ABF Freight
P.O. Box 10048 (72917-0048)
3801 Old Greenwood Road
Fort Smith, AR 72903
479.785.8700
abf.com

October 11, 2016

RECEIVED
By Alameda County Environmental Health 10:26 am, Oct 20, 2016

Mr. Mark Detterman, RG, CEG
Senior Hazardous Materials Specialist
Alameda County Environmental Health Department
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577

Re: **Perjury Statement-**
Data Gaps Work Plan
ABF Freight System Facility (SLIC Case No. RO#0003134)
4575 Tidewater Avenue
Oakland, California

Dear Mr. Detterman:

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

Sincerely,

Michael K. Rogers
Director, Real Estate
ArcBest Corporation

TRINITY
source group, inc.
Environmental Consultants

October 11, 2016
Project 154.010.001

Mr. Mark Detterman, RG, CEG
Senior Hazardous Materials Specialist
Alameda County Environmental Health Department
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577

Re: *Data Gaps Work Plan*
ABF Freight System Facility
4575 Tidewater Avenue
Oakland, California
RO#0003033 and RO#0003134

Dear Mr. Detterman:

This letter, prepared by Trinity Source Group, Inc. (Trinity) on behalf of ABF Freight System, Inc. (ABF), presents a *Data Gaps Work Plan (Work Plan)* for the referenced site (Figures 1 and 2). This *Work Plan* was requested by Alameda County Environmental Health Department (ACEHD) in a letter dated August 30, 2016. This *Work Plan* focuses on assessing the extent of halogenated volatile organic compounds (HVOCs) in sub-slab vapor and conducting an additional sub-slab vapor sampling event. The ACEHD letter is included in Attachment A of this *Work Plan*.

BACKGROUND

The site encompasses approximately 6.7 acres situated between Tidewater Avenue and the water channel extending north from San Leandro Bay, which separate the cities of Alameda and Oakland (Figures 1 and 2). Land-use in the area is industrial.

Currently the site is in use as a trucking terminal with a maintenance building located near the western property boundary. One aboveground storage tank that existed adjacent to the maintenance building, and is labeled with “Diesel Fuel”, “Not in Use”, and “Permanently Closed Jan. 1995”, was removed by ABF on August 13, 2014. An underground clarifier is in use near the maintenance building. The underground storage tanks (USTs) at the site were also located near the maintenance building. The maintenance building is used for routine maintenance of site vehicles, and is infrequently occupied.

The site consists of two separate cases: one for petroleum hydrocarbons and another for chlorinated solvents as tetrachloroethene (PCE). The petroleum hydrocarbon case is currently under consideration for closure under the low–threat closure policy for a commercial land use scenario. The PCE case is active, and the PCE sub-slab vapor concentrations beneath the maintenance shop in sub-slab probe SVP-2 are below the commercial screening level. A table summarizing the results of sub-slab vapor sampling is presented as Table 1.

A detailed site background is provided in Trinity's January 9, 2015 *Data Gap Investigation Work Plan and Focused Site Conceptual Model (SCM).*

SCOPE OF WORK

Trinity presents the following scope of work to further assess the sub-slab beneath the maintenance shop building. This scope of work is based upon the following Department of Toxic Substances Control California Environmental Protection Agency guidance documents:

- *Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (Vapor Intrusion Guidance),* October 2011
- *Advisory Active Soil Gas Investigations*, July 2015

The proposed scope of work is the installation of one additional sub-slab vapor probe and sampling of all sub-slab vapor probes.

Prefield

Prefield tasks will include obtaining necessary permits, preparing a site-specific health and safety plan, and notifying inspectors as needed. In addition, Trinity staff will mark the proposed sub-slab vapor probe location and notify Underground Service Alert for utility clearance.

Sub-Slab Vapor Probe Installation

One additional sub-slab probe, designated SVP-3, will be installed through the concrete building slab north of Probe SVP-2 as shown on Figure 2. Trinity proposes using Vapor Pin™ technology for the sub-slab vapor probe. The Vapor Pin™ installation procedures are presented in Attachments B and B-1.

Sub-Slab Vapor Probe Sampling and Analysis

Existing sub-slab vapor probes SVP-1 and SVP-2 and proposed probe SVP-3 will be sampled using Summa canisters and a helium shroud as summarized in the field procedures presented in Attachment B and B-2. A schematic diagram of the sub-slab vapor probe sampling equipment is included in Attachment B. Samples will be transmitted to Curtis & Tompkins Laboratories, a state-certified laboratory (ELAP #2896) under chain of custody, for analysis for PCE, trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), 1,1-dichloroethene (1,1-DCE) and vinyl chloride using EPA Method TO-15. The sub-slab samples will also be analyzed for helium as the leak-check compound.

Reporting

Following receipt of sub-slab analytical results, Trinity will prepare a summary report of the procedures and findings of this sub-slab vapor sampling along with recommendations. The report will include a map showing sample collection locations, and analytical data, along with certified analytical reports and chain of custody documentation. The sub-slab vapor HVOC concentrations will be compared to screening levels, and conclusions and recommendations will be presented.

SCHEDULE

Trinity will initiate the proposed scope of work after ACEHD approval of this *Work Plan.* Upon approval to proceed and under normal circumstances, the investigation will take approximately 1 to 4 weeks to complete. The final comprehensive report will be submitted within 8 to 12 weeks after receipt of all analytical data.

Should you have any questions regarding this letter, please call Trinity at (831) 426-5600.

Sincerely,

TRINITY SOURCE GROUP, INC.

Information, conclusions, and recommendations made by Trinity in this document regarding this site have been prepared under the supervision of and reviewed by the licensed professional whose signature appears below.

Debra J. Moser, PG, CEG, CHG
Senior Geologist

Brady Nagle
Project Manager

Attachments:

Table 1:	Sub-Slab Vapor Analytical Data
Figure 1:	Site Location Map
Figure 2:	Proposed Sub-Slab Vapor Sampling Probe Location
Attachment A:	ACEHD Letter Dated November 10, 2015
Attachment B:	Sub-Slab Vapor Probe Installation and Sampling Field Procedures
Attachment B-1:	Cox – Colvin Standard Operating Procedure Installation and Extraction of the Vapor Pin™
Attachment B-2:	Curtis & Tompkins Field Guide for Use of C&T Helium Shrouds

DISTRIBUTION

A copy of this submittal has been forwarded to:

Mr. Mike Rogers (via email to mkrogers@arkbest.com)

Leroy Griffin (via email to lgriffin@oaklandnet.com)

TABLE

Table 1
Sub-Slab Vapor Analytical Data

DRAFT

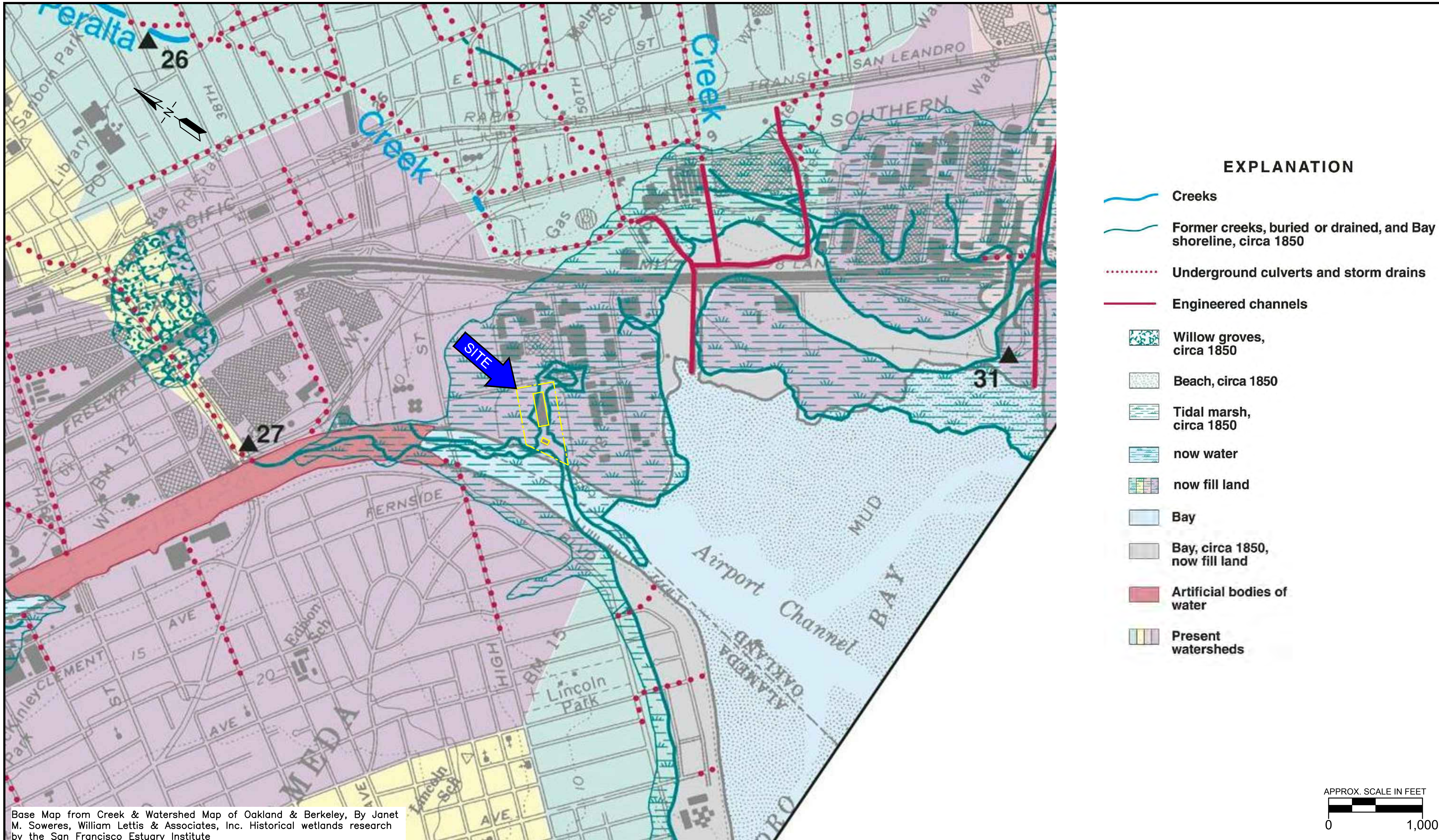
ABF Freight System Facility
4575 Tidewater Avenue
Oakland, California

