## Roe, Dilan, Env. Health

**From:** Nowell, Keith, Env. Health
**Sent:** Monday, September 21, 2015 12:04 PM
**To:** PDKing0000@aol.com
**Cc:** Gary_Bates@efiglobal.com; patrick@ellwoodcommercial.com; ronpatelvidge@gmail.com; wkochenderfer@cs.com; dave@bblandlaw.com; Roe, Dilan, Env. Health
**Subject:** RE: RO 2981 Red Hanger Cleaners at 6239 College Ave - Draft tenant notification
**Attachments:** RO2981_ Fact Sheet_ Indoor Air Mitigation-2015-08-21_DR.docx

Paul,

As discussed in the Alameda County Environmental Health (ACEH) email correspondence dated August 21, 2015, please revise the draft tenant notification for the subject site in accordance with the DTSC Vapor Intrusion Public Participation Advisory (March 2012) including but not limited to Appendix C – Indoor Air Sampling.

ACEH has attached a word document of a sample fact sheets/notification from Alameda County for your use as a starting template.

Additionally, please upload all correspondences to the ACEH ftp and State Water Resources Control Board (SWRCB) GeoTracker websites prepared after 6:35 PM, 9/15/2015.

Regards,
Keith Nowell

**From:** Roe, Dilan, Env. Health
**Sent:** Friday, August 21, 2015 11:13 AM
**To:** PDKing0000@aol.com; Nowell, Keith, Env. Health <Keith.Nowell@acgov.org>
**Cc:** Gary_Bates@efiglobal.com; patrick@ellwoodcommercial.com; ronpatelvidge@gmail.com; wkochenderfer@cs.com; dave@bblandlaw.com
**Subject:** RE: RO 2981 Red Hanger Cleaners at 6239 College Ave - Draft tenant notification

Hi Paul:

Please revise the draft tenant notification for the subject site in accordance with the DTSC Vapor Intrusion Public Participation Advisory (March 2012) including but not limited to Appendix C – Indoor Air Sampling

I have attached a word document of a sample fact sheets/notification from Alameda County for your use as a starting template.

**Dilan Roe, P.E.**
*Program Manager - Land Use & Local Oversight Program*
Alameda County Environmental Health
1131 Harbor Bay Parkway
Alameda, CA 94502
510.567.6767; Ext. 36767
QIC: 30440
dilan.roe@acgov.org

PDF copies of case files can be reviewed/downloaded at:

*http://www.acgov.org/aceh/lop/ust.htm*

RO2981

# Fact Sheet on Environmental Assessment

**Swiss Valley Cleaners Site**
1395 MacArthur Boulevard
San Leandro, California
Alameda County
ACEH File No. RO0003120
July 2014

This fact sheet is being provided to describe site background, past work to investigate site contamination, next steps, the oversight process for the site, and how you can obtain more information.

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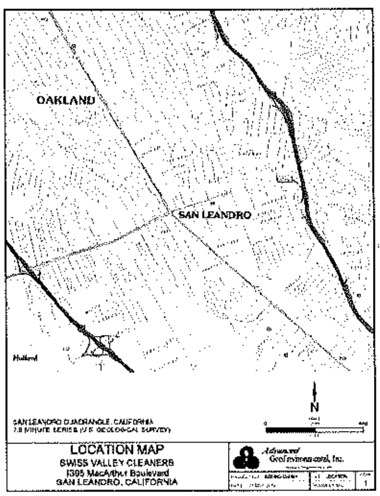
Summer, 2014

The Alameda County Environmental Health Department (ACEH) is issuing this fact sheet to inform you of ongoing investigation work at the Swiss Valley Cleaners (site), located at 1395 MacArthur Boulevard in San Leandro, California (Figure1).




The purpose of the investigation work is to gather more information on the nature and extent of contamination within the dry cleaning suite (soil, groundwater, soil vapor, and indoor air), as well as off-site (soil and soil vapor) and in indoor air samples in suites adjacent to the dry cleaners, within the building. This fact sheet contains information concerning site background, results of recent investigations, remediation activities, and information contacts. A glossary of certain terms also is included.

**Site Background** - The Swiss Valley Cleaners site currently is situated within a commercial area of the Estudillo Shopping Center just west of Interstate 580 on the corner of MacArthur Boulevard and Joaquin Avenue. The subject site is in a strip mall on a 1.76-acre lot with several operating businesses within suites at ~~of~~ the mall~~facility~~. The subject site was a small retail dry-cleaner for 30 years or more, prior to initial site investigations. The site currently houses a 55-gallon capacity closed-loop, chemical dry cleaning machine, which is bolted to the floor and recently used green chemicals as

a dry cleaning agent. Prior to 2001, the dry cleaning operation utilized tetrachloroethylene (PCE) as the dry cleaning solvent, until the machine was replaced with the current machine. Volatile Organic Compounds (VOCs) such as PCE are able to move in the environment, from soil to groundwater, from groundwater to soil, and from groundwater or soil to air. Of particular interest is the potential for movement of VOCs into the inside of buildings where people could be exposed to contaminated air. This process is called soil-vapor intrusion into indoor air.

| Glossary of Terms |
|---|
| *Soil Gas*—Soil gas refers to the air that is present in the open spaces between soil particles between the ground surface and the water table. It includes air (primarily oxygen and nitrogen, like above ground), water vapor, and occasionally pollutants.<br>*Volatile organic compounds (VOCs)*—VOCs are organic liquids, including many common solvents that readily evaporate at temperatures normally found at ground surface and at shallow depths. Many VOCs are known human carcinogens. Examples of VOC usage include dry cleaning solvent, carburetor cleaner, brake cleaner, and paint solvents. |

**Recent Investigation Activities** - Environmental investigations have been performed at the site from 1998 through 2014; these investigations have included sampling and analysis of soil, soil-vapor, groundwater and indoor air to assess the type and extent of contamination at the site. In total, laboratory analysis has been conducted on 182 samples collected from 96 borings and indoor air sampling containers.

Investigations performed at the site have identified that VOCs, specifically PCE, leaked into the subsurface beneath the subject building. Soil and soil vapor samples have only been collected to date beneath the dry cleaning suite; however, work is planned to collect additional soil and soil vapor samples beneath adjacent suites in order to define the lateral extent of the PCE contamination. Limited groundwater data has been collected, but additional data will also be collected in the near future.

Concentrations of PCE have been also been detected in subsurface soil-vapor samples in the parking lot and surrounding the perimeter of the Estudillo Plaza shopping center.

Concentrations reported in soil-vapor and indoor air samples collected beneath the dry cleaning suite were found at concentrations greater than applicable regulatory agency screening levels requiring additional investigation. The presence of these chemicals at concentrations exceeding regulatory screening levels does not indicate that adverse impacts to human health or the environment are necessarily occurring, but rather indicates that a potential for adverse risk may exist and that additional evaluation is warranted.

~~Concentrations of PCE have been also been detected in subsurface soil-vapor samples in the parking lot and surrounding the perimeter of the Estudillo Plaza shopping center.~~

The ~~data collected at the site to date, indicate that the~~ highest concentrations of PCE in ~~subsurface soil-vapor and~~ indoor air are located within the suite associated with dry cleaning at the site and in the adjacent suite located at 1383 MacArthur Boulevard (Solthea Salon & Beauty Supply). Concentrations of PCE over screening levels have also been detected in indoor air samples collected in the Estudillo Plaza Optometry facility located at 1377 MacArthur Boulevard. PCE concentrations were reported in the indoor air of the suite at 1369 MacArthur Boulevard, but were well below established regulatory screening levels requiring further investigation.

Because the screening levels were exceeded and indoor air samples indicated vapor intrusion of PCE into a number of ~~several~~ suites at the site, Advanced GeoEnvironmental Inc. (AGE) was recently requested to evaluate health risks associated with the contamination and the analysis indicated that there does not appear to be an imminent risk, but these concentrations still require clean-up.

**Cleanup of Environmental Impacts** – As discussed, VOCs have been detected in soil, groundwater, soil-vapor and indoor air samples at the site. In general, soil and groundwater concentrations reported during the investigations performed at the site are below regulatory screening levels. However, ~~as discussed above,~~ soil-vapor concentrations reported during investigative activities are well above regulatory screening levels and are likely the cause of PCE vapors intruding into the subject facility and immediately surrounding units. PCE vapor concentrations reported in soil-vapor and indoor air ~~do~~ require remediation (clean-up) at this time to mitigate ~~reduce~~ the potential for health risks by reducing concentrations in both soil and soil vapor.

**~~Planned~~ Soil-Vapor and Indoor Air Mitigation and Remediation** - AGE has been working with ACEH to plan and implement corrective action at the site in conjunction with site use. Currently, AGE is determining the appropriate remedial measures for removal of residual soil-vapor impact from the subsurface at the site.

Initially, mitigation measures are being implemented currently ~~and although health risks do not appear to be imminent,~~ due to elevated VOC impact to indoor air with the ~~, AGE has begun to~~ installation of a fresh air circulation system in the dry cleaning suite and immediately adjacent suites to increase fresh air intake and exhaust into the ~~adjacent~~ suites. This will aid in reducing the overall residual impacts to indoor air.

A pilot test, installation of fresh air and exhaust fans in the subject facility and modifications to existing HVAC systems in the adjacent suites were presented as recommendations in the AGE-prepared, *Indoor Air Sampling Report – Second Quarter 2014*, dated July 1, 2014. AGE conducted a soil vapor ~~extraction pilot test in August 2014 within the dry cleaning~~ suite to determine the effectiveness of this remedial technology on the residual contaminate mass at the site and the effectiveness of reducing the soil-vapor concentrations of PCE.

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**Next Steps** – AGE ~~has implanted will also be implementing a soil vapor extraction pilot test within the subject facility to determine the effectiveness of the most likely remedial technology on the residual contaminate mass at the site and the effectiveness of reducing the soil vapor concentrations of PCE.~~ Based on results of the pilot test, it is likely that a dedicated remediation system will be installed to continue to remove the PCE impact soil-vapor from the site. This will include the installation of additional vapor extraction wells and a temporary remediation system and enclosure.

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~~**Next Steps** – The proposed pilot test, installation of fresh air and exhaust fans in the subject facility and modifications to existing HVAC systems in the adjacent suites were presented as recommendations in the AGE prepared, *Indoor Air Sampling Report – Second Quarter 2014*, dated 01 July 2014. AGE has performed the proposed pilot test in August 2014 and anticipates installing a permanent remediation system to remediate subsurface impact in the subject unit.~~

~~Additionally, modifications to the ventilation system are underway and fresh air and exhaust fans are being installed.~~

The entire case file can be viewed over the Internet on the ACEH at http://www.acgov.org/aceh/lop/ust.htm or at the State of California Water Resources Control Board website at http://geotracker.swrcb.ca.gov.

Please send written comments regarding the investigation and proposed actions to Mark Detterman at the address below.

**For More Information**

Please contact any of the following individuals with questions or concerns you may have:

Mark Detterman
Alameda County Environmental Health Case Manager
510-567-6876
mark.detterman@acgov.org

Daniel Villanueva
Advanced GeoEnvironmental Inc.; Consultant
209-467-1006
dvillanueva@advgeoenv.com

**Roe, Dilan, Env. Health**

| | |
|---|---|
| **From:** | PDKing0000@aol.com |
| **Sent:** | Friday, September 25, 2015 3:37 PM |
| **To:** | Roe, Dilan, Env. Health |
| **Cc:** | Nowell, Keith, Env. Health; Gary_Bates@efiglobal.com; ron_holt@efiglobal.com; patrick@ellwoodcommercial.com; ronpatelvidge@gmail.com; dave@bblandlaw.com |
| **Subject:** | RO 2981 Red Hanger Cleaners at 6239 College Ave - 9/4/15 Air Sample Lab Report |
| **Attachments:** | 136577-136579.pdf |

Hi Dilan,

You will find attached a pdf copy of the lab report and chain of custody document for the post-mitigation interim confirmation air samples collected during a 24-hour period from 9/3/15 to 9/4/15 in the hallway on the second floor, in the men's room on the third floor, and at the ambient air sample collection location (document 136577-136579.pdf). The sample collection locations are shown in site maps that were previously provided to you.

At the time that we collected the air samples, we had been unsuccessful in obtaining SIM-certified flow controllers from Eurofins/ Air Toxics (the lab that we had previously used for air testing), and we only had access to a limited number of flow controllers and Summa canisters from the laboratory K Prime, Inc. that we diverted from another project to the College Avenue project. The samples arrived at the laboratory Friday night 9/4/15 at the beginning of the Labor Day 3-day weekend and were analyzed on an expedited basis the following week.

The sample results were verbally communicated to Keith Nowell during a conference call with Paul King and Gary Bates on 9/11/15.

Please let me know if you have any questions or need any additional information.

Thank you!

Paul

Paul H. King
Professional Geologist

P&D Environmental, Inc.
55 Santa Clara Avenue, Suite 240
Oakland, CA 94610

(510) 658-6916 telephone
(510) 834-0152 facsimile
(510) 387-6834 cellular
Paul.King@pdenviro.com

# K PRIME, Inc.

CONSULTING ANALYTICAL CHEMISTS

3621 Westwind Blvd.
Santa Rosa CA 95403
Phone: 707 527 7574
FAX: 707 527 7879


## TRANSMITTAL

**DATE:** 9/8/2015

**TO:** MR. PAUL KING
P&D ENVIRONMENTAL, INC.
55 SANTA CLARA AVE., SUITE 240
OAKLAND, CA 94610

**ACCT:** 4639
**PROJ:** 0461

Phone: 510-658-6916
Fax: 510-834-0152
Email: lab@pdenviro.com
PDKing0000@aol.com

**FROM:** Richard A. Kagel, Ph.D. RAK 9/8/2015
Laboratory Director

**SUBJECT:** LABORATORY RESULTS FOR YOUR PROJECT 0461

Enclosed please find K Prime's laboratory reports for the following samples:

| SAMPLE ID | TYPE | DATE | TIME | KPI LAB # |
|---|---|---|---|---|
| IA4 (HALLWAY) | AIR | 9/4/2015 | 13:35 | 136577 |
| IA5 (MENS ROOM 3RD FL) | AIR | 9/4/2015 | 13:40 | 136578 |
| BG2 (AMBIENT) | AIR | 9/4/2015 | 13:47 | 136579 |

The above listed sample group was received on 9/4/2015 and tested as requested on the chain of custody document.

Please call me if you have any questions or need further information.
Thank you for this opportunity to be of service.

**K PRIME, INC.**
**LABORATORY REPORT**

**SAMPLE ID:** IA4 (HALLWAY)
**LAB NO:** 136577
**SAMPLE TYPE:** AIR
**DATE SAMPLED:** 09/04/2015
**TIME SAMPLED:** 13:35
**BATCH ID:** 090415A1
**DATE ANALYZED:** 09/08/2015

**K PRIME PROJECT: 4639**
**CLIENT PROJECT: 0461**

**METHOD: VOC'S IN AIR**
**REFERENCE: EPA METHOD TO-15-SIM (GC-MS-SIM)**

| | | PPB (V/V) | | µg/cu. m | |
|---|---|---|---|---|---|
| COMPOUND NAME | CAS NO. | MRL | SAMPLE CONC | MRL | SAMPLE CONC |
| DICHLORODIFLUOROMETHANE | 75-71-8 | 0.0100 | 0.571 | 0.0495 | 2.82 |
| DICHLOROTETRAFLUOROETHANE | 76-14-2 | 0.0100 | 0.0212 | 0.0699 | 0.148 |
| CHLOROMETHANE | 74-87-3 | 0.0500 | 0.542 | 0.103 | 1.12 |
| VINYL CHLORIDE | 75-01-4 | 0.0100 | ND | 0.0256 | ND |
| CHLOROETHANE | 75-00-3 | 0.0100 | ND | 0.0264 | ND |
| 1,1-DICHLOROETHENE | 75-35-4 | 0.0100 | ND | 0.0397 | ND |
| TRANS-1,2-DICHLOROETHENE | 156-60-5 | 0.0100 | ND | 0.0396 | ND |
| 1,1-DICHLOROETHANE | 75-34-3 | 0.0100 | ND | 0.0405 | ND |
| CIS-1,2-DICHLOROETHENE | 156-59-2 | 0.0100 | ND | 0.0397 | ND |
| CHLOROFORM | 67-66-3 | 0.0100 | 0.853 | 0.0488 | 4.17 |
| 1,1,1-TRICHLOROETHANE | 71-55-6 | 0.0100 | 0.0254 | 0.0546 | 0.138 |
| 1,2-DICHLOROETHANE | 107-06-2 | 0.0100 | 0.0901 | 0.0405 | 0.365 |
| BENZENE | 71-43-2 | 0.0500 | 0.135 | 0.160 | 0.432 |
| CARBON TETRACHLORIDE | 56-23-5 | 0.0100 | 0.101 | 0.0629 | 0.634 |
| TRICHLOROETHENE | 79-01-6 | 0.0100 | 1.51 | 0.0537 | 8.09 |
| TOLUENE | 108-88-3 | 0.0500 | 0.848 | 0.188 | 3.19 |
| 1,1,2-TRICHLOROETHANE | 79-00-5 | 0.0100 | ND | 0.0546 | ND |
| 1,2-DIBROMOETHANE | 106-93-4 | 0.0100 | ND | 0.0768 | ND |
| TETRACHLOROETHENE | 127-18-4 | 0.0100 | 1.05 | 0.0678 | 7.15 |
| ETHYLBENZENE | 100-41-4 | 0.0100 | 0.286 | 0.0434 | 1.24 |
| XYLENE (M+P) | 1330-20-7 | 0.0200 | 0.476 | 0.0868 | 2.07 |
| XYLENE (O) | 95-47-6 | 0.0100 | 0.176 | 0.0434 | 0.765 |
| 1,1,2,2-TETRACHLOROETHANE | 79-34-5 | 0.0100 | ND | 0.0687 | ND |
| 1,4-DICHLOROBENZENE | 106-46-7 | 0.0100 | 0.0317 | 0.0601 | 0.190 |

**NOTES:**
ND - NOT DETECTED AT OR ABOVE THE STATED REPORTING LIMIT
MRL - METHOD REPORTING LIMIT
NA - NOT APPLICABLE OR AVAILABLE
µg/cu. m VALUES ARE CALCULATED FROM PPB RESULTS USING NORMAL TEMPERATURE AND PRESSURE (NPT).

**APPROVED BY:** BMC
**DATE:** 9/8/15

K PRIME, INC.
LABORATORY REPORT

K PRIME PROJECT: 4639
CLIENT PROJECT: 0461

METHOD: VOC'S IN AIR
REFERENCE: EPA METHOD TO-15-SIM (GC-MS-SIM)

SAMPLE ID: IA5 (MENS ROOM 3RD FL)
LAB NO: 136578
SAMPLE TYPE: AIR
DATE SAMPLED: 09/04/2015
TIME SAMPLED: 13:40
BATCH ID: 090415A1
DATE ANALYZED: 09/08/2015

| COMPOUND NAME | CAS NO. | PPB (V/V) MRL | PPB (V/V) SAMPLE CONC | µg/cu. m MRL | µg/cu. m SAMPLE CONC |
|---|---|---|---|---|---|
| DICHLORODIFLUOROMETHANE | 75-71-8 | 0.0100 | 0.525 | 0.0495 | 2.60 |
| DICHLOROTETRAFLUOROETHANE | 76-14-2 | 0.0100 | 0.0200 | 0.0699 | 0.140 |
| CHLOROMETHANE | 74-87-3 | 0.0500 | 0.558 | 0.103 | 1.15 |
| VINYL CHLORIDE | 75-01-4 | 0.0100 | ND | 0.0256 | ND |
| CHLOROETHANE | 75-00-3 | 0.0100 | ND | 0.0264 | ND |
| 1,1-DICHLOROETHENE | 75-35-4 | 0.0100 | ND | 0.0397 | ND |
| TRANS-1,2-DICHLOROETHENE | 156-60-5 | 0.0100 | ND | 0.0396 | ND |
| 1,1-DICHLOROETHANE | 75-34-3 | 0.0100 | ND | 0.0405 | ND |
| CIS-1,2-DICHLOROETHENE | 156-59-2 | 0.0100 | ND | 0.0397 | ND |
| CHLOROFORM | 67-66-3 | 0.0100 | 1.38 | 0.0488 | 6.72 |
| 1,1,1-TRICHLOROETHANE | 71-55-6 | 0.0100 | 0.0270 | 0.0546 | 0.147 |
| 1,2-DICHLOROETHANE | 107-06-2 | 0.0100 | 0.0579 | 0.0405 | 0.234 |
| BENZENE | 71-43-2 | 0.0500 | 0.145 | 0.160 | 0.462 |
| CARBON TETRACHLORIDE | 56-23-5 | 0.0100 | 0.0861 | 0.0629 | 0.542 |
| TRICHLOROETHENE | 79-01-6 | 0.0100 | 1.67 | 0.0537 | 8.98 |
| TOLUENE | 108-88-3 | 0.0500 | 0.766 | 0.188 | 2.88 |
| 1,1,2-TRICHLOROETHANE | 79-00-5 | 0.0100 | ND | 0.0546 | ND |
| 1,2-DIBROMOETHANE | 106-93-4 | 0.0100 | ND | 0.0768 | ND |
| TETRACHLOROETHENE | 127-18-4 | 0.0100 | 1.18 | 0.0678 | 8.01 |
| ETHYLBENZENE | 100-41-4 | 0.0100 | 0.201 | 0.0434 | 0.871 |
| XYLENE (M+P) | 1330-20-7 | 0.0200 | 0.378 | 0.0868 | 1.64 |
| XYLENE (O) | 95-47-6 | 0.0100 | 0.131 | 0.0434 | 0.568 |
| 1,1,2,2-TETRACHLOROETHANE | 79-34-5 | 0.0100 | ND | 0.0687 | ND |
| 1,4-DICHLOROBENZENE | 106-46-7 | 0.0100 | 0.0271 | 0.0601 | 0.163 |

NOTES:
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APPROVED BY: [signature]
DATE: 9/8/15

**K PRIME, INC.**
**LABORATORY REPORT**

**K PRIME PROJECT: 4639**
**CLIENT PROJECT: 0461**

**METHOD: VOC'S IN AIR**
**REFERENCE: EPA METHOD TO-15-SIM (GC-MS-SIM)**

**SAMPLE ID:** BG2 (AMBIENT)
**LAB NO:** 136579
**SAMPLE TYPE:** AIR
**DATE SAMPLED:** 09/04/2015
**TIME SAMPLED:** 13:47
**BATCH ID:** 090415A1
**DATE ANALYZED:** 09/08/2015

| | | PPB (V/V) | | µg/cu. m | |
|---|---|---|---|---|---|
| **COMPOUND NAME** | **CAS NO.** | **MRL** | **SAMPLE CONC** | **MRL** | **SAMPLE CONC** |
| DICHLORODIFLUOROMETHANE | 75-71-8 | 0.0100 | 0.589 | 0.0495 | 2.91 |
| DICHLOROTETRAFLUOROETHANE | 76-14-2 | 0.0100 | 0.0208 | 0.0699 | 0.146 |
| CHLOROMETHANE | 74-87-3 | 0.0500 | 0.593 | 0.103 | 1.22 |
| VINYL CHLORIDE | 75-01-4 | 0.0100 | ND | 0.0256 | ND |
| CHLOROETHANE | 75-00-3 | 0.0100 | ND | 0.0264 | ND |
| 1,1-DICHLOROETHENE | 75-35-4 | 0.0100 | ND | 0.0397 | ND |
| TRANS-1,2-DICHLOROETHENE | 156-60-5 | 0.0100 | ND | 0.0396 | ND |
| 1,1-DICHLOROETHANE | 75-34-3 | 0.0100 | ND | 0.0405 | ND |
| CIS-1,2-DICHLOROETHENE | 156-59-2 | 0.0100 | ND | 0.0397 | ND |
| CHLOROFORM | 67-66-3 | 0.0100 | ND | 0.0488 | ND |
| 1,1,1-TRICHLOROETHANE | 71-55-6 | 0.0100 | ND | 0.0546 | ND |
| 1,2-DICHLOROETHANE | 107-06-2 | 0.0100 | 0.0147 | 0.0405 | 0.0596 |
| BENZENE | 71-43-2 | 0.0500 | 0.0999 | 0.160 | 0.319 |
| CARBON TETRACHLORIDE | 56-23-5 | 0.0100 | 0.104 | 0.0629 | 0.653 |
| TRICHLOROETHENE | 79-01-6 | 0.0100 | ND | 0.0537 | ND |
| TOLUENE | 108-88-3 | 0.0500 | 0.410 | 0.188 | 1.54 |
| 1,1,2-TRICHLOROETHANE | 79-00-5 | 0.0100 | ND | 0.0546 | ND |
| 1,2-DIBROMOETHANE | 106-93-4 | 0.0100 | ND | 0.0768 | ND |
| TETRACHLOROETHENE | 127-18-4 | 0.0100 | 0.0314 | 0.0678 | 0.213 |
| ETHYLBENZENE | 100-41-4 | 0.0100 | 0.0526 | 0.0434 | 0.229 |
| XYLENE (M+P) | 1330-20-7 | 0.0200 | 0.195 | 0.0868 | 0.848 |
| XYLENE (O) | 95-47-6 | 0.0100 | 0.0736 | 0.0434 | 0.319 |
| 1,1,2,2-TETRACHLOROETHANE | 79-34-5 | 0.0100 | ND | 0.0687 | ND |
| 1,4-DICHLOROBENZENE | 106-46-7 | 0.0100 | ND | 0.0601 | ND |

**NOTES:**
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MRL - METHOD REPORTING LIMIT
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µg/cu. m VALUES ARE CALCULATED FROM PPB RESULTS USING NORMAL TEMPERATURE AND PRESSURE (NPT).

**APPROVED BY:** RMC
**DATE:** 9/8/15

**K PRIME, INC.**

**LABORATORY METHOD BLANK REPORT**

**METHOD BLANK ID:** B090415A1
**SAMPLE TYPE:** AIR

**BATCH ID:** 090415A1
**DATE ANALYZED:** 09/04/2015

**METHOD: VOC'S IN AIR**
**REFERENCE: EPA METHOD TO-15-SIM (GC-MS-SIM)**

| | | PPB (V/V) | | µg/cu. m | |
|---|---|---|---|---|---|
| COMPOUND NAME | CAS NO. | MRL | SAMPLE CONC | MRL | SAMPLE CONC |
| DICHLORODIFLUOROMETHANE | 75-71-8 | 0.0100 | ND | 0.0495 | ND |
| DICHLOROTETRAFLUOROETHANE | 76-14-2 | 0.0100 | ND | 0.0699 | ND |
| CHLOROMETHANE | 74-87-3 | 0.0500 | ND | 0.103 | ND |
| VINYL CHLORIDE | 75-01-4 | 0.0100 | ND | 0.0256 | ND |
| CHLOROETHANE | 75-00-3 | 0.0100 | ND | 0.0264 | ND |
| 1,1-DICHLOROETHENE | 75-35-4 | 0.0100 | ND | 0.0397 | ND |
| TRANS-1,2-DICHLOROETHENE | 156-60-5 | 0.0100 | ND | 0.0396 | ND |
| 1,1-DICHLOROETHANE | 75-34-3 | 0.0100 | ND | 0.0405 | ND |
| CIS-1,2-DICHLOROETHENE | 156-59-2 | 0.0100 | ND | 0.0397 | ND |
| CHLOROFORM | 67-66-3 | 0.0100 | ND | 0.0488 | ND |
| 1,1,1-TRICHLOROETHANE | 71-55-6 | 0.0100 | ND | 0.0546 | ND |
| 1,2-DICHLOROETHANE | 107-06-2 | 0.0100 | ND | 0.0405 | ND |
| BENZENE | 71-43-2 | 0.0500 | ND | 0.160 | ND |
| CARBON TETRACHLORIDE | 56-23-5 | 0.0100 | ND | 0.0629 | ND |
| TRICHLOROETHENE | 79-01-6 | 0.0100 | ND | 0.0537 | ND |
| TOLUENE | 108-88-3 | 0.0500 | ND | 0.188 | ND |
| 1,1,2-TRICHLOROETHANE | 79-00-5 | 0.0100 | ND | 0.0546 | ND |
| 1,2-DIBROMOETHANE | 106-93-4 | 0.0100 | ND | 0.0768 | ND |
| TETRACHLOROETHENE | 127-18-4 | 0.0100 | ND | 0.0678 | ND |
| ETHYLBENZENE | 100-41-4 | 0.0100 | ND | 0.0434 | ND |
| XYLENE (M+P) | 1330-20-7 | 0.0200 | ND | 0.0868 | ND |
| XYLENE (O) | 95-47-6 | 0.0100 | ND | 0.0434 | ND |
| 1,1,2,2-TETRACHLOROETHANE | 79-34-5 | 0.0100 | ND | 0.0687 | ND |
| 1,4-DICHLOROBENZENE | 106-46-7 | 0.0100 | ND | 0.0601 | ND |

**NOTES:**

ND - NOT DETECTED AT OR ABOVE THE STATED REPORTING LIMIT
MRL - METHOD REPORTING LIMIT
NA - NOT APPLICABLE OR AVAILABLE
µg/cu. m VALUES ARE CALCULATED FROM PPB RESULTS USING NORMAL TEMPERATURE AND PRESSURE (NPT).

**K PRIME, INC.**
**LABORATORY QUALITY CONTROL REPORT**

**LAB CONTROL ID:** L090415A1
**LAB CONTROL DUPLICATE ID:** D090415A1

**SAMPLE TYPE:** AIR
**BATCH ID:** 090415A1
**DATE ANALYZED:** 09/04/2015

**METHOD: VOC'S IN AIR**
**REFERENCE: EPA METHOD TO-15-SIM (GC-MS-SIM)**

| COMPOUND NAME | SPIKE ADDED (PPB) | REPORTING LIMIT (PPB) | SAMPLE CONC (PPB) | SPIKE CONC (PPB) | SPIKE REC (%) | REC LIMITS (%) |
|---|---|---|---|---|---|---|
| 1,1-DICHLOROETHENE | 0.500 | 0.010 | ND | 0.475 | 95 | 60 - 140 |
| TRICHLOROETHENE | 0.500 | 0.010 | ND | 0.567 | 113 | 60 - 140 |
| BENZENE | 0.500 | 0.050 | ND | 0.427 | 85 | 60 - 140 |
| TOLUENE | 0.500 | 0.050 | ND | 0.532 | 106 | 60 - 140 |
| TETRACHLOROETHENE | 0.500 | 0.010 | ND | 0.611 | 122 | 60 - 140 |

| COMPOUND NAME | SPIKE ADDED (PPB) | SPIKE DUP CONC (PPB) | SPIKE DUP REC (%) | RPD (%) | QC LIMITS RPD (%) | QC LIMITS REC (%) |
|---|---|---|---|---|---|---|
| 1,1-DICHLOROETHENE | 0.500 | 0.470 | 94 | 1.2 | 25 | 60 - 140 |
| TRICHLOROETHENE | 0.500 | 0.552 | 110 | 2.7 | 25 | 60 - 140 |
| BENZENE | 0.500 | 0.425 | 85 | 0.3 | 25 | 60 - 140 |
| TOLUENE | 0.500 | 0.536 | 107 | 0.7 | 25 | 60 - 140 |
| TETRACHLOROETHENE | 0.500 | 0.595 | 119 | 2.6 | 25 | 60 - 140 |

**NOTES:**
NA - NOT APPLICABLE OR AVAILABLE
ND - NOT DETECTED AT OR ABOVE THE STATED REPORTING LIMIT

4639

# CHAIN OF CUSTODY RECORD



P&D ENVIRONMENTAL, INC.
55 Santa Clara Ave., Suite 240
Oakland, CA 94610
(510) 658-6916

PROJECT NUMBER: 04C01

PROJECT NAME: RED HANGER KLEANERS, 6239 COLLEGE AVE, OAKLAND, CA

SAMPLED BY: (PRINTED & SIGNATURE) JAY MILLER [signature]

| SAMPLE NUMBER | DATE | TIME | TYPE | SAMPLE LOCATION: START VAC | FINAL VAC | CANISTER # | NUMBER OF CONTAINERS | ANALYSIS(ES): TO-15 | KPI# | PRESERVATIVE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| IA4 (HALLWAY) | 9/4/15 | 133000 133500 | AIR | -30 | -8 | A-783 | 1 | X | 1365 77 | NONE | 24 HR RUSH |
| IA5 (MENS ROOM 3RD FL) | 9/4/15 | 133800 134000 | " | -30 | -4.5 | A-303 | 1 | X | 1365 78 | " | ↓ |
| BG2 (AMBIENT) | 9/4/15 | 132100 134700 | " | -30 | -3 | A-604 | 1 | X | 1365 79 | " | ↓ |

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED BY: (SIGNATURE) |
|---|---|---|---|
| [signature] | 9/4 | 15:36 | [signature] |
| [signature] | 9/4 | 18:58 | [signature] |
| | | | RECEIVED FOR LABORATORY BY: (SIGNATURE) |

Total No. of Samples (This Shipment): 3

Total No. of Containers (This Shipment): 3

LABORATORY: K PRIME INC

LABORATORY CONTACT: RICHARD KAGEL

LABORATORY PHONE NUMBER: (707) 527-7574

SAMPLE ANALYSIS REQUEST SHEET ATTACHED: ( ) YES (X) NO

Results and billing to:
P&D Environmental, Inc.
lab@pdenviro.com

REMARKS: FLOW CONTROLLER 24 HR (SIM CERTIFIED) 6-LITER SUMMA

**Roe, Dilan, Env. Health**

| | |
|---|---|
| **From:** | PDKing0000@aol.com |
| **Sent:** | Friday, September 25, 2015 3:43 PM |
| **To:** | Roe, Dilan, Env. Health |
| **Cc:** | Nowell, Keith, Env. Health; Gary_Bates@efiglobal.com; ron_holt@efiglobal.com; patrick@ellwoodcommercial.com; ronpatelvidge@gmail.com; dave@bblandlaw.com |
| **Subject:** | RO 2981 Red Hanger Cleaners at 6239 College Ave - 9/24/15 Air Mitigation Status |

Hi Dilan,

The air filtration units were received Wednesday 9/23/15 and were installed the same day. Tenant notifications (a DRAFT copy was sent to you on 9/18/15) was also distributed to the tenants and posted in the building at the entrances and next to the elevator doors on each floor on 9/23/15.

