# Remedial Investigation Work Plan

Former Alderwood Laundry and Dry Cleaner
3815 196th Street SW
Lynnwood, Washington
VCP NW3066

*for*
**Lynnwood Public Facilities District**

April 6, 2021

GeoEngineers
Earth Science + Technology

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Redmond, Washington
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## 3815 196th Street SW
## Lynnwood, Washington
## VCP NW3066

**Project No. 17787-001-15**

**April 6, 2021**

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# TITLE AND APPROVAL PAGE

Remedial Investigation Work Plan
Document Title

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## 1.0 INTRODUCTION AND BACKGROUND

This supplemental Remedial Investigation (RI) Work Plan (Work Plan) describes soil, soil vapor and groundwater investigations to be conducted at the former Alderwood Laundry and Dry Cleaner (ALDC) ("Site") (Figure 1). The ALDC was historically located at 3815 196th Street SW, in the southwest corner of the Lynnwood Public Facilities District (PFD) Property (Figure 2) in Lynnwood, Washington. The PFD is conducting an independent cleanup of the former ALDC Site with oversight provided under the Washington State Department of Ecology's (Ecology) Voluntary Cleanup Program (VCP).

Pursuant to the Washington State Model Toxics Control Act (MTCA) Cleanup Regulation (Chapter 173-340 Washington Administrative Code [WAC]), the purpose the RI is to collect sufficient data and information to define the extent of contamination, characterize the Site, and evaluate cleanup action alternatives in the feasibility study (FS). Previous subsurface investigations completed at the Site were documented in an RI report (GeoEngineers 2018) and the RI Addendum report (GeoEngineers 2019). An Ecology Opinion Letter, dated December 31, 2019, prepared in response to the RI Addendum, indicated that the lateral extent of soil and groundwater contamination from dry cleaning chlorinated volatile organic compounds (cVOCs) has been delineated; however, indoor air on the adjacent WES Property required additional assessment due to the potential for seasonal variability, and the vertical extent of groundwater contamination was not fully defined and further assessment is necessary. Additional indoor air assessment was subsequently performed February 2020 in the building on the adjacent WES Property. Ecology stated in their September 4, 2020 Opinion Letter that based on the additional assessment, cVOC concentrations detected in indoor air were protective of current receptors under the current use of the WES Property (i.e., commercial).

To address remaining Site characterization data gaps so that cleanup action alternatives can be developed and evaluated in the FS, additional subsurface data will be collected to document sub-slab soil and soil vapor conditions beneath the former dry cleaner strip mall location, delineate the vertical extent of groundwater contamination in the source area as noted above, establish baseline conditions for soil physiochemical properties and groundwater geochemical parameters, and evaluate seasonal and temporal groundwater conditions. This Work Plan describes the planned supplemental soil, soil vapor and groundwater investigations to be conducted, including installation of a remediation well for planned pilot testing. The work plan for the pilot study will be presented under separate cover.

## 2.0 REMAINING DATA GAPS

This section identifies the remaining Site characterization data gaps that are the basis for the RI field program described in Section 3.0.

### 2.1. Vertical Extent of Groundwater Contamination in the Vicinity of Source Area

The vertical extent of Site groundwater contamination near the source area has not been delineated, specifically deeper than approximately 50 feet below ground surface (bgs). The existing wells and the most recent boring and well installations near the source area (i.e., monitoring well MW-17) did not vertically delineate groundwater contamination in the aquifer and none of the existing wells extended deep enough to encounter a confining layer. Therefore, additional assessment deeper into the aquifer is necessary.

## 2.2. Strip Mall Shallow Soils

Soil directly underneath the former tenant space in the building has not previously been sampled except for one angled boring, which did not enable sampling of soil in the upper 10 to 12 feet bgs due to the geometry and logistics of angled boring drilling. The objective of shallow soil sampling beneath the former dry cleaning tenant space is to: collect data regarding contaminant concentrations in shallow soil directly beneath the building to evaluate remedial technologies, remedial alternatives and costs for the FS; for future waste profiling relative to requirements of the Dangerous Waste regulations (WAC 173-303); and for remedial planning.

## 2.3. Strip Mall Sub-Slab Soil Vapor

Soil vapor under the strip mall and former dry cleaning tenant space (potential area of historic release via leaky drains, spillage and/or floor cracks) has not been quantitatively sampled in the past. Indoor air sampling was performed by PBS Environmental for the PFD in 2013 to evaluate potential impacts to indoor air inside the strip mall building. Results of the 2013 assessment indicated an exceedance of the MTCA Method B Indoor Air Cleanup Level (value published by Ecology as of September 2012) for vinyl chloride in one sample. However, the detected concentration of vinyl chloride was lower than the commercial/occupational worker risk-based air concentration. Vinyl chloride has not been detected in soil or groundwater at the Site and was also detected in outdoor air, the indoor air detection was interpreted to not be attributed to the historic dry cleaner. However, due to the age of the previous indoor air sampling data and potential for indoor air conditions to change over time, an updated assessment is warranted to evaluate potential indoor air vapor intrusion in the strip mall building under current Site conditions. Sub-slab soil vapor samples are initially proposed and will be utilized to assess whether indoor air sampling should be performed.