Sample ID	Sample Date	Analytical Test Methods																
		ASTM D-1946				EPA TO-15											EPA TO-17	
		Carbon Dioxide (%)	Methane (%)	Oxygen (%)	Helium (%)	PCE (µg/m³)	1,1,2-TCA (µg/m³)	1,2,4 - TMB (µg/m3)	TPHg (µg/m³)	Benzene (µg/m³)	Toluene (µg/m³)	Ethyl Benzene (µg/m³)	Ethyl Acetate (µg/m³)	Total Xylenes (µg/m³)	Ethanol (µg/m³)	Other VOCs (µg/m³)	Naphthalene (µg/m³)	TPHd (µg/m3)
SVP-1	6/20/2012	2.2	<0.0001	16	0.049	**60**	<11	<10	<1,800	<2.8	<7.7	<8.8	**20**	<27	**180**	ND	<2.0	
SVP-1	12/17/2012				8.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		<0.6	<125
SVP-1	1/17/2013	0.8	<0.0002	20	0.23	**16**	<11	<10	**1,300**	<6.5	<7.7	**9.6**	**33**	**77**	**290**	**Acetone, 340**	**2.0**	
SVP-2	6/20/2012	0.22	0.00018	18	<0.005	**530**	**38**	**13**	**1,900**	**2.9**	**11**	**20**	**19**	**160**	**100**	**Acetone, 230**	**3.4**	
SVP-2	12/17/2012				1.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		<0.6	<125
SVP-2	1/17/2013				40	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA			
SVP-2	2/5/2013	1.21	<0.0009	17.1	NA	**901**	<0.03	**0.02**	NA	**0.03**	**0.02**	<0.02	<0.02	**0.04**	NA	**Acetone, 20.4 1,1-DFE, 12.5 (leak check) Others as listed on Certified Analytical Report**		
SVP-2 (QC Sample)	2/5/2013	1.22	<0.001	17.3	NA	**971**	<0.03	**0.064**	**450***	**0.15**	**0.21**	<0.02	<0.02	**0**	**NA**	**Acetone, 67.1 1,1-DFE, 426 (leak check) Others as listed on Certified Analytical Report**		
	ESLs for Commercial Human Health Risk					2,100	770	NA	2,500,000	420	1,300,000	4,900	NA	440,000	NA	NA	360	570,000

Notes:

ID = Identification
% = Percentage
µg/m³ = micrograms per meter cubed
PCE = Tetracholoroethene
1,1,2-TCA = 1,1,2 - Trichloroethane
1,2,4-TMB = 1,2,4 - Trimethylbenzene
TPHg = Total Petroleum Hydrcarbons as Gasoline
1,1-DFE = 1,1-Difluoroethane
ASTM = American Society for Testing Materials
< = Not detected at or above detection limit
ND = Not detected
NA = Not applicable
Bold = data detected above laboratory detection limits
* Duplicate sampled was analyzed for TPHg; result of 450 (µg/m³) was attributed to single discrete peak (PCE).
ESLs = Environmental Screening Levels - February 2016 (Revision 3)
SFRWQCB = San Francisco Bay Regional Water Quality Control Board, California EPA
http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/ESL/ESL%20Workbook_ESLs_Interim%20Final_22Feb16_Rev3_PDF.pdf

FIGURES



Base Map from Creek & Watershed Map of Oakland & Berkeley, By Janet M. Soweres, William Lettis & Associates, Inc. Historical wetlands research by the San Francisco Estuary Institute

PREPARED BY
TRINITY
source group, inc.
Environmental Consultants
119 Encinal Street
Santa Cruz, California 95060
v: 831.426.5600
f: 831.426.5602

