Site Investigation Work Plan

Protective Coatings, Inc.
1215 2nd Avenue and 1208 4th Avenue North
Kent, Washington

PCC Aerostructures

May 22, 2023

→ **The Power of Commitment**

9725 3rd Avenue NE, Suite 204
Seattle, Washington 98115
United States
www.ghd.com

Our ref: 12602154

May 22, 2023

Ms. Corrine Dobbins
EHS Manager
PCC Aerostructures
1208 4th Avenue South
Kent, WA

Site Investigation Work Plan

Dear Ms. Dobbins:

GHD Services, Inc (GHD) is pleased to submit this Site Investigation Work Plan to conduct additional environmental investigations at the PCC Aerostructures (PCC) Protective Coatings Facility located at 1215 2nd Avenue North and 1208 4th Avenue North, Kent, King County, Washington. Please contact Heather Gadwa at **heather.gadwa@ghd.com** if you have any questions.

Sincerely,

HKGadwa

Scott K

Heather Gadwa Project Manager	**Scott Kranz, RG, LG, LHG** Project Director
+1 425 563-6509 heather.gadwa@ghd.com	+1 503 816-6643 scott.kranz@ghd.com

EK/trc/RPT-1

Encl.

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The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

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[Status code]							
[Status code]							

GHD Services Inc.

9725 3rd Avenue NE, Suite 204

Seattle, Washington 98115, United States

T +1 425 563 6500 | **F** +1 425 563 6599 | **E** info-northamerica@ghd.com | **ghd.com**

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1. Introduction

1.1 Site Information

Site Name:	Protective Coatings, Inc.
Site Address:	1215 2nd Avenue North and 1208 4th Avenue North Kent, Washington
Voluntary Cleanup Program Number:	NW2843
Project Consultant:	GHD Services, Inc.
Project Consultant Contact Information:	Heather Gadwa 9725 3rd Avenue Northeast Seattle, Washington, 98115 Office – 425.563.6500 Direct – 425.563.6509
Current Owner/Operator:	PCC Aerostructures/Protective Coatings, Inc.

1.2 Purpose

GHD Services Inc. (GHD) prepared this Site Investigation Work Plan (work plan) on behalf of PCC Aerostructures (PCC) for the Protective Coatings Facility located at 1215 2nd Avenue North and 1208 4th Avenue North, Kent, King County, Washington (Property), identified on Figure 1. This work plan describes environmental investigation activities necessary to satisfy requests for additional information outlined by the State of Washington Department of Ecology (Ecology) in their Further Action Opinion Letter dated November 28, 2022. The additional environmental investigation and subsequent reporting is intended to obtain a No Further Action (NFA) determination from Ecology and fulfills the requirements of the Model Toxics Control Act (MTCA) Cleanup Regulation Chapter 173 340 Washington Administrative Code (WAC).

2. Site Identification and Description

2.1 Site Discovery and Regulatory Status

A chemical release to soil and groundwater was reported to Ecology on March 28, 2014, and the Property was listed with Ecology's Toxics Cleanup Program (Cleanup Site ID #12337). The Property was entered into Ecology's Voluntary Cleanup Program (VCP) on March 28, 2014, and issued VCP number NW2843. The current status of the site with Ecology is "Cleanup Started".

The MTCA site (Site) is defined as all current and historically affected areas from the release associated with the Property, including affected adjacent parcels. The Site boundary was approximated from the results of previous environmental investigations and is presented on Figure 2.

2.2 Property and Site Use/Location/Definition

The Property is located in the north central portion of Kent, Washington, northwest of Highway 167 and covers an area of approximately 4.3 acres of level land. The Property consists of King County tax parcel numbers 383090-0320 and

383090-0380. Currently, the Property is used for industrial purposes as a metals coating and plating facility. Land use and zoning in the vicinity of the Property is additionally listed by King County as industrial.

The Property layout is shown on Figure 2. Facilities consist of two large production floors, one packaging/shipping warehouse, one general use warehouse, and an outdoor wastewater treatment and chemical storage area.

2.3 Summary of Previous Investigations and Interim Actions

Based on investigation data, volatile organic compounds (VOCs) were released to the subsurface sometime prior to 2004. The release was likely trichloroethylene (TCE) in the chemical bunker area. According to the current Site operator, a prior operator historically poured waste TCE onto the concrete surface in Bunker 2 to allow the TCE to evaporate, which is consistent with environmental investigation results. The TCE likely naturally degraded over time resulting in the presence of daughter products (cis) 1,2-dichloroethene (1,2-DCE) and vinyl chloride in groundwater.

Ten monitoring wells, 17 soil borings, and 4 soil gas probes have been completed at the Site. The most recent soil remedial activities, including excavation and in-situ treatment, were completed in the vicinity of MW-3/Bunker 2 between April 16, 2018 and May 4, 2018. After this work was completed, the contaminants of concern at the Site were primarily limited to areas beneath Bunker 1 and 2 and the parking lot near well MW-7 and include TCE in soil and soil vapor and (cis) 1,2-DCE, vinyl chloride, and arsenic in groundwater.

A complete chronological summary of work completed at the Site during previous investigations is included in Appendix A. A summary of groundwater monitoring results is presented in Tables 1 and 2, a summary of historical soil analytical data is presented in Table 3, a summary of soil gas data is presented in Table 4, and well construction data is presented in Table 5.

2.4 Data Gap Identification

Following the most recent remedial action, the subsequent data gaps have been identified:

- Soil containing concentrations of TCE exceeding MTCA Method C cleanup levels remain at 5 feet below ground surface (bgs) in the southwest wall of the remedial excavation. It has been determined that the extent of contaminated soil and groundwater plume require additional definition beneath the west-adjacent building in the area west and southwest of the excavation.
- Based on cadmium concentration in soil exceeding the MTCA Level A cleanup level and chromium VI detections in groundwater, the soil in the area adjacent to previous borings MW-9, HA-1, and SB-6 requires additional delineation.
- The extent of dissolved arsenic and chromium VI in groundwater across the Site requires additional definition.

3. Objectives and Scope

The following scope of work addresses the data gaps identified through evaluation of the historical activities and most recent Site investigation results.

- Advance four shallow soil borings near MW-9, HA-1, and SB-6 to evaluate the potential presence of chromium VI and cadmium concentrations in shallow soil.
- Advance three shallow soil borings and install three soil gas probes to delineate the western extent of VOCs in soil and evaluate soil gas concentrations along the western Property boundary.
- Complete four quarters of groundwater monitoring at existing wells to evaluate the presence of arsenic and chromium VI concentrations.

- Install one groundwater monitoring well west of the Property to laterally delineate the western extent of TCE and associated degradation daughter product concentrations.

4. Pre-Field Activities

Pre-field activities that will be completed by GHD are summarized below.

4.1 Health and Safety Plan

GHD will update the current Site-Specific Health and Safety Plan to protect GHD staff and subcontractors. The plan will be reviewed and signed by each site worker and kept on the Site during field activities.

4.2 Underground Utility Clearance

Prior to any Site work involving soil disturbance, Washington State One Call Utility Notification Service will be called to alert the utility companies in the area of the scheduled work and to request identification of underground utilities in the vicinity of the disturbance area. A private utility locating contractor will be subcontracted to verify the absence of underground utilities near each of the proposed boring locations.

To further mitigate the chances of encountering a subsurface utility, each soil boring will be cleared to a minimum depth of 5 feet bgs using a hand auger, air knife, or other appropriate method. Borehole clearance may be extended if surrounding utilities are identified at depths greater than 5 feet bgs.

5. Investigation Activities

5.1 Soil Assessment

Eight soil borings will be advanced to further characterize soil, groundwater, and soil gas concentrations at the Site. The borings will be advanced by a Washington State licensed driller using a direct push drill rig, vac truck, and/or hand auger. The locations of the proposed borings are presented on Figure 2. The table below outlines sample location, sample depth, purpose, and selected analysis per boring location.

Table 5.1 Sampling and Analysis Plan

Proposed Boring	Anticipated Soil Samples and Sample Depth Per Boring	Anticipated Total Depth and Completion Details	Purpose	Soil Analysis
A	--	Monitoring well Approximately 15 feet bgs 2-inch Schedule 40 PVC casing, 0.010 slot screen from 5-15 feet bgs	Evaluate groundwater quality southwest of the bunker area	--
B, C, and D	1 soil sample at 5 feet bgs	Soil gas probe Approximately 6 feet bgs	Delineate extent of COC concentrations in soil and soil vapor	TCE; 1,1-DCE; (cis) 1,2-DCE; (trans) 1,2-DCE; vinyl chloride, arsenic
E, F, G, and H	1 soil sample at 3-4 feet bgs	Soil boring Approximately 5 feet bgs. Filled and abandoned after sample collected	Delineate metals concentrations in soil near MW-9, HA-1, and SB-6	Cadmium; Chromium VI

Proposed Boring	Anticipated Soil Samples and Sample Depth Per Boring	Anticipated Total Depth and Completion Details	Purpose	Soil Analysis
Notes: EPA = Environmental Protection Agency PVC = polyvinyl chloride 1,1-DCE by EPA Method 8260B (cis) 1,2-DCE by EPA Method 8260B (trans) 1,2-DCE = (trans) 1,2-dichloroethene by EPA Method 8260B Cadmium by EPA Method 6010B Chromium VI by EPA Method 7196				

Soil will be continuously logged using the modified Unified Soil Classification System by an environmental professional and overseen by a Washington State Licensed Geologist. Soil samples will be screened continuously using a photoionization detector and visual inspection. Soil samples will be collected in accordance with Table 5.1 above. Soil samples submitted for chemical analyses will be labeled, entered onto a chain of custody form, packed on ice, and transported to ALS Environmental of Everett, Washington.

5.2 Soil Gas Probe Installation and Sampling

Borings B through D will be completed as soil gas probes. Each of the soil borings will be advanced to 5.5 feet bgs, and completed as a soil gas probe, with a 0.5-foot length 1-inch diameter steel well screen with 0.010-inch machined slots installed from approximately 5 to 5.5 feet bgs. A length of 1/4-inch Teflon tubing will be attached to the top of the screen and extend to the ground surface. Sand will be placed in the annular space around the screen to approximately 3.5 feet bgs and hydrated bentonite chips will be placed from the top of the sand pack to approximately 1-foot bgs. A 4-inch to 8-inch diameter flush-mount, traffic rated, steel well cover will be installed above the soil gas probe and secured in place with cement. Excess Teflon tubing will be coiled in the flush well box and capped with a plug for future sampling.

The soil gas probe will be sampled per GHD's *Soil Gas Sampling Standard Operating Procedures* (Appendix B). An ambient air sample will also be collected. Sampling will be completed once and analyzed for one or more of the following contaminants:

– VOCs: 1,1-DCE; (cis) 1,2-DCE; (trans) 1,2-DCE, vinyl chloride, TCE by Method Toxic Organics -15

– Fixed gases (oxygen, nitrogen, methane, hydrogen, carbon dioxide, carbon monoxide) by EPA Method 3C

If soil gas results are in compliance with MTCA Method C screening levels, then sampling will be considered complete, and the vapor intrusion pathway will be considered adequately assessed. If contaminant concentrations exceed MTCA Method C screening levels, then additional sampling may be required, in accordance with Ecology's *Guidance for Evaluating Vapor Intrusion in Washington State, Publication 09-09-047*, dated March 2022.

5.3 Groundwater Monitoring Well Installation and Sampling

Boring A will be completed as a permanent groundwater monitoring well (MW-10). The well is estimated to be installed with 10 feet of screen from approximately 5 to 15 feet bgs. The top of screen will be installed approximately 3 to 4 feet above the level of encountered groundwater. Final depth and screening will be determined based on observations of groundwater in the field. The wells will be constructed with 2-inch Schedule 40 PVC, 0.010-inch slot screen, flush threaded with PVC blank well casing from the top of the screen to the top of the well. The well annulus will be backfilled with a sand pack to a minimum of 1 foot above the top of the screen and sealed with a minimum of 1 foot of hydrated bentonite chips above the filter pack. The surface of the wells will be completed with flush mount, traffic rated well boxes set in concrete.

Following installation, the wells will be developed by surging the well screen with a surge block for 5 to 10 minutes, followed by pumping of the well with a monsoon-style down-hole pump. Well development will be considered complete when turbidity is below 100 Nephelometric Turbidity units or when the well has pumped dry.

The new well will be surveyed by a licensed surveyor to determine the horizontal coordinates and vertical elevation of the top of well casing. Monitoring well MW-10 will be monitored for a minimum of four quarters to observed seasonal fluctuation of contaminants, if present. The monitoring well will be analyzed for the following:

- VOCs: 1,1-DCE, (cis) 1,2-DCE, (trans) 1,2-DCE, vinyl chloride by EPA Method 8260,
- Metals: chromium VI and dissolved arsenic by Method SM 3500-CR D Modified and EPA Method 6020A, respectively.

The existing monitoring wells (MW-1 through MW-9) will also be monitored on a quarterly basis; however, will only be sampled for chromium VI and arsenic.

Groundwater samples will be obtained with a peristaltic pump and clean tubing using a low-flow method. During the purging process, groundwater quality parameters, including temperature, electrical conductance, pH, turbidity, dissolved oxygen, and oxygen reduction potential are measured at regular intervals using a water quality meter. Purging at a given well is considered complete when three consecutive readings for the above parameters were observed within 10 percent of one another. The water quality meter will be calibrated in accordance with the manufacturer's specification prior to use. The groundwater parameters measured during purging, flow rates, and instrument calibrations will be documented in the field by the sampling contractor.

During the collection of the groundwater samples, the pump discharge is maintained at the same flow rate used for low-flow purging. Groundwater samples are collected in appropriate glassware provided by the laboratory and immediately placed into a cooler containing ice or ice substitute. Samples will be labeled, entered onto a chain of custody form, packed on ice, and transported to ALS Environmental of Everett, Washington.

5.4 Investigation Derived Waste

Investigation derived waste (IDW) will include decontamination fluids, soil cuttings from borings, and purged well water. All IDW will be placed in properly labelled 55-gallon drums and stored onsite pending analyses. After waste profiling is completed, the IDW will be disposed of according to applicable regulatory requirements.

6. Reporting

Following completion of the environmental investigation, GHD will prepare a revised Cleanup Action Report and if applicable, include a request for a Site-specific NFA-determination in accordance with WAC 173-340-350. Site data will be entered into Ecology's Environmental Information Management database.

Tables

Table 1

Summary of Groundwater Analytical Data
Hydrocarbons and Volatile Organic Compounds
Protective Coatings Facility
1215 2nd Avenue North and 1208 4th Avenue North
Kent, Washington