The HVAC units on the building roof were modified to allow for the introduction of increased volumes of atmospheric air to the tenant spaces beginning at 8:30 AM on Friday 9/25/15, and that work has now been completed.

At the beginning of the week of 9/28/15 SIM-certified 24-hour flow controllers and Summa canisters will be deployed in the second floor hallway, in the third floor men's room, and at the ambient air sampling location for interim post-mitigation air sampling to determine if TCE and PCE air concentrations have been reduced. If the interim post-mitigation air sample results indicate that the mitigation measures have been successful, a more comprehensive post-mitigation confirmation sampling event will then be scheduled. Upon completion of the comprehensive post-mitigation confirmation sampling event, a complete report documenting all previous indoor air sampling and corrective action activities will be prepared.

Please let me know if you have any questions or need any additional information.

Thank you!

Paul

Paul H. King
Professional Geologist

P&D Environmental, Inc.
55 Santa Clara Avenue, Suite 240
Oakland, CA 94610

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(510) 834-0152 facsimile
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Paul.King@pdenviro.com

**From:** PDKing0000@aol.com
**Sent:** Friday, September 25, 2015 3:48 PM
**To:** Roe, Dilan, Env. Health
**Cc:** Nowell, Keith, Env. Health; Gary_Bates@efiglobal.com; ron_holt@efiglobal.com; patrick@ellwoodcommercial.com; ronpatelvidge@gmail.com; dave@bblandlaw.com
**Subject:** RO 2981 Red Hanger Cleaners at 6239 College Ave - 9/24/15 Tenant Call

Hi Dilan,

I received a call last night 9/24/15 from Esther Lerman of suite 302 at the subject site and we spoke from 5:46 to 6:06 PM. Esther had initially called and left me a voicemail at 4:27 PM, and when I returned the call at 4:55 PM she asked that we speak later. She then called me back at 5:46 PM. Her contact information is 510-548-6241, EstherLermanmft@gmail.com .

Esther said that she spoke with the property manager Patrick Ellwood who referred her to me. She said that she has a client who is near the end of the first trimester of her pregnancy, and Esther wanted to know the risks and if it was safe for her tenant to visit the building for one hour once a week. I said that I am not a toxicologist, epidemiologist or physician, and for that reason the answer to the question was beyond the scope of my professional knowledge. I said that there is regulatory agency guidance regarding pregnant women and TCE in air, and that we are currently recommending that no pregnant women enter the building until we have been able to reduce TCE concentrations in the air in the building.

I asked if Esther had received the tenant notification that we had distributed on Wednesday 9/23/15 and she said no. I told Esther that the tenant notification that we distributed 9/23/15 provided an update to our 8/20/15 tenant notification, and she confirmed that she had received the 8/20/15 tenant notification. I said that I would arrange for Esther to receive a copy of the notification that we distributed 9/23/15, that indoor conditions have not changed since our 8/20/15 notification, and that this new notification provides the same recommendations regarding pregnant women not entering the building as the 8/20/15 notification.

I told Esther that we had installed and were operating air filtration units in the hallways and in the stairwells on Wednesday 9/23/15 (she acknowledged that she had seen them), and that beginning at 8:30 AM on Friday 9/25/15 the HVAC units on the roof would be adjusted to increase the amount of atmospheric air entering the suites. I said that we don't know yet if the TCE air concentrations have been reduced by the air filtration, that we are scheduled to perform air testing at the beginning of next week, that we should have the sample results back by the end of next week or the beginning of the following week, and that I will let her know once we get the results.

Esther asked if we were addressing the odor from the third floor bathrooms that have been on-going for the past year. She described it as a chemical, nasty, unpleasant odor that was strongest at the men's room (closest to the stairwell). I told Esther that we had performed a smoke test to identify leaks in plumbing on 8/26/15 and had sealed all leaks that we had identified on 8/26/15, and I asked her if she had smelled the odor recently. She said that she had smelled the odor after 8/26/15, and that although she is only in the office Tuesday nights, Wednesdays and Thursdays, she believed that she had smelled it last week. I said that I was not aware of any reports of odors after we completed our smoke test, but that I appreciated the information and that I would check with the building maintenance people and investigate it further.

We discussed what exposure Esther might have in the building, and said that the OSHA and CalOSHA standard (the PEL) for exposure to a chemical in air is 8 hours per day for 40 hours per week for 40 years with no adverse health effects, that the TCE PEL is 562,000 units (I also told her that the units are micrograms per cubic meter), and that we detected TCE concentrations of about 4 to 8 units or less, and from an OSHA or CalOSHA perspective she was not being exposed to concentrations exceeding the PEL.

I said that the heightened awareness regarding TCE in air is based on recent work showing that TCE can result in heart valve defects for developing fetuses during the first trimester, and that the standard of care for a work environment where exposure will be 8 hours per day for 40 hours per week is 8 ug/m3. We discussed that the only locations where TCE air concentrations exceeding 8 ug/m3 were in common areas such as the hallway, and that concentrations lower than 8 had been detected in all of the suites that we had tested, including her suite. I said that I did not know how the standard of 8 ug/m3 compared to 1 hour of exposure per week, but that we had taken a conservative position and recommended that any pregnant women not enter the building until we can verify that the TCE air concentrations

Esther said that this helped her to better understand and thanked me.

Paul

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**well, Keith, Env. Health**

| | |
|---|---|
| **/om:** | PDKing0000@aol.com |
| **ent:** | Friday, October 02, 2015 8:11 AM |
| **To:** | Nowell, Keith, Env. Health |
| **Cc:** | Roe, Dilan, Env. Health; Gary_Bates@efiglobal.com; ron_holt@efiglobal.com; patrick@ellwoodcommercial.com; ronpatelvidge@gmail.com; dave@bblandlaw.com |
| **Subject:** | RO2981 Red Hanger Kleaners Fact Sheet DRAFT 3 |
| **Attachments:** | RO2981_FactSheet_IndoorAirMitigation_DRAFT 3.docx |

Hi Keith,

You will find attached the RO2981 Red Hanger Kleaners Fact Sheet DRAFT 3 for your review and comment (document RO2981_FactSheet_IndoorAirMitigation_DRAFT 3.docx).

Please let me know if you have any questions or comments.

Thank you!

Paul

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# Fact Sheet on Environmental Assessment

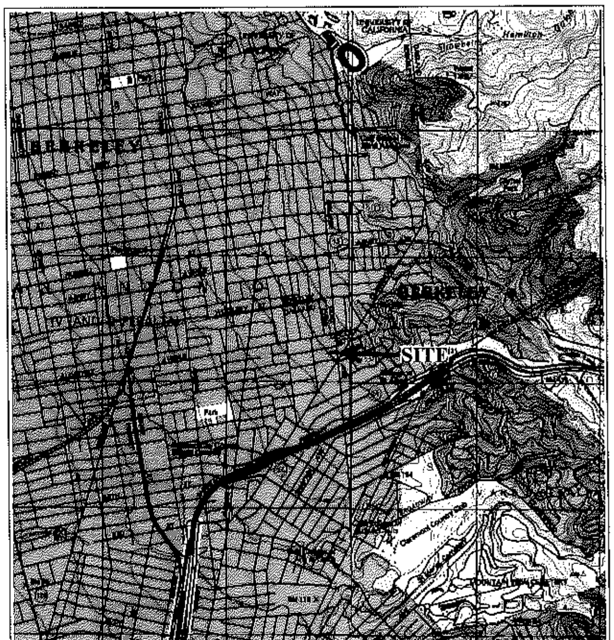
## Former Red Hanger Kleaners Site

6239 College Avenue
Oakland, California
Alameda County
ACEH File No. RO0002981
October 2015

This fact sheet is being provided to describe site background, past work to investigate site contamination, next steps, the oversight process for the site, and how you can obtain more information.

Fall, 2015

The Alameda County Environmental Health Department (ACEH) is issuing this fact sheet to inform you of ongoing investigation work at the former Red Hanger Kleaners (site), located at 6239 College Avenue in Oakland, California (Figure 1).



Base Map From:
U.S. Geologic Survey 7.5 Minute Quadrangles Oakland East, and Oakland West, both maps edited 1996.

Figure 1
Site Location Map
Red Hanger Kleaners
6239 College Avenue
Oakland, California

0 1,000 2,000
Approximate Scale in Feet
N

The purpose of the investigation work is to gather more information on the nature and extent of soil gas contamination in the vicinity of the former dry cleaning suite. This fact sheet contains information concerning site background, results of recent investigations, mitigation activities, and information contacts. A glossary of certain terms also is included.

**Site Background** - The former Red Hanger Kleaners site currently is situated within a commercial portion of College Avenue just north of Claremont Avenue near the corner of 63rd Street. The subject site is a three-story building on a 0.17-acre lot with several operating businesses within suites at the building. The former Red Hanger Kleaners store occupied the ground floor of the building from 1987 until 2015 (approximately 28 years). The adjacent store to the north at 6251-6255 College Avenue was reported to have been occupied by dry cleaner stores from 1953 to 1987 (approximately 34 years) with Red Hanger Kleaners identified at this location from 1982 to 1987. It is unknown when the dry cleaning operation utilized tetrachloroethene (PCE) as the dry cleaning solvent. Volatile Organic Compounds (VOCs) such as PCE are able to move in the environment, from soil to groundwater, from groundwater to soil, and from groundwater or soil to air. Of particular interest is the potential for movement of VOCs into the inside of buildings where people could be exposed to contaminated air. This process is called soil-vapor intrusion into indoor air.

**Glossary of Terms**

*Soil Gas*—Soil gas refers to the air that is present in the open spaces between soil particles between the ground surface and the water table. It includes air (primarily oxygen and nitrogen, like above ground), water vapor, and occasionally pollutants.

*Volatile organic compounds (VOCs)*—VOCs are organic liquids, including many common solvents that readily evaporate at temperatures normally found at ground surface and at shallow depths. Many VOCs are known human carcinogens. Examples of VOC usage include dry cleaning solvent, carburetor cleaner, brake cleaner, and paint solvents.

**Recent Investigation Activities** - Environmental investigations have been performed at the site beginning in March 2005; these investigations have included sampling and analysis of soil, soil-vapor, groundwater and indoor air to assess the type and extent of contamination at the site. In total, laboratory analysis has been conducted on 69 samples collected from 48 borings and indoor air sampling containers.

Investigations performed at the site have identified that VOCs, specifically PCE, leaked into the subsurface beneath the subject building. Soil, groundwater, and soil vapor samples have been collected to date beneath and in the vicinity of the dry cleaning suite; however, work is planned to collect additional soil vapor samples in the vicinity of the site building in order to define the lateral and vertical extent of the PCE contamination.

Concentrations of PCE reported in soil-vapor and indoor air samples were found at concentrations greater than applicable regulatory agency screening levels requiring additional investigation. In addition, trichloroethene (TCE) has been detected in indoor air samples at concentrations greater than applicable regulatory agency screening levels requiring additional investigation and mitigation. The presence of these chemicals at concentrations exceeding regulatory screening levels does not indicate that adverse impacts to human health or the environment are necessarily occurring, but rather indicates that a potential for adverse risk may exist and that additional evaluation is warranted. Based on recent government information regarding the effects of TCE with pregnant women, we are providing you with this notification as a precaution and to advise you that women who are of child-bearing age or who suspect that they might be pregnant are advised to not enter the premises until TCE air concentrations in the building are reduced.

The highest concentrations of VOCs in indoor air are located in the hallway and a bathroom on the second and third floors of the building. Lower concentrations of PCE were detected in tenant suites on the second and third floors.

Because the screening levels were exceeded and indoor air samples indicated vapor intrusion of PCE into a number of suites at the site, EFI Global Inc. (EFI) was recently requested to evaluate health risks associated with the contamination and the analysis indicated that there does not appear to be an imminent risk, but these concentrations still require clean-up.

**Cleanup of Environmental Impacts** – As discussed, VOCs have been detected in soil, groundwater, soil-vapor and indoor air samples at the site. In general, soil and groundwater concentrations reported during the investigations performed at the site are near or below regulatory screening levels. However, soil-vapor concentrations reported during investigative activities are above regulatory screening levels and are likely the cause of PCE vapors intruding into the subject facility. PCE vapor concentrations reported in soil-vapor and indoor air require remediation (clean-up) at this time to mitigate the potential for health risks by reducing subsurface VOC concentrations.

**Soil-Vapor and Indoor Air Mitigation and Remediation** – EFI has been working with ACEH to plan and implement corrective action at the site in conjunction with site use. EFI will be preparing a work plan for subsurface investigation to determine the appropriate remedial measures for removal of residual soil-vapor impact from the subsurface at the site.

Initial mitigation measures that have been implemented include sealing cracks and holes in the floor of the former dry cleaner store and the elevator pit, and performing a smoke test to identify where sewer pipes could be leaking vapors from the subsurface into the building, and sealing any detected pipe leaks. Most recently mitigation measures that are being implemented currently include the installation of fresh air filtration systems in the second and third floor hallways, the stairwells, and in suites where outside air is not circulated into the building with the existing Heating, Ventilation and Air Conditioning (HVAC) system. In addition, the HVAC systems for suites where air can be introduced to the suite from outside of the building were recently modified to allow the additional air to be circulated into the building to increase fresh air intake into the suites. This will aid in reducing the overall residual impacts to indoor air.

**Next Steps** – Based on results of the upcoming subsurface investigation remedial solutions will be evaluated to reduce subsurface PCE concentrations.

The entire case file can be viewed over the internet on the ACEH at http://www.acgov.org/aceh/lop/ust.htm or at the State of California Water Resources Control Board website at http://geotracker.swrcb.ca.gov.

Please send written comments regarding the investigation and proposed actions to Keith Nowell at the address below.

**For More Information**

Please contact any of the following individuals with questions or concerns you may have:

Keith Nowell
Alameda County Environmental Health Case Manager
510-567-6764
keith.nowell@acgov.org

Paul King
P&D Environmental Inc.; Consultant
510-658-6916
Paul.King@pdenviro.com

mailto:

**Nowell, Keith, Env. Health**

**From:** PDKing0000@aol.com
**Sent:** Friday, October 02, 2015 8:25 AM
**To:** Nowell, Keith, Env. Health
**Cc:** Gary_Bates@efiglobal.com
**Subject:** Interim Framework TCE
**Attachments:** TCE_Interim_VI_Framework SFRWQCB.pdf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San Francisco Bay Regional Water Quality Control Board

# Interim Framework for Assessment of Vapor Intrusion at TCE-Contaminated Sites in the San Francisco Bay Region

October 16, 2014 – D R A F T

Prepared by the Trichloroethene Vapor Intrusion Workgroup:
Uta Hellmann-Blumberg, PhD
Alec Naugle, PG
Roger Papler, PG
Cheryl Prowell, PE
Ross Steenson, CHG

Approved by:
Stephen Hill, Toxics Cleanup Division Chief
Terry Seward, Groundwater Protection Division Chief

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3 – Comparison of 2008 versus 2013 Residential Indoor Air ESLs for TCE

4 – USEPA Region 9 Accelerated Response Action Levels and Urgent Response Action Levels for Indoor Air

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1 – Modified Stepwise Approach with Interim Response Actions for TCE

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A – Discussion of the Six Items in the USEPA Region 9 Letter

B – Johnson & Ettinger Model Printouts for Groundwater TCE Trigger Levels

## Acronyms and Abbreviations

| | |
|---|---|
| ARAL | USEPA Accelerated Response Action Level |
| bgs | Below ground surface |
| CalEPA | California Environmental Protection Agency (includes the Air Resources Board; Department of Pesticide Regulation; Department of Resources Recycling and Recovery or CalRecycle; Department of Toxic Substances Control; Office of Environmental Health Hazard Assessment; and State Water Resources Control Board and Regional Water Quality Control Boards. |
| CAP | Corrective Action Plan |
| COPC | Chemical of potential concern |
| CSM | Conceptual Site Model (sometimes called Site Conceptual Model) |
| CVOC | Chlorinated volatile organic compound/chemical |
| DTSC | Department of Toxic Substances Control |
| DTSC-HERO | DTSC Health and Ecological Risk Office |
| EC | Engineering control |
| ESA | Environmental Site Assessment |
| ESL | Water Board Environmental Screening Level |
| FAQ | Frequently asked question |
| GWIA ESLs | Groundwater-to-indoor-air ESLs |
| HI | Hazard Index (sum of the hazard quotients or HQs for all chemicals with similar non-carcinogenic health effects and their exposure pathways) |
| HQ | Hazard Quotient (ratio of non-carcinogenic health effects of the exposure under consideration over the exposure at which no adverse effects have been observed; an HQ > 1 means that an adverse effect can occur but does not necessarily mean an adverse effect will occur) |
| HVAC | Heating, ventilation, and air conditioning |
| IC | Institutional control |
| Johnson & Ettinger | Johnson & Ettinger Model |
| Low-Threat Tool | Water Board Assessment Tool for Closure of Low-Threat Chlorinated Solvent Sites – Interim Final |
| MassDEP | Massachusetts Department of Environmental Protection |
| NA | Not applicable |
| NAVFAC | Naval Facilities Engineering Command |

| | |
|---|---|
| NPL | National Priorities List |
| PCE | Tetrachloroethene (also known as tetrachloroethylene or perchloroethylene) |
| ppb | Parts per billion |
| RAP | Remedial Action Plan |
| RfC | Inhalation Reference Concentration (non-carcinogens) |
| RfD | Oral Reference Dose (non-carcinogens) |
| RSL | USEPA Regional Screening Level |
| Soil Gas Advisory | CalEPA Advisory – Active Soil Gas Investigations |
| SWRCB | State Water Resources Control Board |
| TCE | Trichloroethene (also known as trichloroethylene) |
| URAL | USEPA Urgent Response Action Level |
| USCS | Unified Soil Classification System |
| USDA | United States Department of Agriculture |
| USEPA | U.S. Environmental Protection Agency |
| VI | Vapor intrusion |
| VIG | DTSC Vapor Intrusion Guidance |
| VIM | Vapor intrusion mitigation |
| VIMA | DTSC Vapor Intrusion Mitigation Advisory |
| VOC | Volatile organic compound/chemical |
| Water Board | San Francisco Bay Regional Water Quality Control Board |
| $\mu g/m^3$ | Micrograms per cubic meter |
| $\mu g/L$ | Micrograms per liter |

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## Executive Summary

The purpose of the Interim Framework for Assessment of Vapor Intrusion at TCE-Contaminated Sites in the San Francisco Bay Region ("Framework") is to provide a set of guidelines for addressing vapor intrusion (VI) of trichloroethene (TCE) and other chlorinated volatile organic compounds from the subsurface to indoor air, at all sites under the oversight of the San Francisco Bay Regional Water Quality Control Board ("Water Board"). In other words, it is intended to complement professional judgment, not to replace it. Moreover, it is intended to complement related documents provided by the Water Board such as the 2013 Environmental Screening Levels (ESLs) and the 2009 Assessment Tool for Closure of Low-Threat Chlorinated Solvent Sites. It does not establish policy or regulation and is intended as guidance for Water Board staff. Water Board staff anticipates the need to periodically update the Framework as the science evolves and when the Department of Toxic Substances Control (DTSC) issues an update to its 2011 Vapor Intrusion Guidance, on which much of this guidance is based.

The following prompted the development of this Framework:

- Updated information regarding the TCE short-term toxicity, specifically an increased risk of fetal heart defects that was included as one of the non-cancer endpoints in the derivation of widely used chronic non-cancer toxicity factors.
- USEPA Region 9 TCE guidance ("Region 9 guidance") consisting of the December 3, 2013, letter also known as "South Bay Letter" together with the follow-up memorandum from July 9, 2014, which provide USEPA-recommended interim action levels (termed "accelerated response action levels" and "urgent response action levels") for TCE in indoor air and recommendations for indoor air sampling.
- Increased awareness of the uncertainties related to the collection and interpretation of data for VI investigations.
- A recent surge in building and redevelopment activities on or near contaminated sites in the Bay Area and a need to consider vapor intrusion mitigation (VIM) as an interim measure at sites where cleanup of the subsurface VOC vapor source is progressing slowly.

This Framework summarizes the Water Board's VI approach, explains background information on the toxicity criteria for evaluating cancer and non-cancer health effects of TCE, and presents guidelines for evaluating VI mitigation. Specific features are:

- A listing of CalEPA VI guidance (Section 2.a).
- A modified stepwise approach and expanded description of evaluating multiple lines of evidence based on the DTSC's 2011 vapor intrusion guidance (Section 3).

- Interim response action levels for TCE in indoor air and interim response actions designed to reduce indoor air TCE levels consistent with the USEPA Region 9 guidance (Section 4.b.i).
- Specific recommendations for mitigation of indoor air TCE threats (Section 4.b.ii).
- TCE trigger levels for soil gas and groundwater that prompt accelerated VI investigation when exceeded. Soil-gas trigger levels for TCE are based on the same default attenuation factors from DTSC that are used for the Water Board's ESLs. Groundwater trigger levels for TCE are derived by two models similar to those used for the groundwater-to-indoor air ESLs for TCE (Section 4.c).
- Guidelines for evaluating VIM systems and determining the appropriate level of regulatory agency oversight relative to 1) the VI threat and 2) a proposed mitigation system's intrinsic reliability (Section 5).
- Discussion of VI concerns for closed landfills (Section 6).
- Discussion of the six items in the South Bay Letter and modifications to the Water Board's VI approach (Attachment A).

# 1. Introduction

## a. Scope and Purpose

This Framework addresses vapor intrusion concerns largely driven by recent discussions regarding the short-term toxicity of trichloroethene (TCE) and uncertainties associated with vapor intrusion (VI) investigations. It presents information intended for staff of the San Francisco Bay Regional Water Quality Control Board (Water Board) regarding the following VI issues:

1. Modifications to the Water Board VI approach in response to the USEPA Region 9 December 3, 2013, letter with specific guidelines for South Bay National Priorities List (NPL) sites under joint oversight (USEPA, 2013c).
2. Integration of two approaches to investigate and evaluate vapor intrusion: the stepwise approach, which starts with review of available information and subsurface investigation and then moves towards sampling indoor air if necessary, and multiple lines of evidence approach to data evaluation.
3. Explanation of the toxicological findings that gave rise to concerns about adverse health effects resulting from short-term (three weeks or less) exposure to TCE by inhalation of indoor air.
4. Evaluation criteria for proposed vapor intrusion mitigation (VIM) systems.

Recent research indicates that adequately evaluating vapor intrusion requires more comprehensive (and more costly) datasets than commonly used in the past due to concerns about the uncertainties resulting from the spatial and temporal variability in the data and potential short-term effects of TCE. As a result, these investigations are more resource-intensive both for responsible parties and Water Board staff. This Framework is designed considering reasonable balance between requiring sufficient and appropriate data to make timely, informed decisions, and the resource burdens to responsible parties, Water Board staff, and other stakeholders in doing so. Water Board staff will continue to focus resources towards those sites presenting the greatest threats.

This Framework primarily addresses VI for chlorinated volatile organic compounds (CVOCs, e.g., TCE) not petroleum hydrocarbons. There are significant differences between CVOC vapor intrusion and petroleum vapor intrusion. For CVOCs, biodegradation typically occurs under anaerobic conditions, which is generally slower than aerobic biodegradation. In contrast, petroleum hydrocarbons are aerobically degraded (oxidized) by nearly ubiquitous microbes in both the groundwater and the vadose zone. The concentrations of petroleum hydrocarbons can be decreased by several orders of magnitude over short vertical distances (SWRCB, 2012). The USEPA document *Petroleum Hydrocarbons and Chlorinated Solvents Differ in their Potential for Vapor Intrusion* (USEPA, 2012b) provides an excellent discussion of the differences in the vapor intrusion potential of CVOCs and petroleum hydrocarbons.

VI evaluation is a critical component of a regulatory case closure process. The Framework is consistent with the overall Water Board approach to site evaluation and closure for sites contaminated with CVOCs (e.g., TCE) as described in the *Assessment Tool for Closure of Low-Threat Chlorinated Solvent Sites – Interim Final* (Low-Threat Tool; Water Board, 2009).

While vapor intrusion is the focus of this Framework, the investigation and cleanup of TCE-contaminated groundwater for protection of drinking water resources remains a priority for the Water Board.

### b. Disclaimers

This Framework is an interim document prepared by Water Board staff. It is not intended to establish policy or regulation. The information presented in this document is not a final Board action. Water Board staff reserves the right to change this information at any time without public notice. This document is not intended, nor can it be relied upon, to create any rights enforceable by any party in litigation in the State of California. Based on an analysis of site-specific circumstances, Water Board staff may decide to act at variance with the guidelines in this document.

## 2. Background

### a. Vapor Transport in the Subsurface

Evaluation of vapor intrusion can be complex because there are many different factors that influence when or if VI will occur. Major technical aspects include the characteristics of the subsurface VOC vapor source (strength and location), vadose zone geology (soil type, stratum continuity), vadose zone hydrology (moisture content, depth to groundwater, capillary fringe thickness), vadose zone chemical and biological factors that determine the level of biodegradation, building (type and condition of slab, operation of the HVAC), and climate. An excellent discussion of the technical aspects of VI is USEPA *Conceptual Model Scenarios for the Vapor Intrusion Pathway* (USEPA, 2012a).

The transport of vapors in the vadose zone is dominated by diffusion with advection only occurring in the immediate vicinity of buildings or when there is a pressure gradient (e.g., landfills) (USEPA, 2012a). Diffusion occurs from areas of greater concentration to lower concentration. Air-phase diffusion is about 10,000-times greater than water-phase diffusion. Vapor-phase diffusion in the subsurface varies with total porosity and moisture content (i.e., how much of that total porosity is water filled). McAlary (2009) showed:

> "For a given compound, the effective vapor-phase diffusion coefficient in gravel with 32.5% total porosity, 10% water-filled porosity, and 22.5% air-filled porosity is only 3.5 times higher than the diffusion coefficient in clay with 50% total porosity, 30% water-filled porosity, and 20% air-filled porosity, even though the permeability of the clay may be a million times lower."

Where the VOC vapor source is groundwater, the capillary fringe can significantly influence the attenuation of vapors. USEPA (2012a) provides a useful description of how the capillary fringe functions for vapor transport:

> "The capillary fringe is a zone immediately above the water table that acts like a sponge sucking water up from the underlying groundwater. At the base of the capillary fringe, most of the soil pores are completely filled with water. Above this zone, water content

decreases with increasing distance above the water table. The grain size of the soil particles influences the height of the capillary fringe: fine-grained soils exert greater suction on the groundwater table, resulting in a thicker capillary fringe that may be irregular across the upper surface, while coarse-grained soils exert less suction, resulting in a thinner capillary fringe that tends to be flatter along the top. The capillary fringe may reduce the emission of vapors from a dissolved groundwater source because its elevated water content limits the vapor migration (VOCs migrate much more slowly through water than through air)."

### b. CalEPA Vapor Intrusion Guidance

For evaluation of the VI pathway (VI evaluation), in addition to the *Environmental Screening Levels* (ESLs; Water Board, 2013a and 2013b), the Water Board utilizes the four guidance documents issued by the Department of Toxic Substances Control (DTSC) or the California Environmental Protection Agency (CalEPA) that address VI sampling, evaluation, mitigation, remediation, and public participation. These documents and a summary of their content are listed below:

- *Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air* (Vapor Intrusion Guidance or VIG) (DTSC, 2011a) – The VIG presents the overall approach to VI evaluation, which includes 11 steps, and multiple lines of evidence. The document also includes sampling methodology for indoor air and subslab soil gas probe installation as well as site-specific inputs for Johnson & Ettinger modeling.
- *Final Vapor Intrusion Mitigation Advisory, Revision 1* (VIMA) (DTSC, 2011b) – The VIMA addresses all aspects of VIM system design and implementation.
- *Advisory – Active Soil Gas Investigations* (Soil Gas Advisory) (CalEPA, 2012) – The Soil Gas Advisory addresses sampling of soil gas by active removal of vapor and laboratory analysis.
- *Final Vapor Intrusion Public Participation Advisory* (VIPPA) (DTSC, 2012) – The VIPPA addresses public participation aspects specifically for VI issues such as public perceptions and concerns, risk communication, and other issues (e.g., privacy).

### c. USEPA Region 9 Guidance and Changes to the Water Board VI Approach

On December 3, 2013, USEPA Region 9 issued a letter ("South Bay Letter"; USEPA, 2013c) to the Water Board that provides guidelines and supplemental information for VI evaluations at nine South Bay Superfund or NPL sites with subsurface TCE and PCE contamination that the Water Board oversees. The South Bay Letter includes an attachment with the guidelines and supplemental information for six specific items. Attachment A includes a discussion of the six items and adjustments to the Water Board VI approach in response to the South Bay Letter.

In response to the USEPA's South Bay Letter and subsequent discussions, the following two key changes have been incorporated into this Framework:

- TCE Action Levels for Indoor Air – As discussed in Section 4, Water Board staff now provisionally incorporates the USEPA Indoor Air TCE Action Levels to determine when interim response actions (mitigation measures) are warranted;

- Indoor Air Sampling with HVAC-Off as well as HVAC-On – The previous Water Board approach only included HVAC-On indoor air sampling. Water Board staff now incorporates HVAC-Off indoor air sampling to assess building susceptibility to soil gas entry and whether the HVAC system is providing a level of mitigation.

## 3. Integrating the Stepwise Approach with Multiple Lines of Evidence

The stepwise approach is described in the DTSC VIG and refers to a process of site investigation that begins with 1) assembling available information regarding the release, contaminant transport and potential exposure pathways, 2) conducting subsurface sampling, and 3) progressing towards evaluating the building and indoor air, if necessary. At the same time, evaluating multiple lines of evidence means considering more than one type of information (Table 1) before making decisions about a potential VI threat.

The following sections (3a – d) present the Water Board's approach to evaluating vapor intrusion threats. It includes a modified stepwise approach, a description of multiple lines of evidence that is expanded from the VIG (Step 2, p. 4), a summary of the key data lines of evidence, and some special considerations.

### a. Modified Stepwise Approach to Vapor Intrusion Evaluation

The 11 steps in the stepwise approach generally proceed from the subsurface source toward the indoor receptor:

- Steps 1 through 5 consist of a <u>subsurface investigation</u> (site history, geology/hydrogeology, utility corridor assessment, and extent of contaminants defined by sampling soil, soil gas, and groundwater), and development of a conceptual site model (CSM);
- Steps 6 and 7 describe a <u>building envelope[1] investigation</u> and include subslab soil gas sampling, crawl space air sampling, and site-specific modeling (e.g., Johnson & Ettinger model).
- Steps 8 through 10 are focused on the <u>indoor air investigation,</u> including work plan development, building survey for potential indoor air sources, and indoor air and ambient air sampling during at least two rounds of sampling to determine seasonal variations. Pathway sampling (likely locations for subsurface vapor entry such as sumps, floor drains, elevator shafts or stairwells) is included during this process. Indoor air sampling for all chemicals of potential concern (COPCs) is conducted at the appropriate point during implementation of the stepwise approach or if the appropriate media-specific Water Board Trigger Level for TCE is exceeded (Section 4).
- Step 11 addresses <u>subsurface remediation, building mitigation, institutional controls and long-term monitoring</u>.

A modified stepwise approach is presented in Table 1 and Figure 1 that incorporates the TCE Trigger Levels (discussed in Section 4.c) used to prioritize indoor air sampling.