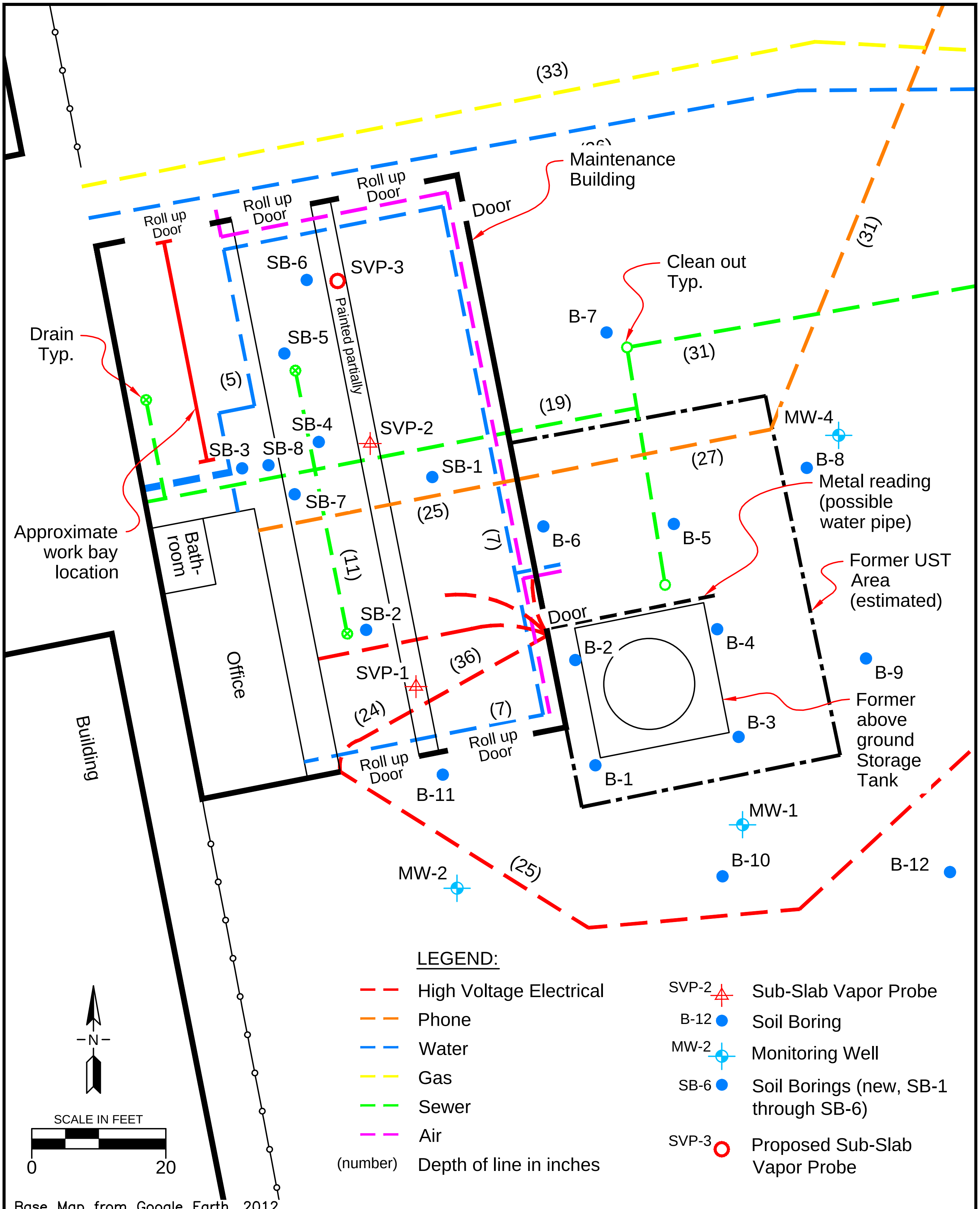
SITE LOCATION MAP

ABF Freight System Facility
4575 Tidewater Ave.
Oakland, California

PROJECT: 154.009.001

FIGURE: 1

REF. 154_001\154.008.001 fig1.dwg



REF. 154_001\154.010.001 fig2.dwg

PREPARED BY

TRINITY source group, inc.
Environmental Consultants

119 Encinal Street
Santa Cruz, California 95060
v: 831.426.5600
f: 831.426.5602

PROPOSED SUB-SLAB VAPOR SAMPLING PROBE LOCATION

ABF Freight System Facility
4575 Tidewater Ave.
Oakland, California

PROJECT:
154.010.001

FIGURE:
2

ATTACHMENT A

ACEHD Letter Dated August 30, 2016

ALAMEDA COUNTY
HEALTH CARE SERVICES
AGENCY
REBECCA GEBHART, Interim Director

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

August 30, 2016

Arkansas Bandag Corporation
PO Box 10048
Fort Smith AR 72917

Mr. Mike Rogers
ABF Freight Systems, Inc.
PO Box 10048
Fort Smith AR 72917
(Sent via electronic mail to: mrogers@arcb.com)

Subject: Request for Work Plan; Site Cleanup Program Case No. RO0003134 and GeoTracker Global ID T00000005825; ABF Freight Maintenance Shop, 4575 Tidewater Avenue, Oakland, CA 94601

Dear Mr. Rogers:

Alameda County Department of Environmental Health (ACDEH) staff has reviewed the case file for the above-referenced site, including the *Indoor Air Sampling Work Plan Addendum*, dated May 20, 2016. The document was prepared and submitted on your behalf by the Trinity Source Group, Inc (Trinity). Thank you for submitting the addendum.

The addendum conducted a review of a chlorinated volatile organic compound (VOC; in particular tetrachlorethene or PCE) vapor plume located beneath the maintenance building at the site with respect to the February 2016 revised Environmental Screening Levels (ESLs) promulgated by the San Francisco Bay Regional Water Quality Control Board (RWQCB). The addendum discussed recent changes in vapor ESLs due to changes in the understanding of vapor intrusion concerns in regional climate conditions, including the Mediterranean climate such as California's, and specifically how these changes affected the RWQCB ESLs. In general, ACDEH is in agreement with the summary of the changes, and with the recommendation to eliminate an investigation into indoor air concentrations; however, due to documentation of temporal changes in vapor concentrations at many sites including this site (see SVP-2), it appears appropriate to request an additional round of vapor sampling at the site, as well as an extension of the area of investigation as discussed below.

Therefore, based on the review of the case file, ACDEH requests that you address the following technical comments and send us the documents requested below.

TECHNICAL COMMENTS

1. **Lateral Extent of PCE Vapor –** Review of Figure 3 of the January 9, 2015 *Data Gap Investigation Work Plan and Focused Site Conceptual Model*, indicates that the passive vapor survey extended moderately elevated PCE and related daughter product concentrations northwards from SVP-2 at similar passive vapor concentrations, but did not define the northerly extent of these concentrations. In order to limit the known extent of VOC concentrations to the north, define those vapor concentrations in the north, and to refine our understanding of temporal variations in VOC vapor concentrations within the vapor plume, it appears appropriate to conduct an additional vapor sampling event at existing vapor locations and to define the extent to the north. Therefore, please submit a work plan, using existing procedures, by the date identified below.

TECHNICAL REPORT REQUEST

Please upload technical reports to the ACDEH ftp site (Attention: Mark Detterman), and to the State Water Resources Control Board's Geotracker website, in accordance with the specified file naming convention below, according to the following schedule:

- **October 31, 2016** – Data Gap Work Plan
  File to be named: RO3134_WP_R_yyyy-mm-dd

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.

If you have any questions, please call me at (510) 567-6876 or send me an electronic mail message at mark.detterman@acgov.org.

Sincerely,

Digitally signed by Mark Detterman
DN: cn=Mark Detterman, o=ACEH, ou=ACEH, email=mark.detterman@acgov.org, c=US
Date: 2016.08.30 17:34:44 -07'00'

Mark E. Detterman, PG, CEG
Senior Hazardous Materials Specialist

Enclosures: Attachment 1 – Responsible Party (ies) Legal Requirements / Obligations
Electronic Report Upload (ftp) Instructions

cc: Debra Moser, Trinity Source Group, Inc, 500 Chestnut Street, Suite 225, Santa Cruz, CA 95060 (Sent via electronic mail to: djm@tsgcorp.net)

Dilan Roe, ACDEH, (Sent via electronic mail to: dilan.roe@acgov.org)
Mark Detterman, ACDEH, (Sent via electronic mail to: mark.detterman@acgov.org)
Electronic File, GeoTracker

Attachment 1

Responsible Party(ies) Legal Requirements / Obligations

REPORT REQUESTS

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.

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.waterboards.ca.gov/water_issues/programs/ust/electronic_submittal/).

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.

UNDERGROUND STORAGE TANK CLEANUP FUND

Please note that delays in investigation, later reports, or enforcement actions may result in your becoming ineligible to receive grant money from the state's Underground Storage Tank Cleanup Fund (Senate Bill 2004) to reimburse you for the cost of cleanup.

AGENCY OVERSIGHT

If it appears as though significant delays are occurring or reports are not submitted as requested, we will 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.

Alameda County Environmental Cleanup Oversight Programs (LOP and SLIC)	**REVISION DATE:** May 15, 2014 **ISSUE DATE:** July 5, 2005 **PREVIOUS REVISIONS:** October 31, 2005; December 16, 2005; March 27, 2009; July 8, 2010, July 25, 2010
SECTION: Miscellaneous Administrative Topics & Procedures	**SUBJECT:** Electronic Report Upload (ftp) Instructions

The Alameda County Environmental Cleanup Oversight Programs (LOP and SLIC) require submission of all reports in electronic form to the county's ftp site. Paper copies of reports will no longer be accepted. The electronic copy replaces the paper copy and will be used for all public information requests, regulatory review, and compliance/enforcement activities.

REQUIREMENTS

- **Please <u>do not</u> submit reports as attachments to electronic mail.**
- Entire report including cover letter must be submitted to the ftp site as **a single portable document format (PDF) with no password protection**.
- It is **preferable** that reports be converted to PDF format from their original format, (e.g., Microsoft Word) rather than scanned.
- **Signature pages and perjury statements must be included and have either original or electronic signature.**
- **Do not password protect the document**. Once indexed and inserted into the correct electronic case file, the document will be secured in compliance with the County's current security standards and a password. **Documents with password protection will not be accepted**.
- Each page in the PDF document should be rotated in the direction that will make it easiest to read on a computer monitor.
- Reports must be named and saved using the following naming convention:

  RO#_Report Name_Year-Month-Date (e.g., RO#5555_WorkPlan_2005-06-14)

Submission Instructions

1) Obtain User Name and Password
   a) Contact the Alameda County Environmental Health Department to obtain a User Name and Password to upload files to the ftp site.
      i) Send an e-mail to deh.loptoxic@acgov.org
   b) In the subject line of your request, be sure to include **"ftp PASSWORD REQUEST"** and in the body of your request, include the **Contact Information, Site Addresses**, and the **Case Numbers (RO# available in Geotracker) you will be posting for**.

2) Upload Files to the ftp Site
   a) Using Internet Explorer (IE4+), go to ftp://alcoftp1.acgov.org
      (i) Note: Netscape, Safari, and Firefox browsers will not open the FTP site as they are NOT being supported at this time.
   b) Click on Page located on the Command bar on upper right side of window, and then scroll down to Open FTP Site in Windows Explorer.
   c) Enter your User Name and Password. (Note: Both are Case Sensitive.)
   d) Open "My Computer" on your computer and navigate to the file(s) you wish to upload to the ftp site.
   e) With both "My Computer" and the ftp site open in separate windows, drag and drop the file(s) from "My Computer" to the ftp window.