					Hydrocarbons			VOCs												
Sample ID	**Date**	**TOC**	**DTW***	**GWE**	**TPHg**	**TPHd**	**TPHo**	**Benzene**	**Toluene**	**Vinyl Chloride**	**Chloroethane**	**Acetone**	**1,1-Dichloroethene**	**1,1-Dichloroethane**	**(trans) 1,2-Dichloroethene**	**(cis) 1,2-Dichloroethene**	**1,2-Dichloroethane**	**1,1,1-Trichloroethane**	**Trichloroethene**	**1,1,2-Trichloroethane**
	Site-Specific Cleanup Level[1]				**NA**	**NA**	**NA**	**NA**	**NA**	**2**	**NA**	**NA**	**7**	**NA**	**100**	**16**	**5**	**200**	**5**	**5**
	MTCA Method B Cleanup Level				**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**7200**	**NA**	**1,600/7.68**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
	Units	**ft**	**ft**	**ft**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
MW-1	8/12/2008	38.94	9.41	29.53	---	---	---	<0.2	<0.2	0.2	2	7.7	0.5	0.6	<0.2	1.6	<0.2	<0.2	<0.2	<0.2
MW-1	7/2/2012	38.94	8.48	30.46	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MW-1	7/17/2014	38.94	8.75	30.19	---	---	---	<0.50	<0.50	<0.20	1.2	<20.0	<0.50	<0.50	<0.50	1.4	<0.50	1.4	<0.40	<0.40
MW-1	10/7/2014	38.94	9.04	29.90	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<1.0	1.6	<0.50	<0.50	<0.40	<0.40
MW-1	1/13/2015	38.94	8.26	30.68	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-1	6/1/2015	38.59	8.62	29.97	---	---	---	<0.50	<0.50	<0.20	1.1	<20.0	<0.50	<0.50	<0.50	1.5	<0.50	<0.50	<0.40	<0.40
MW-1	5/31/2018	38.59	8.57	30.02	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MW-1	6/4/2018	38.59	8.70	29.89	---	---	---	---	---	<0.20	<1.0	<20.0	<1.0	<1.0	<1.0	2.7	<1.0	<1.0	<0.40	<1.0
MW-1	9/24/2018	38.59	9.76	28.83	---	---	---	---	---	<0.20	<1.0	<20.0	<1.0	<1.0	<1.0	3.1	<1.0	<1.0	<0.40	<1.0
MW-1	12/31/2018	38.59	9.09	29.50	---	---	---	---	---	<0.20	<1.0	<20.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.40	<1.0
MW-1	3/13/2019	38.59	8.53	30.06	---	---	---	---	---	<0.20	<1.0	25.7	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.40	<1.0
MW-2	8/12/2008	38.71	8.82	29.89	---	---	---	<0.2	<0.2	<0.2	<0.2	<2.5	<0.2	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
MW-2 DUP	8/12/2008	38.71	8.82	29.89	---	---	---	<0.2	<0.2	<0.2	<0.2	3.7	<0.2	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
MW-2	7/2/2012	38.71	8.00	30.71	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MW-2	7/17/2014	38.71	8.20	30.51	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-2	10/7/2014	38.71	8.53	30.18	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<1.0	<1.0	<0.50	<0.50	<0.40	<0.40
MW-2	1/13/2015	38.71	7.71	31.00	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-2 DUP	1/13/2015	38.71	7.71	31.00	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-2	6/1/2015	38.27	7.11	31.16	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-3	8/12/2008	38.68	9.41	29.27	---	---	---	0.3	4.1	**5.8**	87 c	7.3	120 c	**340 c**	34	**5,600 c**	1.0	4.9	3.9	0.8
MW-3	7/2/2012	38.68	8.48	30.20	<0.25	<0.50	<0.50	<0.2	0.37	1.8	17 a	5.5	20	**82 J**	12	**540 c**	0.7	0.58	0.27	0.75
MW-3	7/17/2014	38.68	8.94	29.74	---	---	---	<0.50	0.85	2.0	21.0	<20.0	36.5	**146**	17.7	**607**	1.6	<0.50	<0.40	<0.40
MW-3	10/7/2014	38.68	9.31	29.37	---	---	---	<5.0	<5.0	<2.0	27.8	<200	47.6	**174**	20.6	**879**	<5.0	<5.0	<4.0	<4.0
MW-3	1/13/2015	38.68	8.37	30.31	---	---	---	<2.5	<2.5	**2.9**	16.2	<100	32.6	**124**	18.6	**672**	<2.5	<2.5	<2.0	<2.0
MW-3	6/1/2015	38.61	8.89	29.72	---	---	---	<2.5	<2.5	2.0	15.0	<100	25.0	**98.4**	15.8	**488**	<2.5	<5.0	<2.0	<2.0
MW-3													Well MW-3 decomissioned							
MW-3R	5/31/2018	NS	7.71	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MW-3R	6/4/2018	NS	8.20	---	---	---	---	---	---	0.50	<1.0	<20.0	<1.0	<1.0	<1.0	1.1	<1.0	<1.0	<0.40	<1.0
MW-3R	9/24/2018	NS	9.35	---	---	---	---	---	---	0.58	<1.0	<20.0	<1.0	<1.0	<1.0	2.3	<1.0	<1.0	<0.40	<1.0
MW-3R	12/31/2018	NS	8.25	---	---	---	---	---	---	0.75	<1.0	<20.0	1.1	<1.0	<1.0	3.8	<1.0	<1.0	<0.40	<1.0
MW-3R	3/13/2019	NS	7.91	---	---	---	---	---	---	0.82	1.8	<20.0	<1.0	<1.0	<1.0	5.3	<1.0	<1.0	<0.40	<1.0
MW-4	6/29/2012	36.63	6.41	30.22	<0.25	<0.50	<0.50	<0.2	<0.2	<0.2	<0.2	<5.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
MW-4	7/17/2014	36.63	6.80	29.83	---	---	---	<0.50	<0.50	<0.40	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-4 DUP	7/17/2014	36.63	6.80	29.83	---	---	---	<0.50	<0.50	<0.40	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-4	10/7/2014	36.63	7.07	29.56	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<1.0	<1.0	<0.50	<0.50	<0.40	<0.40
MW-4	1/13/2015	36.63	5.76	30.87	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-4	6/1/2015	36.56	6.51	30.05	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-5	6/29/2012	37.07	6.89	30.18	<0.25	<0.50	<0.50	<0.2	<0.2	0.32	<0.2	<5.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
MW-5	7/17/2014	37.07	7.12	29.95	---	---	---	<0.50	<0.50	<0.40	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-5	10/7/2014	37.07	7.39	29.68	---	---	---	<0.50	<0.50	0.28	<1.0	<20.0	<0.50	<0.50	<1.0	<1.0	<0.50	<0.50	<0.40	<0.40
MW-5	1/13/2015	37.07	6.35	30.72	---	---	---	<0.50	<0.50	0.39	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-5	6/1/2015	37.00	6.99	30.01	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-6	6/29/2012	39.44	9.40	30.04	<0.25	<0.50	<0.50	<0.2	<0.2	<0.2	<0.2	6.7	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
MW-6	7/17/2014	39.44	9.71	29.73	---	---	---	<0.50	<0.50	<0.40	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-6	10/7/2014	39.44	9.95	29.49	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<1.0	<1.0	<0.50	<0.50	<0.40	<0.40
MW-6	1/13/2015	39.44	8.99	30.45	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-6	6/1/2015	39.38	9.80	29.58	---	---	---	<0.50	<0.50	<0.40	<1.0	<20.0	<0.50	<0.50	<1.0	2.2	<0.50	<1.0	<0.40	<0.40
MW-6	5/31/2018	39.38	9.22	30.16	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MW-6	6/4/2018	39.38	9.50	29.88	---	---	---	---	---	<0.20	<1.0	<20.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.40	<1.0
MW-6	9/24/2018	39.38	10.34	29.04	---	---	---	---	---	<0.20	<1.0	<20.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.40	<1.0
MW-6	12/31/2018	39.38	9.37	30.01	---	---	---	---	---	<0.20	<1.0	<20.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.40	<1.0
MW-6	3/13/2019	39.38	8.95	30.43	---	---	---	---	---	<0.20	<1.0	<20.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.40	<1.0
MW-7	6/29/2012	38.28	8.98	29.30	<0.25	<0.50	<0.50	<0.2	<0.2	<0.2	<0.2	<5.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
MW-7	7/17/2014	38.28	9.14	29.14	---	---	---	<0.50	<0.50	<0.40	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-7	10/7/2014	38.28	9.15	29.13	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<1.0	<1.0	<0.50	<0.50	<0.40	<0.40

Table 1

Summary of Groundwater Analytical Data
Hydrocarbons and Volatile Organic Compounds
Protective Coatings Facility
1215 2nd Avenue North and 1208 4th Avenue North
Kent, Washington

					Hydrocarbons			VOCs												
Sample ID	Date	TOC	DTW*	GWE	TPHg	TPHd	TPHo	Benzene	Toluene	Vinyl Chloride	Chloroethane	Acetone	1,1-Dichloroethene	1,1-Dichloroethane	(trans) 1,2-Dichloroethene	(cis) 1,2-Dichloroethene	1,2-Dichloroethane	1,1,1-Trichloroethane	Trichloroethene	1,1,2-Trichloroethane
	Site-Specific Cleanup Level[1]				NA	NA	NA	NA	NA	2	NA	NA	7	NA	100	16	5	200	5	5
	MTCA Method B Cleanup Level				NA	NA	NA	NA	NA	NA	NA	7200	NA	1,600/7.68	NA	NA	NA	NA	NA	NA
	Units	ft	ft	ft	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-7	1/13/2015	38.28	8.35	29.93	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-7	6/1/2015	38.21	8.99	29.22	---	---	---	<0.50	<0.50	<0.40	<1.0	<20.0	<0.50	<0.50	<1.0	0.72	<0.50	<1.0	<0.40	<0.40
MW-7	5/31/2018	38.21	8.81	29.40	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MW-7	6/4/2018	38.21	9.02	29.19	---	---	---	---	---	<0.20	<1.0	<20.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.40	<1.0
MW-7	9/24/2018	38.21	9.99	28.22	---	---	---	---	---	<0.20	<1.0	<20.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.40	<1.0
MW-7	12/31/2018	38.21	8.68	29.53	---	---	---	---	---	<0.20	<1.0	<20.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.40	<1.0
MW-7	3/13/2019	38.21	8.39	29.82	---	---	---	---	---	<0.20	<1.0	<20.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.40	<1.0
MW-8	6/29/2012	39.06	9.80	29.26	<0.25	<0.50	<0.50	<0.2	<0.2	<0.2	<0.2	<5.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
MW-8	7/17/2014	39.06	10.04	29.02	---	---	---	<0.50	<0.50	<0.40	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-8	10/7/2014	39.06	10.10	28.96	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<1.0	<1.0	<0.50	<0.50	<0.40	<0.40
MW-8 DUP	10/7/2014	39.06	10.10	28.96	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<1.0	<1.0	<0.50	<0.50	<0.40	<0.40
MW-8	1/13/2015	39.06	8.87	30.19	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-8	6/1/2015	38.98	9.81	29.17	---	---	---	<0.50	<0.50	<0.40	<1.0	<20.0	<0.50	<0.50	<1.0	<0.50	<0.50	<1.0	<0.40	<0.40
MW-9	5/28/2015	37.70	7.75	29.95	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MW-9	6/1/2015	37.70	8.11	29.59	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-9 DUP	6/1/2015	37.70	8.11	29.59	---	---	---	<0.50	<0.50	<0.20	<1.0	<20.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.40	<0.40
MW-9	5/31/2018	37.70	7.69	30.01	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MW-9	6/4/2018	37.70	8.00	29.70	---	---	---	---	---	0.44	<1.0	<20.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.40	<1.0
MW-9	9/24/2018	37.70	9.25	28.45	---	---	---	---	---	0.43	<1.0	<20.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.40	<1.0
MW-9	12/31/2018	37.70	7.91	29.79	---	---	---	---	---	0.51	<1.0	<20.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.40	<1.0
MW-9	3/13/2019	37.70	7.39	30.31	---	---	---	---	---	0.61	<1.0	<20.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.40	<1.0

Abbreviations and Notes:

DTW = Depth to Water in feet
GWE = Groundwater Elevation
TOC = Top of Casing
TPHg = Total petroleum hydrocarbons as gasoline range organics analyzed by HCID Method
TPHd = Total petroleum hydrocarbons as diesel range organics analyzed by HCID Method
TPHo = Total petroleum hydrocarbons as heavy oil range organics analyzed by HCID Method
VOC = Volatile Organic Compounds analyzed by EPA Method 8260 (See analytical laboratory reports for a complete list of VOCs)
EDC=1,2-Dichloroethane
µg/L = Micrograms per liter
NE = Not established
NA = Not applicable
NS = Not Surveyed
---- = Not analyzed
<*n* = Below laboratory detection limit of *n* ug/L
MTCA = Model Toxics Control Act Cleanup Regulations [WAC 173-340-720(2)(a)(1), as amended February 2001]

[1] The Site-Specific cleanup level is based on Federal maximum contaminant level (MCL) established by the Environmental Protection Agency where available and in accordance with Ecology's July 6, 2017 opinion letter. MTCA Method B cleanup levels are referenced in the absence of a Site-Specific cleanup level.

*The DTW data from 2008 and 2012 was calculated by subtracting the given GWE from the calculated TOC data. DTW was not provided in the previous consultant's report.

All data prior to 2014 collected by Golder Associates, Inc. (Golder) and provided in Golder's *Phase II Environmental Site Assessment* report dated October 1, 2012.

Data values in **bold** indicate that the concentration exceeds the MTCA Method C cleanup leve

a = Surrogate recovery is outside control limits
b = Detection based on dilution of initial sample
J = Estimated

Table 2

Summary of Groundwater Analytical Data
Metals and General Chemistry
Protective Coatings Facility
1215 2nd Avenue North and 1208 4th Avenue North
Kent, Washington

					Metals							General Chemistry		
Sample ID	**Date**	**TOC**	**DTW***	**GWE**	**Arsenic (total)**	**Arsenic (dissolved)**	**Cadmium (total)**	**Cadmium (dissolved)**	**Chromium III (total)**	**Chromium III (dissolved)**	**Chromium VI (hexavalent)**	**Cyanide**	**N-Nitrate**	**N-Nitrite**
	Site-specific Cleanup Level [1]				**10**	**10**	**17.5**	**17.5**	**52,500**	**52,500**	**110**	**NA**	**NA**	**NA**
	Units	**ft**	**ft**	**ft**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug-N/L**	**ug-N/L**
MW-1	8/12/2008	38.94	9.41	29.53	**121**	---	---	---	5	---	<11	<5	<100	---
MW-1	7/2/2012	38.94	8.48	30.46	---	---	---	---	---	---	---	---	---	---
MW-1	7/17/2014	38.94	8.75	30.19	**159**	**46.9**	0.34	<0.080	8.1	5.1	<5,000	---	---	---
MW-1	10/7/2014	38.94	9.04	29.90	**137**	**90.8**	0.092	<0.080	7.1	6.4	<0.10	---	---	---
MW-1	1/13/2015	38.94	8.26	30.68	**37.3**	**17.6**	<0.080	<0.080	2.9	3.5	<50	---	---	---
MW-1	6/1/2015	38.59	8.62	29.97	---	**83.9**	---	<0.080	---	5.6	---	---	---	---
MW-1	6/4/2018				---	<20.0	---	---	---	---	---	---	---	---
MW-1	9/24/2018				---	<20.0	---	---	---	---	---	---	---	---
MW-1	12/31/2018				---	<20.0	---	---	---	---	---	---	---	---
MW-1	3/13/2019				---	<20.0	---	---	---	---	---	---	---	---
MW-2	8/12/2008	38.71	8.82	29.89	**149**	---	---	---	5	---	<11	<5	<100	---
MW-2 DUP	8/12/2008	38.71	8.82	29.89	**154**	---	---	---	5	---	<11	<5	<100	---
MW-2	7/2/2012	38.71	8.00	30.71	--	---	---	---	---	---	---	---	---	---
MW-2	7/17/2014	38.71	8.20	30.51	**116**	**22.7**	<0.080	<0.080	3.4	1.6	<1,000	---	---	---
MW-2	10/7/2014	38.71	8.53	30.18	**143**	**67.9**	<0.080	<0.080	3.2	2.6	<0.10	---	---	---
MW-2	1/13/2015	38.71	7.71	31.00	**118**	**20.3**	0.11	<0.080	3.4	1.6	<50	---	---	---
MW-2 DUP	1/13/2015	38.71	7.71	31.00	**121**	**19.0**	0.091	<0.080	3.6	1.6	<50	---	---	---
MW-2	6/1/2015	38.27	7.11	31.16	---	**34.9**	---	<0.080	---	1.7	---	---	---	---
MW-3	8/12/2008	38.68	9.41	29.27	**138**	---	---	---	---	---	<11	<5	<100	---
MW-3	7/2/2012	38.68	8.48	30.20	**115**	**120**	---	<0.1	5.2	---	14	<5	<50	<50
MW-3	7/17/2014	38.68	8.94	29.74	**168**	**42.4**	0.086	<0.080	6.8	3.9	<500	---	---	---
MW-3	10/7/2014	38.68	9.31	29.37	**163**	**85.8**	0.091	<0.080	7.5	4.8	<0.10	---	---	---
MW-3	1/13/2015	38.68	8.37	30.31	**151**	**29.0**	0.23	<0.080	10.2	3.8	<50	---	---	---
MW-3	6/1/2015	38.61	8.89	29.72	---	**69.9**	---	<0.080	---	4.4	---	---	---	---
MW-3								Well MW-3 Decommissioned						
MW-3R	6/4/2018				---	**21.8**	---	---	---	---	---	---	---	---
MW-3R	9/24/2018				---	<20.0	---	---	---	---	---	---	---	---
MW-3R	12/31/2018				---	<20.0	---	---	---	---	---	---	---	---
MW-3R	3/13/2019				---	<20.0	---	---	---	---	---	---	---	---
MW-4	6/29/2012	36.63	6.41	30.22	**33.7**	**31**	---	<0.1	1.0	---	<10	<5	<50	<50

Table 2

Summary of Groundwater Analytical Data
Metals and General Chemistry
Protective Coatings Facility
1215 2nd Avenue North and 1208 4th Avenue North
Kent, Washington

					Metals							General Chemistry		
Sample ID	**Date**	**TOC**	**DTW***	**GWE**	**Arsenic (total)**	**Arsenic (dissolved)**	**Cadmium (total)**	**Cadmium (dissolved)**	**Chromium III (total)**	**Chromium III (dissolved)**	**Chromium VI (hexavalent)**	**Cyanide**	**N-Nitrate**	**N-Nitrite**
	Site-specific Cleanup Level [1]				**10**	**10**	**17.5**	**17.5**	**52,500**	**52,500**	**110**	**NA**	**NA**	**NA**
	Units	**ft**	**ft**	**ft**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug-N/L**	**ug-N/L**
MW-4	7/17/2014	36.63	6.80	29.83	**74.7**	8.9	<0.080	<0.080	1.2	<0.50	<500	---	---	---
MW-4 DUP	7/17/2014	36.63	6.80	29.83	**78.5**	**23.6**	<0.080	<0.080	1.2	0.59	<100	---	---	---
MW-4	10/7/2014	36.63	7.07	29.56	**156**	**67.1**	<0.080	<0.080	1.8	0.69	<0.10	---	---	---
MW-4	1/13/2015	36.63	5.76	30.87	**103**	**20.2**	<0.080	<0.080	1.5	0.67	<50	---	---	---
MW-4	6/1/2015	36.56	6.51	30.05	---	**28.9**	---	<0.080	---	0.79	---	---	---	---
MW-5	6/29/2012	37.07	6.89	30.18	**27.5**	**28.9**	---	<0.1	1.6	---	<10	<5	52	<50
MW-5	7/17/2014	37.07	7.12	29.95	**32.8**	3.1	<0.080	<0.080	2.1	1.1	<500	---	---	---
MW-5	10/7/2014	37.07	7.39	29.68	**68.7**	**29.4**	<0.080	<0.080	2.1	1.5	<0.10	---	---	---
MW-5	1/13/2015	37.07	6.35	30.72	**59.1**	**11.7**	<0.080	<0.080	2.5	1.1	<50	---	---	---
MW-5	6/1/2015	37.00	6.99	30.01	---	**11.8**	---	<0.080	---	1.5	---	---	---	---
MW-6	6/29/2012	39.44	9.40	30.04	**179**	**178**	---	<0.1	4.3	---	<10	<5	<50	<50
MW-6	7/17/2014	39.44	9.71	29.73	**190**	**29.5**	<0.080	<0.080	5.4	2.9	<500	---	---	---
MW-6	10/7/2014	39.44	9.95	29.49	**189**	**136**	<0.080	<0.080	4.4	3.9	<0.10	---	---	---
MW-6	1/13/2015	39.44	8.99	30.45	**177**	**31.1**	<0.080	<0.080	5.8	3.3	<50	---	---	---
MW-6	6/1/2015	39.38	9.80	29.58	---	**89.6**	---	<0.080	---	4.0	---	---	---	---
MW-6	6/4/2018				---	**32.2**	---	---	---	---	---	---	---	---
MW-6	9/24/2018													
MW-6	12/31/2018					<20.0								
MW-6	3/13/2019					<20.0								
MW-7	6/29/2012	38.28	8.98	29.30	**92.7**	**92**	---	<0.1	1.6	---	<10	<5	<50	<50
MW-7	7/17/2014	38.28	9.14	29.14	**134**	**13.5**	<0.080	<0.080	2.8	3.3	<500	---	---	---
MW-7	10/7/2014	38.28	9.15	29.13	**136**	**109**	<0.080	<0.080	2.1	1.8	<0.10	---	---	---
MW-7	1/13/2015	38.28	8.35	29.93	**121**	**31.2**	<0.080	<0.080	2.1	1.2	<50	---	---	---
MW-7	6/1/2015	38.21	8.99	29.22	---	**41.9**	---	<0.080	---	1.5	---	---	---	---
MW-7	6/4/2018				---	<20.0	---	---	---	---	---	---	---	---
MW-7	9/24/2018				---	<20.0	---	---	---	---	---	---	---	---
MW-7	12/31/2018				---	<20.0	---	---	---	---	---	---	---	---
MW-7	3/13/2019				---	<20.0	---	---	---	---	---	---	---	---
MW-8	6/29/2012	39.06	9.80	29.26	**115**	**145**	---	<0.1	4.1	---	19	<5	<50	<50
MW-8	7/17/2014	39.06	10.04	29.02	**173**	**10.8**	<0.080	<0.080	5.9	2.5	<500	---	---	---
MW-8	10/7/2014	39.06	10.10	28.96	**212**	**185**	<0.080	<0.080	5.4	4.9	<0.10	---	---	---