[1] Building envelope = ground surface/building interface.

| Table 1 – Modified Stepwise Approach for Vapor Intrusion Evaluations | | |
|---|---|---|
| | **Steps in the VIG** | **Description** |
| **Subsurface Investigation and Conceptual Site Model Development** | Step 1 – Identify all spills and releases | Review site history records to identify known or suspected areas of VOC use. |
| | Step 2 – Characterize the site | Define the lateral and vertical extent of VOCs in soil, soil gas and groundwater to locate the subsurface VOC vapor source. Characterize site geology, potential preferential pathways, and building susceptibility. |
| | Step 3 – Evaluate whether there is a complete exposure pathway | If the pathway is complete (i.e., there is a subsurface VOC vapor source and buildings are present above the contamination, within 100 feet of the source), develop public participation plan and begin public notification. |
| | Step 4 (existing building) – Determine if there is an imminent hazard | If appropriate, inspect the building and talk to occupants to determine if there are imminent hazards. Imminent hazards include noticeable odors and potentially explosive conditions (e.g., gasoline, methane) or other conditions that can be detected without instrumentation or laboratory analyses. |
| | Step 5 – Perform screening evaluation using default attenuation factors | Compare all data to appropriate VI ESLs and TCE Trigger Levels (Section 4). If the site fails the ESL screening evaluation, options include proceeding stepwise to a more detailed, site-specific evaluation (Steps 6 and 7) or skipping to later steps (indoor air sampling, Steps 8 through 10; or remediation and/or mitigation, Step 11). If the site fails the TCE Trigger Level evaluation, then indoor air sampling (Steps 8 through 10) should be conducted while site investigation and cleanup activities continue. |
| **Building Envelope Investigation and Modeling** | Step 6 – If site fails Step 5, collect additional site data | Collect and evaluate: (1) soil samples for physical properties (for inputs to a site-specific Johnson & Ettinger model); (2) subslab soil gas samples; or (3) crawl space air samples. |
| | Step 7 – Site-specific screening evaluation (modeling) | Use a Johnson & Ettinger model to derive site-specific attenuation factors. If the site fails Step 7, proceed to indoor air sampling (Steps 8 through 10) or skip to remediation and mitigation (Step 11). |
| **Indoor Air Investigation** | Step 8 (existing building) – Indoor Air Sampling Part 1: building survey, indoor air sampling work plan, contingency plan, notification | Plan indoor air sampling: 1) survey the building to identify potential vapor entry points (see Building Susceptibility in Section 3.d.ii) and sources (e.g., household products or building materials) that could confound indoor air sampling results; 2) prepare a detailed plan for indoor and outdoor air sampling (e.g., locations, methods, etc.), laboratory analytical methods and reporting limits; 3) develop a contingency plan should results indicate significant threat; and 4) prepare public notification. |
| | Step 9 (existing building) – Indoor Air Sampling Part 2: perform indoor air sampling | Indoor and outdoor air sampling is performed over a minimum of two seasons to include cold weather sampling. See the VIG for duration, number of sampling events, number of samples, locations, equipment, and analytes. The collection of pathway samples (likely locations for subsurface vapor entry like drains, utilities, sumps, etc.) is also discussed. |
| | Step 10 (existing building) – Indoor Air Sampling Part 3: Evaluate the data | Promptly interpret all data, weigh lines of evidence, characterize the risks, and evaluate risk management decisions. Prepare post-sampling public notification, giving consideration to privacy concerns. |
| **Building Mitigation and Subsurface Remediation** | Step 11a (existing building) – If site fails Step 10, conduct remediation and/or mitigation as appropriate | If there is significant current risk, implement VIM in accordance with the contingency plan. Remediate the subsurface vapor source until it no longer poses a significant threat. VIM systems are not considered a means of remediating subsurface vapor source areas. |
| | Step 11b (no buildings/ future construction) – Remediate contamination or implement ICs | Remediate subsurface vapor source. If this is not feasible (e.g., accessibility), then engineering controls and (ICs; e.g., land use covenant) can be used to control exposure. When new construction is proposed, remediation and/or mitigation will be required. |
| | Step 11c (all sites) – Institute long-term monitoring. | Evaluate the need for long-term monitoring and amount of regulatory oversight for sites with VIM systems. |

## b. Evaluating Multiple Lines of Evidence

Evaluation of the VI pathway is complex because there are subsurface factors as well as building and climate factors affecting the extent to which contaminant vapors move from subsurface into overlying buildings. There is considerable uncertainty associated with individual lines of evidence resulting from the spatial and temporal variability of volatile contaminant concentrations in groundwater, soil gas (including subslab soil gas), and indoor air (Holton et al. 2013; Winkler et al. 2001). Multiple lines of evidence are used to reduce these uncertainties and increase confidence in making site management decisions regarding VI.

The following considerations are intended to supplement the VIG and provide the basic principles for evaluating lines of evidence:

- **Developing and Maintaining the CSM** – The lines of evidence should be evaluated in light of the CSM, and the CSM should be revised as lines of evidence are added or conflicting lines of evidence are resolved.

- **Weighting Based on Proximity of Sampled Medium to the Receptor** – Typically, the closer the sampled medium is to the receptor, the greater those data are weighted. However, the data may also be weighted on quality and representativeness of samples or other factors.

- **Minimum Number of Data Lines of Evidence** – Reliance on a single data line of evidence generally is not considered adequate. In general, Water Board staff requires two data lines of evidence that are in agreement as the minimum number of data lines of evidence necessary for a complete VI evaluation. In situations where the data lines of evidence are not clearly in agreement, then adding another data line of evidence, continued temporal monitoring to better resolve a data line of evidence, or increasing data density is advised.

  In some circumstances, a single data line of evidence may be sufficient if supported by a robust CSM. One example is an offsite area where groundwater is the only subsurface VOC vapor source, the extent of VOCs in groundwater are adequately defined laterally and vertically, concentration trends are stable or decreasing, depth to groundwater is greater than 10 feet bgs such that there is a reduced likelihood of existing or future preferential pathways, and relevant ESLs are met. In such a case, Water Board staff would rely on direct comparison of contaminant concentrations in groundwater to the groundwater-to-indoor-air ESLs (GWIA ESLs).

- **Characteristics of Primary Data Lines of Evidence** – Each data line of evidence should be weighed based on an understanding of its limitations. For instance, soil gas concentrations typically show considerable spatial and temporal variability. Therefore, reliance on a few soil gas samples from a single sampling event would introduce significant uncertainty into a site management decision.

- **Special Considerations** – There are factors that need to be evaluated as part of every vapor intrusion evaluation including proximity to the subsurface VOC vapor source and potential preferential pathways and building susceptibility. In addition, for situations where modeling is incorporated into the evaluation, there are several aspects that need to be addressed to enable the Water Board to properly weight the modeling results as a line of evidence.

Potential lines of evidence considered by Water Board staff are listed in Table 2. The lines are not in any particular order and should not be assumed to carry equal weight.

**Table 2 – Lines of Evidence for Vapor Intrusion Evaluations***

| Line of Evidence | Reference for Further Information |
|---|---|
| Sources | ESL User's Guide Section 1.3 (Conceptual Site Models) |
| Release mechanisms | |
| Site history | |
| Routes of fate and transport | |
| Preferential pathways | |
| Potential receptors and exposure pathways | |
| Groundwater data | VIG, Step 5 (p. 17) |
| Soil gas data | Soil Gas Advisory and VIG, Step 5 (p. 17) |
| Subslab soil gas data | VIG, Step 6 (p. 21) and Appendix G |
| Passive soil gas data | VIG, p. Step 2 (p. 12) and Soil Gas Advisory Appendix A |
| Soil matrix data | VIG, Step 5 (p. 17) and Appendix E |
| Crawl space air data | VIG, Step 6 (p. 22) |
| Indoor air data | VIG, Steps 8 through 10, (p. 25); and Appendices K, L, and M |
| Outdoor (ambient) air data | VIG, Step 9 (p. 31) |
| Radon data | VIG, Step 7 (p. 24) and Step 9 (p. 34), NAVFAC |
| Building construction/susceptibility | VIG, Step 8 (p. 25) |
| Spatial and temporal variability of data | VIG, Step 2 (p. 6); Step 5 (p. 18); Step 6 (p. 22); and Step 8 (p. 26). |
| Comparison of constituent ratios between different media (e.g., soil gas versus indoor air) | VIG, Step 10 (p. 34) |
| Site-specific fate and transport modeling (e.g., Johnson & Ettinger model) | VIG, Step 7 (p. 22) and Appendix D; and ESL User's Guide Appendix D |
| Portable GC/MS for real-time sampling | VIG Step 8 (p. 27), NAVFAC (2013) |
| Building pressure control | NAVFAC (2013) |
| Compound-specific isotope analysis | VIG Step 10 (p. 34), NAVFAC (2013) |
| **Note:** *Lines of evidence do not have equal weight and are listed in no particular order. | |

## c. Primary Data Lines of Evidence

### i. Groundwater

Groundwater samples for vapor intrusion evaluations should be collected in accordance with the recommendations in the VIG. The default GWIA ESLs are based on a Johnson & Ettinger model with soil layer and parameter inputs referred to as the Fine-Coarse Scenario to match an empirically-derived attenuation factor (ESL User's Guide Section 6.3). This model is considered protective at depths at or below 10 feet bgs when other criteria are met. At shallower depths, the Fine-Coarse Scenario-derived GWIA ESLs should not be used.

Shallow groundwater raises several questions regarding the applicability of available models and screening levels. In extreme cases, fluctuations in already shallow groundwater may lead to contact with the slab. Options for sites where groundwater is shallower than 10 feet bgs, are, in order of preference: 1) develop an additional line of evidence (e.g., soil gas if there is sufficient vadose zone or proceed to indoor air sampling); 2) use the Sand Scenario-derived ESLs (ESL Detail Table E-1); or 3) develop a site-specific Johnson & Ettinger model. The latter may not be appropriate for all site conditions.

### ii. Soil Gas

Soil gas samples should be collected in accordance with the Soil Gas Advisory (CalEPA, 2012) or other technically equivalent methods (e.g., for fine-grained soils, see McAlary, 2009). Water Board staff considers the soil gas line of evidence (i.e., direct measurement of vapor concentrations) as critical to most vapor intrusion evaluations, provided that the soil gas line of evidence is developed as discussed below.

There are two primary objectives for soil gas sampling: 1) assessing whether the subsurface VOC vapor source is vadose zone soil and/or groundwater; and 2) collecting appropriate near-source soil gas data for comparison to soil gas ESLs (evaluation of VI potential).

Vertical soil gas sampling is used to locate the VOC vapor source, ideally with numerous vertical profiles of soil gas (CalEPA, 2012). After the VOC vapor source is located, then additional soil gas sampling can be focused close to the source to collect data that can be used for comparison against soil gas ESLs or evaluated with a site-specific Johnson & Ettinger model. Different vertical soil gas concentration profiles develop in areas where there is ground cover (e.g., building foundations and pavement) versus uncovered areas (see Step 2 of the VIG and Section 4 of the USEPA *Conceptual Model Scenarios for the Vapor Intrusion Pathway*, (USEPA, 2012a). Near-source soil gas data are considered to better represent soil gas concentrations near the foundation of a structure than soil gas samples collected at shallow depths outside a building footprint. The VIG cautions against the use of shallow soil gas data where those data are not collected immediately above the contaminant source because they likely are biased low.

For most sites, soil gas concentrations should be monitored over time to establish trends (i.e., there is uncertainty with reliance on a single soil gas sampling event) because of temporal fluctuations of soil gas concentrations.

### iii. Subslab Soil Gas

Subslab soil gas samples should be collected in accordance with the VIG. Subslab soil gas data are useful in assessing vapor concentrations closest to the building and are recommended to be collected concurrently with indoor air data to help determine whether TCE detected in indoor air is from VI or some other source (e.g., indoor TCE source or outdoor air). A sufficient number and distribution of samples should be collected recognizing that subslab soil gas concentrations typically spatially vary one or more orders of magnitude beneath the slab (Luo et al., 2009). Reliance on subslab soil gas data alone is not acceptable because bi-directional flow across the slab is possible such that in some situations subslab vapors may originate from indoor air rather than the subsurface (McHugh et al., 2006).

The Water Board does not utilize the VIG default subslab attenuation factor (0.05) because it was derived using the USEPA Vapor Intrusion Database, and significant validity concerns have been identified regarding whether it is possible to derive subslab to indoor air attenuation factors given the extreme temporal and spatial variability of both indoor air data and subslab soil gas data (Song et al., 2011; Song et al., 2014; Yao et al., 2013; Holton et al., 2013). Until the Water Board selects a default subslab attenuation factor, Water Board staff recommends collecting subslab soil gas samples concurrently with indoor air samples as discussed above.

### iv. Crawl Space Air

Crawl space air samples (air in the area of a raised foundation) should be collected in general accordance with VIG methods for indoor air sampling. Samples should be collected towards the center of the building footprint where the potential threat is greatest, particularly for enclosed crawl spaces, as well as potentially near the edge of the building. The Water Board uses the VIG default crawlspace attenuation factor of 1.0 (i.e., no attenuation) to evaluate crawlspace air data. Crawl space air data may be less affected by consumer products and potentially less challenging to interpret, than indoor air.

### v. Indoor Air

Indoor air and ambient air samples should be collected in accordance with the VIG. The process of indoor air sampling can be complex because it involves a building survey to identify potential confounding factors (e.g., indoor sources), multiple rounds of indoor air sampling due to significant temporal variability, concurrent ambient air sampling, potentially concurrent subslab soil gas sampling, and weighing these lines of evidence to interpret the indoor air results.

In the normal progression of the stepwise approach, Water Board staff does not recommend skipping ahead to indoor air sampling unless the TCE Trigger Levels are exceeded (Section 4) or there are other limitations (e.g., groundwater is so shallow that soil gas sampling is not possible).

Indoor air typically contains detectable levels of VOCs (USEPA, 2011a) and likely will require assessing the source of the detections (e.g., consumer products, building materials, ambient air, intruding subsurface vapors, or a combination thereof). One of the simplest techniques to distinguish between sources is comparing chemical constituent ratios detected in indoor air and subsurface media (e.g., soil gas). The U.S. Department of Health & Human Services maintains the Household Products Database,[2] which can be searched for individual chemical ingredients (e.g., TCE).

For some situations, pathway sampling and other specialized techniques may be necessary to fully assess whether the sources of the detections are ambient air, indoor air sources (e.g., consumer products or building materials), intruding subsurface vapors, or some combination thereof. Some of the specialized techniques include a portable gas chromatograph with mass spectrometer (GC/MS) for real-time sampling (considered to be one of the most reliable tools to identify and locate indoor sources), building pressure control, and compound-specific isotope analysis. The Naval Facilities Engineering Compound (NAVFAC) *Innovative Vapor Intrusion Site Characterization Methods Fact Sheet* (NAVFAC, 2013) provides an excellent introduction on these and other techniques.

## d. Special Considerations

### i. Proximity to Subsurface Vapor Source

The character of VI evaluations varies depending on site location relative to the subsurface vapor source. Near the original release for instance, the expectation is that VOC vapors are diffusing from contaminated vadose zone soil as well as from contaminated groundwater. All else being equal, the vapor flux from vadose zone soil is expected to be greater than groundwater because substantial contaminant mass may remain in source area soils and the capillary fringe, which has a low air-filled porosity (i.e., significant moisture content), will suppress vapor diffusion from groundwater. In this situation, both soil gas and groundwater data are necessary to evaluate VI.

Away from the release location, the vapor source will primarily be contaminated groundwater. In the central portion of the plume, due to fluctuations in groundwater levels, there may be some contamination of the vadose zone over the zone of fluctuation. In the distal portions of the plume, there may be clean groundwater overlying the plume due to recharge or downward migration of the plume. This clean groundwater will further reduce vapor flux because diffusion through liquids is much slower than through gases.

### ii. Preferential Pathways and Building Susceptibility

The identification of preferential pathways and evaluation of building susceptibility is critical for any VI CSM because some site conditions can allow contaminated vapors to be transported into a building with little or no attenuation. Consequently, they represent additional lines of evidence. For sites with significant preferential pathways or building susceptibility, sampling of indoor air likely will be necessary, and subsurface data lines of evidence may be weighted much less in the overall evaluation.

The term preferential pathway is used to describe a manmade or natural pathway that provides a route of least resistance for transport of contaminated liquid or vapor. Examples of manmade

[2] http://hpd.nlm.nih.gov/index.htm.

preferential pathways include utility pipelines (e.g., storm or sanitary sewers), utility backfill (e.g., coarse porous and permeable materials), dry wells, improperly destroyed wells, large filled areas (e.g., former excavations), and foundation sub-base. Examples of natural pathways include vertical fractures in clay soils, bedding planes, sand and gravel channels, and fault and fracture zones.

Building susceptibility refers to building physical or operational features that may allow for vapors to intrude. These include, but are not limited to: cracks (holes or gaps), subgrade structures, floor drains, utility vaults or pits, sumps, elevator shafts (and pits for the pistons), basements, crawl spaces, modifications to the original foundation (e.g., repairs), staining or seeps (wet foundations). Characteristics of the HVAC system operation also are important (e.g., zones of mechanical influence, non-uniform over-pressurization). In addition, exhaust fans and furnaces can induce local pressure gradients that encourage VI. Review of site geology information, utility maps, building designs, and conducting building inspections to identify these features are an important part of VI evaluations.

### iii. Use of Site-Specific Johnson & Ettinger Models

The Water Board regularly receives reports in which VI risks from contaminated groundwater or soil gas are evaluated using a Johnson & Ettinger Model (several versions are available from USEPA and DTSC[3]) with site-specific inputs. These models usually are employed when the groundwater or soil gas concentrations exceed the default ESLs which incorporate default attenuation factors that are often considered too conservative by responsible parties. The site-specific model runs in the reports reviewed thus far have invariably indicated much greater attenuation (smaller attenuation factor) which in turn supported an argument that these concentrations do not pose unacceptable risk. When such a model is based on adequate site-specific geotechnical soil parameters and includes an uncertainty parameter analysis, and is consistent with VIG Appendix D (Overview of the Johnson and Ettinger Model) and *ESL User's Guide* Appendix D (Recommendations for Site-Specific Vapor Intrusion Models) such a model may be considered as an additional line of evidence. Otherwise, models may only be partially weighted when considered together with other lines of evidence. Solutions to shortcomings commonly encountered with the reports that present the results of site-specific VI models include the following:

- **Evaluate site conditions against model assumptions** – The model assumptions are listed in the *User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings* (Johnson & Ettinger User's Guide; USEPA, 2004). Key model assumptions are: 1) homogeneous soil properties in the horizontal plane; and 2) capillary fringe devoid of contamination. Site conditions, which typically are heterogeneous, should be evaluated against these assumptions.
- **Provide justification for the model soil layer design** – Reports documenting VI models should present the site geology and hydrogeology (e.g., depth to groundwater

[3] Water Board staff recommends the most recent (March 2014) DTSC-HERO SG-SCR and GW-SCR (one-layer) versions of the model, because HERO maintains the models (California toxicity factors, DTSC-recommended inputs, and chemical properties). Alternatively, the USEPA 2004 SG-ADV and GW-ADV (3-layer) versions can be used, but the model parameters will need to be updated.

and range of fluctuation) and provide a basis or correlation with the soil layers used in the models. Cross sections should be provided to visually depict the site geology and boring logs so that the cross sections can be checked.

- **Characterize model soil types and physical parameters by direct measurement (geotechnical laboratory analysis)** – Water Board staff supports the VIG statement that estimating soil physical properties from a visual description of subsurface soil, as annotated onto a boring log, is not an appropriate approach for the selection of model input parameters. Instead, to reduce uncertainty, direct measurement is recommended by the collection of at least three soil samples from each layer for analysis of grain size, moisture content, and other physical properties. These samples should be collected at lateral and vertical locations consistent with the subsurface VOC vapor source and the receptor being evaluated. Due to model sensitivity to soil moisture, consideration should be given to seasonal soil moisture fluctuations as well as spatial differences. For instance, soil beneath a large building or pavement may have less soil moisture than at an unpaved site. Preference should be given to soil sampling techniques that minimally disturb the soil core (e.g., Shelby tube), otherwise the sampling technique may compress the soil sample, thus increasing the bulk density and decreasing soil porosity. Soil physical property testing methods are listed in the VIG Appendix H (Soil Laboratory Measurements). The following aspects of the soil layer classification and physical parameters should be addressed in VI modeling reports.
    - Soil layer classification – The Johnson & Ettinger model uses the Soil Conservation Service (now US Department of Agriculture) Soil Texture Classification system, which differs from the Unified Soil Classification System commonly employed in the environmental remediation industry. Care should be taken that the grain size analysis results (i.e., soil texture) are classified using the same system as the model.
    - Soil physical parameters – Soil physical parameters as named in the Johnson & Ettinger model are dry bulk density, total porosity, and water-filled porosity (commonly referred to as soil moisture). The VIG recommends using the results that yield the most conservative output as inputs to the model.
- **Include an uncertainty and sensitivity analysis** – Even under optimal conditions, the Johnson & Ettinger model is generally considered to have a precision no greater than an order of magnitude (Weaver and Tillman, 2005; DTSC, 2011a). The uncertainty is due to the fact that few of the inputs are actually measured. Also, the Johnson & Ettinger modeling reports that the Water Board staff receives rarely, if ever, include calibrated site-specific data (i.e., indoor air measurements) that demonstrate the model's predictive capability. Therefore, running the model with order-of-magnitude variations of key parameters both individually and together helps decision makers by providing a range of outputs. Typically, key parameters include soil moisture (soil water-filled porosity in the model) and for groundwater models, the depth to groundwater and capillary fringe thickness. Further information is provided in the *ESL User's Guide* (Appendix D - Recommendations for Site-Specific Vapor Intrusion Models).

## 4. TCE Toxicity and Implications for Vapor Intrusion Approach

TCE can be present at a variety of sites. Significant releases to the environment are commonly associated with these historic uses:

- Industrial solvent (e.g., circuit board manufacturing, plating facilities).

- Metal parts cleaner (e.g., auto repair facilities with waste oil tanks).
- Degradation product of tetrachloroethene (PCE) (e.g., common dry-cleaning solvent) (Section 4.d).

As of 2011, the amount of TCE used in the United States is 255 million pounds per year and the primary purposes are: 1) an intermediate for manufacturing the refrigerant (closed system) HFC-134a (about 84%); and 2) as a solvent for metals degreasing (about 15%) (USEPA, 2014b). TCE is found in some products in homes and office settings (US Department of Human & Health Services, Household Products Database, accessed September 22, 2014).

## a. 2011 Changes to TCE Toxicity Criteria

Adverse health effects are evaluated by comparison to toxicity criteria set by federal or state agencies. Typically, these criteria are based on chronic effects and they are used for risk assessments, cleanup levels and screening levels. On September 28, 2011, the USEPA Integrated Risk Information System (IRIS) published new toxicity criteria for TCE (USEPA, 2011b). The most significant changes included a substantial reduction in the numbers for non-cancer inhalation toxicity factors and a change in the non-cancer toxicity endpoints (adverse effects on specific parts or functions of the human body).

The new toxicity factors have been widely accepted by regulators in California and other states for use in risk assessments, cleanup levels and screening levels, and they were incorporated into the 2013 ESLs. While changes in the TCE ESLs for cancer effects were small, changes in the magnitude of the non-cancer numbers were substantial (Table 3). For residential indoor air based on *non-cancer effects*, the 2008 ESL was 130 micrograms per cubic meter ($\mu g/m^3$), but is now 2.1 $\mu g/m^3$. At the same time, the residential indoor air ESL based on *cancer effects* is 0.59 $\mu g/m^3$, which is still about 3.5-times lower than the ESL based on non-cancer effects. The changes in indoor air residential ESLs between 2008 and 2013 are presented in Table 3.

**Table 3 – Comparison of 2008 versus 2013 Residential Indoor Air ESLs for TCE**

| Basis | 2008 Indoor Air ESL ($\mu g/m^3$) | 2013 Indoor Air ESL ($\mu g/m^3$) | Ratio (2013/2008) |
|---|---|---|---|
| Cancer | 1.2 | 0.59* | 0.49 |
| Non-Cancer | 130 | 2.1 | 0.02 |
| Most Conservative | 1.2 | 0.59 | not applicable |

**Note:**
* - The 2013 Residential Indoor Air Cancer ESL for TCE differs from the corresponding USEPA Residential Indoor Air Cancer RSL for TCE. The RSL uses a different formula for TCE to account for a mutagenic mechanism, whereas the ESLs use the standard formula for the cancer endpoint.

Adverse non-cancer health effects documented for TCE include hepatic, renal, neurological, immunological, reproductive and developmental damage. IRIS selected rodent studies showing adverse effects on the kidneys, the immune system and the developing fetus for the 2011 oral reference dose (RfD). The 2011 inhalation reference concentration (RfC) is also based on oral studies. The first two endpoints (kidney and immune system) are chronic (long-term) effects whereas the third (fetal heart malformation) is a developmental effect, which is necessarily the result of a short-term exposure, in this case three weeks during the first trimester of pregnancy. Congenital heart defects in humans are common, rarely debilitating, and may have multiple causes making it difficult to interpret epidemiological studies. However, both the new RfD for chronic *oral* exposure and the RfC for chronic *inhalation* exposure obtained from rodent studies suggest that the fetal heart malformation risk could increase in pregnant women exposed to TCE from contaminated drinking water as well as from inhalation of vapors (USEPA 2011b). IRIS did not provide any guidance whether the inclusion of the developmental endpoint was intended to trigger additional, accelerated actions by regulatory agencies overseeing TCE-contaminated sites. Regulatory agencies that adopted the 2011 IRIS toxicity factors have been grappling with the practical implications. Some of the agencies that have addressed the TCE short-term toxicity include USEPA Region 10 (USEPA, 2012d), USEPA Region 9 (USEPA, 2013c; discussed in Attachment A and Section 4.b); the Massachusetts Department of Environmental Health (MassDEP, 2014); and DTSC (DTSC, 2014). On August 27, 2014, the USEPA Office of Solid Waste and Emergency Response issued guidance regarding early or interim actions at Superfund sites along with information about the inhalation toxicity of TCE (USEPA, 2014d).

Given the short duration of this critical exposure period (the period when the fetal heart is formed), the implication is that a rapid response action may be warranted to protect women of reproductive age at sites with potential TCE VI risks. Furthermore, consideration should be given to protection of both remediation workers and nearby members of the public where TCE remediation is taking place due to the short duration of the critical exposure period. Factors to consider include: providing adequate ventilation; appropriate personal protective equipment for remediation workers; field monitoring equipment capable of detecting concentrations in the range of the screening levels (i.e., photoionization detector capable of detecting in the ppb range); and possible air sampling using an onsite or offsite laboratory. The DTSC *Proven Technologies and Remedies Guidance: Remediation of Chlorinated Volatile Organic Compounds in Vadose Zone Soil* (DTSC, 2010) provides further information on work zone and perimeter air monitoring.

Developmental toxicity has been linked to inhalation of TCE vapors as well as ingestion of TCE-contaminated drinking water with more substantial evidence for the latter. Therefore, while this Framework only addresses the recent changes regarding the inhalation pathway for TCE, it is recognized that in addition to actions based on the maximum contaminant level (5 µg/L) more immediate action may be necessary if an existing drinking water source is impacted or threatened by TCE at concentrations above the non-cancer ESL for drinking water (7.8 µg/L). The investigation and cleanup of TCE-contaminated groundwater for protection of drinking water resources remains a priority for the Water Board and groundwater cleanup should not be delayed.

## b. USEPA-Recommended Action Levels for Indoor Air and Interim Response Actions for TCE

On July 9, 2014, USEPA Region 9 issued a memorandum to Region 9 Superfund Staff and Management entitled *EPA Region 9 Response Action Levels and Recommendations to Address Near-Term Inhalation Exposures to TCE in Air from Subsurface Vapor Intrusion* (Memorandum; USEPA, 2014c). The information in the July 9, 2014, memorandum supersedes Item 1 in the USEPA Region 9 December 3, 2013 letter (see Attachment A). The Memorandum provides two sets of TCE indoor air response action levels for both residential and commercial exposure scenarios that are intended to protect women of reproductive age. It distinguishes between a hazard quotient (HQ) of 1 and an HQ of 3. The Accelerated Response Action Levels (ARALs) and Urgent Response Action Levels (URALs) are presented in Table 4.

**Table 4 – USEPA Region 9 Accelerated Response Action Levels and Urgent Response Action Levels for Indoor Air**

| Exposure Scenario | Accelerated Response Action Level (HQ = 1) | Urgent Response Action Level (HQ = 3) |
|---|---|---|
| Residential | 2 µg/m$^3$ | 6 µg/m$^3$ |
| Commercial (8-hour workday) | 8 µg/m$^3$ | 24 µg/m$^3$ |
| USEPA recommends that the response time associated with the ARALs be a few weeks whereas it should be a few days for the URALs. | | |

The numerical values for the accelerated response action levels correspond to the chronic non-cancer screening levels (i.e., these numbers essentially are the same as the non-cancer ESLs for indoor air; see ESL Detail Table E-3). USEPA recommends that the results from time-weighted air sampling methods be compared to these levels and provides suggestions on how to determine whether expedited laboratory analysis turnaround times may be appropriate.

The *Tiered Response Actions* in the July 9, 2014, USEPA Region 9 memorandum from are:

- **TCE Indoor Air Concentration ≤ ARAL (HQ 1)** – USEPA recommends routine periodic confirmatory sampling or monitoring.
- **TCE Indoor Air Concentration > ARAL (HQ1)** – USEPA recommends early or interim response measures be evaluated and implemented quickly, within a few weeks. These include:
  - Increasing building pressurization and/or ventilation;
  - Sealing potential conduits where vapors may be entering the building;
  - Treating indoor air (carbon filtration, air purifiers);
  - Installing and operating engineered exposure controls (subslab or crawl space depressurization systems)

**TCE Indoor Air Concentration > URAL (HQ3)** – USEPA recommends early or interim response measures be evaluated and implemented quickly, within a few days, and that effectiveness be confirmed before additional exposure is allowed to occur. Temporary relocation may be necessary to prevent additional exposure, if other mitigation measures are not available or effective.

In all cases, the evaluation of subsurface VI for long term exposure would continue.

The USEPA Region 9 memorandum also lists recommendations for (a) sampling, (b) expediting turn-around time for TCE analytical results, and (c) implementing early or interim measures to mitigate TCE inhalation exposure.

### i. Water Board Indoor Air TCE Interim Response Action Levels

> **Interim Response Action Levels** are concentrations in indoor air that prompt immediate response actions to reduce exposure.

Water Board staff has provisionally selected residential and commercial/industrial indoor air interim response action levels for TCE that are the same as the USEPA Region 9 ARALs and URALs to determine when to initiate a prompt response action. The residential and commercial/industrial indoor air TCE ARALs are 2 and 8 μg/m$^3$, respectively. These correspond to the ESLs based on a non-carcinogenic endpoint and a HQ of 1 (ESL Detail Table E-3). The residential and commercial/industrial indoor air TCE URALs are 6 and 24 μg/m$^3$, respectively, based on a HQ of 3. If there is an exceedance of these action levels, then interim response actions should be evaluated consistent with the Tiered Response Actions listed above and as discussed further in the next section. The action levels and response actions and potential expedited laboratory turnaround times should be incorporated into indoor air sampling work plans and associated contingency plans.

### ii. Water Board Interim Response Actions for TCE in Indoor Air

Interim response actions are actions taken by the responsible party or occupant to reduce or eliminate exposure after indoor air sample results exceed the appropriate residential or commercial/industrial TCE ARAL or URAL. These actions include immediately encouraging the occupant to take precautions to reduce exposure. Actions for residents should include increasing ventilation, sealing potential conduits, or treating indoor air as well as other measures. Actions for commercial occupants should include increasing use of the HVAC system (i.e., increasing ventilation through greater outdoor air intake or increasing building pressurization), sealing potential conduits, or treating indoor air. Possible sources of TCE inside the building should be evaluated and removed and the building should be retested as soon as possible. If multiple lines of evidence indicate that TCE attributable to the subsurface is migrating into indoor air at concentrations exceeding the chronic exposure levels, a VIM system should be installed (Section 5). The performance standard (i.e., TCE concentration) for a VIM system should be the appropriate cancer risk ESL, which is lower than the non-cancer ESL and is expected to be protective of non-cancer effects regardless of the time to manifestation.

## c. Water Board Trigger Levels for Soil Gas and Groundwater

**Trigger Levels** are concentrations in environmental media that prompt prioritization of indoor air sampling.

The Water Board has developed concentrations for TCE in soil gas and groundwater to prioritize indoor air sampling due to concerns regarding potential TCE short-term effects and potential need for prompt action. These concentrations are called Trigger Levels and are listed in Table 5 along with TCE screening levels for soil gas and groundwater and two endpoints (cancer and non-cancer). As shown, the Trigger Levels are based on the non-cancer hazard; that is, the target concentrations are the indoor air ARALs (2 µg/m$^3$ and 8 µg/m$^3$ for residential and commercial/industrial exposure scenarios, respectively).

**Table 5 – TCE ESLs and Trigger Levels for Indoor Air Sampling**

| Medium | Residential | | | Commercial/Industrial | | |
|---|---|---|---|---|---|---|
| | **Cancer Risk ESL** | **Non-cancer Hazard ESL** | **Trigger Level** | **Cancer Risk ESL** | **Non-cancer Hazard ESL** | **Trigger Level** |
| Indoor Air | 0.59 µg/m$^3$ | 2.1 µg/m$^3$ | **NA** | 3.0 µg/m$^3$ | 8.8 µg/m$^3$ | **NA** |
| Soil Gas* | 300 µg/m$^3$ | 1,100 µg/m$^3$ | **1,000 µg/m$^3$** | 3,000 µg/m$^3$ | 8,800 µg/m$^3$ | **8,000 µg/m$^3$** |
| Groundwater - Sand Scenario[1] ** | 4.9 µg/L | 17 µg/L | **17 µg/L** | 49 µg/L | 140 µg/L | **140 µg/L** |
| Groundwater - Fine-Coarse Scenario[2] | 130 µg/L | 460 µg/L | **460 µg/L** | 1,300 µg/L | 3,900 µg/L | **3,900 µg/L** |

**Notes:**

1 – Sand Scenario – Predominantly coarse soils or likelihood of preferential pathways (manmade or natural; see Section 3.d.ii) or shallow first groundwater (<10 feet bgs). See Framework text (Section 4.c.i) for basis of derivation. This scenario should be used as the default scenario if any of the criteria are met.