3) Send E-mail Notifications to the Environmental Cleanup Oversight Programs
   a) Send email to deh.loptoxic@acgov.org notify us that you have placed a report on our ftp site.
   b) Copy your Caseworker on the e-mail. Your Caseworker's e-mail address is the entire first name then a period and entire last name @acgov.org. (e.g., firstname.lastname@acgov.org)
   c) The subject line of the e-mail must start with the RO# followed by **Report Upload**. (e.g., Subject: RO1234 Report Upload) If site is a new case without an RO#, use the street address instead.
   d) If your document meets the above requirements and you follow the submission instructions, you will receive a notification by email indicating that your document was successfully uploaded to the ftp site.

ATTACHMENT B

Sub-Slab Vapor Probe Installation and Sampling Field Procedures

ATTACHMENT B
SUB-SLAB VAPOR PROBE INSTALLATION AND SAMPLING FIELD PROCEDURES

Sub-Slab Vapor Probe Installation

Trinity utilizes the attached Cox-Colvin & Associates, Inc., Vapor Pin™ Standard Operating Procedures for installation of sub-slab vapor probes. These procedures are presented in Attachment B-1.

Probe Sampling and Analysis – Fixed Laboratory

Sub-slab probes may be sampled for analysis by a fixed laboratory. The samples are collected into Summa canisters, following the procedures described below.

Sub-Slab Vapor Sample Collection

Sampling Set-up

Mobilization for sub-slab vapor sampling will not occur if measurable precipitation or site irrigation near the sampling location has occurred in the previous five days.

Prior to sampling, the sampling technician puts on a new pair of clean gloves, and the sub-slab probe is uncapped and quickly connected to a Swagelok manifold. A tee fitting is connected to two one-liter Summa canisters with a pressure gauge installed on each of these fittings.

The two Summa canisters are connected by approximately 1 to 2 feet of tubing and a third tee fitting. The vacuum reading on each canister is confirmed and recorded before proceeding. The vacuum reading is expected to be 30 inches Mercury (“Hg). On the downhole side of the third tee fitting, a 100 to 200-milliliter per minute (ml/min) flow regulator followed by a laboratory-supplied particulate filter is installed. On the downhole side of the particulate filter, a vapor-tight valve is installed to connect the sampling equipment with the probe. A schematic drawing of the sub-slab vapor probe sampling set-up is shown on Figure B-1.

Leak Testing

A vacuum test is conducted on the connections between the Summa canisters and the valve on the downhole side of the regulator for 10 minutes by opening and closing the purge canister valve to place a test vacuum on the assembly. If vacuum is not maintained during the vacuum test, corrective action is taken to identify and remove the source of the leak.

Additional leak testing is performed during the sub-slab vapor sampling by placing a shroud over the sampling train and sub-slab probe and introducing helium into the shroud. Helium concentration in the shroud atmosphere is measured throughout sample collection using an appropriate helium field meter. Helium is analyzed in the sub-slab vapor samples by the laboratory to determine if the sample stream was compromised. These procedures are presented in Attachment B-2.

Purging

If the vacuum test is successful, purging is conducted. The purge canister valve and the valve on the downhole side of the particulate filter are opened and the time is recorded. The purge canister valve is closed after three volumes of air have been purged from the sample apparatus and borehole. The purge volume is calculated based on the internal volume of the tubing and probe apparatus. The amount of air purged is measured based on the time that the flow-control orifice is opened, with a flow rate of 100 to 200-ml/min, and based on a discernible vacuum drop on the purge canister pressure gauge. The time at which purging is terminated is recorded. Because of the small volume of the sub-slab probe, the purge time is minimal.

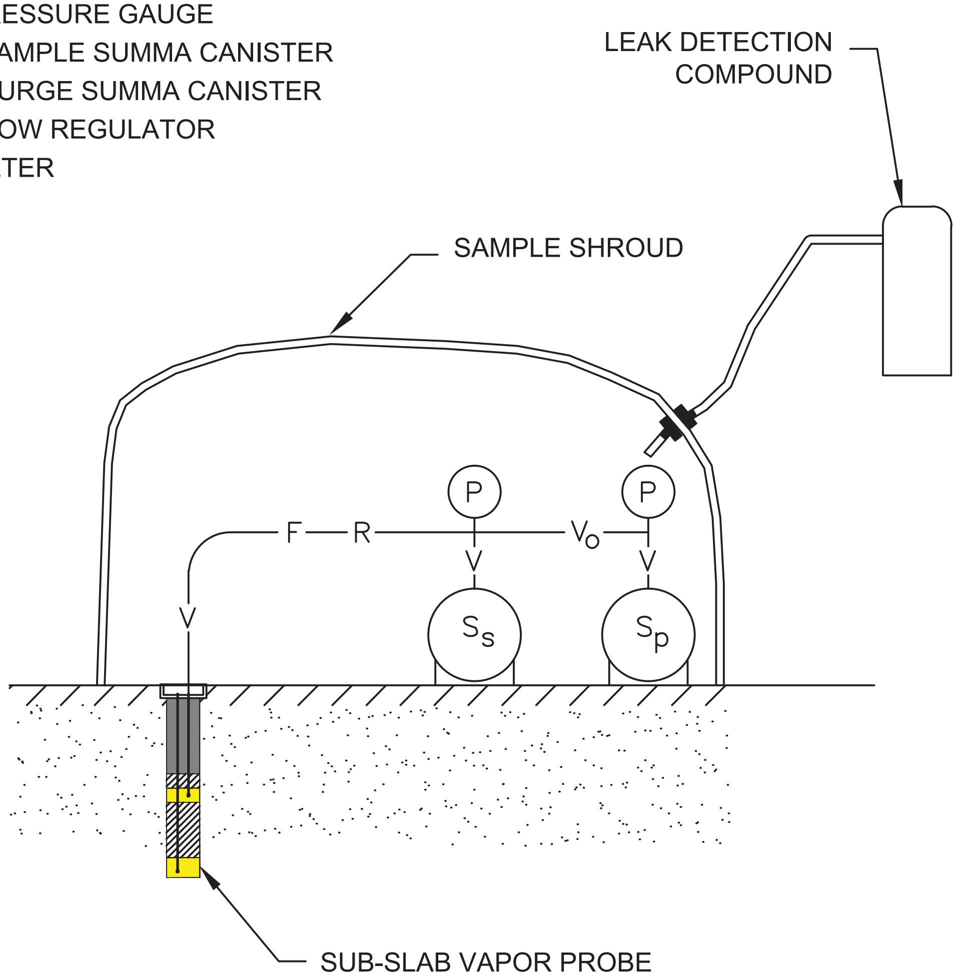
Sampling

Following purging, the sample Summa canister valve is opened to begin sample collection. The time at which sample collection begins is recorded.

The flow-control orifice is maintained at 100 to 200-ml/min, and is kept open until the sample Summa canister pressure gauge indicates approximately -5 ”Hg. At that point, the sample canister valve is closed and the time recorded. The tee fitting on the sample canister is replaced with a laboratory-supplied brass plug.

The sample canister is labeled and chain-of-custody maintained by recording: sample name, sample date, sample time, final vacuum, canister and flow controller serial numbers, initials of sample collector, and the compounds to be analyzed by the certified laboratory. The sample canisters are stored in a container that blocks sunlight to the opaque canister and does not subject the air-tight canister to changes in pressure and temperature. The sample canisters are delivered to the analytical laboratory via ground transportation under chain-of-custody documentation.

V = VALVE
Vo = OPTIONAL VALVE
P = PRESSURE GAUGE
Ss = SAMPLE SUMMA CANISTER
Sp = PURGE SUMMA CANISTER
R = FLOW REGULATOR
F = FILTER



* USE SWAGELOK FITTINGS ON ALL CONNECTIONS

REF. 169_001\169.003.001 figC2.dwg

PREPARED BY TRINITY source group, inc. Environmental Consultants 119 Encinal Street Santa Cruz, California 95060 v: 831.426.5600 f: 831.426.5602	**SUB-SLAB VAPOR PROBE SAMPLING EQUIPMENT SCHEMATIC** ABF Freight System Facility 4575 Tidewater Avenue Oakland, California	PROJECT: 154.010.001 FIGURE: B-1

ATTACHMENT B-1

Cox – Colvin Standard Operating Procedure
Installation and Extraction of the Vapor Pin™

Standard Operating Procedure
Installation and Extraction of the Vapor Pin™

May 20, 2011

Scope:

This standard operating procedure describes the installation and extraction of the Vapor Pin™[1] for use in sub-slab soil-gas sampling.

Purpose:

The purpose of this procedure is to assure good quality control in field operations and uniformity between field personnel in the use of the Vapor Pin™ for the collection of sub-slab soil-gas samples.