Table 2

Summary of Groundwater Analytical Data
Metals and General Chemistry
Protective Coatings Facility
1215 2nd Avenue North and 1208 4th Avenue North
Kent, Washington

					Metals							General Chemistry		
Sample ID	**Date**	**TOC**	**DTW***	**GWE**	**Arsenic (total)**	**Arsenic (dissolved)**	**Cadmium (total)**	**Cadmium (dissolved)**	**Chromium III (total)**	**Chromium III (dissolved)**	**Chromium VI (hexavalent)**	**Cyanide**	**N-Nitrate**	**N-Nitrite**
	Site-specific Cleanup Level [1]				**10**	**10**	**17.5**	**17.5**	**52,500**	**52,500**	**110**	**NA**	**NA**	**NA**
	Units	**ft**	**ft**	**ft**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug-N/L**	**ug-N/L**
MW-8 DUP	10/7/2014	39.06	10.10	28.96	**221**	**161**	<0.080	<0.080	5.6	4.9	<0.10	---	---	---
MW-8	1/13/2015	39.06	8.87	30.19	**182**	**23.3**	<0.080	<0.080	5.8	3.1	<50	---	---	---
MW-8	6/1/2015	38.98	9.81	29.17	---	**47.8**	---	<0.080	---	3.6	---	---	---	---
MW-9	5/28/2015	37.70	7.75	29.95	---	---	---	---	---	---	---	---	---	---
MW-9	6/1/2015	37.70	8.11	29.59	---	**59.2**	---	<0.080	---	3.4	---	---	---	---
MW-9 DUP	6/1/2015	37.70	8.11	29.59	---	**51.6**	---	<0.080	---	3.1	---	---	---	---
MW-9	6/4/2018				---	<20.0	---	---	---	---	---	---	---	---
MW-9	9/24/2018				---	<20.0	---	---	---	---	---	---	---	---
MW-9	12/31/2018				---	<20.0	---	---	---	---	---	---	---	---
MW-9	3/13/2019				---	<20.0	---	---	---	---	---	---	---	---

Abbreviations and Notes:

ug/L = Micrograms per liter

ug-N/L = Micrograms of atomic Nitrogen per liter

NE = Not established

---- = Not analyzed

<*n* = Below laboratory detection limit of *n* ug/L

Arsenic, Cadmium, and chromium (total and dissolved) analyzed by method 200.8 prior to 2014 and by EPA Method 6020A after 2014; hexavalent chromium analyzed by method SM 3500-CR D Modified.

Cyanide analyzed by method SM4500CN-I; N-Nitrate and N-Nitrite analyzed by EPA Method 353.2.

MTCA = Model Toxics Control Act Cleanup Regulations [WAC 173-340-720(2)(a)(1), as amended February 2001]

[1] The cleanup levels in the table are from the following standards: Federal Maximum Contaminant Levels (MCLs) from US Environmental Protection Agency, and MTCA Method C cleanup levels from Cleanup Level Risk Calculations (CLARC) value for groundwater.

All data prior to 2014 collected by Golder Associates, Inc. (Golder) and provided in Golder's *Phase II Environmental Site Assessment* report dated October 1, 2012.

Data values in **bold** indicate that the concentration exceeded the MTCA Method C cleanup level

Table 3

Summary of Soil Analytical Data
Protective Coatings Facility
1215 2nd Avenue North and 1208 4th Avenue North
Kent, Washington

				VOCs									Metals												Other
Report Referenced	Sample ID	Sample Date	Sample Depth	Acetone	1,1-Dichloroethene	1,1-Dichloroethane	(cis) 1,2-Dichloroethene	2-Butanone	1,1,1-Trichloroethane	Trichloroethene	1,1,2-Trichloroethane	Vinyl Chloride	Arsenic	Barium	Berylium	Cadmium	Chromium	Copper	Lead	Selenium	Silver	Mercury	Nickel	Zinc	Total Cyanide
	MTCA Method C (industrial) Cleanup Levels			**3.15E+06**	**175000**	**700000**	**7000**	**NE**	**7.00E+06**	**0.03***	**2300**	**0.67**	**87.5**	**7.00E+05**	**7000**	**3500**	**1.05E+04**	**1.40E+05**	**NE**	**1.75E+04**	**1.75E+04**	**NE**	**NE**	**1.05E+06**	**2100**
				(mg/kg)	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**
Golder 2012	MW1-2-080208	8/2/2008	2-4	0.028	<0.0011	<0.0011	<0.0011	<0.0054	<0.0011	<0.0011	<0.0011	<0.0011	<5	--	0.2	<0.2	26.6	21	5	--	--	<0.05	27	37	--
Golder 2012	MW2-2-080208	8/2/2008	1.5-3	0.016	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	<0.0010	<0.0010	<0.0010	<6	--	0.2	<0.2	20.7	22.2	5	--	--	<0.05	19	37	--
Golder 2012	MW3-1-080208	8/2/2008	1-3	0.037	0.01	0.0026	0.001	<0.0047	0.18 B	**2.5 B**	0.0024	<0.0010	<6	--	0.2	<0.2	24.6	26.1	4	--	--	<0.05	23	41	--
Golder 2012	HA1-0.5-080208	8/2/2008	0.5	0.15	<0.0010	<0.0010	<0.0010	0.015	<0.0010	<0.0010	<0.0010	<0.0010	5	--	0.2	**3.6**	369	41.9	13	--	--	0.06	24	111	--
Golder 2012	CB-1-080208 A	8/2/2008	N/A	--	--	--	--	--	--	**0.092**	--	--	<20	--	0.6	**617**	722	397	52	--	--	0.07	286	959	11.5
CRA 2015	SO-062175-051415-JS-SB-1-5'	5/14/2015	5	<0.019	0.025	0.0062	<0.0038	<0.019	<0.0038	<0.0038	<0.0038	<0.0038	3.7	64.6	--	0.095	26.6	--	3.4	<0.55	<0.55	0.024	--	--	--
CRA 2015	SO-062175-051415-JS-SB-1-10'	5/14/2015	10	0.025	<0.0049	<0.0049	<0.0049	<0.024	<0.0049	<0.0049	<0.0049	<0.0049	4.2	62	--	<0.099	17.1	--	3.3	0.71	<0.62	0.055	--	--	--
CRA 2015	SO-062175-051415-JS-SB-1-20'	5/14/2015	20	0.030	<0.0046	<0.0046	<0.0046	<0.23	<0.0046	<0.0046	<0.0046	<0.0046	3.2	38.4	--	<0.095	10.4	--	2.2	<0.59	<0.59	<0.025	--	--	--
CRA 2015	SO-062175-051315-JS-SB-2-5'	5/13/2015	5	<0.022	<0.0045	<0.0045	<0.0045	<0.022	<0.0045	<0.0045	<0.0045	<0.0045	4.1	60.2	--	0.082	27.7	--	4.3	0.49	<0.46	0.039	--	--	--
CRA 2015	SO-062175-051315-JS-SB-2-10'	5/13/2015	10	0.023	<0.0044	<0.0044	0.0056	<0.022	<0.0044	<0.0044	<0.0044	<0.0044	3.3	45.8	--	<0.094	13.2	--	2.4	<0.59	<0.59	0.050	--	--	--
CRA 2015	SO-062175-051315-JS-SB-2-14'	5/13/2015	14	0.061	<0.0056	<0.0056	<0.0056	<0.028	<0.0056	<0.0056	<0.0056	<0.0056	5.1	60.3	--	<0.10	15.3	--	3.7	0.81	<0.64	0.091	--	--	--
CRA 2015	SO-062175-051215-JS-SB-3-3'	5/12/2015	3	<0.018	<0.0036	<0.0036	<0.0036	<0.018	<0.0036	<0.0036	<0.0036	<0.0036	2.5	131	--	<0.081	24.7	--	3.0	<0.51	<0.51	<0.021	--	--	--
CRA 2015	SO-062175-051315-JS-SB-3-5'	5/13/2015	5	0.054	<0.0043	<0.0043	<0.0043	<0.021	<0.0043	<0.0043	<0.0043	<0.0043	4.8	89.4	--	0.12	39.9	--	4.3	<0.52	<0.52	0.028	--	--	--
CRA 2015	SO-062175-051315-JS-SB-3-10'	5/13/2015	10	0.054	<0.0048	<0.0048	<0.0048	<0.024	<0.0048	<0.0048	<0.0048	<0.0048	4.9	54.5	--	<0.073	14.2	--	2.7	0.57	<0.45	<0.022	--	--	--
CRA 2015	SO-062175-051315-JS-SB-3-14'	5/13/2015	14	0.064	<0.0054	<0.0054	<0.0054	<0.027	<0.0054	<0.0054	<0.0054	<0.0054	6.8	88.8	--	0.11	20.9	--	5.2	0.97	<0.65	0.048	--	--	--
CRA 2015	SO-062175-051215-JS-SB-4-3'	5/12/2015	3	0.064	0.036	0.011	0.0070	<0.026	0.23	**1.2**	<0.0052	<0.0052	3.0	71.9	--	0.10	25.1	--	4.2	0.52	<0.45	0.023	--	--	--
CRA 2015	SO-062175-051315-JS-SB-4-5'	5/13/2015	5	<0.018	0.95	0.47	0.0068	<0.018	1.6	**0.034**	0.0098	<0.0037	3.8	62.0	--	0.11	30.5	--	3.6	0.56	<0.55	0.035	--	--	--
CRA 2015	SO-062175-051315-JS-SB-4-10'	5/13/2015	10	0.039	0.036	0.11	0.52	<0.023	<0.0046	<0.0046	<0.0046	<0.0046	3.7	52.3	--	<0.087	12.4	--	2.4	<0.54	<0.54	0.035	--	--	--
CRA 2015	SO-062175-051315-JS-SB-4-15'	5/13/2015	15	0.054	<0.0060	<0.0060	0.063	<0.030	<0.0060	<0.0060	<0.060	<0.0060	9.9	96.2	--	0.10	24.4	--	5.4	0.99	<0.61	0.059	--	--	--
CRA 2015	SO-062175-051215-JS-SB-5-3'	5/12/2015	3	0.83	0.0047	<0.0041	<0.0041	<0.021	0.014	**0.035**	<0.0041	<0.0041	2.8	63.2	--	0.79	24.5	--	4.9	<0.49	<0.49	0.027	--	--	--
CRA 2015	SO-062175-051315-JS-SB-5-5'	5/13/2015	5	0.6	0.038	0.017	0.012	<0.022	0.063	**0.053**	<0.0044	<0.0044	3.2	82.0	--	0.35	23.7	--	4.4	<0.52	<0.52	0.028	--	--	--
CRA 2015	SO-062175-051315-JS-SB-5-10'	5/13/2015	10	0.041	<0.0050	<0.0050	0.012	<0.025	<0.0050	<0.0050	<0.0050	<0.0050	4.3	62.7	--	<0.074	16.3	--	2.9	0.56	<0.46	<0.027	--	--	--
CRA 2015	SO-062175-051315-JS-SB-5-15'	5/13/2015	15	0.037	<0.0057	<0.0057	0.0071	<0.029	<0.0057	<0.0057	<0.0057	<0.0057	8.5	89.3	--	0.10	22.7	--	5.0	1.1	<0.51	0.069	--	--	--
CRA 2015	SO-062175-051215-JS-SB-6-0.5'	5/12/2015	0.5	0.028	<0.0044	<0.0044	<0.0044	<0.022	<0.0044	<0.0044	<0.0044	<0.0044	3.4	62.4	--	**3.0**	93.9	--	4.1	<0.44	<0.44	0.047	--	--	--
CRA 2015	SO-062175-051315-JS-SB-6-5'	5/13/2015	5	0.042	<0.0040	<0.0040	<0.0040	<0.020	<0.0040	<0.0040	<0.0040	<0.0040	4.6	78.5	--	0.13	37.8	--	4.4	0.69	<0.53	0.034	--	--	--
CRA 2015	SO-062175-051315-JS-SB-6-10'	5/13/2015	10	0.068	<0.0058	<0.0058	0.011	<0.029	<0.0058	<0.0058	<0.0058	<0.0058	4.4	58.8	--	<0.080	15.3	--	3.1	0.56	<0.50	0.043	--	--	--
CRA 2015	SO-062175-051215-JS-SB-6-13'	5/12/2015	13	0.11	<0.0060	<0.0060	0.055	<0.030	<0.0060	<0.0060	<0.0060	<0.0060	9.9	82.7	--	0.24	24.7	--	5.2	0.97	<0.56	0.042	--	--	--
CRA 2015	SO-062175-051215-JS-SB-7-2'	5/12/2015	2	0.037	<0.0039	<0.0039	<0.0039	<0.019	<0.0039	<0.0039	<0.0039	<0.0039	3.2	62.8	--	0.089	22.9	--	2.9	<0.56	<0.56	0.027	--	--	--
CRA 2015	SO-062175-051415-JS-SB-7-5'	5/14/2015	5	0.019	<0.0036	<0.0036	<0.0036	<0.018	<0.0036	<0.0036	<0.0036	<0.0036	4.9	69.6	--	0.10	34.0	--	3.8	0.69	<0.51	0.022	--	--	--
CRA 2015	SO-062175-051415-JS-SB-7-13'	5/14/2015	13	0.044	<0.0053	<0.0053	<0.0053	<0.026	<0.0053	<0.0053	<0.0053	<0.0053	6.9	76.4	--	0.12	22.8	--	4.6	0.88	<0.69	0.065	--	--	--
CRA 2015	SO-062175-051415-JS-SB-7-20'	5/14/2015	20	0.023	<0.0040	<0.0040	<0.0040	<0.020	<0.0040	<0.0040	<0.0040	<0.0040	2.1	39.6	--	<0.087	11.2	--	1.8	<0.55	<0.55	<0.022	--	--	--
CRA 2015	SO-062175-051415-JS-MW-9-5'	5/14/2015	5	0.072	<0.0040	<0.0040	<0.0040	<0.020	0.0061	<0.0040	<0.0040	<0.0040	4.4	462	--	**2.1**	132	--	9.6	0.59	<0.54	0.070	--	--	--
CRA 2015	SO-062175-051415-JS-MW-9-10'	5/14/2015	10	0.061	<0.0058	<0.0058	<0.0058	<0.029	<0.0058	<0.0058	<0.0058	<0.0058	10.6	88.8	--	0.29	23.7	--	6.1	1.2	<0.62	0.076	--	--	--
CRA 2015	SO-062175-051415-JS-MW-9-15'	5/14/2015	15	<0.024	<0.0048	<0.0048	<0.0048	<0.024	<0.48	<0.0048	<0.0048	<0.0048	2.4	46.3	--	<0.11	11.9	--	2.0	<0.67	<0.67	0.029	--	--	--
GHD 2016	***SO-062175-031516-SB-8-5'	3/15/2016	5	<1.15	4.10	3.90	0.364	<0.287	15.40	<0.0574	0.431	<0.0574	3.9	65.4	--	0.12	31.2	--	3.8	<0.55	<0.55	0.026	--	--	--
GHD 2016	***SO-062175-031516-SB-8-10'	3/15/2016	10	<1.29	<0.0645	0.161	0.922	<0.323	<0.0645	<0.0645	<0.0645	<0.0645	2.9	40.7	--	<0.076	10.6	--	2.1	<0.48	<0.48	<0.025	--	--	--
GHD 2016	SO-062175-031516-SB-8-15'	3/15/2016	15	<1.53	<0.0763	<0.0763	0.0927	<0.381	<0.0763	<0.0763	<0.0763	<0.0763	8.2	114	--	0.13	22.0	--	6.2	<0.72	<0.72	0.068	--	--	--
GHD 2016	***SO-062175-031516-SB-9-5'	3/15/2016	5	<1.120	0.363	1.520	0.434	<0.280	<0.0559	<0.0559	<0.0559	<0.0559	5.0	69.9	--	0.13	35.2	--	4.0	<0.45	<0.45	0.040	--	--	--
GHD 2016	***SO-062175-031516-SB-9-10'	3/15/2016	10	<1.330	<0.0667	<0.0667	0.241	<0.333	<0.0667	<0.0667	<0.0667	<0.0667	4.1	54.9	--	<0.096	13.3	--	2.8	<0.60	<0.60	0.026	--	--	--
GHD 2016	SO-062175-031516-SB-9-15'	3/15/2016	15	<1.420	<0.0710	<0.0710	0.136	<0.355	<0.0710	<0.0710	<0.0710	<0.0710	7.6	95.3	--	<0.10	20.1	--	5.5	<0.65	<0.65	0.056	--	--	--
GHD 2016	***SO-062175-031516-SB-10-5'	3/15/2016	5	<1.120	<0.0562	<0.0562	0.183	<0.281	<0.0562	**22.50**	<0.0562	<0.0562	3.7	56.5	--	0.10	26.8	--	3.6	<0.50	<0.50	<0.020	--	--	--
GHD 2016	***SO-062175-031516-SB-10-10'	3/15/2016	10	<1.370	<0.0685	<0.0685	0.247	<0.342	<0.0685	**0.193**	<0.0685	<0.0685	3.4	44.3	--	<0.088	17.4	--	2.4	<0.55	<0.55	<0.026	--	--	--
GHD 2016	SO-062175-031516-SB-10-15'	3/15/2016	15	<1.430	<0.0715	<0.0715	<0.0715	<0.357	<0.0715	<0.0715	<0.0715	<0.0715	6.2	76.4	--	<0.083	16.8	--	4.8	<0.52	<0.52	<0.025	--	--	--
GHD 2016	SO-062175-031516-SB-11-5'	3/15/2016	5	<1.120	<0.0561	<0.0561	<0.0561	<0.281	<0.0561	<0.0561	<0.0561	<0.0561	3.2	68.4	--	0.10	33.8	--	6.2	<0.47	<0.47	<0.020	--	--	--
GHD 2016	SO-062175-031516-SB-11-10'	3/15/2016	10	<1.400	<0.698	<0.698	<0.698	<0.349	<0.698	<0.698	<0.698	<0.698	3.6	37.2	--	<0.10	11.4	--	2.3	<0.65	<0.65	<0.027	--	--	--
GHD 2016	SO-062175-031516-SB-11-15'	3/15/2016	15	<1.490	<0.0743	<0.0743	<0.0743	<0.372	<0.0743	<0.0743	<0.0743	<0.0743	10.4	119	--	<0.11	24.2	--	7.1	<0.68	<0.68	0.054	--	--	--
GHD 2016	SO-062175-031516-SB-12-5'	3/15/2016	5	<1.150	<0.0574	<0.0574	<0.0574	<0.287	<0.0574	<0.0574	<0.0574	<0.0574	4.6	79.4	--	0.17	36.9	--	5.9	<0.52	<0.52	<0.021	--	--	--
GHD 2016	SO-062175-031516-SB-12-10'	3/15/2016	10	<1.290	<0.0644	<0.0644	<0.0644	<0.322	<0.0644	<0.0644	<0.0644	<0.0644	4.1	44.3	--	<0.073	14.8	--	2.5	<0.46	<0.46	<0.022	--	--	--
GHD 2016	SO-062175-031516-SB-12-15'	3/15/2016	15	<1.530	<0.0764	<0.0764	<0.0764	<0.382	<0.0764	<0.0764	<0.0764	<0.0764	8.6	107	--	0.12	21.7	--	6.4	<0.63	<0.63	0.065	--	--	--
GHD 2016	SO-062175-031516-SB-13-5'	3/15/2016	5	<1.120	<0.0561	<0.0561	<0.0561	<0.281	<0.0561	<0.0561	<0.0561	<0.0561	2.2	35.3	--	0.094	17.2	--	4.0	<0.45	<0.045	0.034	--	--	--
GHD 2016	SO-062175-031516-SB-13-10'	3/15/2016	10	<1.320	<0.0662	<0.0662	<0.0662	<0.331	<0.0662	<0.0662	<0.0662	<0.0662	6.8	65.4	--	0.20	15.1	--	11.5	<0.54	<0.54	0.054	--	--	--
GHD 2016	SO-062175-031516-SB-13-15'	3/15/2016	15	<1.460	<0.0732	<0.0732	<0.0732	<0.366	<0.0732	<0.0732	<0.0732	<0.0293	8.2	104	--	0.11	21.0	--	6.0	<0.60	<0.60	0.075	--	--	--
GHD 2017	SO-053117-BP-SB-14-5	5/31/2017	5	<0.0558	<0.0045	<0.0045	<0.0045	<0.0223	<0.0045	<0.0045	<0.0045	<0.0045	3.5	76.2	--	<0.17	37.3	--	3.8	<1.1	<0.57	0.042	--	--	--
GHD 2017	SO-053117-BP-SB-14-10	5/31/2017	10	0.0627	<0.0050	<0.0050	<0.0050	<0.0251	<0.0050	<0.0050	<0.0050	<0.0050	2.9	31.7	--	<0.19	12	--	1.8	<1.3	<0.64	0.025	--	--	--
GHD 2017	SO-053117-BP-SB-15-5	5/31/2017	5	<0.0553	<0.0044	<0.0044	<0.0044	<0.0221	<0.0044	<0.0044	<0.0044	<0.0044	3.6	62.1	--	<0.15	29.6	--	3.5	<1.0	<0.51	0.039	--	--	--
GHD 2017	SO-053117-BP-SB-15-10	5/31/2017	10	<0.0527	<0.0042	<0.0042	<0.0042	<0.0221	<0.0042	<0.0042	<0.0042	<0.0042	4.3	57.8	--	<0.21	14	--	3.2	<1.4	<0.69	0.048	--	--	--
GHD 2017	SO-053117-BP-SB-16-5	5/31/2017	5	<0.0446	<0.0036	<0.0036	<0.0036	<0.0178	<0.0036	<0.0036	<0.0036	<0.0036	2.8	50.5	--	<0.16	22.6	--	2.7	<1.1	<0.54	0.040	--	--	--
GHD 2017	SO-053117-BP-SB-16-10	5/31/2017	10	<0.0604	<0.0048	<0.0048	<0.0048	<0.0242	<0.0048	<0.0048	<0.0048	<0.0048	3.7	47.7	--	<0.19	13.5	--	2.1	<1.3	<0.64	<0.028	--	--	--
GHD 2017	SO-053117-BP-SB-17-5	5/31/2017	5	<0.0594	0.0582	0.0192	0.147	<0.0238	<0.0048	**11.4**	<0.0048	<0.0048	3.2	72.4	--	<0.16	24.6	--	3.3	<1.1	<0.53	0.034	--	--	--
GHD 2017	SO-053117-BP-SB-17-10	5/31/2017	10	<0.0635	<0.0051	<0.0051	<0.0051	<0.0254	<0.0051	<0.0051	<0.0051	<0.0051	3.3	50.5	--	<0.19	17	--	2.7	<1.3	<0.63	0.043	--	--	--
GHD 2018	062175-20180417-SO-BP-WSW-1	4/17/2018	5	--	3.7	0.0069	2.2	--	4.5	0.0041	0.0041	<0.0022	--	--	--	--	--	--	--	--	--	--	--	--	--
GHD 2018	062175-20180417-SO-BP-NSW-1	4/17/2018	5	--	0.011	0.052	0.0029	--	<0.0018	<0.0018	<0.0018	<0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 3