2 – Fine-Coarse Scenario – Continuous fine-grained soil layer at the water table and lower likelihood of preferential pathways and deep first groundwater (≥10 feet bgs). See Framework text for basis of derivation. This scenario may also be used if multiple lines of evidence indicate that a site more resembles this scenario.

* – ESLs and trigger levels for soil gas vary slightly due to changes in exposure assumptions between the USEPA ARALs and the ESLs

** – The Sand Scenario uses an updated Johnson and Ettinger model, which will be incorporated in the next ESL update

The basis of the Trigger Levels is presented below:

### i. Soil Gas TCE Trigger Levels for Indoor Air Sampling

Soil gas sampling is important for initially locating and defining the VOC vapor sources as well as quantitatively evaluating VI (with properly located samples or vapor wells). Soil gas TCE Trigger Levels are used to prioritize indoor air sampling for TCE while site investigation and cleanup activities continue (i.e., skipping ahead in the stepwise approach; Figure 1). The residential and commercial/industrial soil gas TCE Trigger Levels are based on the DTSC default attenuation factors of 0.002 and 0.001 (VIG Table 2), respectively. For example, the residential soil gas TCE Trigger Level (1,000 µg/m$^3$) is calculated by dividing the TCE residential ARAL (2 µg/m$^3$) by the DTSC default attenuation factor of 0.002. The residential and commercial/industrial soil gas TCE Trigger Levels are: 1,100 and 8,000 µg/m$^3$, respectively. No Trigger Levels are established for subslab data because Water Board staff considers subslab data to be best used as one line of evidence to be evaluated when interpreting indoor air data.

#### ii. Groundwater TCE Trigger Levels for Indoor Air Sampling

Groundwater TCE Trigger Levels are used to prioritize and expedite indoor air sampling for TCE while site investigation and cleanup activities continue to address the subsurface VI threat (i.e., skip steps 6 and 7 in the stepwise approach; see Table 1). Groundwater TCE Trigger Levels were developed for residential and commercial/industrial exposure scenarios using an approach similar to the one that generated two sets of screening levels in the ESLs. The Trigger Levels are applied as follows:

- **Sand Scenario:** The Sand Scenario is applied in cases of predominantly coarse soils <u>or</u> large likelihood of manmade or natural preferential pathways <u>or</u> first groundwater is less than 10 feet bgs. The Sand Scenario TCE Trigger Levels were developed using the Johnson & Ettinger model (DTSC-HERO March 2014 GW-SCR version) with sand, a 5-foot depth to groundwater, and a target indoor air concentration equal to the RfC. The residential and commercial shallow groundwater TCE Trigger Levels are 17 and 140 µg/L, respectively. Water Board staff considers that natural (e.g., conduits created by sand lenses, fractures, or desiccation cracks), manmade (e.g., utility vaults or associated backfill) and building-specific (e.g., below-ground elevator components) preferential pathways responsible for minimal attenuation of contaminant vapors are more likely to be present and affect vapor transport in the upper 10 feet of soil.

- **Fine-Coarse Scenario:** The Fine-Coarse Scenario is applied in cases where there is continuous fine-grained soil layer at the water table <u>and</u> lower likelihood of preferential pathways <u>and</u> first groundwater is 10 feet bgs or deeper). The Fine-Coarse Scenario groundwater TCE Trigger Levels were developed using the Johnson & Ettinger model (USEPA 2004 GW-ADV version) with the Fine-Coarse Scenario soil type inputs and a target indoor air concentration equal to the RfC. The Fine-Coarse Scenario is most applicable to sites where there is a continuous, predominantly fine-grained soil at the depth of the water table resulting in a relatively thick capillary fringe. The empirical basis of the Fine-Coarse Scenario soil type and restriction of its application to depths of 10 feet bgs or deeper are described in Section 6.3 of the *ESL User's Guide*. The residential and commercial deep groundwater TCE Trigger Levels are: 460 and 3,900 µg/L, respectively.

### d. Recommendations Regarding PCE

PCE can be a source of TCE if site conditions favor dechlorination. Reductive dechlorination is a major anaerobic biodegradation pathway for the chlorinated solvents (e.g., PCE and TCE) provided that the geochemical conditions are suitable (e.g., sufficient electron donors and the requisite microorganisms are present – USEPA, 2013b). During the oxidative degradation of a variety of organic compounds (e.g., naturally occurring or added organic carbon sources or petroleum hydrocarbons from comingled releases) electron donors (hydrogen or reduced compounds) are generated that then can be used for the stepwise reduction of chlorinated VOCs. The typical transformation sequence is PCE to TCE to dichloroethene (DCE) to vinyl chloride and ultimately to non-toxic end products (e.g., ethene, ethane, and carbon dioxide). The transformation process can slow or stop at DCE or vinyl chloride in some instances with vinyl chloride being the more toxic (carcinogenic) product. However, the transformation does not typically slow or stall from PCE to TCE to DCE. Therefore, for PCE release sites, TCE and the remaining degradation products should be tested and monitored. If chemicals are added to facilitate PCE degradation (i.e., enhanced in-situ biodegradation) TCE production should be monitored.

### e. Public Participation for TCE/PCE Sites

Water Board staff utilizes the *Final Draft – Public Participation at Cleanup Sites* (SWRCB, 2005) to determine the appropriate level of effort for public participation at cleanup sites. The guidance describes three categories of public participation effort and how to determine the appropriate category for a site. For this purpose, "the site" should be considered as the source area and down- and cross-gradient extent of all COPCs exceeding applicable screening levels in all media. For TCE contaminated sites, the following should be considered:

- Re-Evaluation of Public Participation Level for TCE/PCE Sites – Many smaller cleanup sites, such as drycleaners, were considered Category 1; however, if a TCE release has migrated away from the original source property and has the potential to migrate to indoor air off-site, these sites should be re-categorized as Category 2. Many larger cleanup sites already fall under public participation Category 2 or 3 due to the significance of the contamination and the like likelihood for groundwater contamination to migrate away from the source property. Soil gas contamination can also migrate past the property boundary of the original release, thus the likely extent of contamination in all media should be considered in determining the notification area. Additional notification may be required if new data indicates that the extent of contamination is larger than the original notification area.
- Conduct Additional Public Participation Activities if Re-Evaluation Results in a Public Participation Level Increase – If the re-evaluation indicates that a Category 1 or 2 site should be increased to a Category 2 or 3 site, additional public participation activities should be conducted. The additional activities should mention all potential exposure pathways including VI, actions that are being taken to evaluate and remediate the site, and actions that persons can take to reduce potential exposure.
- Expedite Public Notification if TCE Trigger Levels or Action Levels Are Exceeded – If TCE has been detected at concentrations exceeding the trigger levels or action levels; a notification regarding TCE should be made promptly so that women of child-bearing age are informed of the potential concerns, actions that are being taken to evaluate and remediate the site, and actions they can take to reduce potential exposure.

For VI sites, there are additional concerns that may need to be taken into consideration such as privacy (indoor air sampling), risk communication, and outreach to prospective buyers and new occupants. The VIPPA (DTSC, 2012a) addresses these issues.

### f. Re-Opening TCE/PCE Sites based on Vapor Intrusion and Short-Term, Developmental Toxicity Concerns

Water Board staff may re-open any site if data indicates that residual contamination poses an unacceptable risk to public safety, health, or the environment or if previously undetected contamination is discovered. For example, in the case of a property transfer, a Phase I or Phase II environmental site assessment may reveal that contamination remains at the property at concentrations that are no longer considered protective due to the new toxicity criteria. A site brought to the attention of Water Board staff will be reevaluated to determine whether it should be reopened. Water Board staff does not routinely reopen closed sites. Decisions will be made only after thorough review by the site project manager and supervisor.

## 5. Evaluating a VIM System

Vapor Intrusion Mitigation (VIM) and remediation are complementary approaches to addressing volatile contaminants. The purpose of remediation is to reduce the level of contamination in the environmental medium that is acting as a source of indoor air vapors (DTSC, 2011b). Interim remedial actions including aggressive source control should be conducted to the extent feasible to remove contaminant mass remaining sorbed to soil, in non-aqueous phase liquids, and in very large concentrations in groundwater. Complete cleanup (remediation) of volatile contaminants may take years to decades to meet site cleanup goals. The purpose of mitigation is to reduce contaminant entry into existing building structures or remove contaminants after they have entered a building (e.g., residence).

VIM is an engineering control[4] that is a useful tool to manage the effects of residual contaminants and to reduce short term risk during investigation and implementation of cleanup. VIM may also be used as a precautionary measure even if not required under current circumstances to reduce the potential for exposure and liability should conditions change in the future. A typical VIM system consists of a vapor barrier and a sub-barrier vapor venting system to prevent soil gas from entering a building and posing a risk to the occupants.

Because such systems are not fail-safe due to potential construction or renovation damage or operating errors, the importance of post-construction monitoring (e.g., indoor air or subslab soil gas) and reporting and regulatory or independent review is critical to demonstrate effectiveness. Water Board staff has encountered several issues associated with VIM systems that warrant special attention. These include: proposed VIM systems without adequate investigation and source remediation; improperly constructed VIM; no post-construction testing to determine whether the VIM system is operating properly and successfully; and no independent review of monitoring results after initial startup.

[4] An engineering control is a general term used to describe a variety of engineered or constructed physical barriers (e.g., soil capping, subsurface venting systems, mitigation barriers) to contain or prevent exposure to contamination on a property (USEPA, 2010).

## a. Water Board Approach to VIM

The Water Board approach to VIM follows the VIMA (DTSC, 2011b), and it is also consistent with the Low-Threat Tool, which requires source control to the extent feasible (Water Board, 2009). The goal of VIM is to prevent the intrusion of subsurface contaminant vapors to indoor air and prevent human exposure at unacceptable levels from these contaminants. VIM is considered an interim measure and not meant as a substitute for remediation or as the sole remedial option for releases of volatile chemicals (DTSC, 2011b). In this way remediation and mitigation are complementary. However, for situations where the volatile chemical source is off-site or regional in nature, mitigation may be the only viable long-term response action due to impracticability of mass removal at the source (e.g., the source is inaccessible).

The following aspects must be addressed to ensure success of a VIM system: proper design, proper construction, post-construction quality assurance testing, operation and maintenance, long-term verification monitoring, reporting, financial assurance, land use controls, and ongoing regulatory review and involvement.

## b. Evaluation Criteria for Approving VIM as Part of a Remedy

Water Board staff may become involved at two steps: 1) determination that VIM is likely to be effective as part of the remedy (i.e., approval of concept for the specific site); and 2) determination that a building is safe for occupancy (i.e., approval of installation and operational effectiveness). The first decision is made by Water Board staff (based on review of the work plan and design report), and the second is made by the local planning department with Water Board staff input (based on review of the completion report documenting construction in accordance with approved work plan and post-construction testing documenting the system is operating properly and successfully).

Figure 2 and Table 6 are used to help staff evaluate the threat posed by a site and the vulnerability of possible VIM systems. These factors are used to help determine the appropriate level of regulatory oversight and determine what documentation and operation and maintenance requirements for the VIM system are appropriate. This discussion is intended to help in the identification of potential problem areas and regulatory tools. This discussion is not guidance or policy. It is not intended to prohibit or allow any given VIM proposal.

The following factors describe the VI threat posed by a site:

1. **Magnitude of VI Threat** – VIM typically is more challenging at sites where the current contaminant concentrations and mass are great regardless of the reason (cleanup is just getting started, accessibility of the VOC vapor source, or VOC vapor source is offsite). This should be assessed based on multiple lines of evidence including groundwater, soil gas, and indoor air (for existing construction).

2. **Duration of VI Threat** – The length of time required until the system is no longer needed (i.e., no unacceptable risks remain) is important. Over extended periods of time and with successive property transfers, institutional knowledge and vigilance may decrease,

rendering long-term VIM system operation less dependable. Systems that would have to run in perpetuity because the source is not remediated are not preferred.

3. **Building Location Relative to Areas of Contamination** – Distance between the subsurface VOC vapor source or plume and the building can serve to reduce the overall VI threat. Additional measures may be needed for buildings that are not located on the source property.
4. **Foundation Type** – Some foundation designs, such as podium construction, can potentially reduce VI by depending on the placement of conduits (e.g., elevator shafts, stairwells, or utility penetrations). Potential conduits should be located on the exterior of the building where they can easily be monitored. VI is considered to pose a moderate threat to slab-on-grade foundations and a greater threat to basements, strip-footing foundations with crawl spaces, or other sub-grade foundations. Limited options are available for retrofitting existing buildings.

As the VI threat increases, the VIM system must be increasingly robust to address the threat or conversely, less vulnerable to system failure. Water Board staff should weigh the following factors to determine how vulnerable the system is, how much oversight is needed, and whether or not to approve a proposed VIM system:

1. **System Reliability** – In general, less maintenance results in a more reliable system. Passive systems (e.g., subslab venting systems) are considered more reliable than active systems (e.g., subslab depressurization systems), even though the latter may be more effective at the outset. Therefore, passive systems are preferred. Passive systems have the added benefit that they can be adapted to function as active system if the system is not effective as designed. Subslab liners (passive membranes or vapor barriers) are not considered as likely to completely eliminate VI over time due to the likelihood of punctures, perforations, tears, and incomplete seals (DTSC, 2011b).

2. **Management Type** – In general, greater density and more centralized ownership or management of a property correlate with increased VIM system reliability. For example, it would be relatively straightforward for a building engineer or manager of an apartment building or condominium complex to maintain a VIM system in a single building over the long term. However, for multiple individual homeowners, successful long-term maintenance of systems for each residence likely will not be reliable. Maintaining a VIM system requires recognition of the health risk posed by VI, technical ability to operate and troubleshoot the system, and a willingness and financial commitment. The potential for VIM system failure is greater when such systems are maintained by individual homeowners. Site access should also be considered. If the proposed system is on a property owned by the responsible party VIMs systems are easier to implement and maintain. Group management structures, including home owners associations may be reasonably reliable if the HOA has a dedicated manager or engineer funded by a viable responsible party, with a financial assurance mechanism. In that case, the HOA may be able to provide support similar to a commercial property. However, in redevelopment situations if there is no longer a viable responsible party, the HOA may more closely resemble a group of single family property owners. HOAs should be evaluated carefully, with consideration of how the HOA may change over time.

| Table 6 – Evaluation Criteria for VIM | | | |
|---|---|---|---|
| | VI Threat | | |
| **Criterion** | **Lesser** | **Moderate** | **Greater** |
| **Magnitude of VI Threat** | Concentrations ≤ ESLs | Concentrations > ESLs | Concentrations >> ESLs |
| **Duration of VI Threat** | Short (e.g., 1-2 years) | Medium (e.g., 3-10 years) | Long (e.g., >10 years) |
| **Building Location** | Building >100 feet from plume boundary | Building near plume boundary | Building overlying plume |
| **Foundation Type** | Podium | Slab-on-grade | Basement |
| | VI System Failure Vulnerability | | |
| **Criterion** | **Less Vulnerable** | **Moderate** | **More Vulnerable** |
| **System Reliability** | Intrinsically safe building design | Passive VIM | Active VIM |
| **Management Type** | Professional management (e.g., Commercial or rental apartments) | Group management (e.g., Condominiums with home owner's association) | Dispersed (e.g., Single-family homes) |

**Note:**
Each factor (row) presents a range of possibilities that are not necessarily linked to the entry in the same column for the other factors (rows). The columns are organized qualitatively not quantitatively and are not intended to prohibit or allow any particular VIM proposal without site specific review by Water Board staff.

### c. VIM System Effectiveness

For new construction, local building departments often refer to Water Board staff for technical guidance prior to granting official building occupancy permits. This evaluation will begin with consideration of design and continue as the system is installed and tested. For existing construction, VIM should be implemented quickly and may need to be adjusted in an iterative process. If the VIM system is not effective, it likely will be necessary to augment the system or conduct additional remedial actions.

After Water Board staff evaluate whether a VIM system is an appropriate part of a remedy using the criteria above, the system must be appropriately designed, constructed, and tested before Water Board staff can find that the VIM system is effective, no unacceptable risks remain, and recommend that buildings are suitable for occupancy. All VIM systems should be designed, built, installed, operated, and maintained in conformance with standard geologic, engineering, and construction principles and practices by appropriately licensed professionals (DTSC, 2011b).

#### i. VIM System Design

A proposed design report should be submitted for Water Board review and concurrence before construction. The report should address the following topics consistent with the VIMA (DTSC, 2011b), with the understanding that the level of detail may vary based on the site-specific needs:

- Project background (e.g., rationale for VIM);
- Site conditions summary (e.g., types of volatile contaminants and concentrations, environmental hazards such as methane, subsurface conditions such as soil types, depth to groundwater, and presence of utility corridors);
- Existing building design report (e.g., condition of the foundation including identification of potential vapor entry points);
- Operation and maintenance plan (Section 5.c.iii);
- Design basis (e.g., assumptions and performance criteria);
- Construction methods (e.g., specifications, permits, procedures, construction quality control procedures, and post-construction testing procedures);
- Design calculations and drawings (e.g., justification that the VIM system is expected to provide an attenuation factor that will adequately reduce VI risk);
- Conceptual drawings;
- VIM approach;
- Implementation mechanisms (e.g., land use controls and soil management plan); and
- Financial assurance (especially if the responsible party does not own the property, or will not own the property after redevelopment, or if the responsible party may have limited resources)

Further details on the content of the proposed design report are provided in the VIMA.

### ii. VIM System Construction and Quality Control

A completion report is required to document that the system was constructed appropriately. Elements of the report may include:

- Description of VIM system construction process, issues encountered, and any variances from the design;
- As-built drawings signed and stamped by a California licensed Engineer with a statement that the VIM system was installed to the manufacturer's specifications.
- Photo documentation of installation;
- Results of quality control testing (e.g., smoke testing and indoor air sampling of the building shell) and documentation of any rework needed; and
- Third party quality assurance/quality control inspection report.

Site visits by Water Board staff are encouraged. After review of the completion report, staff may recommend that the site does not pose a threat for the proposed use, or that additional corrective action is necessary by augmenting the VIMS or adding remedial action.

### iii. Operation and Maintenance

Routine documentation of required O&M is required in accordance with an agency-approved O&M Plan that addresses the following elements:

- Responsible entities (e.g., homeowner's association or property manager)
- Performance goals and measures (e.g., vapor concentrations or pressure measurements)
- Monitoring (e.g., system operation parameters and volatile contaminant and combustible gas monitoring)
- Vapor sampling and analysis (e.g., indoor air and subslab soil gas sampling)
- Inspections (e.g., observing visible components to confirm their function)
- Contingency plan in the event of failure to meet performance goals
- Reporting
- Periodic reviews

The level of documentation and frequency of reporting will vary depending on the vulnerability of the VIM system. In addition, the frequency of reporting may be more frequent at start-up and later reduced.

### iv. Institutional Controls and Administrative Safeguards

Additional aspects to consider for a VIM system include the following:

- **Institutional controls (ICs)**[5] – ICs typically are incorporated into land use covenants and include provisions for notifications, prohibitions (land uses, interference with the VIM system, land disturbing activities), access, and inspection and reporting requirements. The Water Board has an approved model Covenant and Environmental Restriction on Property that should be used when developing a site-specific land use covenant.
- **Enforcement mechanisms** – Enforcement mechanisms typically are legal instruments or agreements to ensure compliance (e.g., order or cost recovery agreement).
- **Financial assurance** – Financial assurance ensures that sufficient funds will be available to continue operation of the system and to conduct any corrective action required. Financial assurance may include a trust fund, surety bond, letter of credit, insurance, corporate guarantee, or qualification as a self-insurer by means of a financial test. The basis for the amount of financial assurance (e.g., detailed cost estimate) should be provided.
- **Access agreement** – An access agreement is necessary to allow for access for operation and maintenance, testing and construction and also to address concerns by affected parties (owners and tenants).

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5 ICs are non-engineered instruments, such as administrative and legal controls (e.g., covenants), that help minimize the potential for exposure to contamination and/or protect the integrity of the remedy (USEPA, 2012c).

- **Inter-agency coordination** – Depending on the nature of the VIM system, potentially significant coordination may be necessary and potential agencies include air management districts, building departments, fire departments, etc.
- **Building control termination process** – Eventually, subsurface remediation will reduce volatile contaminant concentrations to levels that no longer require remediation and VIM system operation can be terminated. The process for making this decision, which should be based on multiple lines of evidence, should be defined and documented in an appropriate document.

## 6. Vapor Intrusion Concerns on Closed Landfills

The Water Board recently has received proposals for mixed use (residential and commercial) redevelopments with VIM systems on closed landfill sites. At each of these sites, soil gas characterization indicated the presence of methane as well as concentrations of benzene and vinyl chloride exceeding ESLs. In general, Water Board staff does not recommend these proposed redevelopments due to: 1) the presence of an unremediated subsurface vapor source that is potentially under pressure (i.e., greater driving force; see VIG Step 3); and 2) reliability concerns for the VIM system due to differential settling, potential gas production due to water use getting into the waste, and potential creation or propagation of preferential vapor migration pathways.

The following issues would have to be addressed as part of Water Board staff's consideration of residential or commercial redevelopments on closed landfill sites:

- Full characterization of groundwater and soil gas, including temporal monitoring, and development of a robust CSM. This information should include understanding the zone of vapor influence around the existing waste footprint.
- Removal of all non-inert waste from the footprint of all future structures, including a setback distance around the structure footprints commensurate with the site-specific zone of vapor influence.
- Removal of as much of the subsurface VOC vapor source as practicable through technologies such as soil vapor extraction prior to development
- A VIM system consistent with the VIMA and recommendations in this Framework.
- Robust long-term monitoring of each building to potentially include external soil gas and subslab monitoring points in addition to in-building monitoring.
- Institutional controls are implemented.
- Financial assurance is maintained and updated.
- A single entity is responsible for managing, operating, and maintaining the VIM system.
- Independent review is conducted (i.e., either Water Board staff review or another certified entity like a City or County Local Enforcement Agency).

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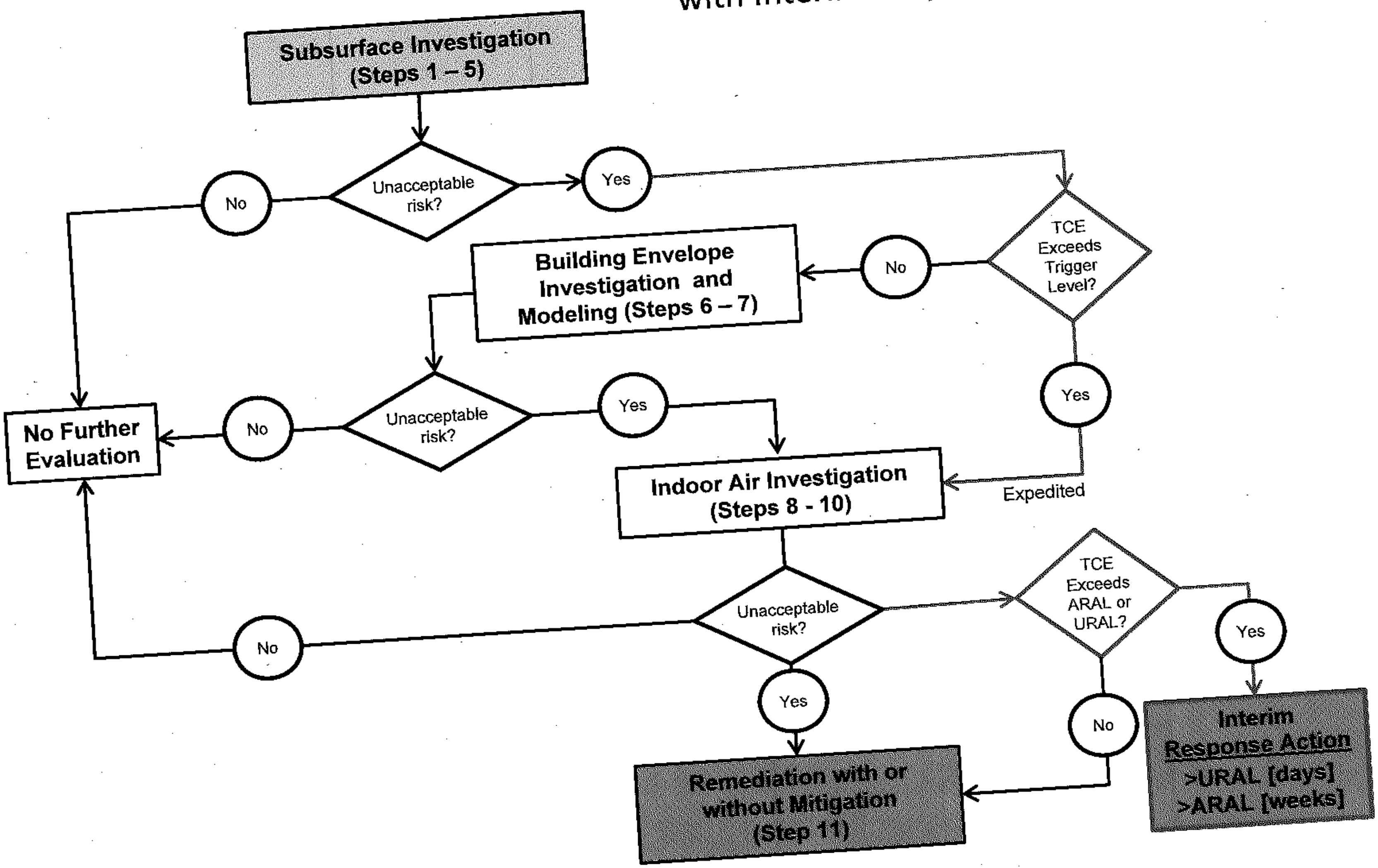
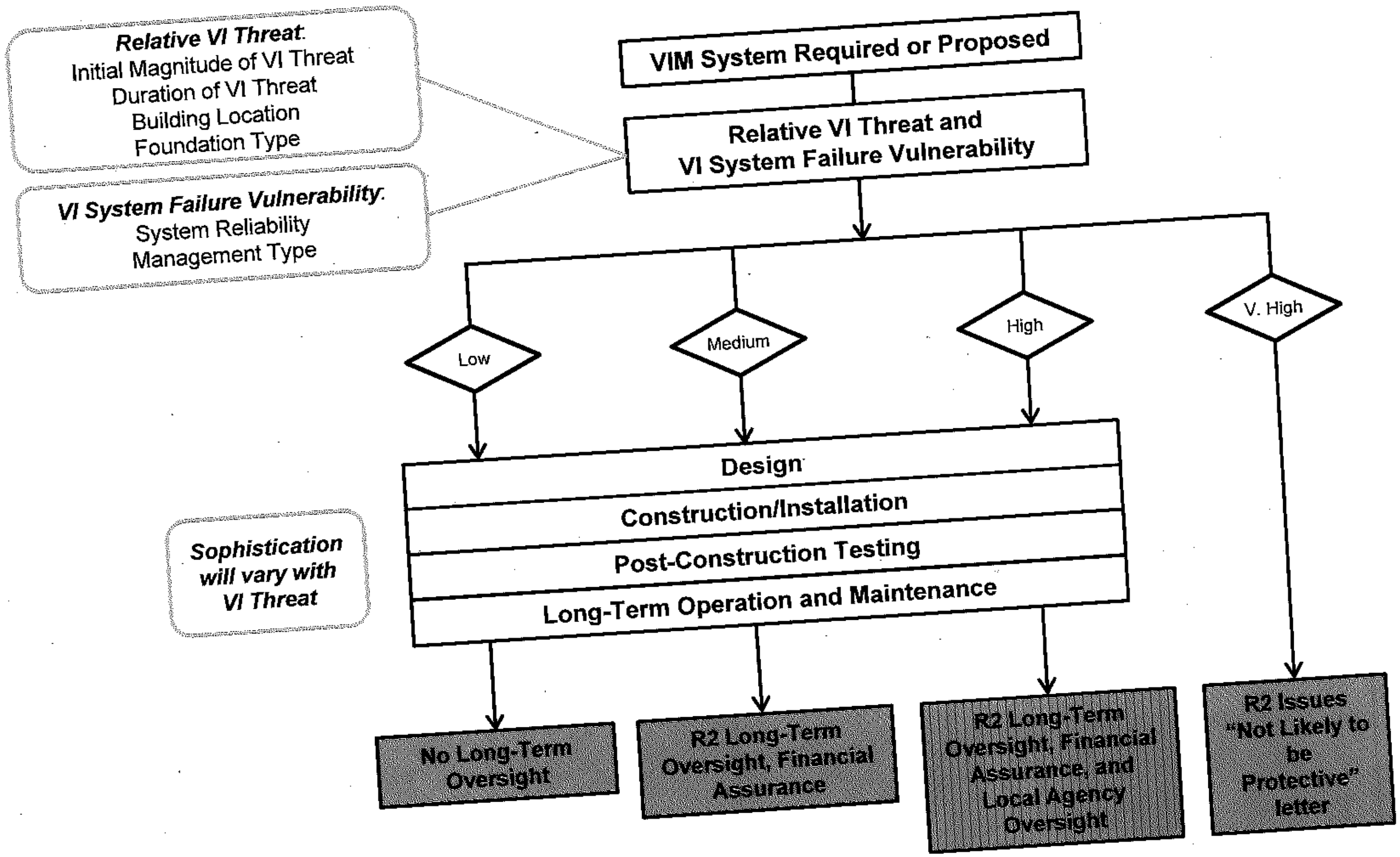
# Figures

Figure 1 - Modified Stepwise Approach with Interim Response Actions for TCE



## Figure 2 – VI Mitigation Oversight



# Attachment A

Discussion of the Six Items in the USEPA Region 9 Letter

## Discussion of the Six Items in the USEPA Region 9 Letter

On December 3, 2013, USEPA Region 9 issued a letter ("South Bay Letter"; USEPA, 2013c) to the Water Board that provides guidelines and supplemental information for VI evaluations at nine South Bay Superfund or NPL sites with subsurface TCE and PCE contamination that Water Board staff oversees. Below is a brief description of the six items and adjustments to the Water Board VI approach in response to the South Bay Letter followed by a summary.

### 1. Interim TCE Short-Term Response Action Levels and Guidelines

The South Bay Letter provided Interim TCE Short-Term Response Action Levels for indoor air and recommended interim response action (mitigation measures) along with guidelines on the speed of implementation (e.g., days or weeks). The numerical values corresponded to the chronic, non-cancer screening levels (based on a hazard quotient of 1). On July 9, 2014, USEPA Region 9 issued a memorandum to Region 9 Superfund Staff and Management entitled *EPA Region 9 Response Action Levels and Recommendations to Address Near-Term Inhalation Exposures to TCE in Air from Subsurface Vapor Intrusion* (memorandum; USEPA, 2014c). The information in the memorandum supersedes Item 1 in the South Bay Letter. See Section 4 of the main Framework text for further information.

Water Board staff has not previously developed interim or short-term response actions or levels for indoor air or other media. The Water Board is provisionally using these recommendations. Staff now incorporates the TCE indoor air interim action levels and response actions into the Water Board VI approach.

### 2. PCE Indoor Air Screening Levels

The South Bay Letter recognizes that the California-modified indoor air screening levels for PCE differ from USEPA's May 2013 Regional Screening Levels and states that California Environmental Protection Agency (CalEPA) toxicity values and indoor air screening levels should be used for PCE.

The ESLs use the current CalEPA toxicity factors for PCE.

### 3. Residential Building Sampling Approach – Multiple Rounds of Sampling including Colder Weather and Crawl Space Sampling

The South Bay Letter requires multiple rounds of indoor air sampling, including sampling during colder weather months when the potential for VI may be higher. USEPA staff has interpreted this as at least two rounds of sampling; including one each in the warm and cool season. The South Bay Letter also calls for crawl space, basement, and pathway sampling. The term "pathway sampling" in the South Bay Letter refers to sampling likely locations for subsurface vapor entry such as sumps, floor drains, elevator shafts or stairwells, and slab cracks.

Two rounds of indoor air sampling are consistent with the Water Board VI approach: a) the VIG (Step 9, p. 30) calls for at least two rounds of indoor air sampling to detect seasonal variations (late summer/early autumn and late winter/early spring); and b) crawl space and basement sampling are identified as lines of evidence in the VIG. The utility of this type of sampling is recognized in Step 9 of the VIG.

## 4. Commercial Building Sampling Approach – Building HVAC-Off, HVAC-On, and Pathway Sampling

The South Bay Letter requires that, for commercial buildings, indoor air sampling to be conducted with the heating, ventilation, and air conditioning system (HVAC) both on and off, and requires pathway sampling. HVAC-off sampling addresses whether there is potential for subsurface VI into buildings without reliance on the indoor air ventilation system.

This is consistent with the Water Board approach with the exception that the VIG does not currently specify HVAC-off sampling. When conducting indoor air sampling where there is an HVAC, Water Board staff plans to incorporate both HVAC-on and HVAC-off sampling to assess building susceptibility to soil gas entry and whether the HVAC is providing a level of mitigation.

## 5. On-Property Study Area Building Sampling

The South Bay Letter requires that indoor air be sampled at buildings with existing VIM systems because those systems can be damaged during construction and renovation activities. This sampling requirement extends to buildings overlying subterranean parking garages because of potential preferential pathways (e.g., elevator shafts, stairwells).