Equipment Needed:

- Assembled Vapor Pin™ [Vapor Pin™ and silicone sleeve (Figure 1)];
- Hammer drill;
- 5/8-inch diameter hammer bit (Hilti™ TE-YX 5/8" x 22" #00206514 or equivalent);
- 1½-inch diameter hammer bit (Hilti™ TE-YX 1½" x 23" #00293032 or equivalent) for flush mount applications;
- ¾-inch diameter bottle brush;
- Wet/dry vacuum with HEPA filter (optional);
- Vapor Pin™ installation/extraction tool;
- Dead blow hammer;
- Vapor Pin™ flush mount cover, as necessary;
- Vapor Pin™ protective cap; and
- VOC-free hole patching material (hydraulic cement) and putty knife or trowel.

[1]Cox-Colvin & Associates, Inc., designed and developed the Vapor Pin™; a patent is pending.

Figure 1. Assembled Vapor Pin™.

Installation Procedure:

1) Check for buried obstacles (pipes, electrical lines, etc.) prior to proceeding.

2) Set up wet/dry vacuum to collect drill cuttings.

3) If a flush mount installation is required, drill a 1½-inch diameter hole at least 1¾-inches into the slab.

4) Drill a 5/8-inch diameter hole through the slab and approximately 1-inch into the underlying soil to form a void.

5) Remove the drill bit, brush the hole with the bottle brush, and remove the loose cuttings with the vacuum.

6) Place the lower end of Vapor Pin™ assembly into the drilled hole. Place the small hole located in the handle of the extraction/installation tool over the Vapor Pin™ to protect the barb fitting and cap, and tap the Vapor Pin™ into place using a

dead blow hammer (Figure 2). Make sure the extraction/installation tool is aligned parallel to the Vapor Pin™ to avoid damaging the barb fitting.

Figure 2. Installing the Vapor Pin™.

For flush mount installations, unscrew the threaded coupling from the installation/extraction handle and use the hole in the end of the tool to assist with the installation (Figure 3).

Figure 3. Flush-mount installation.

During installation, the silicone sleeve will form a slight bulge between the slab and the Vapor Pin™ shoulder. Place the protective cap on Vapor Pin™ to prevent vapor loss prior to sampling (Figure 4).

Figure 4. Installed Vapor Pin™.

7) For flush mount installations, cover the Vapor Pin™ with a flush mount cover.

8) Allow 20 minutes or more (consult applicable guidance for your situation) for the sub-slab soil-gas conditions to equilibrate prior to sampling.

9) Remove protective cap and connect sample tubing to the barb fitting of the Vapor Pin™ (Figure 5).

Figure 5. Vapor Pin™ sample connection.

10) Conduct leak tests [(e.g., real-time monitoring of oxygen levels on extracted sub-slab soil gas, or placement of a water

dam around the Vapor Pin™) Figure 6]. Consult your local guidance for possible tests.

Figure 6. Water dam used for leak detection.

11) Collect sub-slab soil gas sample. When finished sampling, replace the protective cap and flush mount cover until the next sampling event. If the sampling is complete, extract the Vapor Pin™.

Extraction Procedure:

1) Remove the protective cap, and thread the installation/extraction tool onto the barrel of the Vapor Pin™ (Figure 7). Continue

Figure 7. Removing the Vapor Pin™.

turning the tool to assist in extraction, then pull the Vapor Pin™ from the hole (Figure 8).

Figure 8. Extracted Vapor Pin™.

2) Fill the void with hydraulic cement and smooth with the trowel or putty knife.

3) Prior to reuse, remove the silicone sleeve and discard. Decontaminate the Vapor Pin™ in a hot water and Alconox® wash, then heat in an oven to a temperature of 130° C.

The Vapor Pin™ to designed be used repeatedly; however, replacement parts and supplies will be required periodically. These parts are available on-line at www.CoxColvin.com.

Replacement Parts:

Vapor Pin™ Kit Case - VPC001
Vapor Pins™ - VPIN0522
Silicone Sleeves - VPTS077
Installation/Extraction Tool - VPIE023
Protective Caps - VPPC010
Flush Mount Covers - VPFM050
Water Dam - VPWD004
Brush - VPB026

Soil Gas Sampling Procedures

Probe Construction and Insertion

TEG's hydraulically or manually driven soil vapor probes are constructed of either 1.0, 1.25, or 1.5 inch outside diameter steel probe rods and equipped with a hardened drop-off steel tip. The probes are nominally 4 feet long and threaded together to reach multiple depths. The probe rod is driven into the subsurface with TEG's *Strataprobe*™ direct-push system, or by an electric rotary hammer. Once inserted to the desired depth, an inert 1/8 inch nylaflow tube is threaded down the center of the probe rod and connected to a sampling port just above the drop-off tip. This internal, disposable sample tubing design eliminates any contact between the probe rod and the soil vapor sample. The probe is retracted slightly to expose the vapor sampling port. The probe rod is sealed at the surface with granular and hydrated bentonite and allowed to equilibrate for a minimum of 2 hours before sampling. After a sample is obtained the tubing is removed and the probe rod advanced to the next sampling depth or removed. This design prevents clogging of the sampling port and cross-contamination from soils during insertion.

Alternately, a temporary vapor implant can be installed in an open hole created by a direct push probe rod as above, or in some cases by hand augering. For same day sampling, an inert, plastic sparge implant tip is installed in the middle of a one foot sand pack with 1/8 or 1/4 inch diameter nylaflow tubing running from the tip to the surface. Teflon tubing can also be used if needed. Dry bentonite is placed in the hole above the sand pack, followed by hydrated bentonite to the surface, to complete the vapor point installation and seal the sand pack zone from other zones and ambient air. If the implants are to be installed for a longer period of time for later sampling or to allow for resampling, a stainless steel sparge implant tip is recommended instead of plastic. The vapor implant is allowed to equilibrate, before sampling, for a minimum of 2 hours for sampling points installed by direct push, or 48 hours for points installed by hand augering.

TEG Installation methods are superceded by Trinity's installation method for sub-slab vapor probes

Soil Gas Sampling

A syringe is used to place a vacuum on the sample train to test the integrety of all the conections from the surface to the sampling tip. Soil vapor is withdrawn from the end of the inert nylaflow tubing sample train that runs from the sampling tip to the surface using a 20 to 100 cubic centimeter (cc) syringe or gas tight canister (Summa) connected via an on-off valve. The probe tip and sampling tubing is nominally purged of three internal dead volumes, or based upon a pre-determined purge volume as established by a purge volume test as described below. A sample of in-situ soil vapor is then withdrawn and immediately transferred to the mobile lab for analysis within minutes of collection. The use of small calibrated syringes allows for careful monitoring of purge and sample volumes. This procedure ensures adequate sample flow is obtained without excessive pumping of air or introduction of surface air into the sample.

For off-site analysis, samples are collected in stainless steel canisters or in tedlar bags when allowed. Samples collected in tedlar bags for VOC analysis are either analyzed within six hours or transferred to a canister.

Purge Volume Test

If required, a site specific purge volume test is conducted at the beginning of the soil gas survey to purge ambient air from the sampling system. Three different volumes are sampled (nominally 1, 3, 10 purge volumes) and analyzed immediately to determine the volume amount with the highest concentration. Therefore, the optimum purge volume is achieved and used during the entire site investigation.

Use of Tracer Compound to Ensure Probe Seal Integrity

A tracer compound, typically 1,1 difluoroethane (1,1 DFA), iso-propanol (IPA), or hexane is used to test for leaks around the probe rod at the ground surface and in the sampling system. The tracer is placed around the base of the probe rod and at the top of the probe rod during sample collection. If the tracer is detected per CA-EPA (DTSC), LA-RWQCB, and SF-RWQCB *Advisory – Active Soil Gas Investigations* (April 2012) specifications, the sampling train is inspected for vacuum integrity, and if necessary the sample point is reinstalled, and another sample is collected.

Sample Flow Rate

Sample collection is timed so that the flow rate does not exceed 200 milliliters per minute. This is accomplished by withdrawing the plunger on the syringe at a constant rate of 3 milliliters per second. The collector notes the collection time, and also records any resistance to sample flow that is felt on the syringe during collection.

Summa Canister

Summa canisters are connected to the end of the nylaflow tubing to the same three way valve used with the syringe. A choke is placed on the canister to ensure that the flow rate is no more than 200 milliliters per minute into the summa canister.

Field Records

The field technician maintains a logsheet summarizing:

-- Sample identification

-- Probe location

-- Date and time of sample collection

-- Sampling depth

-- Identity of samplers

-- Sampling methods and devices

-- Soil gas purge volumes

-- Volume of soil gas extracted

-- Observation of soil or subsurface characteristics (any condition that affects sample integrity)

-- Chain of custody protocols, if needed, and records used to track samples from sampling point to analysis.