Summary of Soil Analytical Data
Protective Coatings Facility
1215 2nd Avenue North and 1208 4th Avenue North
Kent, Washington

				VOCs									Metals												Other
Report Referenced	Sample ID	Sample Date	Sample Depth	Acetone	1,1-Dichloroethene	1,1-Dichloroethane	(cis) 1,2-Dichloroethene	2-Butanone	1,1,1-Trichloroethane	Trichloroethene	1,1,2-Trichloroethane	Vinyl Chloride	Arsenic	Barium	Berylium	Cadmium	Chromium	Copper	Lead	Selenium	Silver	Mercury	Nickel	Zinc	Total Cyanide
	MTCA Method C (industrial) Cleanup Levels			**3.15E+06**	**175000**	**700000**	**7000**	**NE**	**7.00E+06**	**0.03***	**2300**	**0.67**	**87.5**	**7.00E+05**	**7000**	**3500**	**1.05E+04**	**1.40E+05**	**NE**	**1.75E+04**	**1.75E+04**	**NE**	**NE**	**1.05E+06**	**2100**
				(mg/kg)	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**
GHD 2018	062175-20180418-SO-BP-SSW-1	4/18/2018	5	--	<0.0052	0.001	0.023	--	<0.0018	<0.0018	<0.0018	<0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--
GHD 2018	062175-20180418-SO-BP-BOT-1	4/18/2018	10	--	<0.0053	0.0026	0.15	--	<0.0021	<0.0021	<0.0021	<0.0021	--	--	--	--	--	--	--	--	--	--	--	--	--
GHD 2018	062175-20180419-SO-BP-BOT-2	4/19/2018	5	--	<0.0058	<0.0012	0.14	--	<0.0023	<0.0023	<0.0023	<0.0023	--	--	--	--	--	--	--	--	--	--	--	--	--
GHD 2018	062175-20180419-SO-BP-SSW-2	4/19/2018	5	--	0.88	0.068	0.044	--	<0.0017	**0.052**	<0.0017	<0.0017	--	--	--	--	--	--	--	--	--	--	--	--	--
GHD 2018	062175-20180419-SO-BP-ESW-1	4/19/2018	6	--	<0.0042	--	0.018	--	<0.0017	<0.0017	<0.0017	<0.0017	--	--	--	--	--	--	--	--	--	--	--	--	--
GHD 2018	062175-20180419-SO-BP-BOT-3	4/19/2018	10	--	<0.0057	<0.0011	<0.0034	--	<0.0023	<0.0023	<0.0023	<0.0023	--	--	--	--	--	--	--	--	--	--	--	--	--
GHD 2018	062175-20180420-SO-BP-ESW-2	4/20/2018	10	--	<0.0057	<0.0011	<0.0034	--	<0.0023	<0.0023	<0.0023	<0.0023	--	--	--	--	--	--	--	--	--	--	--	--	--
GHD 2018	062175-20180420-SO-BP-SSW-3	4/20/2018	5	--	<0.0047	0.001	<0.0028	--	<0.0019	<0.0019	<0.0019	<0.0019	--	--	--	--	--	--	--	--	--	--	--	--	--
GHD 2018	062175-20180420-SO-BP-BOT-4	4/20/2018	10.5	--	<0.0061	<0.0012	<0.0037	--	<0.0024	<0.0024	<0.0024	<0.0024	--	--	--	--	--	--	--	--	--	--	--	--	--
GHD 2018	062175-20180420-SO-BP-ESW-3	4/20/2018	5	--	<0.0050	<0.0010	<0.0030	--	<0.0020	<0.0020	<0.0020	<0.0020	--	--	--	--	--	--	--	--	--	--	--	--	--
GHD 2018	062175-20180420-SO-BP-NSW-2	4/20/2018	5	--	0.022	0.021	0.0088	--	<0.0019	**0.032**	<0.0019	<0.0019	--	--	--	--	--	--	--	--	--	--	--	--	--
GHD 2018	062175-20180420-SO-BP-WSW-2	4/20/2018	5	--	0.0097	0.027	0.014	--	<0.0018	**0.048**	<0.0018	<0.0018	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes
MTCA = Model Toxics Control Act
VOCs = Volatile organic compounds analyzed by EPA Method 8260B; see Analytical Resources Incorporated August 27, 2008 analytical report for full list of VOCs analyzed.
Metals analyzed by EPA Method 6010B, except for mercury which was analyzed by EPA Method 7471A; see Analytical Resources Incorporated August 27, 2008 analytical report for full list of metals analyzed.
Total cyanide analyzed by method SM4500CN-1
mg/kg = milligrams per kilogram
-- = Not analyzed
<x = Not detected above laboratory reporting limit x.
Bolded concentrations indicate the concentration value exceeded the Washington State Department of Ecology Model Toxics Control Act Method A cleanup levels.
NE = Not Established
N/A = Not Applicable or not provided
* Based on MTCA Method A Cleanup Level for Industrial Properties

***Additional concentrations exceeded laboratory detection limits. For complete results, see analytical laboratory report.
A = CB-1 is a stormwater catch basin sediment sample
B = Concentration based on reanalysis of initial soil sample due to required dilution
All data prior to 2014 was obtained from Golder Associates *Phase II Environmental Site Assessment* report dated October 1, 2012.

Table 4

Summary of Soil Gas Analytical Data
Protective Coatings Facility
1215 2nd Avenue North and 1208 4th Avenue North
Kent, Washington

					VOCs																			
Report Referenced	**Soil Gas Probe ID**	**Sample ID**	**Sample Date**	**Sample Type**	**Benzene**	**Toluene**	**Ethylbenzene**	**m,p-Xylene**	**o-Xylene**	**1,1,1-Trichloroethane**	**1,1-Dichloroethane**	**1,2,4-Trimethylbenzene**	**1,2-Dibromoethane (EDB)**	**2-Propanol**	**Bromomethane**	**Chloroform**	**Chloromethane**	**(cis) 1,2-Dichloroethene**	**Freon 11**	**Freon 12**	**Methylene Chloride**	**Tetrachloroethene (PCE)**	**Trichloroethene (TCE)**	**Vinyl Chloride**
MTCA Method C (industrial) - Soil Gas Screening Levels[1]					**107**	**167000**	**33300**	**3330**	**3330**	**167000**	**521**	**233**	**1.39**	**--**	**167**	**36.2**	**3000**	**NE**	**--**	**--**	**83300**	**3210**	**67**	**93.3**
MTCA Method C (industrial) - Indoor Air Cleanup Levels[1]					**30**	**5000**	**1000**	**100**	**100**	**5000**	**15.6**	**7**	**9**	**--**	**5**	**98**	**90**	**NE**	**--**	**--**	**600**	**96.2**	**2.0**	**100**
					µg/m³	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**
Golder 2012	SG-2	SG-2-12"	7/10/2012	Soil Gas	--	17	4.6	17	6.7	110	7.2	--	--	87	14 J	--	--	1.7	--	--	--	<2.1	**1,200**	<0.4
Golder 2012	SG-3	SG-3-12"	6/28/2012	Soil Gas	<0.25	1.7	0.28	1.1	0.42	--	--	--	--	2.0	--	--	--	<0.12	2.1	2.3	--	0.29	7.8	<0.04
Golder 2012	SG-33	Duplicate	6/28/2012	Soil Gas	0.24	1.6	0.29	1.0	0.40	--	--	--	--	1.8 J	--	--	--	<0.12	2.3	2.3	--	0.28	7.5	<0.04
Golder 2012	SG-4	SG-4-9"	6/28/2012	Soil Gas	19	13	--	--	--	--	--	--	--	54	--	--	--	38	--	--	--	99	**4,600**	<8.5
Golder 2012	A1*	Ambient Outdoor Air	6/28/2012	Ambient 4 hr Exterior	0.94	38	2	10	3.6	--	--	--	--	84	--	--	0.81	<0.26	--	1.7	--	<0.45	140	<0.08
Golder 2012	Amb-1*	Ambient Outdoor Air	7/10/2012	Ambient 0.5 hr Exterior	--	71	3.2	11	3.8	--	--	--	--	830	--	--	--	<1.2	--	<7.2	--	<2.0	26	<0.37
Golder 2012	AA-INT-1	Interior-1	8/18/2012	Ambient 8 hr Non-Operational Evening	0.56	21	1.1	4.0	1.3	--	--	0.84	--	94	--	--	0.85	<0.12	1.1	2.2	--	<0.21	**22**	<0.041
Golder 2012	AA-INT-2	Interior-2	8/18/2012	Ambient 8 hr Non-Operational Evening	0.56	26	1.4	5.0	1.6	--	--	1.0	--	120	--	--	0.9	<0.13	1.2	2.3	--	<0.22	**23**	<0.04
Golder 2012	AA-INT-3	Interior-3	8/18/2012	Ambient 8 hr Non-Operational Evening	0.83	37	2.1	7.9	2.6	--	--	--	--	210	--	--	1.3	<0.12	--	2.8	--	<0.21	**42**	<0.1
Golder 2012	AA-EXT-1	Exterior-1	8/18/2012	Ambient 8 hr Non-Operational Evening	0.51	3.4	0.36	1.1	0.39	--	--	--	--		--	--	1.2	<0.32	1.1	2.3	--	<0.54	0.23	<0.04
Golder 2012	AA-INT-1	Interior-1	9/6/2012	Ambient 8 hr Operational Daytime	0.48	9.2	0.67	2.2	0.97	--	--	--	<1.3	76 J	--	--	0.98	<0.13	1.0	2.2	7.3	<0.22	5	<0.042
Golder 2012	AA-INT-2	Interior-2	9/6/2012	Ambient 8 hr Operational Daytime	0.44	8.7	0.66	2.4	1.1	--	--	0.92	<1.3	76 J	--	--	0.98	<0.13	1.1	2.2	6.8	<0.22	4.8	<0.042
Golder 2012	AA-INT-3	Interior-3	9/6/2012	Ambient 8 hr Operational Daytime	0.46	9.7	0.77	2.8	1.3	--	--	1	<1.2	83 J	--	--	1.1	<0.13	1.1	2.3	8.7	<0.22	5.7	<0.041
Golder 2012	AA-EXT-1	Exterior-1	9/6/2012	Ambient 8 hr Operational Daytime	0.43	5.3	0.43	1.4	0.49	--	--	--	<1.3	14 J	--	--	0.96	<0.13	1.1	2.2	6	0.23	4.9	<0.042
Golder 2012	AA-EXT-2	Exterior-2	9/6/2012	Ambient 8 hr Operational Daytime	0.5	7.1	0.48	1.6	0.58	--	--	--	<1.2	4.5 J	--	0.94	1.0	<0.14	1.1	2.2	9.8	<0.23	13	<0.044

Table 4

Summary of Soil Vapor Analytical Data
Protective Coatings Facility
1215 2nd Avenue North and 1208 4th Avenue North
Kent, Washington

					VOCs																			
Report Referenced	**Soil Gas Probe ID**	**Sample ID**	**Sample Date**	**Sample Type**	**Benzene**	**Toluene**	**Ethylbenzene**	**m,p-Xylene**	**o-Xylene**	**1,1,1-Trichloroethane**	**1,1-Dichloroethane**	**1,2,4-Trimethylbenzene**	**1,2-Dibromoethane (EDB)**	**2-Propanol**	**Bromomethane**	**Chloroform**	**Chloromethane**	**(cis) 1,2-Dichloroethene**	**Freon 11**	**Freon 12**	**Methylene Chloride**	**Tetrachloroethene (PCE)**	**Trichloroethene (TCE)**	**Vinyl Chloride**
MTCA Method C (industrial) - Soil Gas Screening Levels[1]					**107**	**167000**	**33300**	**3330**	**3330**	**167000**	**521**	**233**	**1.39**	**--**	**167**	**36.2**	**3000**	**NE**	**--**	**--**	**83300**	**3210**	**67**	**93.3**
MTCA Method C (industrial) - Indoor Air Cleanup Levels[1]					**30**	**5000**	**1000**	**100**	**100**	**5000**	**15.6**	**7**	**9**	**--**	**5**	**98**	**90**	**NE**	**--**	**--**	**600**	**96.2**	**2.0**	**100**
					μg/m^3	**μg/m^3**	**μg/m^3**	**μg/m^3**	**μg/m^3**	**μg/m^3**	**μg/m^3**	**μg/m^3**	**μg/m^3**	**μg/m^3**	**μg/m^3**	**μg/m^3**	**μg/m^3**	**μg/m^3**	**μg/m^3**	**μg/m^3**	**μg/m^3**	**μg/m^3**	**μg/m^3**	**μg/m^3**

Notes
MTCA = Model Toxics Control Act
[1] State of Washington Department of Ecology, *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action,* October 2009 [DRAFT]
VOCs = Volatile organic compounds analyzed by EPA Method TO-15 (modified); See analytical laboratory report for a full list of VOCs analyzed.
μg/m3 = micrograms per cubic meter
-- = Not analyzed/Not established
<x = not detected above laboratory reporting limit x
J = Estimated value due to a QC deficiency, or value below the reporting limit.
Data values in bold indicate the concentration exceeded the MTCA Method C soil gas screening levels and/or indoor air cleanup levels
* Ambient air samples collected from outdoor air during soil gas sampling; A-1 was collected adjacent to SG-2, and AMB-1 was collected midway between SG-3 and SG-4.
All data prior to 2014 provided in Golder Associates *Phase II Environmental Site Assessment* report dated October 1, 2012.