This is consistent with the Water Board approach and is addressed in the following sections of the DTSC VIMA (DTSC, 2011b): 1) Section 6.2 (Construction Quality Assurance/Quality Control Testing), and 2) Section 7.2.2 (Operation and Maintenance – Performance Measures); and 3) Section 7.2.3 – Operation and Maintenance – General Guidelines for Monitoring - Indoor Air Quality Monitoring).

## 6. Indoor Air Sampling Required for Buildings Overlying 5 µg/L TCE in Groundwater

The South Bay Letter has been interpreted to require indoor air sampling in buildings overlying 5 µg/L TCE in groundwater. The letter states that this value is supported by the USEPA Vapor Intrusion Screening Level (VISL) calculator,[1] which uses the USEPA generic default groundwater-to-indoor air attenuation factor of 0.001, and the appropriate Henry's Law conversion, empirical data, and mathematical modeling. However, USEPA has been implementing their VI evaluations, which includes indoor air sampling, beginning with a first cut groundwater TCE concentration of 50 µg/L for residential areas and 100 µg/L for commercial areas and stepping out as needed.

The Water Board is not utilizing the 5 µg/L TCE in groundwater as a trigger for indoor air sampling. Instead, Water Board staff has developed specific Trigger Levels for TCE in soil gas

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1 The VISL calculator is periodically updated. The May 2014 version (USEPA, 2014a) uses the same generic default groundwater-to-indoor air attenuation factor of 0.001 as the previous December 2013 version cited in the South Bay Letter.

samples and groundwater samples. When these Trigger Levels are exceeded, staff will prioritize indoor air sampling while continuing with the stepwise approach integrated with multiple lines of evidence as presented in Section 3.0 of the main Framework. The toxicological basis for actions recommended by the Water Board and the development of the TCE Trigger Levels are presented in Section 4.0 of the main Framework.

## Summary

Overall, the South Bay Letter supports a multiple lines of evidence approach that is consistent with the USEPA *OSWER Final Guidance for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Sources to Indoor Air (External Review Draft)* (USEPA, 2013a). In the approach, indoor air sampling is practically mandatory. This differs from the VIG stepwise approach that starts with review of available information and subsurface investigation and then moves towards indoor air, if necessary. That is, indoor air sampling is not deemed necessary unless subsurface contaminant concentrations indicate a potential risk for VI. Water Board staff continues to use the stepwise approach, but with modifications to address TCE short-term toxicity. This is further discussed in Section 3 (Integrating the Stepwise Approach with Multiple Lines of Evidence) and Section 4 (Evaluating TCE Vapor Intrusion).

The South Bay Letter also provides information on recent research and USEPA Region 9 experience that have implications for VI evaluations, such as:

- Daily indoor air concentrations resulting from subsurface VI can vary by two or more orders of magnitude in residential, passively-ventilated structures. The greatest indoor air concentrations usually occur when the outdoor air temperatures are significantly below indoor air temperatures.
- Longer-term passive samplers can help address the temporal variability of indoor air concentrations by averaging over longer periods than Summa canister samples.
- VI remains a concern at buildings with VIM systems because those systems can be damaged during construction and renovation activities.

In response to the South Bay Letter, Water Board staff has made the following modifications to the Water Board VI evaluation approach:

- **TCE Interim Action Levels for Indoor Air** – Water Board staff now provisionally incorporates the TCE indoor air interim action levels and response actions into the Water Board VI approach. See Section 4 of the main Framework for further information.
- **Indoor Air Sampling with HVAC-Off as well as HVAC-On** – The previous Water Board approach included HVAC-On indoor air sampling. Water Board staff now incorporates HVAC-Off indoor air sampling to assess building susceptibility to soil gas entry and whether the HVAC system is providing a level of mitigation.
- **TCE Trigger Levels for Soil Gas and Groundwater** – Water Board staff has developed soil gas and groundwater TCE Trigger Levels that would result in the prioritization of indoor air sampling, potentially skipping ahead in the stepwise approach. The basis and use of these Trigger Levels are discussed in Section 4.0 of the main Framework.

# Attachment B

Johnson & Ettinger Model Printouts for Groundwater TCE Trigger Levels

USEPA GW-SCREEN
Version 3.0, 04/2003

DTSC Modification
March 2014

Reset to Defaults

# San Francisco Bay Regional Water Quality Control Board - Groundwater TCE Trigger Level: Sand Scenario

Scenario: **Residential**
Chemical: **Trichloroethylene**

DATA ENTRY SHEET

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ X ]

**OR**

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [ ]

| Results Summary | | | | | Risk-Based Groundwater Concentration | |
|---|---|---|---|---|---|---|
| Soil Gas Conc. ($C_{source}$) ($\mu g/m^3$) | Attenuation Factor (alpha) (unitless) | Indoor Air Conc. ($C_{building}$) ($\mu g/m^3$) | Cancer Risk | Noncancer Hazard | Cancer Risk = $10^{-6}$ ($\mu g/L$) | Noncancer HQ = 1 ($\mu g/L$) |
| 2.53E+02 | 4.8E-04 | 1.2E-01 | NA | NA | 4.9E+00 | 1.7E+01 |

MESSAGE: Values of Csource and Cbuilding (INTERCALCS worksheet) are based on unity and do not represent actual values.

Trigger Level

| ENTER Chemical CAS No. (numbers only, no dashes) | ENTER Initial groundwater conc., $C_W$ ($\mu g/L$) | Chemical |
|---|---|---|
| 79016 | | Trichloroethylene |

MESSAGE: See VLOOKUP table comments on chemical properties and/or toxicity criteria for this chemical.

MORE ↓

| ENTER Depth below grade to bottom of enclosed space floor, $L_F$ (15 or 200 cm) | ENTER Depth below grade to water table, $L_{WT}$ (cm) | ENTER SCS soil type directly above water table | ENTER Average soil/ groundwater temperature, $T_S$ (°C) |
|---|---|---|---|
| 15 | 152 | S | 15 |

| ENTER Average vapor flow rate into bldg. (Leave blank to calculate) $Q_{soil}$ (L/m) |
|---|
| 5 |

MORE ↓

| ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability) | OR | ENTER User-defined vandose zone soil vapor permeability, $k_v$ ($cm^2$) | ENTER Vadose zone SCS soil type (Lookup Soil) | ENTER Vadose zone soil dry bulk density, $\rho_b^V$ ($g/cm^3$) | ENTER Vadose zone soil total porosity, $n^V$ (unitless) | ENTER Vadose zone soil water-filled porosity, $\theta_w^V$ ($cm^3/cm^3$) |
|---|---|---|---|---|---|---|
| S | | | S | 1.66 | 0.375 | 0.054 |

MORE ↓

Lookup Receptor Parameters

Residential

| ENTER Target risk for carcinogens, TR (unitless) | ENTER Target hazard quotient for noncarcinogens, THQ (unitless) | ENTER Averaging time for carcinogens, $AT_C$ (yrs) | ENTER Averaging time for noncarcinogens, $AT_{NC}$ (yrs) | ENTER Exposure duration, ED (yrs) | ENTER Exposure frequency, EF (days/yr) | ENTER Exposure Time ET (hrs/day) | ENTER Air Exchange Rate ACH $(hour)^{-1}$ |
|---|---|---|---|---|---|---|---|
| 1.0E-06 | 1 | 70 | 30 | 30 | 350 | 24 | 0.5 |

Used to calculate risk-based groundwater concentration.

END





Last Update: March 2014
DTSC Human and Ecological Risk Office

CHEMICAL PROPERTIES SHEET

**Trichloroethylene**

| Diffusivity in air, $D_a$ ($cm^2/s$) | Diffusivity in water, $D_w$ ($cm^2/s$) | Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$) | Henry's law constant reference temperature, $T_R$ (°C) | Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol) | Normal boiling point, $T_B$ (°K) | Critical temperature, $T_C$ (°K) | Organic carbon partition coefficient, $K_{oc}$ ($cm^3/g$) | Pure component water solubility, S (mg/L) | Unit risk factor, URF ($(\mu g/m^3)^{-1}$) | Reference conc., RfC ($mg/m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6.87E-02 | 1.02E-05 | 9.85E-03 | 25 | 7,505 | 360.36 | 544.20 | 6.07E+01 | 1.28E+03 | 4.1E-06 | 2.0E-03 |

END

INTERMEDIATE CALCULATIONS SHEET

Scenario: **Residential**

Chemical: **Trichloroethylene**

| Source-building separation, $L_T$ (cm) | Vadose zone soil air-filled porosity, $\theta_a^V$ (cm$^3$/cm$^3$) | Vadose zone effective total fluid saturation, $S_{te}$ (cm$^3$/cm$^3$) | Vadose zone soil intrinsic permeability, $k_i$ (cm$^2$) | Vadose zone soil relative air permeability, $k_{rg}$ (cm$^2$) | Vadose zone soil effective vapor permeability, $k_v$ (cm$^2$) | Thickness of capillary zone, $L_{cz}$ (cm) | Total porosity in capillary zone, $n_{cz}$ (cm$^3$/cm$^3$) | Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm$^3$/cm$^3$) | Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm$^3$/cm$^3$) | Floor-wall seam perimeter, $X_{crack}$ (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 137 | 0.321 | 0.003 | 1.00E-07 | 0.998 | 9.99E-08 | 17.05 | 0.375 | 0.122 | 0.253 | 4,000 |

| Bldg. ventilation rate, $Q_{building}$ (cm$^3$/s) | Area of enclosed space below grade, $A_B$ (cm$^2$) | Crack-to-total area ratio, $\eta$ (unitless) | Crack depth below grade, $Z_{crack}$ (cm) | Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol) | Henry's law constant at ave. groundwater temperature, $H_{TS}$ (atm-m$^3$/mol) | Henry's law constant at ave. groundwater temperature, $H'_{TS}$ (unitless) | Vapor viscosity at ave. soil temperature, $\mu_{TS}$ (g/cm-s) | Vadose zone effective diffusion coefficient, $D^{eff}_V$ (cm$^2$/s) | Capillary zone effective diffusion coefficient, $D^{eff}_{cz}$ (cm$^2$/s) | Total overall effective diffusion coefficient, $D^{eff}_T$ (cm$^2$/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 3.39E+04 | 1.00E+06 | 5.00E-03 | 15 | 8,495 | 5.99E-03 | 2.53E-01 | 1.77E-04 | 1.11E-02 | 4.43E-04 | 2.78E-03 |

| Diffusion path length, $L_d$ (cm) | Convection path length, $L_p$ (cm) | Source vapor conc., $C_{source}$ ($\mu$g/m$^3$) | Crack radius, $r_{crack}$ (cm) | Average vapor flow rate into bldg., $Q_{soil}$ (cm$^3$/s) | Crack effective diffusion coefficient, $D^{crack}$ (cm$^2$/s) | Area of crack, $A_{crack}$ (cm$^2$) | Exponent of equivalent foundation Peclet number, exp(Pe$^f$) (unitless) | Infinite source indoor attenuation coefficient, $\alpha$ (unitless) | Infinite source bldg. conc., $C_{building}$ ($\mu$g/m$^3$) | Unit risk factor, URF ($\mu$g/m$^3$)$^{-1}$ | Reference conc., RfC (mg/m$^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 137 | 15 | 2.53E+02 | 1.25 | 8.33E+01 | 1.11E-02 | 5.00E+03 | 3.32E+06 | **4.81E-04** | 1.22E-01 | 4.1E-06 | 2.0E-03 |

**END**

USEPA GW-SCREEN
Version 3.0, 04/2003

DTSC Modification
March 2014

# San Francisco Bay Regional Water Quality Control Board - Groundwater TCE Trigger Level: Sand Scenario

Scenario: **Commercial**
Chemical: **Trichloroethylene**

Reset to Defaults

DATA ENTRY SHEET

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ X ]

**OR**

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [ ]

| ENTER Chemical CAS No. (numbers only, no dashes) | ENTER Initial groundwater conc., $C_W$ (µg/L) | Chemical |
|---|---|---|
| 79016 | | Trichloroethylene |

MESSAGE: See VLOOKUP table comments on chemical properties and/or toxicity criteria for this chemical.

MORE ↓

| ENTER Depth below grade to bottom of enclosed space floor, $L_F$ (15 or 200 cm) | ENTER Depth below grade to water table, $L_{WT}$ (cm) | ENTER SCS soil type directly above water table | ENTER Average soil/ groundwater temperature, $T_S$ (°C) |
|---|---|---|---|
| 15 | 152 | S | 15 |

| ENTER Average vapor flow rate into bldg. (Leave blank to calculate) $Q_{soil}$ (L/m) |
|---|
| 5 |

MORE ↓

| ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability) | OR | ENTER User-defined vadose zone soil vapor permeability, $k_v$ (cm$^2$) | ENTER Vadose zone SCS soil type Lookup Soil | ENTER Vadose zone soil dry bulk density, $\rho_b^V$ (g/cm$^3$) | ENTER Vadose zone soil total porosity, $n^V$ (unitless) | ENTER Vadose zone soil water-filled porosity, $\theta_w^V$ (cm$^3$/cm$^3$) |
|---|---|---|---|---|---|---|
| S | | | S | 1.66 | 0.375 | 0.054 |

MORE ↓

Lookup Receptor Parameters

Commercial

| ENTER Target risk for carcinogens, TR (unitless) | ENTER Target hazard quotient for noncarcinogens, THQ (unitless) | ENTER Averaging time for carcinogens, $AT_C$ (yrs) | ENTER Averaging time for noncarcinogens, $AT_{NC}$ (yrs) | ENTER Exposure duration, ED (yrs) | ENTER Exposure frequency, EF (days/yr) | ENTER Exposure Time ET (hrs/day) | ENTER Air Exchange Rate ACH (hour)$^{-1}$ |
|---|---|---|---|---|---|---|---|
| 1.0E-06 | 1 | 70 | 25 | 25 | 250 | 8 | 1 |

Used to calculate risk-based groundwater concentration.

END

## Results Summary

| Soil Gas Conc. ($C_{source}$) (µg/m$^3$) | Attenuation Factor (alpha) (unitless) | Indoor Air Conc. ($C_{building}$) (µg/m$^3$) | Cancer Risk | Noncancer Hazard | Risk-Based Groundwater Concentration: Cancer Risk = 10$^{-6}$ (µg/L) | Risk-Based Groundwater Concentration: Noncancer HQ = 1 (µg/L) |
|---|---|---|---|---|---|---|
| 2.53E+02 | 2.4E-04 | 6.1E-02 | NA | NA | 4.9E+01 | 1.4E+02 |

MESSAGE: Values of Csource and Cbuilding (INTERCALCS worksheet) are based on unity and do not represent actual values.

Trigger Level

CHEMICAL PROPERTIES SHEET

**Trichloroethylene**

| Diffusivity in air, $D_a$ ($cm^2/s$) | Diffusivity in water, $D_w$ ($cm^2/s$) | Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$) | Henry's law constant reference temperature, $T_R$ (°C) | Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol) | Normal boiling point, $T_B$ (°K) | Critical temperature, $T_C$ (°K) | Organic carbon partition coefficient, $K_{oc}$ ($cm^3/g$) | Pure component water solubility, S (mg/L) | Unit risk factor, URF ($(\mu g/m^3)^{-1}$) | Reference conc., RfC ($mg/m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6.87E-02 | 1.02E-05 | 9.85E-03 | 25 | 7,505 | 360.36 | 544.20 | 6.07E+01 | 1.28E+03 | 4.1E-06 | 2.0E-03 |

END

# INTERMEDIATE CALCULATIONS SHEET

**Scenario:** **Commercial**

**Chemical:** **Trichloroethylene**

| Source-building separation, $L_T$ (cm) | Vadose zone soil air-filled porosity, $\theta_a^V$ ($cm^3/cm^3$) | Vadose zone effective total fluid saturation, $S_{te}$ ($cm^3/cm^3$) | Vadose zone soil intrinsic permeability, $k_i$ ($cm^2$) | Vadose zone soil relative air permeability, $k_{rg}$ ($cm^2$) | Vadose zone soil effective vapor permeability, $k_v$ ($cm^2$) | Thickness of capillary zone, $L_{cz}$ (cm) | Total porosity in capillary zone, $n_{cz}$ ($cm^3/cm^3$) | Air-filled porosity in capillary zone, $\theta_{a,cz}$ ($cm^3/cm^3$) | Water-filled porosity in capillary zone, $\theta_{w,cz}$ ($cm^3/cm^3$) | Floor-wall seam perimeter, $X_{crack}$ (cm) |
|---|---|---|---|---|---|---|---|---|---|---|
| 137 | 0.321 | 0.003 | 1.00E-07 | 0.998 | 9.99E-08 | 17.05 | 0.375 | 0.122 | 0.253 | 4,000 |

| Bldg. ventilation rate, $Q_{building}$ ($cm^3/s$) | Area of enclosed space below grade, $A_B$ ($cm^2$) | Crack-to-total area ratio, $\eta$ (unitless) | Crack depth below grade, $Z_{crack}$ (cm) | Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol) | Henry's law constant at ave. groundwater temperature, $H_{TS}$ (atm-$m^3$/mol) | Henry's law constant at ave. groundwater temperature, $H'_{TS}$ (unitless) | Vapor viscosity at ave. soil temperature, $\mu_{TS}$ (g/cm-s) | Vadose zone effective diffusion coefficient, $D^{eff}_V$ ($cm^2/s$) | Capillary zone effective diffusion coefficient, $D^{eff}_{cz}$ ($cm^2/s$) | Total overall effective diffusion coefficient, $D^{eff}_T$ ($cm^2/s$) |
|---|---|---|---|---|---|---|---|---|---|---|
| 6.78E+04 | 1.00E+06 | 5.00E-03 | 15 | 8,495 | 5.99E-03 | 2.53E-01 | 1.77E-04 | 1.11E-02 | 4.43E-04 | 2.78E-03 |

| Diffusion path length, $L_d$ (cm) | Convection path length, $L_p$ (cm) | Source vapor conc., $C_{source}$ ($\mu g/m^3$) | Crack radius, $r_{crack}$ (cm) | Average vapor flow rate into bldg., $Q_{soil}$ ($cm^3/s$) | Crack effective diffusion coefficient, $D^{crack}$ ($cm^2/s$) | Area of crack, $A_{crack}$ ($cm^2$) | Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless) | Infinite source indoor attenuation coefficient, $\alpha$ (unitless) | Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$) | Unit risk factor, URF $(\mu g/m^3)^{-1}$ | Reference conc., RfC ($mg/m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 137 | 15 | 2.53E+02 | 1.25 | 8.33E+01 | 1.11E-02 | 5.00E+03 | 3.32E+06 | **2.41E-04** | 6.09E-02 | 4.1E-06 | 2.0E-03 |

END

# San Francisco Bay Regional Water Quality Control Board
## Groundwater TCE Trigger Level - Fine-Coarse Scenario

GW-ADV
Version 3.1; 02/04

Reset to

**Scenario:** Residential
**Chemical:** Trichloroethylene

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ X ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [ ]

| | |
|---|---|
| Cancer Risk GW (µg/L): | 1.3E+02 |
| Non-Cancer Hazard GW (µg/L): | 4.6E+02 |
| GW Trigger Level (µg/L): | 4.6E+02 |

| ENTER Chemical CAS No. (numbers only, no dashes) | ENTER Initial groundwater conc., $C_W$ (µg/L) | Chemical |
|---|---|---|
| 79016 | | Trichloroethylene |

MORE ↓

| ENTER Average soil/groundwater temperature, $T_S$ (°C) | ENTER Depth below grade to bottom of enclosed space floor, $L_F$ (cm) | ENTER Depth below grade to water table, $L_{WT}$ (cm) | ENTER Thickness of soil stratum A, $h_A$ (cm) | ENTER Thickness of soil stratum B, (Enter value or 0) $h_B$ (cm) | ENTER Thickness of soil stratum C, (Enter value or 0) $h_C$ (cm) | ENTER Soil stratum directly above water table, (Enter A, B, or C) | ENTER SCS soil type directly above water table | ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability) | OR | ENTER User-defined stratum A soil vapor permeability, $k_v$ (cm²) |
|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 15 | 300 | 100 | 200 | | B | CL | S | | |

Totals must add up to value of $L_{WT}$ (cell G28)

MORE ↓

| ENTER Stratum A SCS soil type (Lookup Soil) | ENTER Stratum A soil dry bulk density, $\rho_b^A$ (g/cm³) | ENTER Stratum A soil total porosity, $n^A$ (unitless) | ENTER Stratum A soil water-filled porosity, $\theta_w^A$ (cm³/cm³) | ENTER Stratum B SCS soil type (Lookup Soil) | ENTER Stratum B soil dry bulk density, $\rho_b^B$ (g/cm³) | ENTER Stratum B soil total porosity, $n^B$ (unitless) | ENTER Stratum B soil water-filled porosity, $\theta_w^B$ (cm³/cm³) | ENTER Stratum C SCS soil type (Lookup Soil) | ENTER Stratum C soil dry bulk density, $\rho_b^C$ (g/cm³) | ENTER Stratum C soil total porosity, $n^C$ (unitless) | ENTER Stratum C soil water-filled porosity, $\theta_w^C$ (cm³/cm³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S | 1.50 | 0.430 | 0.15 | CL | 1.5 | 0.43 | 0.3 | | | | |

MORE ↓

| ENTER Enclosed space floor thickness, $L_{crack}$ (cm) | ENTER Soil-bldg. pressure differential, $\Delta P$ (g/cm-s²) | ENTER Enclosed space floor length, $L_B$ (cm) | ENTER Enclosed space floor width, $W_B$ (cm) | ENTER Enclosed space height, $H_B$ (cm) | ENTER Floor-wall seam crack width, w (cm) | ENTER Indoor air exchange rate, ER (1/h) | ENTER Average vapor flow rate into bldg. OR Leave blank to calculate $Q_{soil}$ (L/m) |
|---|---|---|---|---|---|---|---|
| 15 | 40 | 1000 | 1000 | 244 | 0.1 | 0.5 | 5 |

MORE ↓

| ENTER Averaging time for carcinogens, $AT_C$ (yrs) | ENTER Averaging time for noncarcinogens, $AT_{NC}$ (yrs) | ENTER Exposure duration, ED (yrs) | ENTER Exposure frequency, EF (days/yr) | ENTER Target risk for carcinogens, TR (unitless) | ENTER Target hazard quotient for noncarcinogens, THQ (unitless) |
|---|---|---|---|---|---|
| 70 | 30 | 30 | 350 | 1.0E-06 | 1 |

Used to calculate risk-based groundwater concentration.

END

CHEMICAL PROPERTIES SHEET

| Diffusivity in air, $D_a$ ($cm^2/s$) | Diffusivity in water, $D_w$ ($cm^2/s$) | Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$) | Henry's law constant reference temperature, $T_R$ (°C) | Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol) | Normal boiling point, $T_B$ (°K) | Critical temperature, $T_C$ (°K) | Organic carbon partition coefficient, $K_{oc}$ ($cm^3/g$) | Pure component water solubility, S (mg/L) | Unit risk factor, URF ($(\mu g/m^3)^{-1}$) | Reference conc., RfC ($mg/m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|
| 7.90E-02 | 9.10E-06 | 1.03E-02 | 25 | 7,505 | 360.36 | 544.20 | 1.66E+02 | 1.47E+03 | 4.1E-06 | 2.0E-03 |

END

# INTERMEDIATE CALCULATIONS SHEET

| Exposure duration, $\tau$ (sec) | Source-building separation, $L_T$ (cm) | Stratum A soil air-filled porosity, $\theta_a^A$ (cm³/cm³) | Stratum B soil air-filled porosity, $\theta_a^B$ (cm³/cm³) | Stratum C soil air-filled porosity, $\theta_a^C$ (cm³/cm³) | Stratum A effective total fluid saturation, $S_{te}$ (cm³/cm³) | Stratum A soil intrinsic permeability, $k_i$ (cm²) | Stratum A soil relative air permeability, $k_{rg}$ (cm²) | Stratum A soil effective vapor permeability, $k_v$ (cm²) | Thickness of capillary zone, $L_{cz}$ (cm) | Total porosity in capillary zone, $n_{cz}$ (cm³/cm³) | Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm³/cm³) | Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm³/cm³) | Floor-wall seam perimeter, $X_{crack}$ (cm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9.46E+08 | 285 | 0.280 | 0.130 | ERROR | 0.257 | 1.00E-07 | 0.703 | 7.04E-08 | 46.88 | 0.43 | 0.055 | 0.375 | 4,000 |

| Bldg. ventilation rate, $Q_{building}$ (cm³/s) | Area of enclosed space below grade, $A_B$ (cm²) | Crack-to-total area ratio, $\eta$ (unitless) | Crack depth below grade, $Z_{crack}$ (cm) | Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol) | Henry's law constant at ave. groundwater temperature, $H_{TS}$ (atm-m³/mol) | Henry's law constant at ave. groundwater temperature, $H'_{TS}$ (unitless) | Vapor viscosity at ave. soil temperature, $\mu_{TS}$ (g/cm-s) | Stratum A effective diffusion coefficient, $D^{eff}_A$ (cm²/s) | Stratum B effective diffusion coefficient, $D^{eff}_B$ (cm²/s) | Stratum C effective diffusion coefficient, $D^{eff}_C$ (cm²/s) | Capillary zone effective diffusion coefficient, $D^{eff}_{cz}$ (cm²/s) | Total overall effective diffusion coefficient, $D^{eff}_T$ (cm²/s) | Diffusion path length, $L_d$ (cm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.39E+04 | 1.00E+06 | 4.00E-04 | 15 | 8,495 | 6.25E-03 | 2.64E-01 | 1.77E-04 | 6.16E-03 | 4.82E-04 | 0.00E+00 | 3.42E-05 | 1.68E-04 | 285 |

| Convection path length, $L_p$ (cm) | Source vapor conc., $C_{source}$ (µg/m³) | Crack radius, $r_{crack}$ (cm) | Average vapor flow rate into bldg., $Q_{soil}$ (cm³/s) | Crack effective diffusion coefficient, $D^{crack}$ (cm²/s) | Area of crack, $A_{crack}$ (cm²) | Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless) | Infinite source indoor attenuation coefficient, $\alpha$ (unitless) | Infinite source bldg. conc., $C_{building}$ (µg/m³) | Unit risk factor, URF (µg/m³)⁻¹ | Reference conc., RfC (mg/m³) |
|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 2.64E+02 | 0.10 | 8.33E+01 | 6.16E-03 | 4.00E+02 | 1.71E+220 | 1.72E-05 | 4.55E-03 | 4.1E-06 | 2.0E-03 |

END

DATA ENTRY SHEET

## San Francisco Bay Regional Water Quality Control Board
## Groundwater TCE Trigger Level - Fine-Coarse Scenario

GW-ADV
Version 3.1; 02/04

Reset to

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ X ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [ ]

**Scenario:** Commercial
**Chemical:** Trichloroethylene

| | |
|---|---|
| Cancer Risk GW (µg/L): | 1.3E+03 |
| Non-Cancer Hazard GW (µg/L): | 3.9E+03 |
| GW Trigger Level (µg/L): | 3.9E+03 |

| ENTER Chemical CAS No. (numbers only, no dashes) | ENTER Initial groundwater conc., $C_W$ (µg/L) | Chemical |
|---|---|---|
| 79016 | | Trichloroethylene |

MORE ↓

| ENTER Average soil/ groundwater temperature, $T_S$ (°C) | ENTER Depth below grade to bottom of enclosed space floor, $L_F$ (cm) | ENTER Depth below grade to water table, $L_{WT}$ (cm) | ENTER Thickness of soil stratum A, $h_A$ (cm) | ENTER Thickness of soil stratum B, (Enter value or 0) $h_B$ (cm) | ENTER Thickness of soil stratum C, (Enter value or 0) $h_C$ (cm) | ENTER Soil stratum directly above water table, (Enter A, B, or C) | ENTER SCS soil type directly above water table | ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability) | OR | ENTER User-defined stratum A soil vapor permeability, $k_v$ (cm²) |
|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 15 | 300 | 100 | 200 | | B | CL | S | | |

Totals must add up to value of $L_{WT}$ (cell G28) (applies to thickness of soil strata A, B, C).

MORE ↓

| ENTER Stratum A SCS soil type (Lookup Soil) | ENTER Stratum A soil dry bulk density, $\rho_b^A$ (g/cm³) | ENTER Stratum A soil total porosity, $n^A$ (unitless) | ENTER Stratum A soil water-filled porosity, $\theta_w^A$ (cm³/cm³) | ENTER Stratum B SCS soil type (Lookup Soil Parameters) | ENTER Stratum B soil dry bulk density, $\rho_b^B$ (g/cm³) | ENTER Stratum B soil total porosity, $n^B$ (unitless) | ENTER Stratum B soil water-filled porosity, $\theta_w^B$ (cm³/cm³) | ENTER Stratum C SCS soil type (Lookup Soil) | ENTER Stratum C soil dry bulk density, $\rho_b^C$ (g/cm³) | ENTER Stratum C soil total porosity, $n^C$ (unitless) | ENTER Stratum C soil water-filled porosity, $\theta_w^C$ (cm³/cm³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S | 1.50 | 0.430 | 0.15 | CL | 1.5 | 0.43 | 0.3 | | | | |

MORE ↓

| ENTER Enclosed space floor thickness, $L_{crack}$ (cm) | ENTER Soil-bldg. pressure differential, $\Delta P$ (g/cm-s²) | ENTER Enclosed space floor length, $L_B$ (cm) | ENTER Enclosed space floor width, $W_B$ (cm) | ENTER Enclosed space height, $H_B$ (cm) | ENTER Floor-wall seam crack width, w (cm) | ENTER Indoor air exchange rate, ER (1/h) | ENTER Average vapor flow rate into bldg. OR Leave blank to calculate $Q_{soil}$ (L/m) |
|---|---|---|---|---|---|---|---|
| 15 | 40 | 1000 | 1000 | 244 | 0.1 | 1 | 5 |

MORE ↓

| ENTER Averaging time for carcinogens, $AT_C$ (yrs) | ENTER Averaging time for noncarcinogens, $AT_{NC}$ (yrs) | ENTER Exposure duration, ED (yrs) | ENTER Exposure frequency, EF (days/yr) | ENTER Target risk for carcinogens, TR (unitless) | ENTER Target hazard quotient for noncarcinogens, THQ (unitless) |
|---|---|---|---|---|---|
| 70 | 25 | 8.3 | 250 | 1.0E-06 | 1 |

Used to calculate risk-based groundwater concentration.

END

ED (25 yrs) divided by 3 (24 hours/8 hours = 3) to account for Exposure Time of 8 hours.

CHEMICAL PROPERTIES SHEET

| Diffusivity in air, $D_a$ ($cm^2/s$) | Diffusivity in water, $D_w$ ($cm^2/s$) | Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$) | Henry's law constant reference temperature, $T_R$ (°C) | Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol) | Normal boiling point, $T_B$ (°K) | Critical temperature, $T_C$ (°K) | Organic carbon partition coefficient, $K_{oc}$ ($cm^3/g$) | Pure component water solubility, S (mg/L) | Unit risk factor, URF ($(\mu g/m^3)^{-1}$) | Reference conc., RfC ($mg/m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|
| 7.90E-02 | 9.10E-06 | 1.03E-02 | 25 | 7,505 | 360.36 | 544.20 | 1.66E+02 | 1.47E+03 | 4.1E-06 | 2.0E-03 |

END

# INTERMEDIATE CALCULATIONS SHEET

| Exposure duration, $\tau$ (sec) | Source-building separation, $L_T$ (cm) | Stratum A soil air-filled porosity, $\theta_a^A$ (cm³/cm³) | Stratum B soil air-filled porosity, $\theta_a^B$ (cm³/cm³) | Stratum C soil air-filled porosity, $\theta_a^C$ (cm³/cm³) | Stratum A effective total fluid saturation, $S_{te}$ (cm³/cm³) | Stratum A soil intrinsic permeability, $k_i$ (cm²) | Stratum A soil relative air permeability, $k_{rg}$ (cm²) | Stratum A soil effective vapor permeability, $k_v$ (cm²) | Thickness of capillary zone, $L_{cz}$ (cm) | Total porosity in capillary zone, $n_{cz}$ (cm³/cm³) | Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm³/cm³) | Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm³/cm³) | Floor-wall seam perimeter, $X_{crack}$ (cm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.63E+08 | 285 | 0.280 | 0.130 | ERROR | 0.257 | 1.00E-07 | 0.703 | 7.04E-08 | 46.88 | 0.43 | 0.055 | 0.375 | 4,000 |

| Bldg. ventilation rate, $Q_{building}$ (cm³/s) | Area of enclosed space below grade, $A_B$ (cm²) | Crack-to-total area ratio, $\eta$ (unitless) | Crack depth below grade, $Z_{crack}$ (cm) | Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol) | Henry's law constant at ave. groundwater temperature, $H_{TS}$ (atm-m³/mol) | Henry's law constant at ave. groundwater temperature, $H'_{TS}$ (unitless) | Vapor viscosity at ave. soil temperature, $\mu_{TS}$ (g/cm-s) | Stratum A effective diffusion coefficient, $D^{eff}_A$ (cm²/s) | Stratum B effective diffusion coefficient, $D^{eff}_B$ (cm²/s) | Stratum C effective diffusion coefficient, $D^{eff}_C$ (cm²/s) | Capillary zone effective diffusion coefficient, $D^{eff}_{cz}$ (cm²/s) | Total overall effective diffusion coefficient, $D^{eff}_T$ (cm²/s) | Diffusion path length, $L_d$ (cm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6.78E+04 | 1.00E+06 | 4.00E-04 | 15 | 8,495 | 6.25E-03 | 2.64E-01 | 1.77E-04 | 6.16E-03 | 4.82E-04 | 0.00E+00 | 3.42E-05 | 1.68E-04 | 285 |

| Convection path length, $L_p$ (cm) | Source vapor conc., $C_{source}$ (µg/m³) | Crack radius, $r_{crack}$ (cm) | Average vapor flow rate into bldg., $Q_{soil}$ (cm³/s) | Crack effective diffusion coefficient, $D^{crack}$ (cm²/s) | Area of crack, $A_{crack}$ (cm²) | Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless) | Infinite source indoor attenuation coefficient, $\alpha$ (unitless) | Infinite source bldg. conc., $C_{building}$ (µg/m³) | Unit risk factor, URF (µg/m³)⁻¹ | Reference conc., RfC (mg/m³) |
|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 2.64E+02 | 0.10 | 8.33E+01 | 6.16E-03 | 4.00E+02 | 1.71E+220 | 8.61E-06 | 2.27E-03 | 4.1E-06 | 2.0E-03 |

**END**

**Nowell, Keith, Env. Health**

| | |
|---|---|
| **From:** | PDKing0000@aol.com |
| **Sent:** | Thursday, October 08, 2015 8:45 PM |
| **To:** | Nowell, Keith, Env. Health |
| **Cc:** | Gary_Bates@efiglobal.com |
| **Subject:** | 6239 College Ave, Oakland - DTSC Toxicologist Contact Information |

Hi Keith,

Per our discussion today regarding contact information for the DTSC toxicologists who I spoke with regarding TCE in indoor air and notifications or restrictions for pregnant women and women of child-bearing age, I have attached HHRA Note Number 5 which has the contact information for Kimberly Gettmann on the front page, and her supervisor Michael Wade if she is not available (Kimberly said that she will leave on maternity leave in 1 to 2 weeks).