Analytical Methodology

The following typical analytical protocols fulfills the specific EPA analytical methods and the most recent CA-EPA (DTSC), LA-RWQCB, and SF-RWQCB advisory and soil gas analytical guidelines (the advisory documents).

Operating Conditions and Instrumentation

Volatile Organic Compounds (VOCs) by EPA 8260

Instrument: Agilent 6850/5973N or 6850/5975N GCMS
Column: 20 meter DB-624, 0.18mm x 1.0u. capillary.
Carrier flow: Helium at 1.0 ml/min.
Detectors: Quadrupole MS, full scan mode or SIM
Concentrator: Tekmar 3000/Archon or Tekmar 3100/Archon

Fixed and Biogenic Gases (O2, CO2, & Methane)

Instrument: SRI 8610 or Carle AGC 311 Gas Chromatograph
Column: 6 foot CTR
Carrier flow: Helium at 15 ml/min.
Detectors: Thermoconductivity (TCD) for O_2 & CO_2.
Detectors: Flame ionization detector (FID) or TCD for methane.

Hydrogen Sulfide

Instrument: Jerome 631x
Detectors: Gold-film

Standard Preparation

Primary (stock) standards: Made from certified neat components or from traceable standards purchased from certified suppliers.

Secondary (working) Standards: Made by diluting primary standard. Typical concentrations are 1ug/ml, 10 ug/ml, and 50 ug/ml.

Laboratory Check Samples are prepared at the midpoint concentration from a standard purchased from a source different than the primary standards.

Lot numbers and preparations of all standards are recorded on a log sheet and kept in the mobile laboratory.

Initial Multi-Point Calibration Curve

An initial calibration curve of multiple points as per the individual method requirements, is performed either:

-- At the start of the project.

-- When the GC column or operating conditions have changed.

-- When the daily mid-point calibration check cannot meet the requirements as specified below.

Calibration curves for each target component are prepared by analyzing low, mid, and high calibration standards covering the expected concentration range. A linearity check of the calibration curve for each compound is performed by computing a correlation coefficient or an average response factor (RF). If a correlation coefficient (r) of 0.99, or a percent relative standard deviation (%RSD) of $\pm$ 30% of the RF, is obtained, an average response factor is used over the entire calibration range. If the linearity criteria are not obtained, the mean of the RSD values can be calculated, or quantitation for that analyte is performed using a calibration curve as per the method (e.g. EPA 8260B). Details of various calibration procedure details are outlined in the method.

After each initial multi-point calibration, the validity of the curve is further verified with a laboratory control standard (LCS) typically prepared at the mid-point of the calibration range. The LCS includes target compounds, and the response factor (RF) must fall within $\pm$ 20% of the RF from the initial calibration curve as per the advisory documents, adjusted to the published accuracy of the LCS standard.

Continuing Calibration (Daily Mid-point Calibration Check)

Calibration Check Compounds (CCCs) are prepared from a traceable source and analyzed at the beginning of each day. Acceptable CCC agreement is set at $\pm$ 20% to the average response factor from the calibration curve. When calibration checks fall outside this acceptable range for analytes detected on the site, corrective action, consisting of verification of the standard and/or a new calibration curve for the analytes out of specifications is performed by the on-site chemist.

The continuing calibration includes all compounds expected or detected at the site in addition to any specific compounds designated in the project workplan.

Reporting Limits

Typical reporting limits are outlined below:

Compound	Detector	Report Limit
VOCs by 8260B	Mass Spec	1.0 to 0.01 ug/l-vapor
Methane	FID	1000 ppmv
Fixed Gases	TCD	1% by vol
H2S	Gold Film	0.10 ppmv

Injection of Soil Gas Samples

Vapor samples from the probe sampling syringe are injected with surrogates into a purge & trap instrument for VOC analysis. Separate aliquots are directly injected into gas chromatographs for fixed gases and methane analysis

Laboratory Data Logs

The field chemist maintains injection and sample analysis records including date and time of analysis, sampler's name, chemist's name, sample ID number, concentrations of compounds detected, calibration data, and any unusual conditions.

Quality Control Procedures

Compliance With Standards

Sampling and analytical procedures complied with the American Society for Testing and Materials' *Standard Guide for Soil Gas Monitoring in the Vadose Zone* (ASTM D5314-93), and the CA-EPA (DTSC), LA-RWQCB, and SF-RWQCB *Advisory – Active Soil Gas Investigations* (April 2012).

Sampling Quality Control

Method Blanks

Prior to sampling each day, all components of the sampling system are checked for contamination by drawing ambient air from above ground through the sampling equipment, and injecting a sample into a gas chromatograph. The analysis results are recorded in the data tables as blanks.

Sample Quality Control

Each sample is given a unique identification number specifying location and depth. Purge and sample volumes are monitored closely using small calibrated syringes to assure a proper flow of soil gas. This ensures a representative sample is obtained from the sample zone without excessive pumping, which could result in sampling of surface air.

Decontamination Procedures

To minimize the potential for cross-contamination between sites, all external soil vapor probe parts are wiped or washed cleaned of excess dirt and moisture with solvents or potable water as appropriate. The probe's internal nylaflow tubing is purged with clean air between sampling locations or replaced as necessary. Sampling syringes are flushed with clean air after each use, baked in an oven, or replaced.

Corrective Action

Corrective action is taken when unexpected contaminant levels are detected. First duplicate samples are taken to verify the initial detection of contamination. If contamination is suspected, then the sample probes are disassembled, wiped cleaned of excess dirt and moisture, rinsed with potable water, washed with Alconox and water, and rinsed again with potable water. The sample tubing in the probe is replaced. Contaminated sampling syringes are baked in an oven or discarded.

Analytical Quality Control

Method Blanks

Method blanks are performed at the start of each day by drawing clean air through the sampling equipment and analyzing. These blanks verify all components of the sampling and analytical system are free of contamination. Additional blanks are performed more often as appropriate depending upon the measured concentrations, generally at a minimum 1 every 20 samples. Blank analyses are typically recorded in the data tables. If a blank shows a measurable amount of any target compound, the on-site chemist will investigate and determine the source, and resolve the contamination problem prior to analyzing any samples.

Duplicate Samples

Duplicate (repetitive) analysis of a sample is performed when inconsistent data are observed, but typically at least one every 20 samples. Because soil vapor duplicates can vary widely, nominal relative percent difference (RPD) acceptance criteria is ± a factor of 2.

Continuing Calibration (Daily Mid-point Calibration Check)

As described earlier, continuing calibration standards prepared from a traceable source are analyzed at the beginning of each day.

The continuing calibration includes all compounds expected or detected at the site and any specific compounds designated in the project workplan.

Laboratory Check Standard

Laboratory check standards, prepared at the RL concentration, are analyzed at the end of each day if all samples are below detection. Acceptance criteria is a minimum recovery of 50% from the true value. If the laboratory check standards fall outside this acceptance range for analytes analyzed on site, corrective action, consisting of verification of the standard and/or a new calibration curve for the analytes out of specifications, is performed.

ATTACHMENT B-2

Curtis & Tompkins Field Guide for Use of C&T Helium Shrouds

Field Guide for

USE OF C&T HELIUM SHROUDS

November 2013

www.curtisandtompkins.com *ph: (510) 486-0900* *2323 Fifth St, Berkeley, CA 94710*

Field Guide for Use of C&T Helium Shrouds

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Field Guide for Use of C&T Helium Shrouds

1.0 INTRODUCTION

Sampling soil gas wells using Helium leak tracer is not inherently difficult using C&T's equipment, it is relatively unforgiving of mistakes. The equipment has been field tested and through these tests we've learned that good results necessitate reviewing this document and following the procedures specified here. We strongly encourage practicing set-up, Helium charging the shroud, using the detectors, and breakdown. We've seen a very strong correlation between a thorough equipment orientation and successful sampling events. User errors related to a lack of orientation and preparation are the primary root cause of sampling errors and equipment failures.

The equipment supplied by C&T has been critically cleaned, assembled, and leak tested using both pressurized Helium and vacuum decay methods. The preparation of all sampling equipment and media has been thoroughly documented.

If you suspect the sampling equipment is damaged or not functional, before using it please inform your project manager by calling the lab at 510-486-0900. Used and returned damaged equipment will be assessed cost for repair and replacement. Please do not disassemble and reassemble sampling trains and shrouds. They have been critically cleaned, assembled and leak checked for your use without further need for alteration. By breaking connections in sampling trains, users invalidate the lab's cleaning and prep effort.