Table 5

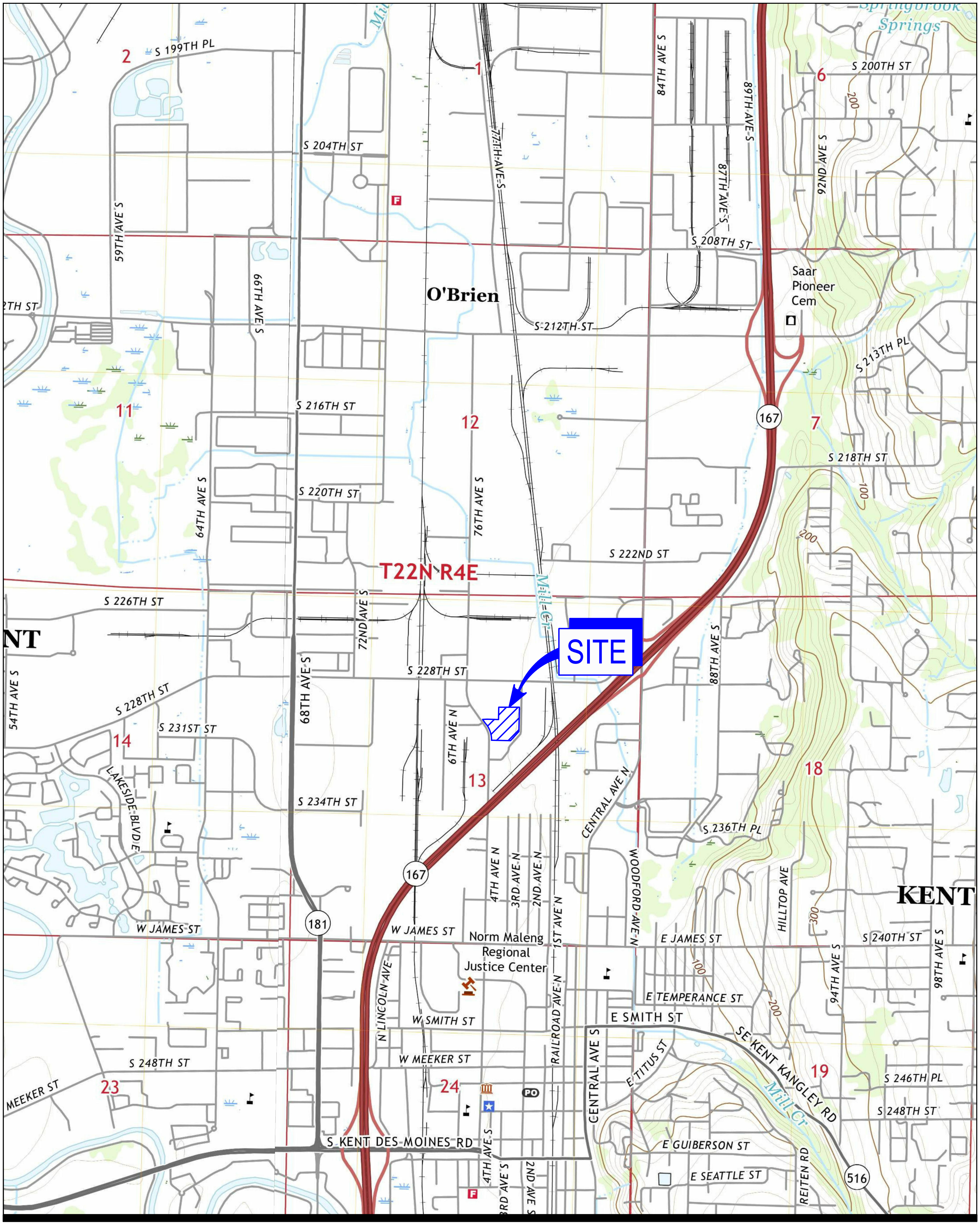
Well Construction Details
Protective Coatings, Inc.
1215 2nd Avenue North and 1208 4th Avenue North
Kent, King County, Washington

Boring/Well I.D.	Installation Date	Boring Depth (feet bgs)	Casing Diameter (inches)	Casing Material	Screen Top (feet bgs)	Screen Bottom (feet bgs)	Screen Size (inches)	Filter Pack Top (feet bgs)	Filter Pack Bottom (feet bgs)	TOC Elevation (feet, amsl)
MW-1	08/02/08	18	2	PVC	7	17	--	5	18	38.94
MW-2	08/02/08	18	2	PVC	7	17	--	5	18	38.71
MW-3	08/02/08	16	2	PVC	6	16	--	6	16	38.68
MW-4	06/20/12	15.5	2	PVC	5	15	0.010	3	15.5	36.63
MW-5	06/20/12	15.5	2	PVC	5	15	0.010	3	15.5	37.07
MW-6	06/21/12	15.5	2	PVC	5	15	0.010	3	15.5	39.44
MW-7	06/21/12	15.5	2	PVC	5	15	0.010	3	15.5	38.28
MW-8	06/21/12	15.5	2	PVC	5	15	0.010	3	15.5	39.06
MW-9	05/14/15	16.5	2	PVC	5	15	0.010	3	15	--

Abbreviations and Notes:

amsl = above mean sea level
bgs = below ground surface
TOC = Top of Casing
-- = not available

Figures



0 1000 2000 ft
1" = 2000 ft

N

GHD

PROTECTIVE COATINGS FACILITY
1215 2ND AVENUE NORTH
AND 1208 4TH AVENUE NORTH
KENT, WASHINGTON

VICINITY MAP

Project No. **11218504**
Date **December 2021**

FIGURE 1

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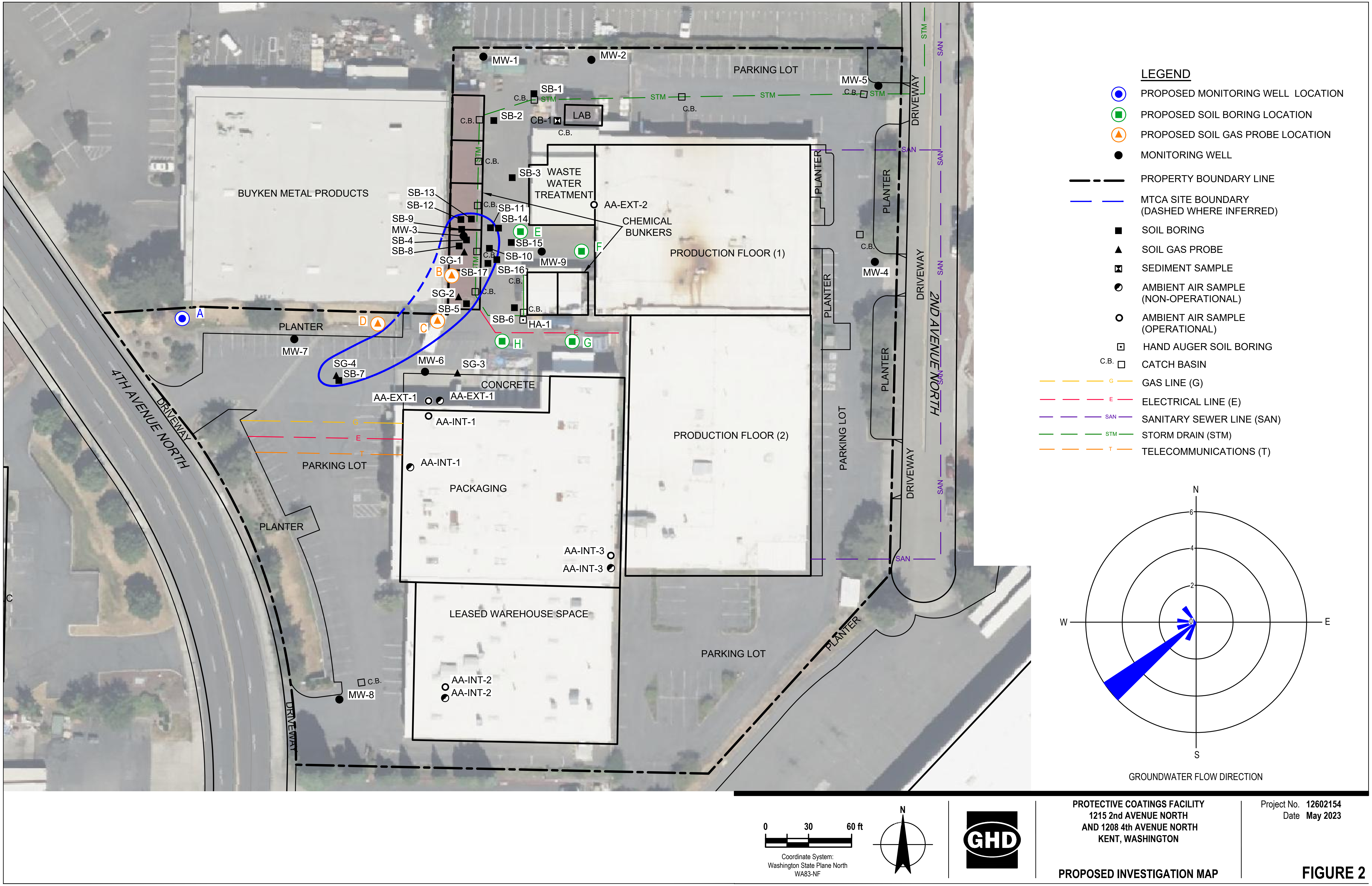
RENTON, WA, 2020



PROTECTIVE COATINGS FACILITY
1215 2nd AVENUE NORTH
AND 1208 4th AVENUE NORTH
KENT, WASHINGTON

Project No. 12602154
Date May 2023

PROPOSED INVESTIGATION MAP

FIGURE 2

Filename: N:\US\Portland\Projects\561\12602154\Digital_Design\ACAD\Figures\RPTWP001\12602154-GHD-00-00-RPT-EN-D101_SO-WP001.dwg
Plot Date: 19 May 2023 1:33 PM

Source: USGS NATIONAL MAP VIEWER AERIAL IMAGERY. STATEWIDE LAND SURVEYING INC. REPORT DATED 7/17/15, WA STATE PLANE COORDINATED SYSTEMS NAD 83/2011 EPCOH 2010.000 NORTH ZONE 4601, IN U.S. SURVEY FEET.

Appendices

Appendix A

Summary of Previous Investigations/Remedial Activities and Environmental Documents List

Appendix A Summary of Previous Investigations

2004 Investigation

In 2004, Krazan & Associates (Krazan) completed a subsurface investigation on the Property. The scope of work completed was unavailable to GHD. However, the results of the investigation, as reported by Golder and Associates (Golder) in 2012, indicate that cadmium exceeded the Model Toxics Control Act (MTCA) unrestricted land use cleanup levels in a soil sample collected northwest of the wastewater treatment plant. Arsenic was detected in all groundwater samples at concentrations ranging from 0.035 to 0.17 milligram per liter (mg/L), which exceeded the MTCA unrestricted land use cleanup level of 0.005 mg/L. Chromium was also detected above the MTCA unrestricted land use cleanup level in one groundwater sample.

2008 Investigation

In 2008, Golder conducted an initial Phase II Environmental Site Assessment (ESA). Three groundwater monitoring wells (MW-1, MW-2, and MW-3) were installed at the northwest corner of the Property. Soil samples were collected from each boring and submitted for laboratory analysis. Soil samples collected from boring MW-3 at depths ranging from approximately 1 to 3 feet below ground surface (bgs) exceeded the MTCA unrestricted land use cleanup level for trichloroethene (TCE). A hand auger boring (HA-1) was advanced in an area where a TCE solvent tank was formerly located. Laboratory analysis of a soil sample collected from 0.5 foot bgs exceeded the MTCA unrestricted land use cleanup level for cadmium. A sediment sample from a storm catch basin sump (CB-1) located near the northwest corner of the Property was also collected for analysis. The sample exceeded the MTCA unrestricted land use cleanup levels for TCE and cadmium. Groundwater samples were collected from each of the three monitoring wells. Concentrations of vinyl chloride and (cis) 1,2-dichloroethene ((cis) 1,2-DCE) exceeded the MTCA unrestricted land use cleanup levels in well MW-3.

In addition, Golder performed field infiltration testing within the plating area. In the plating area, multiple gravity-fed trenches discharge process wastewater generated from operations into a central sump. The process wastewater is routed from the trenches into the sump and eventually to the wastewater treatment facility. The objective of the testing was to determine if potential releases within the sump had the potential to impact groundwater. The results of the test indicated that there is a potential leakage of less than 4 gallons per day (Golder, *Phase II Environmental Site Assessment*, October 1, 2012).

2012 Investigation

In August 2012, Golder performed a facility audit and learned that the original gravity-fed trench system in the production area (tested in 2008) had been replaced with an active pump system. This system upgrade reportedly included re-sealing all of the collection /drainage trenches. The pumps were designed to remove fluids from the trenches when a pre-set volume is reached. Fluids within the trench are pumped to the on-Property wastewater treatment system for processing before being discharged into the King County sanitary sewer system under permit.

In 2012, Golder conducted a Phase II ESA. Five groundwater monitoring wells (MW-4 through MW-8) were installed at the northeast corner of the Property and in the western portion of the Property. Soil samples were not collected for laboratory analyses. In addition, Golder attempted to collect subsurface soil gas samples from four locations (SG-1 through SG-4) during three field events. Three successful samples were collected for analyses (SG-2, SG-3, and SG-4). TCE was identified as the highest of all compounds detected in subsurface samples at locations SG-2 and SG-4. The TCE concentrations exceeded the applicable soil gas screening levels indicating a potential for an elevated risk of vapor intrusion into the 1208 4th Avenue North building. Following the results of the subsurface soil gas sampling, Golder collected indoor and exterior ambient air samples within the 1208 4th Avenue North buildings during facility operations and after hours over an 8-hour period. TCE was detected in all ambient air samples; however, Golder concluded that the contaminant detections in ambient air samples were likely not derived from soil gas, but were resulting from facility operations. Further discussion of soil gas and indoor air is included in Section 4.6.

2015 Investigation

In May 2015, GHD conducted a soil and groundwater investigation to delineate the vertical and lateral extent of volatile organic compounds (VOCs) and metal (cadmium) contamination in soil in the vicinity of HA-1, MW-3, CB-1, SG-2, SG-3, and SG-4, and to delineate the lateral extent of groundwater impacts beyond well MW-3. GHD advanced eight soil borings (SB-1 through SB-7 and MW-9) using a combination of air knife/ vacuum, direct push, and hollow-stem auger drilling to depths between 16.5 and 30 feet bgs. No soil concentrations exceeded MTCA Method C cleanup levels. The boring logs and well construction details are presented in Appendix A. Soil boring locations are presented on Figure 4.

2017 Investigation

In May 2017, GHD conducted a soil investigation to delineate the lateral extent of VOC contamination in soil within the proposed soil excavation area. GHD advanced four soil borings (SB-14 through SB-17) using a combination of air knife/ vacuum and direct push drilling to a depth of 10 feet bgs. TCE was detected in SB-17 at 5 feet bgs. The sample collected at 10 feet bgs from SB-17 did not contain any concentrations exceeding MTCA Method C cleanup levels. The boring logs and well construction details are presented in Appendix B. Soil boring locations are presented on Figure 3.

2018 Interim Remedial Excavation

During April and May 2018, GHD performed a remedial excavation to remove TCE impacted soils. The excavation area was approximately 23-feet by 23-feet, located in the central portion of the Property, within Bunker 2, in the vicinity of MW-3. The total excavation depth was between 9 and 13 feet bgs based on field screening. A total of approximately 307 tons of impacted soil was removed. The excavation was dewatered as needed by pumping accumulated groundwater and a total of approximately 1,330 gallons of water was removed. After collecting confirmation soil samples but prior to backfilling the excavation area, GHD applied 800 pounds (lbs) of 3-D Microemulsion (3DMe) to the base of the excavation to support insitu degradation of any remaining TCE impacts.

