at a "worst case" sampling point, using 1, 3 and 7 purge volumes to determine the appropriate purge volume that yields the highest target compound concentration. For soil gas screening, or where a purge test is not feasible, purge approximately 3 to 5 purge volumes of the tubing and sampling assembly. Do *not* over-purge. Include the purging conducted during the leak-check step above in the purge

volume.

2. Close purge canister valve and open sample canister valve. Sampling should take approximately 30 minutes for a 6-liter Summa canister.
3. During sampling, the integrated flow rate should be checked periodically by closing the sample canister valve and checking the elapsed time versus the sampling volume. Sampling volume for a 6-liter canister can be estimated based on the following table.

**Relationship between Final Canister Vacuum and Volume Sampled**

| Final Vacuum ("Hg) | 0 | 2.5 | 5 | 7.5 | 10 | 12.5 | 15 | 17.5 | 20 |
|---|---|---|---|---|---|---|---|---|---|
| Volume Sampled (L) | 6 | 5.5 | 5 | 4.5 | 4 | 3.5 | 3 | 2.5 | 2 |

Source: Air Toxics, Inc.

4. Close sampling canister valve when vacuum decreases to between 1" and 5" mercury. Do *not* allow vacuum to fall below this range.
5. Use a 1-liter Summa canister to collect a sample from the leak-check enclosure. Submit canister for analysis of leak-check compound only.
6. Disassemble sampling assembly, and cap (or remove and restore) vapor sampling point.
7. Fill out chain-of-custody form, including analysis for chemicals of concern and leak-check compound. Also analyze for oxygen, carbon dioxide and methane. Include final vacuum reading and serial numbers of canister and flow restrictor.
8. 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**

9. Use separate sampling manifold and tubing for each sample location. Return equipment to laboratory for decontamination.
10. Backfill soil vapor probe holes with bentonite slurry.

## REFERENCES


California Regional Water Quality Control Board – Los Angeles Region (LARWQCB), 1997, Interim guidance for active soil gas investigation, February 25.

Cal/EPA, 2003, Advisory – Active soil gas investigations, California Environmental Protection Agency, Department of Toxic Substances Control, January 28.

Cal/EPA, 2004, Interim final guidance for the evaluation and mitigation of subsurface vapor intrusion to indoor air, California Environmental Protection Agency, Department of Toxic Substances Control, December 15 (revised February 7, 2005).

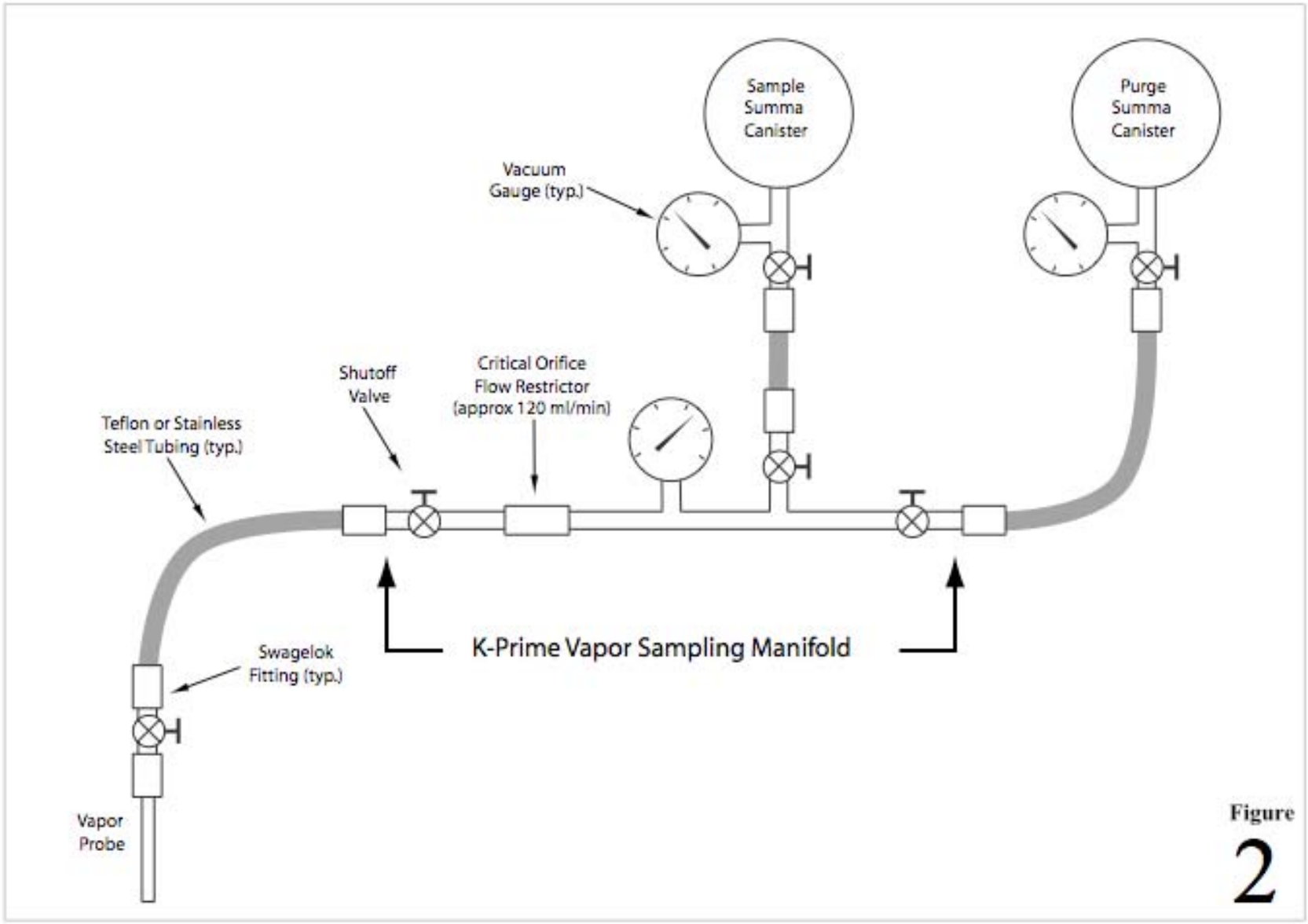


Figure
2

**Subslab and Soil Vapor Sampling Manifold Schematic**

PANGEA