The contact information for Uta Helmann-Blumberg at DTSC is:

Uta Hellmann-Blumberg, PhD

Staff Toxicologist

Department of Toxics Substances Control

Human and Ecological Risk Office

8800 Cal Center Drive

Sacramento, CA 95826

Uta.Hellmann-Blumberg@dtsc.ca.gov

916-255-4326

Please let me know if you need any additional information.

Thank you!

Paul

Paul H. King
Professional Geologist

P&D Environmental, Inc.
55 Santa Clara Avenue, Suite 240
Oakland, CA 94610

(510) 658-6916 telephone
(510) 834-0152 facsimile
(510) 387-6834 cellular
Paul.King@pdenviro.com

**Nowell, Keith, Env. Health**

**From:** PDKing0000@aol.com
**Sent:** Tuesday, October 13, 2015 8:08 AM
**To:** Nowell, Keith, Env. Health
**Cc:** Roe, Dilan, Env. Health; Gary_Bates@efiglobal.com; ron_holt@efiglobal.com; patrick@ellwoodcommercial.com; ronpatelvidge@gmail.com; dave@bblandlaw.com
**Subject:** Re: Interim Framework TCE - Guidance document toxicologist discussions

Hi Keith,

Items discussed during our 10/8/15 conference call with Gary Bates included:

- Status of communicating with lender where note came due.
- Status of communicating with ground floor tenant that might go away.
- Defective air filter replaced last week.
- HVAC modification to allow atmospheric air ventilation was completed.
- HVAC thermostat being enclosed 100815 and fans switched on for continuous ventilation
- Post-mitigation interim air confirmation sampling to occur 36 hours after HVAC adjustment, presently scheduled for sampling at 2 locations where ARAL was exceeded on Monday 10/12/14 with SIM-certified 24 hour flow controllers and 6-liter Summa canisters.
- Work plan is being reviewed by Gary Bates for subsurface investigation.
- We might not need to have a sit down meeting for the next step of site investigation.
- Paul King spoke with Cheryl Prowell, Kimberly Gettmann, and Uta Helmann-Blumberg regarding recommendations for women of child-bearing age being removed from the building, and discussion with Uta about not causing tenants unnecessary stress with excessive communications.

I called Kim Gettmann Monday 10/5/15 after having sent her an e-mail that summarized our indoor air results and mitigative measures taken to date. Kim is a DTSC toxicologist and one of the two people identified to contact regarding HERO HHRA Note Number 5. We discussed the following.

- Kim said that it was very good that we have gotten out notification promptly and that we have had two notifications of status and progress to date.
- Our language in our notifications of recommending that pregnant women not enter the building until TCE air concentrations are reduced is more robust/ stronger than the wording of HHRA Note Number 5.
- We are doing everything that we should be doing (testing to verify conditions, testing tenant suites, shampooing the carpet, sealing the floor cracks, smoke testing the sewer piping, confirmation testing, air filtration, HVAC adjustment for ventilation) and everything that we are doing is consistent with recommendations in HHRA Note Number 5.
- The two week recommendation for response is a suggestion, and HHRA Note Number 5 is purposefully vague to allow flexibility for caseworkers to accommodate unique site-specific conditions. Based on our marginal ARAL conditions and site conditions, the timeframe for our response is reasonable and prudent.
- We do not have URAL conditions, and we are marginally at ARAL conditions. If we were at URAL conditions we would be talking about recommending that women of child-bearing age leave the building. We are taking prudent measures with our recommendations and actions.

- Based on the near-ARAL concentrations and the notifications that we have provided we do not need to have women of child-bearing age leave the building. However, if our interim post-mitigation measures show no reduction in TCE concentrations we should include in our next notification those results and the recommendation that women who are of child-bearing age and are considering having children consult their physician regarding the effects of TCE on pregnant women and how it can affect the pregnancy. At that point we have provided recommendations and it is a risk-based decision that is up to the woman to decide.

I spoke with Uta Hellmann-Blumberg on 10/7/15 and reviewed indoor air quality and mitigation measures to date. I also told her of my 10/5/15 conversation with Kim Gettmann. Uta is a DTSC toxicologist and the primary author of the 10/16/14 draft SFRWQCB Interim Framework TCE vapor intrusion guidance. We discussed the following.

- The idea of telling women of child-bearing age to not be in the building requires a balanced approach to the site conditions and indoor air concentrations. If there is a great concern that women of child-bearing age are being exposed to TCE at concentrations above acceptable levels, the number of hours of those women in the building should be reduced. As an example, reducing the amount of time in the building from 40 hours per week to 20 hours per week would effectively reduce the average weekly exposure to one half.
- Indoor air quality is a very emotional issue, and we need to make sure that we provide notification in a way that does not scare people. There is not a lot of information right now about how TCE could impact a pregnancy. The precautions related to heart valve defects in developing human fetuses are based on a single rat study.
- We want to make sure that the guidance is consistent with USEPA, DTSC and SFRWQCB policy.
- HHRA Note Number 5 provides CARB state-wide ambient TCE concentrations, and we should check for BAAQMD air station data to see how much TCE is in ambient air in the vicinity of the building.
- Women of child-bearing age need to be aware of potential effects of TCE on fetus during the first trimester.
- Stressors are not limited to environmental contaminants. Uta recently attended a conference where sleep deprivation is a stressor to be considered when evaluating stress, and communications and Fact Sheets regarding the project should be at a frequency and with content that does not result in unnecessary stress.
- Regarding women of child-bearing age being removed from the building, Uta commented "who better to comment on pregnant women being in the building than one of the HERO contact people for HHRA Note Number 5, who is 9 months pregnant". She went on to conclude that we do not have URAL conditions in the building, that we have marginal ARAL conditions in the building, and that the conclusions of Kim that women of child-bearing age be notified of the conditions and be advised to consult their physician if they are considering getting pregnant was reasonable.

After you and I spoke on 10/12/15 I called Kim Gettmann on 10/12/15 to verify that my recollection of our conversation was correct. We reviewed the notes above and Kim said that I recalled the conversation perfectly, and that furthermore following her and my conversation on 10/5/15 she had reviewed our discussion with her supervisor Mike Wade, who is the other HERO contact person identified on HHRA Note Number 5, and Mike said that he agreed with everything that we had discussed and concluded. Kim said that she was leaving on maternity leave at the end of the day, but that she would be checking voicemails for the next week and would be responding to e-mails, and would be available to arrange for a telephone call if requested via e-mail or voicemail. In her absence we can contact Mike Wade. She emphasized that they are a resource, and we discussed that these conversations are helping to clarify policy because of the lack of conditions where these criteria have yet been applied.

Kim and I also discussed on 10/12/15 Uta's comments that stressors are not limited to environmental contaminants, and that excessive communications can result in confusion and stress. Kim said that had we not already provided two notifications she would urge us to get a Fact Sheet distributed quickly. But because we have already provided the two notifications she would be concerned that we will be bombarding and overwhelming building occupants with too much information, and they won't know what to believe and will get confused and distressed. Kim said that she believed that providing information at project milestones associated with mitigation and site investigation is a logically sound approach, and that releasing additional information following completion of this next mitigation step makes sense. She said that if our upcoming air testing results show that our mitigation measures have been successful, it would make good sense to then focus communications on upcoming subsurface work. Kim stated that not overwhelming people is part of risk communication.

Please let me know if you need any additional information.

Thank you!

Paul

Paul H. King
Professional Geologist

P&D Environmental, Inc.
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Oakland, CA 94610

(510) 658-6916 telephone
(510) 834-0152 facsimile
(510) 387-6834 cellular
Paul.King@pdenviro.com

In a message dated 10/9/2015 09:47:50 Pacific Daylight Time, Keith.Nowell@acgov.org writes:

Paul,

Please review my notes below regarding the discussion of the Fact Sheet in yesterday's phone conversation. Make edits and add comments to address this issue.

<u>Fact sheet</u>- Paul expressed concern that a premature Fact Sheet distribution would cause unnecessary alarm to the public. Based on conversations between Paul King and SF-RWQCB Cheryl Prowell, and DTSC toxicologists Kimberly Gettmann and Uta Hellmann-Blumberg, all the appropriate step regarding the investigation, confirmation & follow up sampling, mitigation and notification measures have been performed. Paul states that Uta is of the opinion that results of the next round of sampling- scheduled to be conducted next week- should be reviewed prior to distributing the factsheet, and that it should be left up to the woman whether or not to enter the building.

Kimberly and Uta are in agreement that if ARALs are still exceeded, language should be added that states "women considering becoming pregnant should consult with their physician" if confirmation samples continue to exceed the ARALs.

Thanks,

Keith Nowell

**From:** PDKing0000@aol.com [mailto:PDKing0000@aol.com]
**Sent:** Friday, October 02, 2015 8:25 AM
**To:** Nowell, Keith, Env. Health <Keith.Nowell@acgov.org>
**Cc:** Gary_Bates@efiglobal.com
**Subject:** Interim Framework TCE

Paul H. King
Professional Geologist

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## Roe, Dilan, Env. Health

**From:** PDKing0000@aol.com
**Sent:** Tuesday, October 13, 2015 5:05 PM
**To:** Nowell, Keith, Env. Health
**Cc:** Roe, Dilan, Env. Health; Gary_Bates@efiglobal.com; ron_holt@efiglobal.com; patrick@ellwoodcommercial.com; ronpatelvidge@gmail.com; dave@bblandlaw.com
**Subject:** RO2981 Interim Framework TCE - toxicologist discussions - addendum and update

Hi Keith,

As a follow up to my e-mail earlier today regarding my recent conversations with toxicologists regarding TCE in indoor air at RO 2981 - Red Hanger Kleaners at 6239 College Avenue, I forgot to mention that Uta also said that we are doing everything that we should be doing, that we are being prudent and reasonable, and that it seems that we are getting things done in a reasonable time frame.

We also successfully retrieved the interim post-mitigation air sampling media today and the samples were confirmed as received at the lab today. We expect to have the results by Thursday mid-day, if not sooner. I will let you know once we get the sample results.

Please let me know if you need additional information. Thank you!

Paul

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Paul.King@pdenviro.com

In a message dated 10/13/2015 08:07:35 Pacific Daylight Time, PDKing0000@aol.com writes:

> Hi Keith,
>
> Items discussed during our 10/8/15 conference call with Gary Bates included:
>
> - Status of communicating with lender where note came due.
> - Status of communicating with ground floor tenant that might go away.
> - Defective air filter replaced last week.
> - HVAC modification to allow atmospheric air ventilation was completed.
> - HVAC thermostat being enclosed 100815 and fans switched on for continuous ventilation
> - Post-mitigation interim air confirmation sampling to occur 36 hours after HVAC adjustment, presently scheduled for sampling at 2 locations where ARAL was exceeded on Monday 10/12/14 with SIM-certified 24 hour flow controllers and 6-liter Summa canisters.
> - Work plan is being reviewed by Gary Bates for subsurface investigation.

- We might not need to have a sit down meeting for the next step of site investigation.
- Paul King spoke with Cheryl Prowell, Kimberly Gettmann, and Uta Helmann-Blumberg regarding recommendations for women of child-bearing age being removed from the building, and discussion with Uta about not causing tenants unnecessary stress with excessive communications.

I called Kim Gettmann Monday 10/5/15 after having sent her an e-mail that summarized our indoor air results and mitigative measures taken to date. Kim is a DTSC toxicologist and one of the two people identified to contact regarding HERO HHRA Note Number 5. We discussed the following.

- Kim said that it was very good that we have gotten out notification promptly and that we have had two notifications of status and progress to date.
- Our language in our notifications of recommending that pregnant women not enter the building until TCE air concentrations are reduced is more robust/ stronger than the wording of HHRA Note Number 5.
- We are doing everything that we should be doing (testing to verify conditions, testing tenant suites, shampooing the carpet, sealing the floor cracks, smoke testing the sewer piping, confirmation testing, air filtration, HVAC adjustment for ventilation) and everything that we are doing is consistent with recommendations in HHRA Note Number 5.
- The two week recommendation for response is a suggestion, and HHRA Note Number 5 is purposefully vague to allow flexibility for caseworkers to accommodate unique site-specific conditions. Based on our marginal ARAL conditions and site conditions, the timeframe for our response is reasonable and prudent.
- We do not have URAL conditions, and we are marginally at ARAL conditions. If we were at URAL conditions we would be talking about recommending that women of child-bearing age leave the building. We are taking prudent measures with our recommendations and actions.
- Based on the near-ARAL concentrations and the notifications that we have provided we do not need to have women of child-bearing age leave the building. However, if our interim post-mitigation measures show no reduction in TCE concentrations we should include in our next notification those results and the recommendation that women who are of child-bearing age and are considering having children consult their physician regarding the effects of TCE on pregnant women and how it can affect the pregnancy. At that point we have provided recommendations and it is a risk-based decision that is up to the woman to decide.

I spoke with Uta Hellmann-Blumberg on 10/7/15 and reviewed indoor air quality and mitigation measures to date. I also told her of my 10/5/15 conversation with Kim Gettmann. Uta is a DTSC toxicologist and the primary author of the 10/16/14 draft SFRWQCB Interim Framework TCE vapor intrusion guidance. We discussed the following.

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Please let me know if you need any additional information.

Thank you!

Paul

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Paul.King@pdenviro.com

In a message dated 10/9/2015 09:47:50 Pacific Daylight Time, Keith.Nowell@acgov.org writes:

Paul,

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Fact sheet- Paul expressed concern that a premature Fact Sheet distribution would cause unnecessary alarm to the public. Based on conversations between Paul King and SF-RWQCB Cheryl Prowell, and DTSC toxicologists Kimberly Gettmann and Uta Hellmann-Blumberg, all the appropriate step regarding the investigation, confirmation & follow up sampling, mitigation and notification measures have been performed. Paul states that Uta is of the opinion that results of the next round of sampling- scheduled to be conducted next week- should be reviewed prior to distributing the factsheet, and that it should be left up to the woman whether or not to enter the building.

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Thanks,

Keith Nowell

**From:** PDKing0000@aol.com [mailto:PDKing0000@aol.com]
**Sent:** Friday, October 02, 2015 8:25 AM
**To:** Nowell, Keith, Env. Health <Keith.Nowell@acgov.org>
**Cc:** Gary_Bates@efiglobal.com
**Subject:** Interim Framework TCE

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Paul.King@pdenviro.com

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## Roe, Dilan, Env. Health

**From:** Bates, Gary <Gary_Bates@efiglobal.com>
**Sent:** Wednesday, October 14, 2015 4:31 AM
**To:** PDKing0000@aol.com
**Cc:** Roe, Dilan, Env. Health; Nowell, Keith, Env. Health; Browder, Ronald, Env. Health
**Subject:** Re: Voice Message from Unknown Caller - RO 2981

I will be Available at that time.

Gary Bates

Sent from my iPhone

On Oct 13, 2015, at 7:49 PM, "PDKing0000@aol.com<mailto:PDKing0000@aol.com>" <PDKing0000@aol.com<mailto:PDKing0000@aol.com>> wrote:

Gary, you are 2 hours ahead of us. Are you able to do 4:30 PM Pacific Time?

I just called Ellen and left her a voicemail with my office and cell phone numbers, let her know that I am the licensed professional working on indoor air quality, that we just got air samples today, and that we are expecting results on Thursday. I asked that Ellen give me a call.

Paul

In a message dated 10/13/2015 17:36:50 Pacific Daylight Time, Dilan.Roe@acgov.org<mailto:Dilan.Roe@acgov.org> writes:
Lets do 4:30

Dilan Roe, P.E.
Program Manager - Land Use & Local Oversight Program Alameda County Environmental Health
1131 Harbor Bay Parkway
Alameda, CA 94502
510.567.6767; Ext. 36767
QIC: 30440
dilan.roe@acgov.org<mip://0e4fabf8/dilan.roe@acgov.org>

PDF copies of case files can be reviewed/downloaded at:

http://www.acgov.org/aceh/lop/ust.htm

From: PDKing0000@aol.com<mailto:PDKing0000@aol.com> [mailto:PDKing0000@aol.com]
Sent: Tuesday, October 13, 2015 5:27 PM
To: Roe, Dilan, Env. Health <Dilan.Roe@acgov.org<mailto:Dilan.Roe@acgov.org>>; Nowell, Keith, Env. Health <Keith.Nowell@acgov.org<mailto:Keith.Nowell@acgov.org>>; Gary_Bates@efiglobal.com<mailto:Gary_Bates@efiglobal.com>
Cc: Browder, Ronald, Env. Health <ronald.browder@acgov.org<mailto:ronald.browder@acgov.org>>
Subject: Re: FW: Voice Message from Unknown Caller - RO 2981

I can do 11:30 AM but won't be next to a computer and I have to go into another meeting that starts at 12:00 noon.

I can do 4:30 PM.

Paul

In a message dated 10/13/2015 17:20:27 Pacific Daylight Time, Dilan.Roe@acgov.org<mailto:Dilan.Roe@acgov.org> writes:
I can do 11:30 or 4:30 tomorrow

Dilan Roe, P.E.
Program Manager - Land Use & Local Oversight Program Alameda County Environmental Health
1131 Harbor Bay Parkway
Alameda, CA 94502
510.567.6767; Ext. 36767
QIC: 30440
dilan.roe@acgov.org<mip://0e518fb8/dilan.roe@acgov.org>

PDF copies of case files can be reviewed/downloaded at:

http://www.acgov.org/aceh/lop/ust.htm

From: PDKing0000@aol.com<mailto:PDKing0000@aol.com> [mailto:PDKing0000@aol.com]
Sent: Tuesday, October 13, 2015 5:08 PM
To: Roe, Dilan, Env. Health <Dilan.Roe@acgov.org<mailto:Dilan.Roe@acgov.org>>; Nowell, Keith, Env. Health <Keith.Nowell@acgov.org<mailto:Keith.Nowell@acgov.org>>;
Gary_Bates@efiglobal.com<mailto:Gary_Bates@efiglobal.com>
Cc: Browder, Ronald, Env. Health <ronald.browder@acgov.org<mailto:ronald.browder@acgov.org>>
Subject: Re: FW: Voice Message from Unknown Caller - RO 2981

Hi Dilan,

I called Gary Bates and between our schedules we can do 10:30 AM Pacific Time. Does that work for you?

Gary and I called Keith shortly after receiving your e-mail and left him a voicemail, and I just called and left a voicemail again.

The next window of opportunity I have for a conference call is 2:30 PM Pacific Time.

We have previously been in communication with Ellen at 6239 regarding her concerns about the fans blowing continuously.

I also just sent an addendum to my summary of discussions with toxicologists regarding TCE in air, and included an update regarding the interim air confirmation sampling being completed today with results due by Thursday mid-day, if not sooner.

Paul

Paul H. King
Professional Geologist

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Paul.King@pdenviro.com<mailto:Paul.King@pdenviro.com>

In a message dated 10/13/2015 16:07:49 Pacific Daylight Time, Dilan.Roe@acgov.org<mailto:Dilan.Roe@acgov.org> writes:
I received a call this afternoon from Ellen Becker, a tenant at 6239 College Ave. Ellen states that she understands we will be conducting another test on the premises and because one of her patients is pregnant she has not been able to see her on the premises and she wants to know if we have the results of the test and whether it is safe to resume seeing her at her office.

I would like to schedule a conference call to discuss this this afternoon or tomorrow. Please work with Keith to arrange.

Dilan Roe, P.E.
Program Manager - Land Use & Local Oversight Program Alameda County Environmental Health
1131 Harbor Bay Parkway
Alameda, CA 94502
510.567.6767; Ext. 36767
QIC: 30440
dilan.roe@acgov.org<mailto:dilan.roe@acgov.org>

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http://www.acgov.org/aceh/lop/ust.htm

-----Original Message-----
From: Voicemail Admin
Sent: Tuesday, October 13, 2015 3:56 PM
To: Roe, Dilan, Env. Health <Dilan.Roe@acgov.org<mailto:Dilan.Roe@acgov.org>>
Subject: Voice Message from Unknown Caller

Sender's message is located in an attached WAV file.
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## Nowell, Keith, Env. Health

**From:** PDKing0000@aol.com
**Sent:** Wednesday, October 14, 2015 4:06 PM
**To:** Nowell, Keith, Env. Health
**Cc:** Roe, Dilan, Env. Health; Gary_Bates@efiglobal.com; ron_holt@efiglobal.com; patrick@ellwoodcommercial.com; ronpatelvidge@gmail.com; dave@bblandlaw.com
**Subject:** RO2981 Red Hanger Kleaners 10/13/15 air results - mitigation is working
**Attachments:** 1510220_d.pdf; 1510220COC.pdf

Hi Keith,

Attached are the lab report and chain of custody document for interim post-mitigation air samples collected 10/13/15 at Red Hanger Kleaners with results as follows:

- IA4 Hallway (on the second floor): TCE = 0.34 ug/m3, PCE = 0.24 ug/m3
- IA5 Mens Rm (third floor): TCE = 0.27 ug/m3, PCE = 0.80 ug/m3
- BG 2 Ambient: TCE = ND, PCE = ND.

It appears that the mitigation efforts are effectively reducing air concentrations to below commercial environmental screening levels for PCE and TCE and to below trigger levels for TCE.

I look forward to discussing these results and the next steps for the project at our upcoming 4:30 PM conference call with Dilan.

Thank you!

Paul

Paul H. King
Professional Geologist

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eurofins

Air Toxics

10/14/2015
Mr. Paul King
P & D Environmental
55 Santa Clara
Suite 240
Oakland CA 94610

Project Name: RED HANGER KLEANERS 6239 COLLEGE AVE
Project #: 0461
Workorder #: 1510220

Dear Mr. Paul King

The following report includes the data for the above referenced project for sample(s) received on 10/13/2015 at Air Toxics Ltd.

The data and associated QC analyzed by Modified TO-15 SIM are compliant with the project requirements or laboratory criteria with the exception of the deviations noted in the attached case narrative.

Thank you for choosing Eurofins Air Toxics Inc. for your air analysis needs. Eurofins Air Toxics Inc. is committed to providing accurate data of the highest quality. Please feel free to the Project Manager: Kyle Vagadori at 916-985-1000 if you have any questions regarding the data in this report.

Regards,

Kyle Vagadori

Kyle Vagadori
Project Manager

eurofins

Air Toxics

# WORK ORDER #: 1510220

Work Order Summary

**CLIENT:** Mr. Paul King
P & D Environmental
55 Santa Clara
Suite 240
Oakland, CA 94610

**BILL TO:** Mr. Paul King
P & D Environmental
55 Santa Clara
Suite 240
Oakland, CA 94610

**PHONE:** 510-658-6916

**FAX:** 510-834-0772

**DATE RECEIVED:** 10/13/2015

**DATE COMPLETED:** 10/14/2015

**P.O. #**

**PROJECT #** 0461 RED HANGER KLEANERS 6239 COLLEGE AVE

**CONTACT:** Kyle Vagadori

| FRACTION # | NAME | TEST | RECEIPT VAC./PRES. | FINAL PRESSURE |
|---|---|---|---|---|
| 01A | IA 4 HALLWAY | Modified TO-15 SIM | 7.0 "Hg | 5 psi |
| 02A | IA 5 MENS RM (3RD FL) | Modified TO-15 SIM | 7.0 "Hg | 5 psi |
| 03A | BG 2 AMBIENT | Modified TO-15 SIM | 3.0 "Hg | 5 psi |
| 04A | Lab Blank | Modified TO-15 SIM | NA | NA |
| 05A | CCV | Modified TO-15 SIM | NA | NA |
| 06A | LCS | Modified TO-15 SIM | NA | NA |
| 06AA | LCSD | Modified TO-15 SIM | NA | NA |

CERTIFIED BY: Heidi Hayes (signature)

Technical Director

DATE: 10/14/15

Certification numbers: AZ Licensure AZ0775, NJ NELAP - CA016, NY NELAP - 11291,
TX NELAP - T104704343-14-7, UT NELAP CA009332014-5, VA NELAP - 460197, WA NELAP - C935
Name of Accreditation Body: NELAP/ORELAP (Oregon Environmental Laboratory Accreditation Program)
Accreditation number: CA300005, Effective date: 10/18/2014, Expiration date: 10/17/2015.
Eurofins Air Toxics Inc.. certifies that the test results contained in this report meet all requirements of the NELAC standards



180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA - 956:
(916) 985-1000 . (800) 985-5955 . FAX (916) 985-1020

# LABORATORY NARRATIVE
## Modified TO-15 SIM
## P & D Environmental
## Workorder# 1510220

Three 6 Liter Summa Canister (SIM Certified) samples were received on October 13, 2015. The laboratory performed analysis via modified EPA Method TO-15 using GC/MS in the SIM acquisition mode.

This workorder was independently validated prior to submittal using 'USEPA National Functional Guidelines' as generally applied to the analysis of volatile organic compounds in air. A rules-based, logic driven, independent validation engine was employed to assess completeness, evaluate pass/fail of relevant project quality control requirements and verification of all quantified amounts.

Method modifications taken to run these samples are summarized in the table below. Specific project requirements may over-ride the ATL modifications.

| ***Requirement*** | ***TO-15*** | ***ATL Modifications*** |
|---|---|---|
| ICAL %RSD acceptance criteria | </=30% RSD with 2 compounds allowed out to < 40% RSD | Project specific; default criteria is </=30% RSD with 10% of compounds allowed out to < 40% RSD |
| Daily Calibration | +- 30% Difference | Project specific; default criteria is </= 30% Difference with 10% of compounds allowed out up to </=40%.; flag and narrate outliers |
| Blank and standards | Zero air | Nitrogen |
| Method Detection Limit | Follow 40CFR Pt.136 App. B | The MDL met all relevant requirements in Method TO-15 (statistical MDL less than the LOQ). The concentration of the spiked replicate may have exceeded 10X the calculated MDL in some cases |

**Receiving Notes**

There were no receiving discrepancies.

**Analytical Notes**

There were no analytical discrepancies.

**Definition of Data Qualifying Flags**

Eight qualifiers may have been used on the data analysis sheets and indicates as follows:

B - Compound present in laboratory blank greater than reporting limit (background subtraction not performed).

J - Estimated value.

E - Exceeds instrument calibration range.

S - Saturated peak.

Q - Exceeds quality control limits.

U - Compound analyzed for but not detected above the reporting limit, LOD, or MDL value. See data page for project specific U-flag definition.

UJ- Non-detected compound associated with low bias in the CCV
N - The identification is based on presumptive evidence.