2.0 USE OF & CARE FOR THE C&T HELIUM DETECTORS

When used properly, C&T's diffusion cell He sensors provide real time measurement of Helium concentration in air from 1% to 99% Helium to accuracies of 0.1%. Prior to delivery, C&T He sensors are calibrated and performance verified. If, upon initial check, you discover the He gauge is apparently not working properly, call your C&T project manager immediately; repair and replacement costs will be assessed for all sensors returned damaged to the lab.

Figure 1: Diffusion Cell (left) and flow through cell (right) Helium Detectors

Battery Charges last 4 hours: Helium Detectors using rechargeable NiCd batteries are fully charged before leaving the lab and hold a charge for 4 hours of use. Turn detectors on for use and off immediately after use and you'll make it through a day's sampling event without losing charge. The lab does not supply rechargers to users because the Diffusion and Flow through types use employ different voltages, using the wrong charger damages the detectors.

3 position switch: **On** is up, **Off** is neutral and down.

Required use technique for accurate Helium tracer measurements: These He sensors are sufficiently durable for portable field use; however they are precision measurement devices unforgiving of mistreatment or abuse, accordingly;

- Keep the He sensor clean at all times, particularly around the white diffusion membrane cell opening. Dirt on, or in the diffusion cell well will compromise calibration and result in extra fees for cleaning and recalibration.

- The C&T He sensors are shock sensitive. Dropping the gauges onto a hard surface from a height of 2' or more can compromise calibration and may irreversibly damage the sensor and cause replacement or maintenance cost assessments. Please store and transport the gauges in the foam lined box provided.

- Helium detectors are moisture sensitive, don't get them wet

Accepting C&T He sensors binds your firm to the following conditions of use.

Replacement costs are $900 + applicable shipping costs and sales tax. Minimum diagnostic, recalibration, and maintenance charges for damaged sensors are $120.

3.0 SETTING UP

Equipment: The following equipment should be present in the supply kit provided from the lab:

1) Integral shroud box and sampling train with 3 port valve
2) Helium supply components a) Helium bottle(s) (one bottle supplies enough for 4 wells), b) Braided steel Helium transfer tube with male QT connectors and; 3) Helium supply regulator with female QT connector
3) Helium Detector: Diffusion cell type (4 hours use on one charge)
4) Helium Detector: Flow through type (4 hours use on one charge)
5) Male QT ¼" OD Teflon tubing connector for connecting in port on flow through Helium detector to Purge port on Shroud
6) QT Vacuum gauge
7) 1.4 liter Sample canisters, one for each sample to be taken, some users request an extra to cover any aborted sampling events, well relocations etc…
8) Graphite or Ceramic ferules for joining ¼" OD Teflon tubing to well, one provided in each shroud/train inside the nut in the open port of the 3 port valve used to connect the soil gas well to the train.

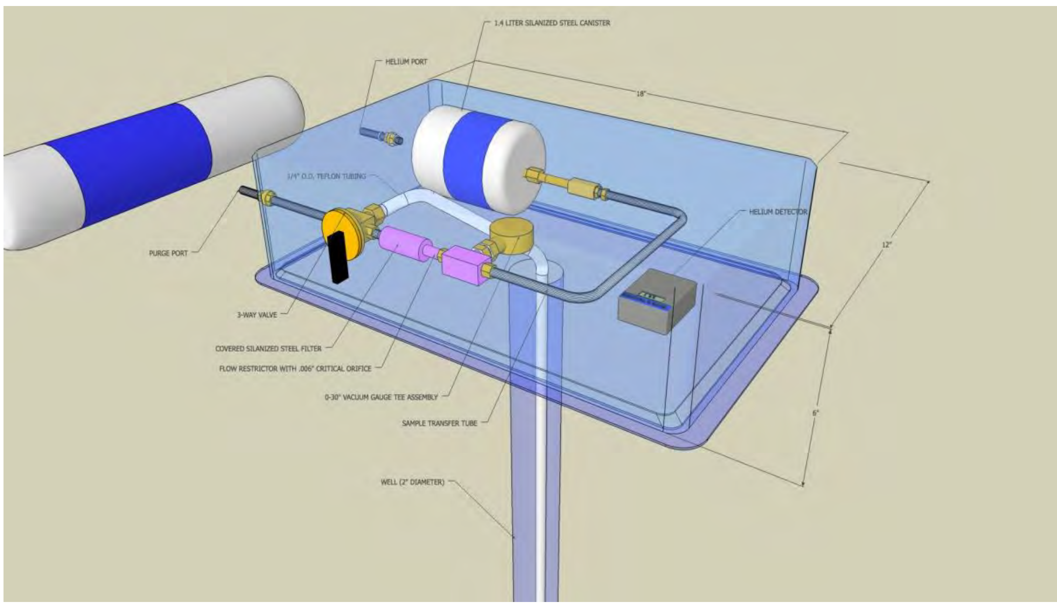
Equipment not Supplied by C&T: You will need the following items to complete your work; these items are not supplied by C&T unless specially requested:

1) Well purge suction source, alternatives available from the lab are: a) 50 ml disposable syringe with tubing adapters, b) evacuated 6 liter summa canister with 180 ml/min flow restrictor and filter, c) battery powered vacuum pump, d) 110V VAC powered vacuum pump
2) ½” x 9/16” open end combination wrench and one small crescent wrench. These are the tools needed to make compression fitting connections. C&T does not rent wrenches.
3) Extra Graphite or ceramic ferules as needed to insure you make a good well to train connection
4) ¼ OD Teflon tubing…Typically the well drillers have a lot of this stuff, if you need it
5) Knife (for cutting Teflon tubing)

Position the shroud lid over the well. Consistent Helium concentrations arise when the shrouds are used with the wellhead box lids provided. Some user protocols specify no box lid, in these cases, piling dirt around the edges of the box works to keep Helium inside the shroud. On windy days, a plastic windscreen employed either as a cover over the shroud or as an “air dam” has provided good results. We’ve experimented with using yoga mat material as “gaskets” for subslab sampling with mixed results.

If you’re using the lid, and we recommend you do, position the lid over the wellhead with the tubing arising through the hole in the lid. There is an audible snap when the lid is optimally attached.

Figure 2: Helium Tracer Shroud Components



Once the shroud lid is positioned over the well, check that the 3 way valve is in the ***off*** position and the train pressure gauge showing a vacuum. This is your indication that the train is leak free since leaving the lab and all you need do is make a tight connection from the well to the open port on the 3 way valve. If the 3 way valve is not in the ***off*** position as a result of some error in shipment, there may be no vacuum on the gauge. At this point, your sampling protocols will determine whether the train can be used or not.

All trains leave the lab holding vacuum with decay rates less than 5” in 12 hours. Many shroud trains have inconsequentially slow leaks; trains are stored more than 3 days since being shipped from the lab may have no vacuum showing on the gauge. In these cases, you can check the vacuum decay rate by connecting an extra canister to the train and observing the vacuum decay rate.

4.0 CONNECTING THE WELL TO THE TRAIN 3-PORT VALVE

To connect the soil gas well to the sampling train, you will be joining ¼” Teflon tubing to the 3 port valve. Either a ceramic or graphite ferule has been provided inside the nut on the open port of the 3 port valve for you to make this connection. The most important component in a compression fitting is the ferrule, which is prone to damage. Care should be used when installing it although if ceramic or graphite ferules become defective, it is easy to install a replacement.

A “straight” even tubing end in the ¼” OD Teflon tubing from the well to the 3 port valve is important to making a “tight” connection. Use a knife rather than scissors to cut the tubing at a 90 degree angle to the tube axis. Remove any “burrs” or irregularities in the tubing end before attempting the connection. Slip the nut over the tubing, then the ferule. The ferule should “point” toward the 3-port valve. Usually, it is not possible to install ferules “backwards”.

Keeping the 3 way valve in the ***off*** position, attach the well tubing to the open 3 way valve port. Avoid excessive force when tightening the nut. If the nut is over-tightened, the ceramic or graphite ferrule frequently deforms improperly causing the joint to fail. Over-tightening is the most common cause of leaks in compression fittings. A good way to make these connections is to tighten the nut first by hand until it is too difficult to continue and then tightened the nut a full 360 degree turn with a 9/16” open end wrench; no more than a 1 and 1/4 turn should be needed to create a leak tight connection.

5.0 ATTACHING THE SAMPLE CANISTER TO THE TRAIN

Check the vacuum in the sample canister using the QT Vacuum gauge, it should read -30” of Hg (full vacuum) if it reads less, use another sample canister. While keeping the 3 way valve in the ***off*** position, attach the canister to the female QT fitting at the rear of the sampling train as follows:

Pull the external sleeve of the female QT connector back to its stop, insert the male valve stem and allow the sleeve to return to its spring loaded position. When the QT connection is made the canister (male) valve is open to the train. Try to pull the canister off the train without retracting the female QT sleeve. A correctly made QT connection cannot be broken without retracting the sleeve on the female valve stem.