The remedial excavation removed the majority of the residual mass in soil, as indicated by confirmatory soil sampling. Minimal residual TCE impacts remain above the MTCA Method C cleanup level near the southwest and northeast excavation corners at a depth of approximately 5 feet bgs. No TCE was detected in groundwater after the first second quarter 2018 post remediation monitoring event indicating that leaching is not occurring.

Appendix B

GHD’s Soil Gas Sampling Standard Operating Procedures

GHD Field Training Manual

Section 15.0
Soil Gas Sampling Standard Operating Procedures

(T113)

January 2017

Please adhere to the following Quality System training requirements:

- Employees who are required to conduct a specific field activity must be properly certified to do the work.
- This involves reviewing the SOP and completing the online training course and exam.
- Employees must also conduct this field work under supervised conditions on at least three occasions, and must be certified by a qualified mentor. Only then can an employee conduct a specific field activity on their own. This is documented on a Field Method Training Record (QSF-021).
- Complete the QSF-021 and forward it to trainingrecords-northamerica@ghd.com.

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15. Soil Gas Sampling Standard Operating Procedures

15.1 Introduction

The procedures described in this section pertain to the installation of temporary and permanent soil gas and sub-slab probes to assess the vapor intrusion pathway. Soil gas and sub-slab probes are both used to collect soil gas samples; however, soil gas probes are installed at a greater depth, often outside a building, and sub-slab probes are installed to collect soil gas samples from immediately below a slab on grade or a basement floor slab. Permanent probes are recommended when more than one sampling event is required or when assessing seasonal variations in soil gas concentrations. Temporary probes are suitable for conducting a screening level assessment of vapor intrusion where the results could assist in locating future, permanent soil gas probes. Temporary probes are also suitable for conducting a preliminary evaluation of the magnitude and extent of volatile organic compound (VOC) impacts to the subsurface (e.g., such as in the case of a soil gas survey).

15.2 Prior Planning and Preparation

When designing and constructing soil gas and sub-slab probes the following questions should be considered:

1. What is the purpose of the soil gas probes?
2. What are the potential health and safety hazards?
3. What type(s) of soil gas probe construction materials are to be used?
4. What kinds of analyses are required (e.g., VOCs, petroleum hydrocarbon fractions)?
5. What are the geologic/hydrogeologic conditions at the site?
6. What are the seasonally high water table levels?
7. Is the water table shallow, (i.e., less than 1 metre below ground surface)?
8. Do perched conditions exist at the site?
9. What is the anticipated total depth of the probes?
10. Are nested soil gas probes required for vertical delineations?
11. Does a vapor barrier already exist under the slab, if so, sub-slab sampling might puncture the barrier, so the hole must be carefully resealed after monitoring is complete?
12. If a basement exists, could the primary entry point(s) for vapor intrusion be through the sidewalls rather than from below the floor slab? If so, sub-slab samples might need to be augmented with samples through the basement walls.
13. Although sample collection and analysis are analogous to those in other types of soil gas sampling, is an analytical method with lower detection limits required?

If field staff are not aware of and able to answer all of the above noted questions before undertaking work in the field, the work plan must be reviewed in detail with the Project Coordinator/Manager. The project team may also consider involving GHD's vapor intrusion and human health risk assessment team during the initial planning to streamline the data evaluation.

15.3 Safety and Health

GHD is committed to conducting field activities with sound safety and health practices. GHD adheres to high safety standards to protect the safety and health of all employees, subcontractors, customers, and communities in which they work. The safety and health of our employees takes precedence over cost and schedule considerations.

Field personnel are required to implement the Safety Means Awareness Responsibility Teamwork (SMART) program as follows:

- Assure the Health and Safety Plan (HASP) is specific to the job and approved by a Regional Safety & Health Manager.
- Confirm that all HASP elements have been implemented for the job.
- A Job Safety Analysis (JSA) for each task has been reviewed, modified for the specific site conditions and communicated to all appropriate site personnel. The JSAs are a component of the HASP.
- Incorporate Stop Work Authority; Stop, Think, Act, Review (STAR) process; Safe Task Evaluation Process (STEP) Observations process; Near Loss and Incident Management process in the day-to-day operations of the job.
- Review and implement applicable sections of the GHD Safety & Health Policy Manual.
- Confirm that all site personnel have the required training and medical surveillance, as defined in the HASP.
- Be prepared for emergency situations, locating safety showers, fire protection equipment, evacuation route, rally point, and first aid equipment before you begin working, and make sure that the equipment is in good working order.
- Maintain all required Personal Protective Equipment (PPE), safety equipment, and instrumentation necessary to perform the work effectively, efficiently and safely.
- Be prepared to call the GHD Incident Hotline at 1-866-529-4886 for all incidents involving injury/illness, property damage, and vehicle incident and/or significant Near Loss.

It is the responsibility of the Project Manager to:

- Ensure that all GHD field personnel have received the appropriate health and safety and field training and are qualified to complete the work.
- Provide subcontractors with a Job Hazard Analysis to enable them to develop their own HASP.
- Ensure that all subcontractors meet GHD's (and the Client's) safety requirements.

15.4 Quality Assurance/Quality Control

Quality assurance and quality control procedures should be implemented in every step of the assessment process to ensure the collection of data of acceptable quality. A well-designed Quality Assurance/Quality Control (QA/QC) program will:

- Ensure that data of sufficient quality are obtained in order to facilitate an efficient site investigation.
- Allow for monitoring of staff and subcontractor performance.
- Verify the quality of the data.

The QA/QC program is developed on a site-specific basis.

15.5 Design Considerations

Diameter

Soil Gas Probes

The probe casing diameter should be kept to a minimum to reduce the volume of soil gas that must be purged from the probe during sampling. A maximum casing diameter of 3/4-inch (19 mm) to 1-inch (25 mm) will be used for solid piping casing material (e.g., polyvinyl chloride [PVC]), although casing diameters this large are not recommended for deep soil gas probes (e.g., greater than 15 feet [4.6 m]) since large purge volumes (e.g., milliliters) will result. Casing diameters of 1/4 inch (6.4 mm) to 3/8-inch (9.5 mm) are typical when flexible tubing is used for the casing material (e.g., Teflon® or nylon).

Sub-Slab Probes

A typical sub-slab probe is constructed from small-diameter (e.g., 01/8- or 1/4-inch outside diameter) stainless steel or another inert material and stainless steel compression fittings. The probes are cut at a length to either float in the slab, if appropriate for your site conditions, or to extend to the base of the slab.

Screened Interval and Sand Pack Material

Soil Gas Probes

The length and depth of the perforated (screened) section should consider the desired monitoring interval as well as the geologic conditions encountered. A typical screened section would consist of a 6-inch (0.15 m) to 1-foot (0.3 m) perforated section. The use of prefabricated stainless steel screen implants is common. Alternatively, the screened interval can be created from casing material by hand-cutting slots, or hand-drilling holes, into the casing at a regular pattern. For hand-cut or hand-drilled screened intervals, the preferred sand pack material for soil gas probes is pea gravel. For prefabricated screens, the preferred sand pack material is inert 10/20 silica sand (#1 morie sand) or glass beads.

Sub-Slab Probes

A screen is not always used with sub-slab probes. When a screen is utilized, it is often pre-fabricated with a length of approximately 6 inches, due to the limited depth intervals sampled. When a screen is not utilized, the bottom of the probe is left open to facilitate sample collection. The perforated or open section should be consistent with the desired monitoring interval and sub-slab conditions encountered.

Monitoring Parts

For both soil gas and sub-slab probes, airtight stainless steel or brass compression fittings (e.g., Swagelok®) with valves should be installed at ground surface to allow for an airtight connection to sampling equipment. The valve is required to isolate the soil gas sampling assembly from the soil gas probe while sampling assembly airtightness tests are conducted prior to probe purging and sampling.

Casing Materials

Soil Gas Probes

The materials selected for soil gas probe casing construction must be compatible with the volatile chemicals anticipated to be present in soil gas. Experience has shown that PVC casing is suitable when VOCs are present. However, as described above, PVC is typically not available in small enough diameters to provide practical soil gas probe purge volumes. To minimize purge volumes, small diameter (e.g., 1/4-inch [6.4 mm] to 3/8-inch [9.5 mm]) flexible tubing (e.g., Teflon® or nylon) is more commonly applied as the soil gas probe casing. Where solid casing is used (i.e., PVC), threaded piping will be used to avoid any possible contamination from solvent cement.

Sub-Slab Probes

The materials selected for sub-slab casing construction must be compatible with the volatile chemicals anticipated to be present in soil gas. Often, 1/4-inch OD stainless steel tubing is utilized to collect sub-slab soil gas. The length of the stainless steel (or brass) tubing is cut to a desired length prior to installation.

15.6 Soil Gas and Sub-Slab Probe Installation

The information contained in this section has been compiled from existing manuals, various reference documents, and a broad range of colleagues with considerable practical and educational backgrounds. This SOP outlines the generic procedures necessary to install a soil gas/sub-slab probe. Site conditions, contaminants and geology may require modification of this procedure. Review applicable government procedures and informational documentation prior to installation.

This SOP is not intended to prohibit those conducting evaluations from using means other than those specified herein to measure soil gas concentrations; however, departures from this guidance will often need to include information for a more detailed review.

15.6.1 Installation Procedures - Soil Gas Probes

The soil gas probe is to be installed using Geoprobe® dual tube sampling system to advance a borehole to the target depth. The dual-tube sampling system consists of first advancing a 2 1/2-inch (6.4 cm) diameter inner sampling probe followed by advancing a 3 1/2-inch (8.9 cm) diameter outer casing. The outer casing should cut away disturbed soil immediately surrounding the borehole left by the inner probe. The outer casing should create a zone of reduced soil disturbance due to the inner probe having already been advanced. It is anticipated that using the dual tube system will result in a minimum amount of soil disturbance around the borehole annulus. The soil lithology should be logged during drilling activities and recorded on a field boring log along with any applicable observations. Permanent soil vapor probes can be installed with a conventional drill rig equipped with a hollow-stem auger, although increased formation disturbances would likely result. Rotosonic and mud or air rotary drilling methods are not recommended since they can influence soil vapor sample results and/or alter the physical properties of the subsurface adjacent to the borehole annulus.

The probes should be constructed with a 6-inch (15 cm) to 12-inch (30 cm) long screened interval. The screened interval can be hand-fabricated or prefabricated. The probe casing should be constructed using flexible tubing or solid casing. Flexible tubing (e.g., Teflon® or nylon) of small diameter (e.g., 1/4-inch [6.4 mm] to 3/8-inch [9.5 mm]) is most commonly used in combination with prefabricated screened intervals. Solid casing (e.g., PVC) of small diameter (e.g., 3/4-inch [19 mm] to 1-inch [25 mm]) is most commonly used with hand-fabricated screened intervals. After positioning the screened interval and casing into the borehole, the screen should be surrounded by the appropriate sand pack material (i.e., pea gravel for hand-fabricated screens and 10/20 silica sand for prefabricated screens). When placing the sand pack into the borehole, 1 inch (2.5 cm) of sand pack material should be placed under the bottom of the probe screen to provide a firm footing. The sand pack should extend to 6 inches (15 cm) above the screened interval. A bentonite pellet seal should then be installed to 1-foot (0.3 m) above the sand pack and should be hand-hydrated. For temporary probes (i.e., that will be sampled for less than a year), the remaining annulus should be backfilled with pre-hydrated bentonite cement. For permanent probes (i.e., that will be sampled for more than a year), the remaining annulus should be backfilled with neat-cement grout[1] (Cal EPA, 2015). The soil gas probe casing should extend to ground surface and should be fitted with airtight stainless steel or brass compression fittings (e.g., Swagelok®) with valves to allow for an airtight connection to soil gas sampling equipment. A flush-mount protective cover should be installed above the soil probe and cemented into place. Schematics of typical soil gas probe installation details are presented on Figures 15.1 and 15.2, respectively, where hand-fabricated and prefabricated screened intervals are applied.

15.6.2 Installation Procedures - Sub-Slab Soil Gas Probes

Sub-slab soil gas probes allow for collection of soil gas samples from directly beneath the slab of a building. Sub-slab soil gas probes are not recommended when groundwater is present directly below the slab, since the sub-slab port could allow groundwater to enter the building. Sub-slab soil gas probes can be installed using several different methods: (1) utilizing a small diameter hole, (2) a larger diameter hole w/ flushmount casing, and (3) a Vapor Pin™. Summaries of the steps involved are presented below:

Small Diameter Sub-Slab Soil Gas Probe:

A schematic of a typical small diameter sub-slab soil gas probe installation detail is presented on Figure 15.3.

1. Prior to drilling holes in a foundation or slab, contact local utility companies to identify and mark utilities coming into the building from the outside (e.g., gas, water, sewer, refrigerant, and electrical lines). Consult with a local electrician and plumber to identify the location of utilities inside the building.
2. Prior to fabrication of the sub-slab vapor probes, use the rotary drill and the two inch diameter drill bit to create a shallow (e.g., 1/4 to 1/2 inch in depth) outer hole that partially penetrates the slab. This outer hole will allow the protective cap to be flush with the concrete surface (Figure 15.4).
3. Use a small portable vacuum cleaner to remove cuttings from the hole.
4. Use the rotary hammer drill and a one-inch drill bit to create a smaller diameter "inner" hole through the remainder of the slab to some depth (e.g., seven to eight centimeters or three inches) into the sub-slab material. Figure 15.5 illustrates the appearance of "inner" and "outer" holes. Drilling into the sub-slab material will create an open cavity, which will prevent the obstruction of any probes during sampling.
5. Use a small portable vacuum cleaner to remove cuttings from the hole.
6. Determine the thickness of the slab and record the measurement.

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[1] Neat-Cement Grout means a mixture in the proportion of 94 pounds of Portland cement and not more than 6 gallons (22.7 liters) of water. Bentonite up to 5 percent by weight of cement (4.7 pounds of bentonite per 94 pounds of Portland cement) may be used to reduce shrinkage.

7. Assemble the vapor point using the basic design of a sub-slab vapor probe illustrated on Figure 15.3.
8. Place the assembled vapor point (Figure 15.6) into the hole and ensure the screen extends beyond the concrete and that the top of the probe is flush with the slab. Also apply the tamper resistant cap so as to not interfere with day-to-day use of the buildings. Cut tubing if necessary (Figure 15.7).
9. Confirm the fit of the rubber shaft plug to the sides of the boring. It should be snug with no gaps present. If additional thickness (diameter) is necessary, non-VOC plumbers putty can be added around the rubber.
10. Mix a quick-drying Portland cement to ensure a tight seal.
11. Inject the Portland cement with a 50 cc syringe or push into the annular space between the probe and outside of the "outer" hole (Figure 15.8).
12. Complete installed vapor point (Figure 15.9) with a plug (Figure 15.10) or tamper-resistant cap (Figure 15.11).
13. Allow cement to cure for at least 24 hours prior to sampling.

Sub-slab probes constructed in the aforementioned manner may be abandoned by removing any tubing and all surface protective covers. The boring annulus can then be backfilled with uncontaminated native material or grout. Inspect/clean the work area, and return site conditions to their original state.

If the tubing cannot be removed, the tubing should be cemented in place. All surface protective covers must be removed and returned to as close as possible to original site conditions.

Larger Diameter Hole w/ Flushmount Casing:

A schematic of a typical large diameter sub-slab soil gas probe installation detail is presented on Figure 15.12.

1. Prior to drilling holes into the building floor, the location of utilities coming into the building (e.g., gas, electrical, water, and sewer lines, etc.) must be identified. Avoid installing sub-slab soil gas probes near where utilities penetrate the slab as these may be entry points for downward ambient air migration through the slab during soil gas sampling.
2. A concrete corer is used to drill a hole through the concrete floor slab. The diameter of the hole should be sufficient to allow the installation of a protective casing within the hole. A sufficient space for placement of cement is required between the outer edge of the flush-mount casing and the hole in the concrete. Smaller diameter flush-mount protective casings are not recommended as they make accessing the probe within the casing difficult.
3. Once the hole in the concrete is cored and the center core removed, the flush-mount protective casing shroud should be cut to a suitable length. Ideally, the length of the shroud should allow the flush-mount casing to be flush with the surrounding floor while resting on the bedding material beneath the slab.
4. The probe assembly, including a valve at the top of the probe, should be placed so that the tip of the probe is within the bedding material beneath the concrete slab. Care should be taken to not force the probe into the bedding so that the open end of the probe doesn't plug. Note: the probe assembly should be vacuum-tested on both sides of the valve prior to installation. A piece of ¼ inch Teflon tubing should be attached at the top of the valve prior to installation. This tubing will allow easier access for the use of compression fittings to attach purging and sampling equipment to the probe.

5. The probe should be cemented into the flush-mount casing with hydraulic cement. The hydraulic cement should form a continuous seal from the bedding material to just below the top hex nut of the probe assembly.

Vapor Pin™

This SOP describes the procedure for installing a sub-slab soil probe using a Vapor Pin™. Borings should be done through the use of a rotary hammer drill. The specific drill utilized must be capable of utilizing the drill and coring bits identified by the SOP (see below) and be of sufficient size to penetrate the expected thickness of the concrete present.

General List of Materials

This installation SOP utilizes the following products, which are available from Cox-Colvin & Associates, Inc. Equipment:

1. Silicone sleeve.
2. Hammer drill.
3. 5/8 inch diameter hammer bit (Hilti™ TEYX 5/8" x 22" #00206514 or equivalent).
4. 1½ inch diameter hammer bit (Hilti™ TEYX 1½" x 23" #00293032 or equivalent) for flush mount applications.
5. 3/4 inch diameter bottle brush.
6. Wet/dry vacuum with HEPA filter (optional).
7. Vapor Pin™ installation/extraction tool.
8. Dead blow hammer.
9. Vapor Pin™ flush mount cover, as necessary.
10. Vapor Pin™ protective cap.
11. Equipment needed for abandonment.
12. Vapor Pin™ installation/extraction tool.
13. Dead blow hammer.
14. Volatile organic compound-free hole patching material (hydraulic cement) and putty knife or trowel.