File extensions may have been used on the data analysis sheets and indicates as follows:
a-File was requantified
b-File was quantified by a second column and detector
r1-File was requantified for the purpose of reissue

eurofins | Air Toxics

# Summary of Detected Compounds
# MODIFIED EPA METHOD TO-15 GC/MS SIM

**Client Sample ID: IA 4 HALLWAY**

**Lab ID#: 1510220-01A**

| Compound | Rpt. Limit (ppbv) | Amount (ppbv) | Rpt. Limit (ug/m3) | Amount (ug/m3) |
|---|---|---|---|---|
| Freon 12 | 0.035 | 0.48 | 0.17 | 2.4 |
| Chloromethane | 0.088 | 0.55 | 0.18 | 1.1 |
| Chloroform | 0.035 | 0.14 | 0.17 | 0.70 |
| Trichloroethene | 0.035 | 0.064 | 0.19 | 0.34 |
| Toluene | 0.035 | 0.14 | 0.13 | 0.52 |
| Tetrachloroethene | 0.035 | 0.036 | 0.24 | 0.24 |
| m,p-Xylene | 0.070 | 0.076 | 0.30 | 0.33 |

**Client Sample ID: IA 5 MENS RM (3RD FL)**

**Lab ID#: 1510220-02A**

| Compound | Rpt. Limit (ppbv) | Amount (ppbv) | Rpt. Limit (ug/m3) | Amount (ug/m3) |
|---|---|---|---|---|
| Freon 12 | 0.035 | 0.47 | 0.17 | 2.3 |
| Chloromethane | 0.088 | 0.57 | 0.18 | 1.2 |
| Chloroform | 0.035 | 0.40 | 0.17 | 2.0 |
| Benzene | 0.088 | 0.10 | 0.28 | 0.32 |
| Trichloroethene | 0.035 | 0.050 | 0.19 | 0.27 |
| Toluene | 0.035 | 0.30 | 0.13 | 1.1 |
| Tetrachloroethene | 0.035 | 0.12 | 0.24 | 0.80 |
| Ethyl Benzene | 0.035 | 0.055 | 0.15 | 0.24 |
| m,p-Xylene | 0.070 | 0.15 | 0.30 | 0.67 |
| o-Xylene | 0.035 | 0.060 | 0.15 | 0.26 |

**Client Sample ID: BG 2 AMBIENT**

**Lab ID#: 1510220-03A**

| Compound | Rpt. Limit (ppbv) | Amount (ppbv) | Rpt. Limit (ug/m3) | Amount (ug/m3) |
|---|---|---|---|---|
| Freon 12 | 0.030 | 0.47 | 0.15 | 2.3 |
| Chloromethane | 0.074 | 0.53 | 0.15 | 1.1 |
| Chloroform | 0.030 | 0.055 | 0.14 | 0.27 |
| Carbon Tetrachloride | 0.030 | 0.062 | 0.19 | 0.39 |
| Benzene | 0.074 | 0.31 | 0.24 | 0.98 |
| Toluene | 0.030 | 0.79 | 0.11 | 3.0 |

eurofins | Air Toxics

# Summary of Detected Compounds
# MODIFIED EPA METHOD TO-15 GC/MS SIM

**Client Sample ID: BG 2 AMBIENT**

**Lab ID#: 1510220-03A**

| | | | | |
|---|---|---|---|---|
| Ethyl Benzene | 0.030 | 0.14 | 0.13 | 0.59 |
| m,p-Xylene | 0.060 | 0.45 | 0.26 | 2.0 |
| o-Xylene | 0.030 | 0.17 | 0.13 | 0.72 |
| 1,4-Dichlorobenzene | 0.030 | 0.034 | 0.18 | 0.20 |

eurofins Air Toxics

**Client Sample ID: IA 4 HALLWAY**

**Lab ID#: 1510220-01A**

**MODIFIED EPA METHOD TO-15 GC/MS SIM**

| | | | |
|---|---|---|---|
| **File Name:** | v101315sim | **Date of Collection:** | 10/13/15 9:00:00 AM |
| **Dil. Factor:** | 1.75 | **Date of Analysis:** | 10/13/15 08:24 PM |

| Compound | Rpt. Limit (ppbv) | Amount (ppbv) | Rpt. Limit (ug/m3) | Amount (ug/m3) |
|---|---|---|---|---|
| Freon 12 | 0.035 | 0.48 | 0.17 | 2.4 |
| Freon 114 | 0.035 | Not Detected | 0.24 | Not Detected |
| Chloromethane | 0.088 | 0.55 | 0.18 | 1.1 |
| Vinyl Chloride | 0.018 | Not Detected | 0.045 | Not Detected |
| Chloroethane | 0.088 | Not Detected | 0.23 | Not Detected |
| 1,1-Dichloroethene | 0.018 | Not Detected | 0.069 | Not Detected |
| trans-1,2-Dichloroethene | 0.18 | Not Detected | 0.69 | Not Detected |
| Methyl tert-butyl ether | 0.18 | Not Detected | 0.63 | Not Detected |
| 1,1-Dichloroethane | 0.035 | Not Detected | 0.14 | Not Detected |
| cis-1,2-Dichloroethene | 0.035 | Not Detected | 0.14 | Not Detected |
| Chloroform | 0.035 | 0.14 | 0.17 | 0.70 |
| 1,1,1-Trichloroethane | 0.035 | Not Detected | 0.19 | Not Detected |
| Carbon Tetrachloride | 0.035 | Not Detected | 0.22 | Not Detected |
| Benzene | 0.088 | Not Detected | 0.28 | Not Detected |
| 1,2-Dichloroethane | 0.035 | Not Detected | 0.14 | Not Detected |
| Trichloroethene | 0.035 | 0.064 | 0.19 | 0.34 |
| Toluene | 0.035 | 0.14 | 0.13 | 0.52 |
| 1,1,2-Trichloroethane | 0.035 | Not Detected | 0.19 | Not Detected |
| Tetrachloroethene | 0.035 | 0.036 | 0.24 | 0.24 |
| 1,2-Dibromoethane (EDB) | 0.035 | Not Detected | 0.27 | Not Detected |
| Ethyl Benzene | 0.035 | Not Detected | 0.15 | Not Detected |
| m,p-Xylene | 0.070 | 0.076 | 0.30 | 0.33 |
| o-Xylene | 0.035 | Not Detected | 0.15 | Not Detected |
| 1,1,2,2-Tetrachloroethane | 0.035 | Not Detected | 0.24 | Not Detected |
| 1,4-Dichlorobenzene | 0.035 | Not Detected | 0.21 | Not Detected |

**Container Type: 6 Liter Summa Canister (SIM Certified)**

| Surrogates | %Recovery | Method Limits |
|---|---|---|
| 1,2-Dichloroethane-d4 | 100 | 70-130 |
| Toluene-d8 | 100 | 70-130 |
| 4-Bromofluorobenzene | 99 | 70-130 |

eurofins

Air Toxics

**Client Sample ID: IA 5 MENS RM (3RD FL)**

**Lab ID#: 1510220-02A**

**MODIFIED EPA METHOD TO-15 GC/MS SIM**

| | | | |
|---|---|---|---|
| **File Name:** | **v101316sim** | **Date of Collection:** | **10/13/15 9:05:00 AM** |
| **Dil. Factor:** | **1.75** | **Date of Analysis:** | **10/13/15 09:02 PM** |

| Compound | Rpt. Limit (ppbv) | Amount (ppbv) | Rpt. Limit (ug/m3) | Amount (ug/m3) |
|---|---|---|---|---|
| Freon 12 | 0.035 | 0.47 | 0.17 | 2.3 |
| Freon 114 | 0.035 | Not Detected | 0.24 | Not Detected |
| Chloromethane | 0.088 | 0.57 | 0.18 | 1.2 |
| Vinyl Chloride | 0.018 | Not Detected | 0.045 | Not Detected |
| Chloroethane | 0.088 | Not Detected | 0.23 | Not Detected |
| 1,1-Dichloroethene | 0.018 | Not Detected | 0.069 | Not Detected |
| trans-1,2-Dichloroethene | 0.18 | Not Detected | 0.69 | Not Detected |
| Methyl tert-butyl ether | 0.18 | Not Detected | 0.63 | Not Detected |
| 1,1-Dichloroethane | 0.035 | Not Detected | 0.14 | Not Detected |
| cis-1,2-Dichloroethene | 0.035 | Not Detected | 0.14 | Not Detected |
| Chloroform | 0.035 | 0.40 | 0.17 | 2.0 |
| 1,1,1-Trichloroethane | 0.035 | Not Detected | 0.19 | Not Detected |
| Carbon Tetrachloride | 0.035 | Not Detected | 0.22 | Not Detected |
| Benzene | 0.088 | 0.10 | 0.28 | 0.32 |
| 1,2-Dichloroethane | 0.035 | Not Detected | 0.14 | Not Detected |
| Trichloroethene | 0.035 | 0.050 | 0.19 | 0.27 |
| Toluene | 0.035 | 0.30 | 0.13 | 1.1 |
| 1,1,2-Trichloroethane | 0.035 | Not Detected | 0.19 | Not Detected |
| Tetrachloroethene | 0.035 | 0.12 | 0.24 | 0.80 |
| 1,2-Dibromoethane (EDB) | 0.035 | Not Detected | 0.27 | Not Detected |
| Ethyl Benzene | 0.035 | 0.055 | 0.15 | 0.24 |
| m,p-Xylene | 0.070 | 0.15 | 0.30 | 0.67 |
| o-Xylene | 0.035 | 0.060 | 0.15 | 0.26 |
| 1,1,2,2-Tetrachloroethane | 0.035 | Not Detected | 0.24 | Not Detected |
| 1,4-Dichlorobenzene | 0.035 | Not Detected | 0.21 | Not Detected |

**Container Type: 6 Liter Summa Canister (SIM Certified)**

| Surrogates | %Recovery | Method Limits |
|---|---|---|
| 1,2-Dichloroethane-d4 | 100 | 70-130 |
| Toluene-d8 | 100 | 70-130 |
| 4-Bromofluorobenzene | 100 | 70-130 |

eurofins | Air Toxics

**Client Sample ID: BG 2 AMBIENT**

**Lab ID#: 1510220-03A**

**MODIFIED EPA METHOD TO-15 GC/MS SIM**

| | | | |
|---|---|---|---|
| **File Name:** | **v101317sim** | **Date of Collection:** | **10/13/15 9:07:00 AM** |
| **Dil. Factor:** | **1.49** | **Date of Analysis:** | **10/13/15 09:46 PM** |

| Compound | Rpt. Limit (ppbv) | Amount (ppbv) | Rpt. Limit (ug/m3) | Amount (ug/m3) |
|---|---|---|---|---|
| Freon 12 | 0.030 | 0.47 | 0.15 | 2.3 |
| Freon 114 | 0.030 | Not Detected | 0.21 | Not Detected |
| Chloromethane | 0.074 | 0.53 | 0.15 | 1.1 |
| Vinyl Chloride | 0.015 | Not Detected | 0.038 | Not Detected |
| Chloroethane | 0.074 | Not Detected | 0.20 | Not Detected |
| 1,1-Dichloroethene | 0.015 | Not Detected | 0.059 | Not Detected |
| trans-1,2-Dichloroethene | 0.15 | Not Detected | 0.59 | Not Detected |
| Methyl tert-butyl ether | 0.15 | Not Detected | 0.54 | Not Detected |
| 1,1-Dichloroethane | 0.030 | Not Detected | 0.12 | Not Detected |
| cis-1,2-Dichloroethene | 0.030 | Not Detected | 0.12 | Not Detected |
| Chloroform | 0.030 | 0.055 | 0.14 | 0.27 |
| 1,1,1-Trichloroethane | 0.030 | Not Detected | 0.16 | Not Detected |
| Carbon Tetrachloride | 0.030 | 0.062 | 0.19 | 0.39 |
| Benzene | 0.074 | 0.31 | 0.24 | 0.98 |
| 1,2-Dichloroethane | 0.030 | Not Detected | 0.12 | Not Detected |
| Trichloroethene | 0.030 | Not Detected | 0.16 | Not Detected |
| Toluene | 0.030 | 0.79 | 0.11 | 3.0 |
| 1,1,2-Trichloroethane | 0.030 | Not Detected | 0.16 | Not Detected |
| Tetrachloroethene | 0.030 | Not Detected | 0.20 | Not Detected |
| 1,2-Dibromoethane (EDB) | 0.030 | Not Detected | 0.23 | Not Detected |
| Ethyl Benzene | 0.030 | 0.14 | 0.13 | 0.59 |
| m,p-Xylene | 0.060 | 0.45 | 0.26 | 2.0 |
| o-Xylene | 0.030 | 0.17 | 0.13 | 0.72 |
| 1,1,2,2-Tetrachloroethane | 0.030 | Not Detected | 0.20 | Not Detected |
| 1,4-Dichlorobenzene | 0.030 | 0.034 | 0.18 | 0.20 |

**Container Type: 6 Liter Summa Canister (SIM Certified)**

| Surrogates | %Recovery | Method Limits |
|---|---|---|
| 1,2-Dichloroethane-d4 | 101 | 70-130 |
| Toluene-d8 | 100 | 70-130 |
| 4-Bromofluorobenzene | 99 | 70-130 |

eurofins Air Toxics

**Client Sample ID: Lab Blank**

**Lab ID#: 1510220-04A**

**MODIFIED EPA METHOD TO-15 GC/MS SIM**

| | | | |
|---|---|---|---|
| **File Name:** | v101306sim | **Date of Collection:** NA | |
| **Dil. Factor:** | 1.00 | **Date of Analysis:** 10/13/15 11:57 AM | |

| Compound | Rpt. Limit (ppbv) | Amount (ppbv) | Rpt. Limit (ug/m3) | Amount (ug/m3) |
|---|---|---|---|---|
| Freon 12 | 0.020 | Not Detected | 0.099 | Not Detected |
| Freon 114 | 0.020 | Not Detected | 0.14 | Not Detected |
| Chloromethane | 0.050 | Not Detected | 0.10 | Not Detected |
| Vinyl Chloride | 0.010 | Not Detected | 0.026 | Not Detected |
| Chloroethane | 0.050 | Not Detected | 0.13 | Not Detected |
| 1,1-Dichloroethene | 0.010 | Not Detected | 0.040 | Not Detected |
| trans-1,2-Dichloroethene | 0.10 | Not Detected | 0.40 | Not Detected |
| Methyl tert-butyl ether | 0.10 | Not Detected | 0.36 | Not Detected |
| 1,1-Dichloroethane | 0.020 | Not Detected | 0.081 | Not Detected |
| cis-1,2-Dichloroethene | 0.020 | Not Detected | 0.079 | Not Detected |
| Chloroform | 0.020 | Not Detected | 0.098 | Not Detected |
| 1,1,1-Trichloroethane | 0.020 | Not Detected | 0.11 | Not Detected |
| Carbon Tetrachloride | 0.020 | Not Detected | 0.12 | Not Detected |
| Benzene | 0.050 | Not Detected | 0.16 | Not Detected |
| 1,2-Dichloroethane | 0.020 | Not Detected | 0.081 | Not Detected |
| Trichloroethene | 0.020 | Not Detected | 0.11 | Not Detected |
| Toluene | 0.020 | Not Detected | 0.075 | Not Detected |
| 1,1,2-Trichloroethane | 0.020 | Not Detected | 0.11 | Not Detected |
| Tetrachloroethene | 0.020 | Not Detected | 0.14 | Not Detected |
| 1,2-Dibromoethane (EDB) | 0.020 | Not Detected | 0.15 | Not Detected |
| Ethyl Benzene | 0.020 | Not Detected | 0.087 | Not Detected |
| m,p-Xylene | 0.040 | Not Detected | 0.17 | Not Detected |
| o-Xylene | 0.020 | Not Detected | 0.087 | Not Detected |
| 1,1,2,2-Tetrachloroethane | 0.020 | Not Detected | 0.14 | Not Detected |
| 1,4-Dichlorobenzene | 0.020 | Not Detected | 0.12 | Not Detected |

**Container Type: NA - Not Applicable**

| Surrogates | %Recovery | Method Limits |
|---|---|---|
| 1,2-Dichloroethane-d4 | 97 | 70-130 |
| Toluene-d8 | 99 | 70-130 |
| 4-Bromofluorobenzene | 98 | 70-130 |

eurofins Air Toxics

**Client Sample ID: CCV**

**Lab ID#: 1510220-05A**

**MODIFIED EPA METHOD TO-15 GC/MS SIM**

| | | | |
|---|---|---|---|
| **File Name:** | v101302sim | **Date of Collection:** | NA |
| **Dil. Factor:** | 1.00 | **Date of Analysis:** | 10/13/15 08:54 AM |

| Compound | %Recovery |
|---|---|
| Freon 12 | 99 |
| Freon 114 | 99 |
| Chloromethane | 85 |
| Vinyl Chloride | 98 |
| Chloroethane | 114 |
| 1,1-Dichloroethene | 90 |
| trans-1,2-Dichloroethene | 96 |
| Methyl tert-butyl ether | 104 |
| 1,1-Dichloroethane | 102 |
| cis-1,2-Dichloroethene | 95 |
| Chloroform | 98 |
| 1,1,1-Trichloroethane | 98 |
| Carbon Tetrachloride | 115 |
| Benzene | 99 |
| 1,2-Dichloroethane | 100 |
| Trichloroethene | 98 |
| Toluene | 102 |
| 1,1,2-Trichloroethane | 104 |
| Tetrachloroethene | 97 |
| 1,2-Dibromoethane (EDB) | 104 |
| Ethyl Benzene | 99 |
| m,p-Xylene | 97 |
| o-Xylene | 95 |
| 1,1,2,2-Tetrachloroethane | 94 |
| 1,4-Dichlorobenzene | 77 |

**Container Type: NA - Not Applicable**

| Surrogates | %Recovery | Method Limits |
|---|---|---|
| 1,2-Dichloroethane-d4 | 95 | 70-130 |
| Toluene-d8 | 100 | 70-130 |
| 4-Bromofluorobenzene | 94 | 70-130 |

eurofins | Air Toxics

**Client Sample ID: LCS**

**Lab ID#: 1510220-06A**

**MODIFIED EPA METHOD TO-15 GC/MS SIM**

| | | | |
|---|---|---|---|
| **File Name:** | v101303sim | **Date of Collection:** | NA |
| **Dil. Factor:** | 1.00 | **Date of Analysis:** | 10/13/15 09:42 AM |

| Compound | %Recovery | Method Limits |
|---|---|---|
| Freon 12 | 111 | 70-130 |
| Freon 114 | 111 | 70-130 |
| Chloromethane | 94 | 70-130 |
| Vinyl Chloride | 110 | 70-130 |
| Chloroethane | 121 | 70-130 |
| 1,1-Dichloroethene | 95 | 70-130 |
| trans-1,2-Dichloroethene | 88 | 70-130 |
| Methyl tert-butyl ether | 110 | 70-130 |
| 1,1-Dichloroethane | 109 | 70-130 |
| cis-1,2-Dichloroethene | 112 | 70-130 |
| Chloroform | 103 | 70-130 |
| 1,1,1-Trichloroethane | 104 | 70-130 |
| Carbon Tetrachloride | 112 | 60-140 |
| Benzene | 103 | 70-130 |
| 1,2-Dichloroethane | 104 | 70-130 |
| Trichloroethene | 102 | 70-130 |
| Toluene | 108 | 70-130 |
| 1,1,2-Trichloroethane | 111 | 70-130 |
| Tetrachloroethene | 103 | 70-130 |
| 1,2-Dibromoethane (EDB) | 111 | 70-130 |
| Ethyl Benzene | 110 | 70-130 |
| m,p-Xylene | 110 | 70-130 |
| o-Xylene | 112 | 70-130 |
| 1,1,2,2-Tetrachloroethane | 106 | 70-130 |
| 1,4-Dichlorobenzene | 94 | 70-130 |

**Container Type: NA - Not Applicable**

| Surrogates | %Recovery | Method Limits |
|---|---|---|
| 1,2-Dichloroethane-d4 | 96 | 70-130 |
| Toluene-d8 | 100 | 70-130 |
| 4-Bromofluorobenzene | 97 | 70-130 |

eurofins | Air Toxics

**Client Sample ID: LCSD**

**Lab ID#: 1510220-06AA**

**MODIFIED EPA METHOD TO-15 GC/MS SIM**

| | | | |
|---|---|---|---|
| **File Name:** | v101304sim | **Date of Collection:** | NA |
| **Dil. Factor:** | 1.00 | **Date of Analysis:** | 10/13/15 10:20 AM |

| Compound | %Recovery | Method Limits |
|---|---|---|
| Freon 12 | 109 | 70-130 |
| Freon 114 | 112 | 70-130 |
| Chloromethane | 94 | 70-130 |
| Vinyl Chloride | 108 | 70-130 |
| Chloroethane | 123 | 70-130 |
| 1,1-Dichloroethene | 96 | 70-130 |
| trans-1,2-Dichloroethene | 90 | 70-130 |
| Methyl tert-butyl ether | 111 | 70-130 |
| 1,1-Dichloroethane | 110 | 70-130 |
| cis-1,2-Dichloroethene | 114 | 70-130 |
| Chloroform | 105 | 70-130 |
| 1,1,1-Trichloroethane | 104 | 70-130 |
| Carbon Tetrachloride | 114 | 60-140 |
| Benzene | 106 | 70-130 |
| 1,2-Dichloroethane | 107 | 70-130 |
| Trichloroethene | 105 | 70-130 |
| Toluene | 108 | 70-130 |
| 1,1,2-Trichloroethane | 115 | 70-130 |
| Tetrachloroethene | 106 | 70-130 |
| 1,2-Dibromoethane (EDB) | 114 | 70-130 |
| Ethyl Benzene | 110 | 70-130 |
| m,p-Xylene | 109 | 70-130 |
| o-Xylene | 110 | 70-130 |
| 1,1,2,2-Tetrachloroethane | 108 | 70-130 |
| 1,4-Dichlorobenzene | 92 | 70-130 |

**Container Type: NA - Not Applicable**

| Surrogates | %Recovery | Method Limits |
|---|---|---|
| 1,2-Dichloroethane-d4 | 95 | 70-130 |
| Toluene-d8 | 100 | 70-130 |
| 4-Bromofluorobenzene | 97 | 70-130 |

# CHAIN OF CUSTODY RECORD

1510220



P&D ENVIRONMENTAL, INC.
55 Santa Clara Ave., Suite 240
Oakland, CA 94610
(510) 658-6916

PROJECT NUMBER: 0461

PROJECT NAME: RED HANGER KLEANERS, 6237 COLLEGE AVE, OAKLAND, CA

SAMPLED BY: (PRINTED & SIGNATURE) JAY MILLER

| SAMPLE NUMBER | DATE | TIME | TYPE | SAMPLE LOCATION: START VAC. | FINAL VAC. | CANISTER # | NUMBER OF CONTAINERS | ANALYSIS(ES): TO-15 | PRESERVATIVE | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| IA 4 HALLWAY | 10/13/15 | [illegible] | AIR | -30 | -7 | 94609 | 1 | X | NONE | 24 HR RUSH |
| IA 5 MENS RM (2ND FL) | 10/13/15 | [illegible] | ↓ | -30 | -5 | 61269 | 1 | X | ↓ | ↓ |
| EA 2 AMBIENT | 10/13/15 | [illegible] | ↓ | -30 | -5 | 34245 | 1 | X | ↓ | ↓ |

| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED BY: (SIGNATURE) | Total No. of Samples (This Shipment) | 3 | LABORATORY: EUROFINS/AIR TOXICS INC |
|---|---|---|---|---|---|---|
| [signature] | 10-13-15 | 1:48 | [signature] | Total No. of Containers (This Shipment) | 3 | |
| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED BY: (SIGNATURE) | LABORATORY CONTACT: KYLE VAGADORI | | LABORATORY PHONE NUMBER: (916) 605-3359 |
| RELINQUISHED BY: (SIGNATURE) | DATE | TIME | RECEIVED FOR LABORATORY BY: (SIGNATURE) | SAMPLE ANALYSIS REQUEST SHEET ATTACHED: ( ) YES (X) NO | | |

Results and billing to: P&D Environmental, Inc. [illegible]@pdenviro.com

REMARKS: 1 LITER SUMMA, FLOW CONTROLLER 24HR (SIM CERTIFIED)

## Nowell, Keith, Env. Health

**From:** PDKing0000@aol.com
**Sent:** Wednesday, October 14, 2015 6:55 PM
**To:** Roe, Dilan, Env. Health; Nowell, Keith, Env. Health
**Cc:** Gary_Bates@efiglobal.com; patrick@ellwoodcommercial.com; ronpatelvidge@gmail.com
**Subject:** RO2981 Red Hanger Kleaners, 10/14/15 calls to tenants

Hi Dilan and Keith,

Following our discussion with Gary Bates on the telephone at the end of today 10/14/15, I called and left a voicemail for the building tenants Esther Lerman (510-548-6241, she and I spoke 9/24/15) and Ellen Becker (510-658-5879, she left a voicemail for Dilan 10/13/15).

In the voicemail I said that we got preliminary air results that indicate that air concentrations have been reduced, that we will be performing comprehensive air testing in the suites in the near future, and that they will receive a notice to let them know when that testing will happen. After we get those next test results from the suites we will be able to comment about pregnant women entering the building.

I also left an additional message for Ellen saying that Dilan and I had spoken today, that I told Dilan that I would provide the most recent air results to Ellen, and that if Ellen still wanted to speak with Dilan she could call Dilan at 510-567-6767.

I also sent an e-mail to Kim Gettmann at DTSC and also to Uta Hellmann-Blumberg with the most recent air sample results and a request that they comment regarding notification related to pregnant women entering the building or women of child-bearing age consulting their physicians about entering the building.

I will let you know when I hear back from any of the parties above.

Thank you!

Paul

Paul H. King
Professional Geologist

P&D Environmental, Inc.
55 Santa Clara Avenue, Suite 240
Oakland, CA 94610

(510) 658-6916 telephone
(510) 834-0152 facsimile
(510) 387-6834 cellular
Paul.King@pdenviro.com

## Nowell, Keith, Env. Health

**From:** PDKing0000@aol.com
**Sent:** Wednesday, October 14, 2015 6:58 PM
**To:** Roe, Dilan, Env. Health; Nowell, Keith, Env. Health
**Subject:** EDF Toxicologist

Hi Dilan and Keith,

The EDF toxicologist who I mentioned earlier today is Richard Denison. Here is the link to the transcript of a show that I heard on the radio that I thought communicated very clearly concerns related to low concentrations of contaminants (he provides three examples).

http://loe.org/shows/segments.html?programID=12-P13-00028&segmentID=4

His EDF web page is as follows.

https://www.edf.org/people/richard-denison

You can click on the Publications and the Media tabs to see some other interesting items.

I sent an e-mail to the Media Contact Jon Coifman asking for information on the PCE study that Richard references in the first link above. Jon said that they were embroiled in TSCA legislation and that they would get back with me.

I will let you know if/when I get the PCE study info.

Paul

Paul H. King
Professional Geologist

P&D Environmental, Inc.
55 Santa Clara Avenue, Suite 240
Oakland, CA 94610

(510) 658-6916 telephone
(510) 834-0152 facsimile
(510) 387-6834 cellular
Paul.King@pdenviro.com

**Nowell, Keith, Env. Health**

| | |
|---|---|
| **From:** | PDKing0000@aol.com |
| **Sent:** | Thursday, October 15, 2015 7:54 AM |
| **To:** | Roe, Dilan, Env. Health; Nowell, Keith, Env. Health |
| **Cc:** | Gary_Bates@efiglobal.com; ron_holt@efiglobal.com; patrick@ellwoodcommercial.com; ronpatelvidge@gmail.com |
| **Subject:** | Re: RO2981 Red Hanger Kleaners, 10/15/15 call from Ellen Becker |

Hi Dilan and Keith,

I received a telephone call this morning 10/15/15 from 6:45 to 6:50 AM from Ellen Becker (tenant at 6239 College Ave). We discussed that we will collect air samples in the waiting room to her offices because the HVAC circulates the same air to all of the offices in the suite, and we made arrangements for access for the sampling once the sampling is scheduled.

Ellen also confirmed that she understands that the most recent air results are preliminary, and that we will wait for the upcoming air sample results from the suites before discussing any changes to the current procedure of not having pregnant women enter the building.

Ellen concluded that we are very reachable, very responsive, and that she is very appreciative.

Paul

Paul H. King
Professional Geologist

P&D Environmental, Inc.
55 Santa Clara Avenue, Suite 240
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(510) 387-6834 cellular
Paul.King@pdenviro.com

In a message dated 10/14/2015 18:55:09 Pacific Daylight Time, PDKing0000@aol.com writes:

> Hi Dilan and Keith,
>
> Following our discussion with Gary Bates on the telephone at the end of today 10/14/15, I called and left a voicemail for the building tenants Esther Lerman (510-548-6241, she and I spoke 9/24/15) and Ellen Becker (510-658-5879, she left a voicemail for Dilan 10/13/15).
>
> In the voicemail I said that we got preliminary air results that indicate that air concentrations have been reduced, that we will be performing comprehensive air testing in the suites in the near future, and that they will receive a notice to let them know when that testing will happen. After we get those next test results from the suites we will be able to comment about pregnant women entering the building.
>
> I also left an additional message for Ellen saying that Dilan and I had spoken today, that I told Dilan that I would provide the most recent air results to Ellen, and that if Ellen still wanted to speak with Dilan she could call Dilan at 510-567-6767.
>
> I also sent an e-mail to Kim Gettmann at DTSC and also to Uta Hellmann-Blumberg with the most recent air sample results and a request that they comment regarding notification related to pregnant women entering the building or women of child-bearing age consulting their physicians about entering the building.
>
> I will let you know when I hear back from any of the parties above.

Thank you!

Paul

Paul H. King
Professional Geologist

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Oakland, CA 94610

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## Roe, Dilan, Env. Health

**From:** PDKing0000@aol.com
**Sent:** Friday, October 16, 2015 4:22 PM
**To:** Roe, Dilan, Env. Health; Nowell, Keith, Env. Health
**Cc:** Gary_Bates@efiglobal.com; ron_holt@efiglobal.com; patrick@ellwoodcommercial.com; ronpatelvidge@gmail.com; dave@bblandlaw.com
**Subject:** RO 2981 - Red Hanger Kleaners - Post-mitigation sampling for 10/20 to 10/21/15
**Attachments:** 0461.M14.doc

Hi Dilan and Keith,

We are presently scheduled to deploy air sampling media at the subject site on Tuesday 10/20/15 beginning at 7:00 AM and retrieve the media on Wednesday 10/21/15 beginning at 7:00 AM associated with confirmation air testing, as discussed in our 8/28/15 proposed post-mitigation test e-mail. We will deploy air sampling media at eight locations inside the building, in addition to one duplicate sample for one indoor location and one ambient air sample.

I have attached with this e-mail and also copied and pasted into the e-mail below our tenant notification associated with the upcoming sampling event (document 0461.M14.doc).

Please let me know if you have any questions or need any additional information.

Thank you!

Paul

Paul H. King
Professional Geologist

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Oakland, CA 94610

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(510) 834-0152 facsimile
(510) 387-6834 cellular
Paul.King@pdenviro.com
**************************************************************************************************************

10/16/2015

Dear Tenant,

This notification is written as a follow-up to our 9/22/15 notification regarding detectable concentrations of the chemical trichloroethene (TCE) and tetrachloroethene (also called perchloroethene, or PCE) that have been identified in air in the building at 6239 College Avenue in Oakland.

The preliminary results of air testing conducted at limited locations in the building on October 13, 2015 indicate that the most recent mitigation measures of air filtration and continuous operation of the air ventilation systems have effectively reduced TCE and PCE concentrations in air in the building.

A more comprehensive testing of air in the building will be performed during the week of October 19, 2015. We are providing you with this notification as a precaution and to continue to advise you that women who are pregnant or who suspect that they might be pregnant are advised to not enter the premises until TCE air concentrations in the building are confirmed by the upcoming testing to have been reduced. We will let you know as soon as the results of the more comprehensive testing become available.

This work is being performed with supervision by the Alameda County Department of Environmental Health (ACDEH).

If you have any questions or need any additional information, please do not hesitate to contact the following:

- Dilan Roe at the ACDEH at 510-567-6767 or
- Patrick Ellwood at 510-238-9111 or
- Paul King of P&D Environmental, Inc. at 510-658-6916.

0461.M14

10/16/2015

Dear Tenant,

This notification is written as a follow-up to our 9/22/15 notification regarding detectable concentrations of the chemical trichloroethene (TCE) and tetrachloroethene (also called perchloroethene, or PCE) that have been identified in air in the building at 6239 College Avenue in Oakland.

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This work is being performed with supervision by the Alameda County Department of Environmental Health (ACDEH).

If you have any questions or need any additional information, please do not hesitate to contact the following:

- Dilan Roe at the ACDEH at 510-567-6767 or
- Patrick Ellwood at 510-238-9111 or
- Paul King of P&D Environmental, Inc. at 510-658-6916.

0461.M14

**Roe, Dilan, Env. Health**

| | |
|---|---|
| **From:** | PDKing0000@aol.com |
| **Sent:** | Thursday, October 22, 2015 9:24 AM |
| **To:** | Roe, Dilan, Env. Health; Nowell, Keith, Env. Health |
| **Cc:** | Gary_Bates@efiglobal.com; ron_holt@efiglobal.com; patrick@ellwoodcommercial.com; ronpatelvidge@gmail.com; dave@bblandlaw.com |
| **Subject:** | College Ave RO 2981 - DTSC toxicologist response re: reduced TCE air results |
| **Attachments:** | HERO-HHRA-Number-4-October-6-2015.pdf |

Hi Dilan and Keith,

The post-mitigation confirmation air samples werecollected and delivered to the lab yesterday 10/21/15 for the subject site. The results are due in a week, and I will let you know when we get the results.

Earlier this week I left messages again for DTSC toxicologists Kim Gettmann, Michael Wade, and Uta Hellmann-Blumberg regarding the need for notifications to women of child-bearing age and also any considerations related to pregnant women entering the building when reduced TCE air concentrations are present in the building at concentrations similar to our most recent interim post-mitigation air sample results of 0.34 and 0.27 ug/m3.

Yesterday 10/21/15 I spoke with Michael Wade in the morning who said that he mostly works on DOD cases, and that Claudio Sorrentino (the chief DTSC HERO toxicologist) would call me later in the day.

I spoke with Claudio in the afternoon, and Claudio confirmed the following:

o A hazard quotient is the ratio of the potential exposure to a substance and the level at which no adverse effects are expected. If the Hazard Quotient is calculated to be less than 1, then no adverse health effects are expected as a result of exposure. If the Hazard Quotient is greater than 1, then adverse health effects are possible.

o HHRA Note Number 5 TCE air trigger concentrations of 2 ug/m3 for residential and 8 ug/m3 for commercial exposure scenarios are based on a Hazard Quotient of 1. These trigger concentrations are referred to as the ARAL in the SFRWQCB 2014 guidance, and are based on US EPA recommended concentrations.

o Our most recent TCE air sample results are well below the HHRA Note Number 5 trigger concentrations of 2 ug/m3 for residential and 8 ug/m3 for commercial exposure scenarios, resulting in our hazard quotient being substantially less than 1.

o Based on our Hazard Quotient being substantially less than 1, no adverse health effects are expected. For this reason, notifications are not required, and restrictions related to women of child-bearing age or pregnant women are not required.

Claudio also mentioned that HHRA Note Number 4 has just been recently updated as of 10/6/15 and suggested reviewing the document regarding ambient air screening levels.

https://www.dtsc.ca.gov/assessingrisk/humanrisk2.cfm

I have attached a pdf copy of the most recent version of HHRA Note Number 4.

After speaking with Claudio I received a call from Uta, and Uta confirmed that my summary of my discussion with Claudio is accurate.

Please let me know if you have any questions or need any additional information.

Thank you!

Paul

Paul H. King
Professional Geologist

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**CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL (DTSC)**
**OFFICE OF HUMAN AND ECOLOGICAL RISK (HERO)**

# HUMAN HEALTH RISK ASSESSMENT (HHRA) NOTE

**HERO HHRA NOTE NUMBER:** 4

**ISSUE DATE:** October 6, 2015

**ISSUE:** Screening Level Human Health Risk Assessments.

## SUMMARY


In a memorandum dated October 28, 1994, HERO recommended guidelines for use of the U.S. EPA Region 9 Preliminary Remediation Goals (PRGs) at military sites (DTSC 1994). In 2008, the U.S. EPA released Regional Screening Levels (RSLs) to replace the PRGs formerly available from several U.S. EPA Regional offices (U.S. EPA 2015). HERO subsequently developed HHRA Note 3 to provide the recommended methodology for use of U.S. EPA RSLs in the HHRA process at DTSC hazardous waste sites and permitted facilities. The latest iteration of HHRA Note 3 was released in September of 2015 (DTSC 2015). This HHRA Note outlines the current recommended methodology for conducting screening level human health risk assessments, and is an update which replaces our 1994 memorandum and the earlier versions of Note 4.

Historically, U.S. EPA PRGs have been used mostly at military facilities. However, the recommendations included in this Note are intended for use at any DTSC site where DTSC has approved the use of RSLs in a screening risk assessment. Please contact the HERO Section Chiefs[1] regarding human health risk assessment at properties and facilities other than military facilities (e.g. civilian facilities, schools).


## WHAT'S NEW

This HHRA Note supersedes HERO's previous June 9, 2011 HHRA Note 4. Among other updates, this revision incorporates updated recommendations for use of the U.S. EPA ambient air RSLs, a definition of a screening level risk assessment, and use of incremental sampling for soil at DTSC sites.

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[1]Northern California Section (Claudio Sorrentino, Ph.D., Senior Toxicologist, 916-255-6656); Southern California Section (William Bosan, Ph.D., Senior Toxicologist, 714-848-5399); Central California Section (Brian Endlich, Ph.D., Senior Toxicologist, 510-540-3804).