A word about Micro QT Fittings: Micro Quick connect valves (QT) offer superior performance and ease of use compared to alternative tubing connections and valves. QT fittings provide highly reliable leak free connections without tools especially for fittings that are made and broken frequently.

Fine sand and/or grit (such as dry bentonite) damages male and female QT valves and connections. Keep both male and female QT valve components scrupulously clean. Please use the orange or red plastic caps provided for the male QT fittings, they protect the valve stem while shipping and protect your sample during return shipment to the lab.

When removing or replacing orange plastic protective caps on the male QT fittings, push them straight on and pull then straight off the valve stem. Twisting the cap counterclockwise while removing or replacing on the valve stem can dissemble the valve stem causing vacuum and/or sample loss.

6.0 POSITIONING THE SHROUD OVER THE WELL

Position the diffusion Helium gauge out of the way on a portion of the lid that allows you a good view of the display with the shroud in place. Then invert the shroud assembly over the lid and snap lid into position.

With the shroud assembled in place, you should be able to view the vacuum gauge well enough to verify that vacuum is holding and you can see the Helium detector display. Our apologies for the opaque portions of the boxes, if you know of hard plastic boxes, with clear panels we'd love to learn about them.

7.0 CHARGING THE SHROUD WITH HELIUM

C&T provides Aluminum lecture bottles filled with 300 psi Helium; each bottle of Helium contains 48 liters at atmospheric pressure, enough to easily supply 20% Helium atmospheres to 6 single Shrouds and 3 double shrouds. The amount of Helium used depends predominantly on wind and time required to sample the well, with experience, you'll use less Helium. Your protocol will specify the Helium concentration in the shroud. The following guidance is based on sampling under a 20-25% Helium in air atmosphere. Regardless of your target helium concentration, your objective should be to maintain a steady concentration of Helium during the sampling event at levels above 10% Helium in air.

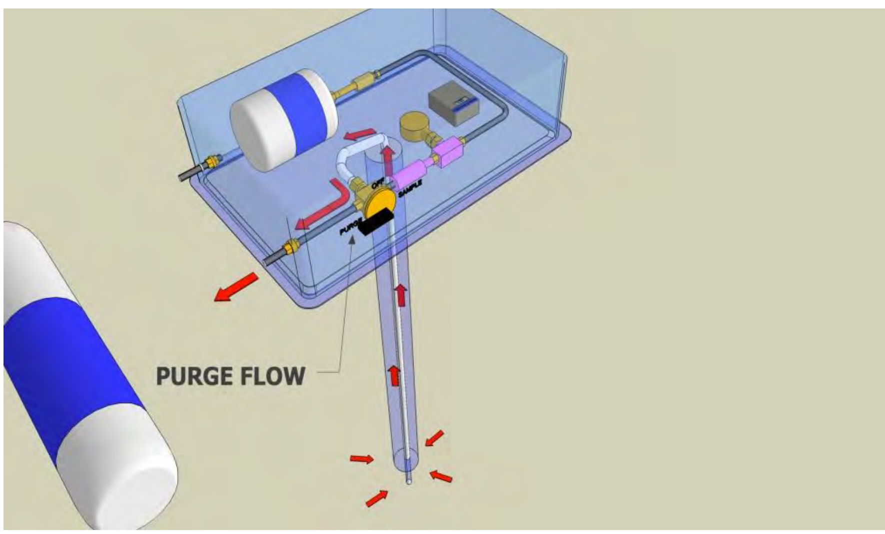
Locate and assemble the Lecture bottle, Helium transfer line, and the gas supply regulator. Tighten the brass nut attaching the regulator to the bottle one half turn past finger tight with a crescent or 9/16" open end wrench. The regulator is preset to deliver Helium at ideal pressure; ***you need not adjust the regulator***. Add Helium to the shroud by opening and closing the valve at the top of the bottle. Attach the Helium transfer line using the QT fittings at the regulator and at the Helium port on the shroud.

To provide Helium flow, slowly open the lecture bottle valve by twisting ***counterclockwise*** about ¼ turn.

Deliver 10 lbs of Helium at a time to the ***single*** shroud and 20 lbs to the ***double***. The diffusion cell Helium detector will respond in about 30 seconds to the new concentration. Unstable Helium detector readings reflect turbulent gas mixing inside the shroud. Plug holes between the shroud and the surface, use plastic sheeting to create an "air dam" or take other measures to air movement around the shroud and thus turbulence inside the shroud.

Monitor the Helium concentration displayed on the gauge in the shroud for about a minute in single shrouds, 90 seconds or longer in doubles. Under ideal conditions, 40 psi from the bottle will charge a single shroud to 25% helium concentration; double shrouds will require 80 psi. 25% Helium concentrations are maintained in the lab (zero wind) for 6-10 minutes. You may add more helium while purging and sampling. We suggest 10 psi increments for singles and 20 psi for doubles by opening the lecture bottle valve ¼ turn. We suggest users record/document the Helium concentration in the shroud at a minimum of 2 minute intervals during sampling.

Figure 3: Purge Flow Diagram



8.0 PURGE TESTING THE WELL UNDER HELIUM

This test will help you establish the integrity of the well and the train to well connection. If no Helium is detected in the purge gas flow using this technique, one can assume the well is tight to breakthrough, and the train connections are all tight, and thus there will be no Helium detected in the sample that goes to the lab.

While getting the Helium concentration established, assemble the well purge train. Place the inline Helium detector between the shroud and whatever device (evacuated canister, syringe, or vacuum pump) that you're using to provide purge suction.

With the Helium atmosphere established in the shroud at 20% or more, and the purge system ready to operate, begin purging by moving the 3 way valve selector position to ***Purge*** and then establishing suction on the purge line.

Observe the inline Helium detector display while applying suction on the purge line. If you've purged enough vapors from the well to represent the entire volume of the path from the surface (under Helium atmosphere) to the distal end of the sampling tube and back up the tube and through the detector without detecting any Helium, your well shows signs of integrity and you may have a good leak free sample.

CA-DTSC guidance provides the opinion that a 5% ambient air dilution is inconsequential to sample integrity. When sampling under a 20% Helium in air atmosphere, 1% Helium detected in the purge gas represents a 5% ambient air sample dilution.

9.0 SAMPLING THE WELL UNDER HELIUM

After you've completed purging the well, verify the reading on the Vacuum gauge of the train is -30 inches and that you have a steady state concentration of Helium between 20-25%, and then begin sampling by moving the 3 way selector valve to the ***Sample*** position.

Monitor the Helium concentration in the shroud by recording the reading on the diffusion cell detector inside the shroud every other minute or so. Add Helium from the bottle as needed to maintain a steady state concentration of Helium under the shroud.

Figure 4: Sampling Flow Diagram

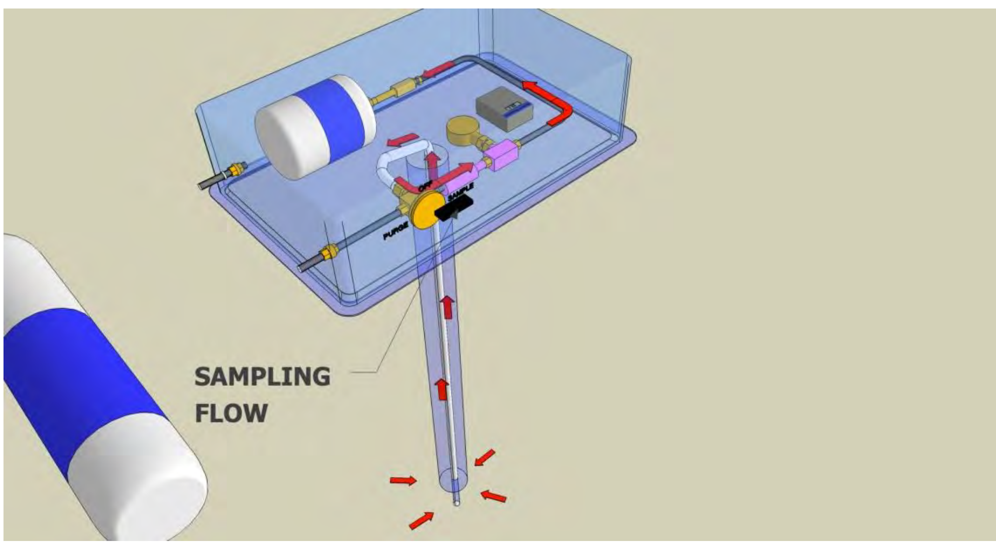


Figure 5: Dual Depth Well Sampling Shroud