Flushmount Vapor Pin™ Installation Protocol

1. Prior to drilling holes in a foundation or slab, contact local utility companies to identify and mark utilities coming into the building from the outside (e.g., gas, water, sewer, refrigerant, and electrical lines). Consult with a local electrician and plumber to identify the location of utilities inside the building.
2. Set up wet/dry vacuum to collect drill cuttings.
3. Drill a 1½ inch diameter hole at least 1¾ inches into the slab.
4. Remove the drill bit, brush the hole with the bottle brush, and remove the loose cuttings with the vacuum.
5. Drill a 5/8 inch diameter hole through the slab and at least six inches into the underlying soil to form a void.

6. Remove the drill bit, brush the hole with the bottle brush, and remove the loose cuttings with the vacuum.
7. Assemble the Vapor Pin™ assembly (Figure 15.13) by threading the Vapor Pin™ into the extraction/installation tool and placing the silicone sleeve over the barbed end.
8. Place the lower end of the Vapor Pin™ assembly into the drilled hole. Place the small hole located in the handle of the extraction/installation tool over the Vapor Pin™ to protect the barb fitting and cap, and tap the Vapor Pin™ into place using a dead blow hammer (Figure 15.14). Make sure the extraction/installation tool is aligned parallel to the Vapor Pin™ to avoid damaging the barb fitting.
9. Unscrew the threaded coupling from the installation/extraction handle and use the hole in the end of the tool to assist with the installation (Figure 15.15). During installation, the silicone sleeve will form a slight bulge between the slab and the Vapor Pin™ shoulder.
10. Place the protective cap on the Vapor Pin™ (Figure 15.16).
11. Cover the Vapor Pin™ with a flushmount cover.
12. Allow 20 minutes or more (consult applicable guidance for your situation) for the sub-slab soil gas conditions to equilibrate prior to sampling.
13. Remove protective cap and connect sample tubing to the barb fitting of the Vapor Pin™.

Temporary Soil Gas Probes

First, a core drill should be used to remove any surface cover, as needed. The temporary soil gas probes should consist of a decontaminated hollow sampling rod driven to the target depth below ground surface. The sampling rod should consist of a decontaminated 1-inch (2.5 cm) hollow stainless steel outer rod that is retracted to expose a 1-foot (0.3 m) long stainless steel screen. The rod should be advanced by a slide hammer to the target depth, and the outer rod retracted to expose the screen at the bottom of the rod. A surface seal comprised of hydrated bentonite cement should be placed around the base of the driven rod. The sampling rod should be completed at ground surface with airtight stainless steel or brass compression fittings (e.g., Swagelok®) with valves to allow for an airtight connection to soil gas sampling equipment. A schematic of a typical temporary soil gas probe installation detail is presented on Figure 15.17.

15.6.3 Installation Documentation

Details of each soil gas probe installation should be recorded on GHD's standard Stratigraphic Log Overburden (Form SP-14), or recorded within a standard GHD field book. The Well Instrumentation Log (Form SP-15) is provided for recording the overburden well instrumentation details, and can be used for soil gas probe installations. This figure must note:

- Borehole depth
- Probe perforation intervals
- Filter pack intervals
- Plug intervals
- Grout interval
- Surface cap detail
- Soil gas probe material

- Soil gas probe instrumentation (i.e., riser and screen length)
- Soil gas probe diameter
- Filter pack material
- Backfill material detail
- Stickup/flush-mount detail
- Date installed

The soil stratigraphy encountered at soil gas probes refusal must be recorded in accordance with GHD's standard borehole advancement methods (see Section 5.0).

Each soil gas probe should be accurately located on a site sketch. An accurate field tie to the center of the gas probe from three adjacent permanent features should be completed. The field ties should be located in a different direction from the installation.

Each soil gas probe must be permanently marked to identify the soil gas probe number designation.

15.6.4 Follow-Up Activities

Once the soil gas probe(s) have been completed, the following activities need to be performed:

1. Conduct initial monitoring round of gas probes.
2. Submit all logs to the appropriate GHD hydrogeology department, who will be responsible for the generation of the final well log.
3. Survey accurate horizontal and vertical control of the soil gas borings and any pertinent structures needed to create a suitable site map.
4. Prepare an accurate soil gas probe/boring location map. Tabulate soil gas probe construction details.
5. Write-up all field activities including, but not necessarily limited to; drilling method(s), construction material, site geology.
6. Distribute all/any field book(s) to the appropriate GHD office.

15.7 Soil Gas and Sub-Slab Sampling Protocol

The following sampling protocols are for collecting a vapor sample through either a soil gas probe and/or sub-slab probe for the analysis of volatile organic compounds (VOCs) by the United States Environmental Protection Agency Method TO-15 (USEPA, 1999).

This SOP does not cover, nor is it intended to provide, a justification or rationale for where a sampling point is installed. It is assumed by using this SOP that site conditions have been fully evaluated and that the sampling location and depth meet the objectives outlined in the work plan or scope of work. Considerations must be given to the types of chemicals of concern, lithology encountered, and the depth of the vapor source. Samples collected deeper than any potential source of vapors may not fully characterize the potential risk and sampling points should never be installed or collected within the zone of saturation. The bottom of the probe should be approximately 0.5 m (1.6 ft) to 1 m (3.2 ft) above the highest water table.

Where possible, external probes should be installed at a minimum depth of 1 m (3.2 ft) to reduce the likelihood of ambient air being drawn through surficial soils (referred to as "short-circuiting"). External shallow probes less than 1 m (3.2 ft) deep may be warranted where there is a shallow water table. Good practice is to place a plastic sheet/tarp around a shallow probe to minimize atmospheric air intrusion (CCME, 2016). Recommended minimum dimensions of the plastic sheet/tarp are 1.5 m (5 ft) by 1.5 m (5 ft). The plastic/tarp should be weighted down at the edges with sand or sand bags (CCME, 2016).

Most soil gas/sub-slab probes are installed at relatively shallow depths (less than ten feet below ground surface) so minimum purge volumes and low-volume samples must be performed to minimize potential breakthrough from the surface or between sampling intervals. Tracer/leak gas is necessary to ensure breakthrough does not occur and that a leak does not occur at any fitting above grade. Sampling should not occur during a significant rain event. A significant rain event is defined as 0.5 inches or greater of rainfall during a 24-hour period by Cal EPA (2015), or 1 centimeter or greater of rainfall during a 24-hour period by MOE (2013). A period of 1 day for coarse-grained soil conditions and several days for fine-grained soil conditions after a significant rain event should occur prior to collecting soil vapor samples. This time interval is required for drainage to occur and soil conditions to return to ambient moisture conditions.

> *The sampling interval after a significant event should be verified based on the applicable jurisdictional regulatory vapor intrusion guidance.*

Samples from wells with multiple points installed must not be collected simultaneously and approximately 30 minutes must elapse between each sampled interval. Sample times should be documented on the field log. Sample flow rates are not to exceed 200 milliliters per minute (mL/min) to minimize the potential for vacuum extraction of contaminants from the soil phase. A flow rate greater than 200 mL/min may be used when purging times are excessive, such as for deep wells with larger-diameter tubing. However, a vacuum of 100 inches of water (7.4 inches of mercury [Hg]) or less must be maintained during sampling whenever a higher flow rate is used. Volumes of various tubing sizes are provided in Table 1 in order to aid in calculating purge volumes.

Table 1 Volumes for Select Tubing Sizes

Tubing Size (inches ID)	Volume/ft (liters)
3/16	0.005
¼	0.010
½	0.039

Care must be used during all aspects of sample collection to ensure that sampling error is minimized and high quality data are obtained. Care must also be taken to avoid excessive purging prior to sample collection and prevent pressure build-up in the enclosure during introduction of the tracer gas. Inspection of the installed sample probe, specifically noting the integrity of the surface seal and the porosity of the soil in which the probe is installed, will help to determine the tracer gas setup. The sampling team must avoid actions (e.g., fueling vehicles, using permanent marking pens, and wearing freshly dry-cleaned clothing or personal fragrances) which could potentially cause sample interference in the field. All data collected should be recorded on the Sub-Slab/Soil Gas Sampling Field Data Sheet (SP-30).

15.7.1 Soil Gas Collection General List of Materials

The equipment required for soil gas sample collection is as follows:

Flow Meters and Detectors

1. Flow regulator with vacuum gauge. Flow regulators provided by a qualified laboratory are pre-calibrated to a specified flow rate (e.g., 100 mL/min).
2. Photoionization detector (with appropriate lamp).
3. Helium detector (if helium is utilized as a tracer gas).
4. Methane meter for petroleum sites that is capable of also measuring percent of methane (CH4), carbon dioxide (CO2), and oxygen (O2).
5. Low flow air pump (e.g., 100 mL/min) (as appropriate)

Tooling and Supplies

1. Sampling canister, Tedlar bag, or syringe (one per location).
2. Regulated flow meter assembly set to a maximum of 200 mL/min (one per location, as appropriate).
3. 1/4 inch tubing (Teflon®, polyethylene, or similar) and assorted fittings.
4. Plastic housing for using tracer gas.
5. 50 ml syringe (for purging).
6. Camera.
7. Adjustable crescent wrenches, small to medium size, and/or open end combo wrenches 9/16 to 1/2 inch.
8. Scissors/snips to cut tubing.
9. Ballpoint pens.
10. Nitrile gloves.
11. Compound to be used as tracer gas - lab grade helium or isopropyl alcohol (IPA).
12. Tarp or plastic sheeting

15.7.2 Soil Gas Tracer Compounds

A leak in the sampling assembly may allow ambient air into the system and dilute the soil gas results (Benton and Shafer, 2007). Therefore, tracer gases must be utilized during the collection of soil gas samples to verify that the sample collected is from the installed sampling point. The presence of a tracer compound, whether liquid or gaseous, can confirm a leak in the sampling train assembly and whether the usability of the sample will need to undergo further evaluation.

Careful thought and consideration must be used when choosing a leak check compound as a tracer, since each compound can have specific benefits and drawbacks.

Helium used as a tracer gas beneath a shroud allows for the screening of the sampling train in the field. In conjunction with the use of a field meter capable of detecting helium, leaks within the sampling train could be detected prior to sampling. A retightening of all fittings prior to collecting the sample for analysis should be done. If a leak has been detected and is unable to be resolved, the sampling point may need to be decommissioned and a new one installed. Only lab-grade helium (UHP-Ultra High Purity) should be used as a tracer, since helium available at general merchandise stores may contain secondary contaminants, such as benzene.

Understanding the relationship between a leak and the concentration detected of the tracer gas used to check for leaks, the potential for absorption of the tracer gas (i.e., helium) onto sample train tubing, and the potential for interference by the tracer gas compound with VOCs is important in answering the data usability. An ambient air leak of up to five percent may be acceptable if quantitative tracer testing is performed. A soil gas vapor well should be decommissioned if the leak cannot be corrected. Any replacement vapor wells should be installed at least five feet from the location where the original vapor well was located

The ambient air leak of up to five percent leak should be verified based on the applicable jurisdictional regulatory vapor intrusion guidance.

15.7.3 Soil Gas and Sub-Slab Probe Leak Testing

The use of leak testing is recommended as a quality control check to ensure ambient air has not leaked into the soil gas probe or sampling assembly, which may affect (i.e., dilute) the analytical results. Contaminants in ambient air can also enter the sampling system and be detected in a sample from a non-contaminated sampling probe resulting in a "false positive" result. The leak testing should be conducted as described in the following two steps:

- Step 1 - Vacuum Test: used to ensure that the tubing and fittings/valves that make up the sampling assembly are air-tight
- Step 2 - Tracer Test: used to ensure that ambient air during soil gas sample collection is not drawn down the soil gas probe annulus through an incomplete seal between the formation and the soil gas probe casing.

The vacuum test and tracer test are detailed below.

Step 1 - Vacuum (shut-in) Test

- The sampling assembly must be connected to the soil gas probe valve at the surface casing. Once connected, the sampling assembly will consist of the soil gas probe, the vacuum gauge supplied by the laboratory, personal sampling pump, and Summa™ canister, all connected in series (i.e., in the order of soil gas probe, vacuum gauge, pump, and canister), using tee-connectors or tee-valves.
- The personal sampling pump will be used to conduct the vacuum test. The vacuum test should consist of opening the valve to the personal sampling pump while leaving closed the valves to the Summa™ canister and the soil gas probe. The pump should then be operated to ensure that it draws no air from the sampling assembly (i.e., creates a negative pressure, or vacuum within the sampling assembly), thus establishing that all assembly connections are air-tight. The sampling pump low-flow detect switch will likely activate within 10 to 15 seconds, turning the pump off. A negative pressure, or vacuum, should be established within the sampling assembly, and should be sustained for at least 1 minute.
- If the pump is capable of drawing flow, or if the vacuum is not sustained for at least 1 minute, all fittings and tubing will be checked for tightness (or replaced) and the vacuum test will be repeated.
- The reading from the vacuum gauge pressure should be recorded in field logbook to demonstrate that the pump is able to create a vacuum within the sampling assembly (it will also be noted whether the low-flow detect switch on the pump was activated), and that the vacuum is sustained for at least 1 minute.

Step 2 - Tracer Test

A tracer compound is released at ground surface immediately around the soil gas probe surface casing and is used to test for ambient air leakage down the annulus of the soil gas probe and into the soil gas sample. Two options are described below for the tracer test where either isopropanol (Option A) or helium (Option B) is used as the tracer compound.

Option A - Isopropanol

- For Option A, isopropanol is used as the tracer compound. It is included as an analyte in U.S. EPA's TO-15 method, it is readily available (i.e., as isopropyl rubbing alcohol), and it is safe to use.
- Approximately 1 teaspoon (approximately 4 mL) of isopropanol (rubbing alcohol) should be mixed in 1 gallon of de-ionized water to create an approximate 1/1,000 solution.
- Paper towels soaked in a dilute solution of isopropanol should then be wrapped around the soil gas probe surface casing and ground surface immediately surrounding the surface casing. Soil gas probe surface casing then should be covered over, using clear plastic sheeting that will be sealed to the ground surface. As the ground surface finish permits, sealing the plastic sheeting to ground surface should be accomplished by using tape or by weighting the edges of the plastic sheeting with dry bentonite.
- Immediately before conducting the soil gas probe purging, remove the paper towels from the solution, wringing out the towels so they are very damp, but not dripping. Place them around the vapor probe and seal them in place using the plastic sheeting.
- The isopropanol solution should be kept fresh, with new solution being made every hour. The solution should be mixed at a central location away from the sampling activities. The isopropanol should be kept tightly capped and kept away from all sampling equipment. The solution should be kept away from the sampling assembly until immediately before sample collection begins. Sampling personnel must wear latex gloves while handling the solution and soaked paper towels, and will remove the gloves while working with the sampling assembly.
- Soil gas samples with laboratory analytical results for isopropanol that are greater than 10 percent of the starting concentration of isopropanol in the vapors emitted from dilute isopropanol solution should not be considered reliable and representative of soil gas concentrations within the formation (ITRC, 2007). The starting concentration should be calculated based on the concentration of isopropanol in the dilute solution, the vapor pressure of isopropanol, and Henry's law.
- A disadvantage in using isopropanol as the tracer compound is that it will not be known whether a significant leak occurred until after the cost of analyzing the sample has been spent. Elevated levels of isopropanol can also interfere with laboratory analytical method detection limits.

Option B - Helium

- The presence of helium within the sampling assembly should be monitored during purging and soil gas sample collection using a helium meter installed in-line with the sampling assembly. The meter should be positioned along the sampling line just before the personal sampling pump.
- Helium is readily available at a variety of retail businesses, is safe to use, and does not interfere with laboratory analytical method detection limits.
- A containment unit is constructed to cover the soil gas probe surface casing. The containment unit should consist of an overturned plastic pail set into a ring of dry bentonite to create a seal between the ground surface and the rim of the pail. The pail can be set directly on top of the sampling assembly tubing connected to the soil gas probe, which when pressed into the dry bentonite, should create a

sufficient seal around the tubing. The pail will have two holes: one to allow for the introduction of helium; and the other to allow for air trapped inside the pail to escape while introducing the helium. The second hole will also allow insertion of the helium meter to measure the helium content within the pail.

- Prior to soil gas probe purging, helium will be introduced into the containment unit to obtain a minimum 50 percent helium content level. The helium content within the containment unit should be confirmed using the helium meter and recorded in the field logbook. Helium should continue to be introduced to the containment unit during soil gas probe purging and sampling and care should be taken not to increase the pressure within the containment unit beyond that of atmospheric pressure.
- During soil gas probe purging and sampling, the helium meter should be connected in-line with the sampling assembly. In the event that the helium meter measures a helium content with the sampling assembly of greater than 10 percent of the source concentration (i.e., 10 percent of the helium content measured within the containment unit), the soil gas probe will be judged to permit significant leakage such that the collected soil gas sample will not be considered reliable and representative of soil gas concentrations within the formation (ITRC, 2007).
- An advantage of using helium as the tracer compound is that a significant leak can be detected in the field and the cost of analyzing the Summa™ canister can be avoided.