Primary HERO authors: Kimberly Gettmann, Ph.D., Staff Toxicologist, HERO
Michael Wade, Ph.D., D.A.B.T, Senior Toxicologist, HERO
James M. Polisini, Ph.D., Supervising Toxicologist, HERO

| | |
|---|---|
| **HERO ISSUE CONTACT PERSONS:** | Michael J. Wade, Ph.D., D.A.B.T.<br>Senior Toxicologist, Military Facilities<br>916.255.6653 Voice<br>916.255.6695 Facsimile<br>michael.wade@dtsc.ca.gov |
| | Kimberly Day Gettmann, Ph.D.<br>Staff Toxicologist<br>916.255.6685 Voice<br>916.255.6695 Facsimile<br>kimberly.gettmann@dtsc.ca.gov |

## I. BACKGROUND

Beginning in the early 1990s, California developed a process for conducting screening level human health risk assessments (HHRAs) at Federal Facilities (open and closed military facilities). Since baseline risk assessments require a more intensive use of resources, time and cost, screening level risk assessments can facilitate the determination of "no further action" (i.e. unrestricted land use including residential uses) or further evaluation. If the cumulative risk and hazard index estimates are acceptable under the most conservative screening assumptions, then site-specific conditions can be expected to result in acceptable risk and hazard index levels. Consequently, the results of a screening risk assessment indicate whether or not a quantitative baseline risk assessment or further site investigation is warranted.

In a memorandum dated October 28, 1994, HERO recommended guidelines for use of the Region 9 PRGs at military sites (DTSC 1994). The screening level HHRA process at Federal Facility sites in California has historically used the U.S. Environmental Protection Agency (U.S. EPA) Region 9 Preliminary Remediation Goals (PRGs, U.S. EPA 2004) supplemented with Cal-modified PRGs that are based on California-derived toxicity criteria from Office of Environmental Health Hazard Assessment (OEHHA). In 2008, the U.S. EPA released Regional Screening Levels (RSLs) to replace the PRGs formerly available from several U.S. EPA Regional offices (U.S. EPA 2015). This, as well as other updates in the area of risk assessment methodology, has necessitated an update to our 1994 recommendations. Subsequently, HHRA Note 4 was developed as a replacement to our 1994 memo. This document is an update to our HHRA Note 4 dated June 9, 2011.

HHRA Note 4 is intended to be used in conjunction with HERO's HHRA Note 3 (DTSC 2015). HHRA Note 3 addresses DTSC's recommended methodology for use of the soil, tap water, and ambient air RSLs and DTSC-modified screening levels in the HHRA risk assessment process and should be used in conjunction with Note 4. The present revision of HHRA Note 3 incorporates HERO recommendations based on review of the May 2014 through June 2015 releases of the RSL tables for soil, tap water, and ambient air. Both Note 3 and Note 4 will be updated periodically and the DTSC website should be checked to ensure use of the most recent versions.

As discussed in HHRA Note 3, for the majority of the approximately 800 constituents with RSLs, HERO recommends use of the soil, tap water, and ambient air values listed in the June 2015 U.S. EPA RSL tables. However, some values listed in the U.S. EPA RSL tables differ significantly (greater than three-fold) from values calculated using Cal/EPA toxicity criteria and risk assessment procedures. HERO has prepared reference tables for soil, tap water, and ambient air which indicate contaminants for which the DTSC-modified screening level (DTSC-SL) should be used. In addition, specific recommendations and discussion are provided for several contaminants. Alternatively and in consultation with HERO, the RSL On-line Screening Calculator can be used to calculate site-specific values using the more protective of Cal/EPA and U.S. EPA toxicity values and applying assumptions consistent with HERO recommendations (e.g., route-to-route extrapolation between oral and inhalation exposure where no inhalation toxicity value is available but an oral toxicity value is available). Cal/EPA toxicity criteria can be located in the OEHHA Toxicity Criterion Database and on OEHHA's Air Toxics Hot Spots website which presents noncancer reference exposure levels (OEHHA 2015).[2]

HERO has completed a review of the RSLs for ambient air and the recommended ambient air DTSC-SL are presented in Table 3 of the September 2015 HHRA Note 3 (DTSC 2015). The indoor air screening levels for VOCs are the more stringent of values calculated using U.S. EPA and DTSC-modified methods. The three-fold difference between U.S. EPA RSLs and DTSC-SLs does not apply to the ambient air screening levels. If an ambient air DTSC-SL is more stringent, it is selected and listed as an ambient air DTSC-SL. Toxicity criteria for ambient air, acceptable to HERO, are also included in the recently revised (December 2014) DTSC version of the Johnson and Ettinger (J&E) indoor air model.[3] This HHRA Note also outlines a process for incorporating the vapor intrusion to indoor air pathway into screening level human health risk assessments.

Prior to implementing the use of RSLs in screening level risk assessments, the U.S. EPA RSL User's Guide and Frequently Asked Questions should be consulted to ensure familiarity with how the numbers were derived and the limitations on their use (U.S. EPA 2015). This HHRA Note reiterates many of the points discussed in the U.S. EPA RSL User's Guide.

Limitations associated with the use of RSLs and DTSC-SLs for screening level HHRAs must be carefully noted and understood prior to making risk management decisions. As discussed in more detail below, it is critical that a site-specific conceptual site model (CSM) or site exposure model be developed prior to conducting a screening level risk assessment. This will ensure that the assumptions used to derive the RSLs and DTSC-SLs are applicable and inclusive of all potentially complete exposure pathways and receptors at a site. For example, the derivation of the U.S. EPA RSLs and DTSC-SLs for soil and tap water did not include an evaluation of the intrusion of vapors from the subsurface to indoor air. Vapor intrusion to indoor air from volatile chemicals in soil or groundwater has become recognized as a potentially major exposure pathway.

Finally, this HHRA Note addresses HERO's recommendation that screening level risk evaluations for hazardous waste sites and permitted facilities include the calculation of both the site-related risk and hazard index, and the total risk and hazard index on a site-specific basis. The latter presents the risk and hazard associated with exposure to all detected chemicals prior to elimination of inorganic chemicals that are determined to be consistent with site-specific background or ambient concentrations. This information may be helpful for making risk management decisions about appropriate land uses and for public transparency.

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[2] http://oehha.ca.gov/risk/chemicaldb/index.asp; http://www.oehha.ca.gov/air/hot_spots/index.html
[3] http://www.dtsc.ca.gov/assessingrisk/humanrisk2.cfm#Vapor

## II. SCREENING LEVEL HUMAN HEALTH RISK ASSESSMENTS

### A. LAND USE AND HUMAN RECEPTORS

A screening level human health risk assessment provides a general indication of whether there is potential risk to human health and helps identify areas of concern at a site where a release of hazardous chemicals has occurred. It normally uses established risk-based screening levels such as RSLs and DTSC-SLs to estimate the cancer risks and noncancer hazards, and is intended to be a health-protective preliminary evaluation of potential risk and hazard (DTSC, 2015). If a site fails the screening level risk assessment, e.g., cancer risks are greater than $1 \times 10^{-6}$ and/or noncancer hazards are greater than 1, then further investigation and/or a more site-specific baseline risk assessment may be necessary to evaluate the potential risk to all receptors.

In general, HERO recommends that an unrestricted land use scenario (i.e. a residential scenario) be assumed for site screening at all facilities, both active and closing/closed. HERO assumes that reuse of hazardous waste sites could result in a change of ownership and land use, including potential residential reuse of the property. For active facilities, HERO considers the residential scenario evaluation a health-conservative approach which will allow for a determination of "no further action", further investigation, or land use management decisions. However, the residential scenario would not necessarily be protective of unrestricted land use for those chemicals that bioaccumulate in food products (e.g., dioxins which are addressed in HHRA Note 2 [DTSC 2009]).

If a residential scenario is not implemented in the screening evaluation, documentation should be provided that unrestricted land use will not occur in the future and DTSC approval should be obtained prior to conducting the risk assessment. For open Military Facilities, the Base Master Plan should indicate that unrestricted land use evaluation is required if future land use changes. For closed Bases or civilian facilities other than Department of Defense (DoD) facilities, a land use control (LUC) may be needed to restrict future residential use of the property if a risk assessment has not been conducted for a residential scenario.

Screening-level human health risk assessments may also include an evaluation of the industrial scenario using industrial RSLs and DTSC-SLs. Evaluation of the industrial scenario provides additional information that may be used to evaluate receptors under current industrial use scenarios and to support risk management decisions. Although sites with acceptable risk under the residential land use scenario will likely have acceptable risk under other scenarios such as industrial land use, the inverse is not necessarily true. Sites with acceptable risk under the industrial land use could pose unacceptable risk under the residential land use scenario.

Construction scenarios cannot be evaluated in the screening level process because of the lack of applicable screening levels. Historically, it has been generally assumed that an evaluation of the residential land use scenario should be protective of construction worker receptors unless specific exposure pathways unique to construction workers exist (e.g., dermal contact with and inhalation of vapors from water in a trench). If such pathways are anticipated at a site, it would be necessary to proceed with a baseline site-specific human health risk evaluation to address potential risk to construction workers. In such cases, HERO recommends upfront discussion and agreement between DTSC and the responsible party regarding which of the following risk assessment approaches will be used: 1) screening level risk assessment for residential and industrial receptors, and a baseline risk assessment for construction workers; or, 2) a baseline risk assessment for all receptors. Please note that because of greater soil exposure to construction workers, an industrial use scenario is not necessarily protective of construction workers. Similarly, screening levels for trespasser and recreational use are also not available. Site specific variability in these exposure scenarios makes development of screening levels impractical. A baseline risk assessment should be performed for these scenarios if they are relevant for the site.

## B. ECOLOGICAL RISK ASSESSMENT

This HHRA Note does not address ecological risk assessment. It is important to understand that ecological receptors were not considered in the calculation of the screening levels. That is, the RSLs and DTSC-SLs apply to human receptors only and are not necessarily protective of ecological receptors. A separate ecological risk evaluation must be conducted if significant ecological habitat is present onsite or there is potential transport of contaminants to offsite habitat. A screening risk assessment for human receptors is never adequate to address the need for ecological risk assessment. Responsible parties should refer to DTSC's Ecological Guidance and EcoNOTEs for more information on appropriate procedures (Section 2.6 of DTSC 2013, DTSC 1996, and DTSC EcoNOTEs [http://www.dtsc.ca.gov/AssessingRisk/eco.cfm]). Prior to conducting an ecological risk assessment, the HERO toxicologist should be contacted.

## C. EXPOSURE PATHWAYS CONSIDERED IN THE CALCULATION OF THE RESIDENTIAL AND INDUSTRIAL SOIL, TAP WATER AND AMBIENT AIR SCREENING LEVELS

Before conducting a screening level human health risk assessment, a site-specific CSM is required to ensure all appropriate receptors and exposure pathways are addressed by the RSLs and DTSC-SLs.

The residential and industrial soil screening levels consider several exposure routes: ingestion, inhalation of particles and volatile chemicals in ambient air, and dermal absorption.

The tap water screening levels are based on assumed residential exposure to water via ingestion from drinking, inhalation of volatile chemicals released during household use (e.g., showering, dish washing), and dermal exposure to tap water during showering/bathing.

The air screening levels address ambient air exposure scenarios and are based on assumed indoor air exposure of a 24-hour time period for a resident and an 8-hour time period for an industrial worker.

Although the soil, tap water, and ambient air screening levels account for many typical exposure pathways they do not account for the following additional potential exposure pathways (discussed with respect to PRGs/RSLs in U.S. EPA 2015, as applicable):

i. The residential and industrial soil RSLs do not account for exposure to indoor air vapors from intrusion of soil gas; ingestion of plants (home-grown fruits and vegetables), meat, or dairy products; or inhalation of particles (fugitive dust) generated by activities which elevate particulate emissions such as truck traffic and use of heavy equipment.

ii. Pathways in the calculation of the tap water RSLs do not include subsurface vapor intrusion to indoor air from volatile organic compounds (VOCs) present in groundwater, ingestion of water during swimming, and transfer of contaminants in the water column to aquatic organisms or terrestrial plants with subsequent ingestion by humans. The RSL On-line Calculator and User's Guide do however include equations which can be used to calculate screening level fish concentrations assuming human consumption of fish. These equations do not address impacts to fish; but rather, human consumption of fish which may be contaminated. The RSL On-line Calculator and User's Guide also includes equations which can be used to calculate soil and surface water screening levels for recreational receptors.

iii. The residential and industrial ambient air RSLs cannot be used directly as screening levels for soil gas. The air screening levels may be used for screening VOCs in soil gas data when used in concert with an appropriate attenuation factor as described in DTSC's 2011 Vapor Intrusion Guidance document (DTSC 2011a). Alternatively, the DTSC-modified version of the J&E model (DTSC 2014a) can be used with DTSC's default soil parameters and exposure conditions to derive soil gas screening levels.

If pathways not considered in the derivation of the soil, tap water, and ambient air screening levels are anticipated at the site, a screening level risk evaluation may underestimate risk. In addition, if there are exposure scenarios other than residential and industrial land uses, a screening level risk evaluation using RSLs and DTSC-SLs may not be appropriate (e.g., sites in which trench workers may be exposed to shallow groundwater). In such cases, the evaluation of risk to human receptors at the site should proceed with the baseline human health risk assessment process, at least for those receptors for which a screening level risk assessment is not appropriate. For reference, HERO has compiled a summary of recommended exposure factors which may be used as default values in baseline human health risk assessments at California hazardous waste sites and permitted facilities (DTSC 2014b). In other instances, the screening risk assessment may overestimate risk. In these cases, preparation of a baseline human health risk assessment is an option.

Additional Considerations Regarding the Use of Industrial Screening Levels

The tap water screening levels are calculated using residential land use assumptions. As such, these screening levels are not reflective of industrial exposures and may overestimate exposures from water exposure pathways.

Screening level evaluations using the industrial soil screening levels do not account for the following pathways: all uses of groundwater; exposure via vapor intrusion to indoor air; exposure to contaminated surface and groundwater, and inhalation of particulates released from wind, truck traffic and use of heavy equipment. If these exposure pathways are significant at a site, screening risk assessment using RSLs and DTSC-SLs is not appropriate.

## D. EVALUATION OF THE VAPOR INTRUSION TO INDOOR AIR PATHWAY

As noted above, the U.S. EPA RSLs and DTSC-SLs do not account for risk and hazard from the vapor intrusion to indoor air pathway. When significant concentrations of VOCs are present, the vapor intrusion pathway often generates the highest cancer risk and hazard index. Therefore, when vapor intrusion is a potentially complete exposure pathway, it is essential that it be included in the screening risk assessment.

Please consult DTSC's vapor intrusion to indoor air guidance for a more detailed discussion of this topic (DTSC 2011a). DTSC guidance recommends that multiple lines of evidence, such as soil gas, indoor air, and groundwater data be used for preliminary screening evaluations of vapor intrusion. Soil gas data provide a direct measurement of the VOCs that may migrate to indoor air. If soil gas data are not available for a given site, a soil gas investigation should be conducted. For sites where groundwater is contaminated with VOCs, DTSC recommends that vapor intrusion to indoor air be evaluated using both soil gas and groundwater data. This recommendation is particularly applicable for sites where groundwater is shallow and there is a large capillary fringe. If the media are in equilibrium, the associated vapor intrusion risk should be approximately the same. Technical difficulties in sample collection and preservation of VOCs in soil matrix, as well as uncertainties associated with the use of partitioning equations make soil matrix data less than ideal for estimating vapor intrusion. However, in some cases, there may be no alternative and this should be discussed with the project team prior to conducting the vapor intrusion evaluation.

The most current DTSC screening-level J&E model can be used to estimate the risk and hazard quotient from vapor intrusion to indoor air in lieu of using the default attenuation factors or calculating soil gas and groundwater screening levels from the J&E model. The DTSC J&E models can be found on the DTSC website at: http://www.dtsc.ca.gov/assessingrisk/humanrisk2.cfm#Vapor.

Another option for evaluation of this pathway is indoor air monitoring, subslab or crawl space sampling. HERO should be contacted before undertaking any form of vapor intrusion sampling.

Risk and hazard from this exposure pathway must be summed with risk and hazard from other pathways to estimate the total site risk and hazard index (See Section III-D entitled "Additivity of Risk and Hazard").

## E. EVALUATION OF IMPACTS TO SURFACE AND GROUNDWATER

The derivation of residential and industrial soil screening levels does not consider the potential for contaminants to migrate to groundwater or surface water. The RSL Tables do however list risk-based and maximum contaminant level (MCL)-based screening levels for soil (SSLs), which identify chemical concentrations in soil that may impact the groundwater. The DTSC geologist and the California Regional Water Quality Control Board (RWQCB) should be contacted regarding the protection of groundwater and surface water.

If it is determined that groundwater has been impacted, exposure to groundwater must be quantitatively evaluated in the screening level risk evaluation unless no VOCs are present in the groundwater and a written statement is available from the RWQCB indicating that groundwater from the site has no beneficial uses. If VOCs are present in groundwater, vapor intrusion to indoor air must be evaluated, regardless of beneficial use determinations.

Contaminated surface water must also be evaluated in screening risk assessments. If tap water screening levels are used to screen surface water, limitations and uncertainties associated with the derivation of tap water screening levels relative to anticipated surface water exposure scenarios must be addressed. Alternatively, the RSL On-line Calculator and User's Guide includes equations which can be used (in conjunction with California-preferred exposure and toxicity factors) to calculate surface water screening levels for recreational receptors.

In most cases, HERO recommends that unfiltered water be used in the risk evaluation given that unfiltered water may be of potable quality at some sites (U.S. EPA 1989). If only grab sample groundwater data are available at a site, they can be used for assessing risk. However, because grab groundwater samples may be associated with high levels of particulate matter, the risk assessment should discuss the potential for additional uncertainty in the risk estimates due to the use of grab sample groundwater data.

Finally, as discussed previously in Section II-B entitled "Ecological Risk Assessment", the tap water screening levels only address human health. It cannot be assumed that these screening levels are protective of aquatic organisms and wildlife.

## F. AIR MODELS USED IN THE CALCULATION OF THE SOIL SCREENING LEVELS

The following points related to the air modeling used in the calculation of the screening levels must be considered during the screening level risk evaluation at sites:

The soil screening levels do not consider the potential for enhanced volatilization of compounds which can occur in the presence of landfill gases such as methane. In addition, the soil screening levels consider exposure to VOCs in outdoor (ambient) air, but not the subsurface vapor intrusion to indoor air pathway. Volatilization from shallow groundwater may be an additional source to ambient air.

Various assumptions were utilized in the air modeling. For example, 0.5 acres was used as the default source area. HERO recommends an evaluation of whether the default assumptions are reasonable for a specific site. If the default assumptions are significantly less health-protective or not representative of the actual conditions at the site, use of the screening levels is not appropriate and a site-specific evaluation is needed.

Some soil RSLs (annotated with an "s" in the RSL tables) and DTSC-SLs (bold values in Note 3's Table 1) are marked to indicate that the screening level exceeds the soil saturation concentration (Csat) for that chemical. The RSL User's Guide defines Csat as the contaminant concentration in soil at which the absorptive limits of the soil particles, the solubility limits of the soil pore water, and saturation of soil pore air have been reached. At levels exceeding the Csat concentration, the soil contaminant may be present in free phase (i.e., nonaqueous phase liquids [NAPLs] for contaminants that are liquid at ambient soil temperatures and pure solid phases for compounds that are solid at ambient soil temperatures). This is important because the volatilization model used to calculate the screening levels is not applicable when free-phase contaminants are present. Cases in which the Csat is exceeded need to be addressed in the risk assessment. These should be discussed with the DTSC toxicologist prior to performing a risk assessment.

## G. LISTING OF STRICTLY RISK-BASED SCREENING LEVELS IN SCREENING-LEVEL TABLES

The soil screening levels are risk-based. They do not consider physical limitations such as soil saturation, and some RSLs exceed the "ceiling limit" concentration of $1x10^{+5}$ mg/kg. Soil RSLs that exceed Csat are denoted as "s" and DTSC-SLs are in bold text. Soil RSLs exceeding $1x10^{+5}$ mg/kg are denoted as "m" and DTSC-SLs are italicized, meaning that the chemical represents more than 10% by weight of the soil sample. At such concentrations, the assumptions for soil contact used to derive the screening levels may no longer be valid. Cases in which the chemicals are present at concentrations exceeding $1x10^{+5}$ mg/kg or Csat need to be identified and addressed in the risk assessment. These cases should be discussed with the DTSC toxicologist prior to performing a risk assessment.

## III. ADDITIONAL CONSIDERATIONS RELATED TO SCREENING LEVEL HUMAN HEALTH RISK ASSESSMENTS

## A. SAMPLING AND ANALYSIS PLANS/ RISK ASSESSMENT WORK PLANS

HERO recommends that sampling and analysis work plans and risk assessment work plans be submitted to DTSC for review and approval prior to sampling activities and the preparation of a risk assessment. A consensus with the regulatory agencies prior to field activities will aid in ensuring that the collected data meet the requirements of a risk assessment. The risk assessment work plan provides the opportunity to resolve issues related to risk assessment methodology so that the risk assessment can be performed in a more efficient and timely manner.

i. <u>Detection Limits.</u>
The work plan should address the adequacy of the method detection limits. In general, the method detection limits must be sufficiently low to detect chemicals below the medium-specific and compound-specific screening levels or applicable risk-based screening criteria. If this is not technically feasible, chemicals for which the method detection limits exceed risk-based screening levels should be discussed in the Uncertainty Section of the screening level risk assessment report.

ii. <u>Soil Sampling.</u>
The work plan should address the proposed soil sampling depths and methodology for review by HERO and the DTSC site geologist. For risk assessment purposes, HERO currently recommends that discrete (rather than composite) soil samples be collected given that composite samples can mask hot spots of contamination. Proposed new sampling methodologies might result in HERO altering this recommendation. If the sampling recommendations change, HERO will reflect this in an update to this HHRA Note. Contacting the HERO toxicologist when developing the sampling plan can provide an early indication of any possible changes.

For evaluation of current and future residential land use scenarios, soil samples from the 0 to 10 foot (ft) below ground surface (bgs) interval should be collected. While recommended soil sampling depths may vary based on site-specific conditions; in general, discrete soil samples should be collected from both surface (0 to 0.5 ft bgs) and subsurface soil. Collection of surface soil is particularly important for contaminants such as lead which have limited vertical mobility in the soil column. A lack of surface soil data for use in assessing risk could lead to a significant underestimate of risk. Please see Section III-E below for a discussion of exposure point concentrations to be used for screening level risk assessments.

Use of incremental sampling methodology presents particular issues for evaluating such data in risk assessments. Incremental sampling data should not be combined with discrete sampling results in the risk evaluation. If incremental sampling is to be conducted, the HERO toxicologist needs to be involved in the development of the sampling plan.

iii. Key Chemical Groups.
The work plan must address the proposed chemical analyses and analytical methods for the collected samples. Typically, HERO recommends that the following comprehensive suite of analytes be included during site investigations: metals, semivolatile organic compounds (SVOCs), VOCs, pesticides, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs). In addition, analyses for additional chemicals (e.g. polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), hexavalent chromium) may be warranted depending on the site history. The screening level risk evaluation should provide a clear and scientifically defensible rationale for selecting the chemical analytes. Unless it can be shown that there is no reason to suspect the presence of a particular chemical group, HERO recommends that the full suite of analyses be conducted.

iv. Total Petroleum Hydrocarbons (TPH). DTSC's Interim Guidance for Evaluating Human Health Risks from TPH dated June 16, 2009 is no longer active or available on the internet. The Preliminary Endangerment Assessment (PEA) Manual (DTSC 2015) discusses appropriate approaches for addressing petroleum hydrocarbon contamination and provides toxicity criteria to evaluate aliphatic and aromatic components of TPHs. Additionally, we recommend TPH be evaluated in screening level risk assessments using data for specific toxic constituents of TPH including benzene, toluene, ethylbenzene, and xylene (BTEX), methyl tert-butyl ether (MTBE), hexane, other volatile fuel components, PAHs, and metals. Depending on site-specific conditions and the results of the screening level evaluation, additional evaluation of TPH using the methodology outlined by others such as the Massachusetts Department of Environmental Protection may be recommended until the revised DTSC TPH Guidance becomes available. The DTSC toxicologist should be contacted for any questions on this issue.

## B. SELECTION OF INORGANICS AS COPCs AND CALCULATION OF BACKGROUND RISK AND HAZARD INDEX

Previous HERO guidance (DTSC 1997) provides a recommended methodology for selecting inorganic constituents as chemicals of potential concern (COPCs). Historically, inorganic chemicals eliminated as COPCs were not carried forward into the quantitative risk assessment. More recent U.S. EPA (2002) guidance recommends the inclusion of naturally occurring inorganic chemicals in the risk assessment. Background issues for inorganic chemicals are to be addressed during risk characterization.

HERO recommends the screening level risk assessment include the calculation of both the site-related risk and hazard index, and the total risk and hazard index on a site-specific basis. The latter presents the risk and hazard associated with exposure to all detected chemicals prior to elimination of inorganic chemicals that are determined to be consistent with site-specific background or ambient concentrations. This information is useful for risk management decisions about appropriate land uses and for public transparency. It is critical that different expressions of the risk assessment results (i.e., site-related and total risk) be based on the same statistical basis in order to be comparable.

The HERO toxicologist should be contacted if there are questions in this regard. In particular, at some sites, it may not be necessary to calculate total risk and hazard. In addition, an important distinction between the approach outlined herein and U.S. EPA's 2002 guidance is that HERO does not allow the elimination of compounds as COPCs based on comparison to risk-based screening levels. HERO's reference to the 2002 U.S. EPA guidance does not imply concurrence with the screening-out of individual chemicals as COPCs based on RSLs, DTSC-SLs or other risk-based criteria.

## C. "SCREENING-OUT" COPCS

In general, HERO recommends that all detected compounds be selected as COPCs and be included in the quantitative risk evaluation. In limited cases, HERO may agree to eliminate specific chemicals from full consideration in the risk assessment; however, such cases must be discussed with and agreed to upfront by the DTSC toxicologist. To facilitate an evaluation regarding whether it is appropriate to exclude a detected chemical from the risk assessment, a rationale should be provided for each chemical proposed for elimination which considers factors such as the frequency of detection, detection limit, chemical toxicity, concentration detected, site history, co-location of high concentrations (i.e., a 'hot spot'), essential nutrient status, and/or comparison to background for inorganics as discussed in Section III-B above. Potential chemical breakdown products must also be considered, and the rationale should not be based on a "brightline" approach (e.g. preliminary cancer risk $<1x10^{-7}$, preliminary hazard quotient <0.1). As detailed above, inorganics which are determined to be present at concentrations consistent with background will still need to be included in the total risk and hazard evaluation.

## D. ADDITIVITY OF RISK AND HAZARDS

For each site-related chemical, the chemical concentrations in each relevant medium should be divided by their corresponding soil, tap water, and air risk-based screening levels. Please see HHRA Note 3 for a listing of chemicals which HERO recommends DTSC-SLs as alternate values other than the RSLs. For compounds with non-threshold effects (carcinogens), the ratio must be multiplied by $10^{-6}$ to provide an estimate of risk. Risk must be summed across all carcinogenic chemicals and exposure pathways (including vapor intrusion to indoor air evaluated separately from comparison to screening levels). Similarly, hazard quotients must be summed across all chemicals and exposure pathways (including vapor intrusion to indoor air evaluated separately from comparison to screening levels) for threshold (non-carcinogenic) effects to provide a hazard index. Please note that the soil, tap water, and indoor air "supporting" tables available on the U.S. EPA RSL website provide RSLs based on both cancer (non-threshold) and non-cancer (threshold) effects for most carcinogens. Since May 2013, U.S. EPA has provided new tables with target hazard quotients (THQ) of 1.0 and 0.1. In general, HERO does not recommend using screening levels based on a THQ of 0.1, and screening levels based on a target hazard quotient of 1 should be used. Carcinogens should be evaluated both for carcinogenicity and for threshold toxicity (noncancer hazard). If the summed hazard index for the site is greater than one, then the hazard index may be recalculated for chemicals which have the same toxic manifestation or which affect the same target organ.

## E. EXPOSURE POINT CONCENTRATIONS

In general, HERO recommends that the maximum detected concentrations of COPCs be used as the exposure point concentrations in screening level risk evaluations. Use of the 95 percent upper confidence limit (95% UCL) on the arithmetic mean concentrations must be approved by the DTSC toxicologist. In most cases, use of the maximum detected concentrations is appropriate because of the screening-level nature of such evaluations and because the screening-level sampling is usually limited.

## F. SURROGATE COMPOUNDS

Compounds for which screening levels are not available should be evaluated in the risk assessment through the selection of a surrogate chemical. Surrogates should have similar structure, activity, and mechanisms of toxicity. The HERO toxicologist should be contacted regarding the selection of the most appropriate surrogates.

## G. CALCULATION OF TETRACHLORODIBENZO-P-DIOXIN

Dioxins and furans are evaluated based on quantitative comparison of the 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)-equivalent concentration with the TCDD RSL. If congener-specific polychlorinated biphenyl (PCB) data are available, these should also be included in the calculation of TCDD-equivalent concentrations. HERO recommends use of the 2005 World Health Organization (WHO) toxic equivalency factors (TEFs) (Van den Berg, 2006). These values can be found in the RSL User's Guide and are also summarized in HERO's HHRA Note 2 (DTSC 2009).

## H. EVALUATION OF LEAD

In 2007, Cal/EPA OEHHA developed a new toxicity evaluation of lead replacing the 10 µg/dL threshold blood lead concentration with a source-specific "benchmark change" of 1 µg/dL (OEHHA 2007, 2009). One µg/dL is the estimated incremental increase in children's blood lead that would reduce IQ by up to 1 point. In light of the updated Cal/EPA lead toxicity criterion, as well as the need for revision to ensure that the model is adequately protective of women of child-bearing age, a new version of the DTSC LEAD RISK ASSESSMENT SPREADSHEET (LeadSpread 8) has been developed (DTSC 2011b, http://www.dtsc.ca.gov/AssessingRisk/LeadSpread8.cfm).

Worksheets 1 and 2 of the LeadSpread 8 file include PRG90 calculations for soil under residential and industrial land use scenarios (80 mg/kg and 320 mg/kg, respectively).

These PRG90s represent concentrations in soil corresponding to a 90th percentile estimate of blood lead in a child or the fetus of a pregnant adult worker equal to 1 µg/dL. While DTSC has historically used the 99th percentile estimate of blood lead, HERO considers the 90$^{th}$ percentile of the distribution appropriate for use in evaluating lead exposures given that the target blood lead level of concern was updated to the more recent health-protective incremental criterion of 1 µg/dL.

Use of PRG90s is a departure from the previously utilized Cal-modified U.S. EPA Region 9 PRGs of 150 mg/kg for residential land use and 800 mg/kg for industrial land use. For the residential evaluations, HERO implements the risk-based concentration as a residential use scenario Exposure Point Concentration (EPC), calculated as the 95 percent upper confidence limit on the arithmetic mean (95% UCL) of 80 mg/kg or less soil lead. For industrial/commercial scenarios, the risk-based concentration is implemented as an EPC, calculated as the 95% UCL of 320 mg/kg or less soil lead.

With regard to assessment of lead risk and evaluating cleanup options, HERO recommends calculating the 95% UCL on the arithmetic mean lead concentration for each exposure area (assuming sufficient data are available for such a calculation). If individual samples exceed the PRG90, it would not mean that the exposure area itself is in exceedance of the PRG90 as long as the 95% UCL itself is below ~80 mg/kg for residential and ~320 mg/kg for industrial/commercial, assuming hot spots are not present. If "hot spots" (i.e., geographically collocated areas of elevated concentration), or "outliers" (i.e., individual samples with elevated concentrations) are present, they must be addressed separately.

For initial site screening where data are insufficient to calculate a 95% UCL, comparison of the maximum detected concentration to the PRG90s would be appropriate. If individual sample results exceed the PRG90s, depending on site-specific conditions and sampling results, additional investigation, evaluation, and potentially remediation may be warranted to address concerns about lead exposure.

It is important to note that background exposures to lead, and media other than soil which may be impacted by lead, are not considered in LeadSpread8. If lead is present at levels above background in media other than soil (e.g. water, air) or if the home grown produce pathway is anticipated at the site, please contact the HERO toxicologist. DTSC's LeadSpread model is currently undergoing additional revision, and we hope to incorporate additional exposure pathways and environmental media in the near future.

## IV. CONCLUSIONS

Screening level risk evaluations are useful for determining whether a finding of "no further action" may be warranted with respect to human health. Such evaluations can also provide preliminary estimates of risk and hazard at a site prior to conducting a baseline risk assessment. There are important limitations which need to be considered when using screening level risk estimates for risk management decisions. Many of the limitations and important aspects of screening level risk evaluations are summarized herein.

Of importance is the fact that screening level risk assessments conducted using U.S. EPA Regional Screening Levels and DTSC screening levels do not consider potential harm to ecological receptors (see Section II-B). A separate ecological risk evaluation must be conducted if ecological habitat is present onsite or there is potential for transport of contaminants to offsite habitat.

Vapor intrusion into indoor air is frequently an important exposure pathway. Since the RSLs and DTSC screening levels do not include this pathway, this HHRA Note provides recommendations to address this deficiency (see Section II-D).

If you have any questions on this HHRA Note, please contact Michael Wade, Ph.D. DABT, HERO Senior Toxicologist, at (916) 255-6653, Michael.Wade@dtsc.ca.gov, or Kimberly Gettmann, Ph.D., HERO Staff Toxicologist at (916) 255-6685, Kimberly.Gettmann@dtsc.ca.gov.

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