> *The 10 percent of the source concentration should be verified based on the applicable jurisdictional regulatory vapor intrusion guidance.*

15.7.4 Sample Collection Procedure - Canister

1. Soil gas samples for assessing the vapor intrusion pathway must be collected using an acceptable canister, including certified clean Summa™ canisters. Only canisters certified clean at the 100 percent level can be used for soil gas sampling activities (i.e., pre-cleaned at the laboratory in accordance with U.S. EPA's TO-15 method and documentation of the cleaning activities will be provided by the laboratory). Summa™ canisters typically come in 1-, 1.7-, and 6-liter capacities, depending upon laboratory availability.
2. The canisters must be fitted with a laboratory-calibrated critical orifice flow regulation device sized to restrict the maximum soil gas sample collection flow rate to approximately 100 milliliters per minute (mL/min), which corresponds to the lower end of the maximum soil gas sampling flow rate recommended by Cal EPA (2015) of 100 to 200 mL/min. The 100 mL/min maximum flow rate is equivalent to sample collection times of 10, 17, or 60 minutes, respectively, for 1, 1.7, or 6 liter canister capacities. A maximum flow rate of 100 mL/min is recommended to limit VOC stripping from soil, prevent the short-circuiting of ambient air from ground surface down the soil gas probe annulus that would dilute the soil gas sample. A maximum flow rate of 100 mL/min increases confidence that the soil gas sample is drawn from immediately surrounding the screened interval.
3. A vacuum gauge should be supplied by the laboratory and used during sample collection to measure the initial canister vacuum, canister vacuum during sample collection, and residual canister vacuum at the end of sample collection. The vacuum gauge will be returned to the laboratory and used by the laboratory to measure the residual canister vacuum upon receipt of the canisters by the laboratory.
4. The canister should be connected to the soil gas probe valve at the surface casing using the sampling assembly (see Figure 15.18). The sampling assembly is connected using short lengths (e.g., 1-foot [0.3 m]) 1/4-inch (6.4 mm) or 3/8-inch (9.5 mm) diameter tubing (the tubing material will

be Teflon® or nylon) and airtight stainless steel or brass tee-connectors and tee-valves (e.g., Swagelok® type). The canister should be connected to the soil gas probe along with a vacuum gauge and a personal sampling pump, all in series, using tee-connectors or tee-valves (in the order of soil gas probe, vacuum gauge, pump, and canister). A tee-valve should be used to connect the pump, which will allow the pump to be isolated from the sampling assembly during sample collection. Fresh tubing must be used for each sample.

5. Prior to collecting a soil gas sample, the stagnant air in the sampling assembly tubes and soil gas probe casing/sand pack must be removed. The soil gas probes should be purged prior to sampling using the personal sampling pump at a flow rate of less than 200 mL/min. A flow rate greater than 200 mL/min may be used when purging times are excessive, such as for deep wells with larger-diameter tubing. However, a vacuum of 100 inches of water (7.4 inches of Hg) or less must be maintained during sampling whenever a higher flow rate is used. This ensures that the collected soil gas sample is representative of actual soil gas concentrations within the formation. Measurements of the lengths and inner diameters of the above-ground sampling assembly and below-ground gas probe casing, screen, and sand pack should be used to calculate the "purge volume" (the purge volume will consider the pore volume of the sand pack assuming a 30 percent sand pack porosity). Prior to sample collection, two to three purge volumes should be drawn from the probe/sample assembly, unless otherwise required by the applicable regulatory guidance. The purge data (calculated purge volume, purging rate, and duration of purging) should be recorded in the field logbook.

6. Prior to purging, a vacuum, or tightness, test should be conducted on the sampling assembly as the first of two leak-testing steps, as described further in Section 15.7.3. Briefly, this first leak-testing step (the vacuum test) should consist of opening the valve to the personal sampling pump leaving the valves to the Summa™ canister and the soil gas probe closed. The pump should then be operated to ensure that it draws no air from the sampling assembly (i.e., creates a negative pressure, or vacuum within the sampling assembly), thus establishing that all assembly connections are airtight. Further details of the vacuum test are described in Section 15.7.3.

7. Prior to purging, and following the vacuum test, the set-up for the second of the two leak-testing steps should be conducted. The second leak-testing step is the tracer compound step. A tracer compound is released at ground surface immediately around the soil gas probe surface casing. The tracer test is used to test for ambient air leakage down the annulus of the soil gas probe and into the soil gas sample. The tracer compound is either monitored using a meter connected in-line to the sampling assembly (e.g., helium), or is included as an analyte in the laboratory analysis of the soil gas samples (e.g., isopropanol). The setup requirements of the tracer compound leak-testing step are described in Section 15.7.3.

8. Following the vacuum test, and the setup for the tracer compound leak-testing step, the soil gas probe purging should commence by opening the valve to the soil gas probe and activating the personal sampling pump (and leaving closed the valve to the Summa™ canister). At the start and the end of the purging period, the total concentration of volatile organic vapors of the personnel sampling pump exhaust gas should be monitored using a portable photoionization detector (PID) meter. The PID meter should be connected in series after the personal sampling pump. Since typical PID instrument flow rates vary from approximately 300 to 500 mL/min (depending on the manufacturer and model), drawing a sample into the PID meter through the personal sampling pump will likely increase the purging flow rate temporarily, until a reading from the PID meter is obtained. PID readings should be recorded and entered in the field logbook and chain of custody form. The PID readings should provide the laboratory with an indication of whether a sample could require dilution before analysis.

9. Following purging, the valve to the personal sampling pump should be closed, and the valves to the soil gas probe and Summa™ canister opened to draw the soil gas sample into the canister. This should be completed concurrent with continued application of the leak-testing tracer compound. The vacuum gauge reading must be recorded during sample collection. Should the vacuum gauge reading remain elevated above 10 inches Hg for more than 30 minutes, this will be taken to indicate that the initial vacuum in the canister has not sufficiently dissipated, and that the soil screened by the soil gas probe does not produce sufficient soil gas to permit sample collection due to low permeability soil. If low permeability conditions are encountered, the probe can be sampled using the techniques outlined in Appendix D (Soil Gas Sampling in Low Permeability Soil) of Cal EPA (2015).
10. To ensure some residual vacuum in each canister following sample collection, the canister vacuum should be recorded at approximately 80 percent through the expected sample collection duration. With a 100 mL/min maximum flow rate, the expected sample collection duration would be 10, 17, or 60 minutes, respectively, for canister capacities of 1, 1.7, or 6 liters. A maximum residual vacuum of 10-inches Hg is allowed. A canister residual vacuum above this value will require continued sampling until vacuum reading is below this threshold, unless the vacuum remains above 10-inches Hg for more than 30 minutes, as described above. A minimum 0.5 to 1-inch Hg residual vacuum will be required for the sample to be considered valid, or the sampling will be repeated using a fresh Summa™ canister. Once the vacuum is measured, the safety cap must be securely tightened on the inlet of the Summa™ canister prior to shipment to the laboratory under chain-of-custody procedures.

    > *The 0.5 to 1-inch Hg residual vacuum should be verified based on the applicable jurisdictional regulatory vapor intrusion guidance.*

11. The vacuum gauge provided by laboratory must be returned with the canister samples to check residual vacuum in the laboratory prior to sample analysis and recorded on the analytical data report. This check will ensure sample integrity prior to laboratory analysis, and that the canister has not become compromised during shipment to the laboratory.
12. If the critical orifice flow regulation devices (provided by the laboratory) and sampling assembly fittings/valves are to be re-used during sampling, they must be cleaned in accordance with laboratory requirements by purging with zero air (provided by laboratory) for minimum 45 seconds at minimum 75 psi (153 inches of Hg).
13. The canisters should be labeled noting the unique sample designation number, date, time, and sampler's initials. A bound field logbook should be maintained to record all soil gas sampling data.
14. The canisters should be listed on the chain-of-custody in order of suspected highest to lowest impact, as evidenced by the recorded PID readings. Indicate on the chain-of-custody for the laboratory to analyze the canisters in order from the lowest to highest PID reading.

The soil gas samples should be analyzed for the project-specified VOCs by the project laboratory using U.S. EPA's TO-15 gas chromatograph/mass spectrometer (GC/MS) methodology, with the mass spectrometer (MS) run in full scan mode. QA/QC measures implemented during the soil gas sampling event will include the two-step leak testing procedure (see Section 15.7.3), maintaining a minimum residual vacuum in the Summa™ canisters following sample collection, collection of one duplicate per sampling event or from at least 10 percent of the samples obtained, and collection of an ambient air sample (if needed). As an additional QA/QC measure, the laboratory should conduct a duplicate analysis of the sample collected in one of the canisters.

15.7.5 Sample Collection Procedure – Tedlar Bag

1. The low flow pump should be connected to the soil gas probe valve at the surface casing and the bag should be connected to the pump. The sampling assembly is connected using short lengths (e.g., 1-foot [0.3 m]) 1/4-inch (6.4 mm) or 3/8-inch (9.5 mm) diameter tubing (the tubing material will be Teflon® or nylon) and airtight stainless steel or brass tee-connectors and tee-valves (e.g., Swagelok® type). Fresh tubing must be used for each sample.
2. Prior to collecting a soil gas sample, the stagnant air in the sampling assembly tubes and soil gas probe casing/sand pack must be removed. The soil gas probes should be purged prior to sampling using the personal sampling pump at a flow rate of less than 200 mL/min. A flow rate greater than 200 mL/min may be used when purging times are excessive, such as for deep wells with larger-diameter tubing. However, a vacuum of 100 inches of water (7.4 inches of Hg) or less must be maintained during sampling whenever a higher flow rate is used. This ensures that the collected soil gas sample is representative of actual soil gas concentrations within the formation. Measurements of the lengths and inner diameters of the above-ground sampling assembly and below-ground gas probe casing, screen, and sand pack should be used to calculate the "purge volume" (the purge volume will consider the pore volume of the sand pack assuming a 30 percent sand pack porosity). Prior to sample collection, two to three purge volumes should be drawn from the probe/sample assembly, unless otherwise required by the applicable regulatory guidance. The purge data (calculated purge volume, purging rate, and duration of purging) should be recorded in the field logbook.
3. Prior to purging, a vacuum, or tightness, test should be conducted on the sampling assembly as the first of two leak-testing steps, as described further in Section 15.7.3. Briefly, this first leak-testing step (the vacuum test) should consist of opening the valve to the personal sampling pump leaving the valves to the bag and the soil gas probe closed. The pump should then be operated to ensure that it draws no air from the sampling assembly (i.e., creates a negative pressure, or vacuum within the sampling assembly), thus establishing that all assembly connections are airtight. Further details of the vacuum test are described in Section 15.7.3.
4. Prior to purging, and following the vacuum test, the set-up for the second of the two leak-testing steps should be conducted. The second leak-testing step is the tracer compound step. A tracer compound is released at ground surface immediately around the soil gas probe surface casing. The tracer test is used to test for ambient air leakage down the annulus of the soil gas probe and into the soil gas sample. The tracer compound is either monitored using a meter connected in-line to the sampling assembly (e.g., helium), or is included as an analyte in the laboratory analysis of the soil gas samples (e.g., isopropanol). The setup requirements of the tracer compound leak-testing step are described in Section 15.7.3.
5. Following the vacuum test, and the setup for the tracer compound leak-testing step, the soil gas probe purging should commence by opening the valve to the soil gas probe and activating the personal sampling pump (and disconnecting the bag). At the start and the end of the purging period, the total concentration of volatile organic vapors of the personnel sampling pump exhaust gas should be monitored using a portable photoionization detector (PID) meter. The PID meter should be connected in series after the personal sampling pump. Since typical PID instrument flow rates vary from approximately 300 to 500 mL/min (depending on the manufacturer and model), drawing a sample into the PID meter through the personal sampling pump will likely increase the purging flow rate temporarily, until a reading from the PID meter is obtained. PID readings should be recorded and entered in the field logbook and chain of custody form. The PID readings should provide the laboratory with an indication of whether a sample could require dilution before analysis.

6. Following purging, the bag should be reconnected to the personal sampling pump and the valves to the soil gas probe opened to draw the soil gas sample into the bag. This should be completed concurrent with continued application of the leak-testing tracer compound. Should the bag not inflate for more than 30 minutes, this will be taken to indicate that the soil screened by the soil gas probe does not produce sufficient soil gas to permit sample collection due to low permeability soil. If low permeability conditions are encountered, the probe can be sampled using the techniques outlined in Appendix D (Soil Gas Sampling in Low Permeability Soil) of Cal EPA (2015).
7. If the pump and sampling assembly fittings/valves are to be re-used during sampling, they must be cleaned in accordance with laboratory requirements by purging with zero air (provided by laboratory) for minimum 45 seconds at minimum 75 psi (153 inches of Hg).
8. The bags should be labeled noting the unique sample designation number, date, time, and sampler's initials. A bound field logbook should be maintained to record all soil gas sampling data.
9. The bags should be listed on the chain-of-custody in order of suspected highest to lowest impact, as evidenced by the recorded PID readings. Indicate on the chain-of-custody for the laboratory to analyze the canisters in order from the lowest to highest PID reading.

The soil gas samples should be analyzed for the project-specified VOCs by the project laboratory using U.S. EPA's TO-15 gas chromatograph/mass spectrometer (GC/MS) methodology, with the mass spectrometer (MS) run in full scan mode. QA/QC measures implemented during the soil gas sampling event will include the two-step leak testing procedure (see Section 15.7.3), collection of one duplicate per sampling event or from at least 10 percent of the samples obtained, and collection of an ambient air sample (if needed). As an additional QA/QC measure, the laboratory should conduct a duplicate analysis of the sample collected in one of the bags.

15.7.6 Sample Collection Procedure – Syringe

1. The syringe should be connected to the soil gas probe valve at the surface casing. The sampling assembly is connected using short lengths (e.g., 1-foot [0.3 m]) 1/4-inch (6.4-mm) or 3/8-inch (9.5-mm) diameter tubing (the tubing material will be Teflon® or nylon) and airtight stainless steel or brass tee-connectors and tee-valves (e.g., Swagelok® type). Fresh tubing must be used for each sample.
2. Prior to collecting a soil gas sample, the stagnant air in the sampling assembly tubes and soil gas probe casing/sand pack must be removed. The soil gas probes should be purged prior to sampling using the personal sampling pump at a flow rate of less than 200 mL/min. A flow rate greater than 200 mL/min may be used when purging times are excessive, such as for deep wells with larger-diameter tubing. However, a vacuum of 100 inches of water (7.4 inches of Hg) or less must be maintained during sampling whenever a higher flow rate is used. This ensures that the collected soil gas sample is representative of actual soil gas concentrations within the formation. Measurements of the lengths and inner diameters of the above-ground sampling assembly and below-ground gas probe casing, screen, and sand pack should be used to calculate the "purge volume" (the purge volume will consider the pore volume of the sand pack assuming a 30 percent sand pack porosity). Prior to sample collection, two to three purge volumes should be drawn from the probe/sample assembly, unless otherwise required by the applicable regulatory guidance. The purge data (calculated purge volume, purging rate, and duration of purging) should be recorded in the field logbook.
3. Prior to purging, a vacuum, or tightness, test should be conducted on the sampling assembly as the first of two leak-testing steps, as described further in Section 15.7.3. Briefly, this first leak-testing step (the vacuum test) should consist of opening the valve to the personal sampling pump leaving

the valves to the syringe and the soil gas probe closed. The pump should then be operated to ensure that it draws no air from the sampling assembly (i.e., creates a negative pressure, or vacuum within the sampling assembly), thus establishing that all assembly connections are airtight. Further details of the vacuum test are described in Section 15.7.3.

4. Prior to purging, and following the vacuum test, the set-up for the second of the two leak-testing steps should be conducted. The second leak-testing step is the tracer compound step. A tracer compound is released at ground surface immediately around the soil gas probe surface casing. The tracer test is used to test for ambient air leakage down the annulus of the soil gas probe and into the soil gas sample. The tracer compound is either monitored using a meter connected in-line to the sampling assembly (e.g., helium), or is included as an analyte in the laboratory analysis of the soil gas samples (e.g., isopropanol). The setup requirements of the tracer compound leak-testing step are described in Section 15.7.3.
5. Following the vacuum test, and the setup for the tracer compound leak-testing step, the soil gas probe purging should commence by opening the valve to the soil gas probe and activating the personal sampling pump (and disconnecting the bag). At the start and the end of the purging period, the total concentration of volatile organic vapors of the personnel sampling pump exhaust gas should be monitored using a portable photoionization detector (PID) meter. The PID meter should be connected in series after the personal sampling pump. Since typical PID instrument flow rates vary from approximately 300 to 500 mL/min (depending on the manufacturer and model), drawing a sample into the PID meter through the personal sampling pump will likely increase the purging flow rate temporarily, until a reading from the PID meter is obtained. PID readings should be recorded and entered in the field logbook and chain of custody form. The PID readings should provide the laboratory with an indication of whether a sample could require dilution before analysis.
6. Following purging, the valve to the syringe should be opened and soil gas should be draw into the syringe at a rate of approximately 60 mL/min. This should be completed concurrent with continued application of the leak-testing tracer compound.
7. If the sampling assembly fittings/valves are to be re-used during sampling, they must be cleaned in accordance with laboratory requirements by purging with zero air (provided by laboratory) for minimum 45 seconds at minimum 75 psi (153 inches of Hg).
8. The syringes should be labeled noting the unique sample designation number, date, time, and sampler's initials. A bound field logbook should be maintained to record all soil gas sampling data.
9. The syringes should be listed on the chain-of-custody in order of suspected highest to lowest impact, as evidenced by the recorded PID readings. Indicate on the chain-of-custody for the laboratory to analyze the canisters in order from the lowest to highest PID reading.

The soil gas samples should be analyzed for the project-specified VOCs by the project laboratory using U.S. EPA's TO-15 gas chromatograph/mass spectrometer (GC/MS) methodology, with the mass spectrometer (MS) run in full scan mode. QA/QC measures implemented during the soil gas sampling event will include the two-step leak testing procedure (see Section 15.7.3), collection of one duplicate per sampling event or from at least 10 percent of the samples obtained, and collection of an ambient air sample (if needed). As an additional QA/QC measure, the laboratory should conduct a duplicate analysis of the sample collected in one of the syringes.

15.7.7 Follow-Up Activities

The following activities should be performed at the completion of the field work.

1. Review and compare newly obtained data with historic data and flag unusual or extreme readings for review.
2. Soil gas concentrations are reported in units of µg/m3 or ppbv. Unlike concentration units for groundwater, these units are not directly interchangeable. The molecular weight of the compound in question is a factor in the conversion from units of mass per unit volume to parts per billion by volume.
3. Ensure site access keys are returned.
4. The equipment should be cleaned and returned to the Equipment Coordinator. All equipment should be cleaned at the site.
5. Monitoring forms and field notes should be sent to the file. The field book should be stored at the appropriate GHD office.

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