## 2.4. Seasonal Variability and Temporal Trends of VOC Concentrations in Groundwater

Previous investigations indicate that dissolved VOC concentrations in groundwater are stable. A monitoring frequency of once every 18 months was approved by Ecology until Site cleanup actions are underway; the next monitoring event is scheduled for spring 2021 per this Work Plan, QAPP and SAP. Groundwater sample data will support the evaluation of seasonal variability and temporal trends in groundwater contaminant concentrations, verify continued plume stability, and inform the evaluation of cleanup action alternatives in the FS. The data will also be used to establish pre-pilot test baseline conditions for groundwater. All existing wells, as well as newly installed wells, will be sampled during this event.

## 2.5. Groundwater Geochemical Conditions

Indicators of Site groundwater geochemical conditions, including ammonia, total organic carbon (TOC), biochemical oxygen demand (BOD), ferrous iron, total iron, dissolved iron, nitrate, nitrite, sulfate and dissolved methane, ethane, ethene, and acetylene have not been evaluated during previous investigations. Groundwater geochemical conditions can influence the evaluation of remediation technologies that may be applicable to the Site. Geochemical indicator data will inform the evaluation of cleanup action alternatives for the FS; the data will also be used to establish pre-pilot test baseline conditions for groundwater.

## 2.6. Soil Physicochemical Properties

Physiochemical properties of Site soil (i.e., grain size distribution, pH, soil bulk density, and TOC) that may be useful in technology screening and remediation planning have not been evaluated during previous investigations. Soil physiochemical properties are considered in the FS process when evaluating remediation technology implementability and performance, and can inform selection of the preferred remedial alternative.

## 2.7. Remediation Well Installation

As part of the RI field assessment, and to prepare for an upcoming remedial action pilot study, one "remediation" well (RW-1, see Figure 2) will be installed to collect soil and groundwater site characterization data and for subsequent pilot test injection. The remediation well will be installed near existing well MW-2, near the suspected historic release area where detected groundwater cVOCs concentrations are elevated relative to other locations. The location proposed for the remediation well was also selected because of the proximity of several existing monitoring wells that will be beneficial for monitoring associated with the pilot test. The work plan for the pilot study will be presented under separate cover.

# 3.0 REMEDIAL INVESTIGATION FIELD PROGRAM

The RI field program is designed to address the data gaps identified in Section 2.0. The main elements of the RI field program are summarized below and are described in more detail in Sections 3.1 through 3.5. Details regarding field sampling procedures are provided in the Sampling and Analysis Plan (Appendix A). Quality control procedures for field activities and laboratory analyses are described in the Quality Assurance Project Plan (Appendix B).

- Perform a site visit to identify and mark proposed exploration locations.
- Conduct a standard "One-Call" underground utility locate, complete a private underground utility locate prior to beginning the fieldwork, and review Site plans showing underground utility locations.
- Drill one deep boring (up to 100 feet bgs) (MW-3 Deep) to assess the vertical contaminant profile of groundwater at 10-foot-depth intervals beginning at approximately 40 feet bgs and extending to the total depth of the boring. Submit select soil samples collected from the boring for laboratory analysis of cVOCs. Following completion of the boring, install a well to evaluate groundwater during future sampling events.
- Drill one boring approximately 15 feet north of well MW-2 and install a remediation well (RW-1). The well will be used for a remediation pilot study (pilot study work plan under separate cover). Submit soil samples collected from select borings for laboratory analysis of select cVOCs.
- Perform one round of groundwater monitoring from all Site monitoring wells (EMRI-MW-1, MW1 through MW-17, ZZA-MW-2, ZZA-MW-3 and RW-1), including wells located on the PFD property and the adjacent Washington Energy Services (WES) property. Sampling under the WES property will be completed in accordance with the existing access agreement, which requires three days advance notice of proposed sampling activities. Groundwater samples collected during the monitoring event will be submitted for laboratory analysis of select cVOCs, geochemical indicators and/or biochemical parameters.

- Complete four direct-push borings through the strip mall sub slab up to 15 feet bgs or refusal, whichever occurs first and collect soil samples from the borings. The number and specific location for the soil borings may change based on results of a site visit with utility locates.
- Collect up to eight sub-slab soil vapor samples beneath the floor of the existing strip mall in select tenant spaces (Figure 2). Submit soil vapor samples for laboratory analysis of select cVOCs.

### 3.1. Soil Borings and Soil Sampling

Two soil borings will be drilled at the proposed locations shown in Figure 2 using sonic drilling methods. One boring (MW-3-Deep) is intended to evaluate deeper aquifer and will be located near existing well MW-3. One boring (RW-1) will be used for the remediation pilot study. Four additional shallow direct-push soil borings are proposed within the strip mall dry cleaner former tenant space, at the approximate locations shown in Figure 2.

Continuous soil cores will be collected from each boring. However, for soil boring MW-3-Deep, a secondary casing will be installed from 40 feet bgs to the total depth of the boring. Soil types observed in the cores will be identified by visual means using the Unified Soil Classification System (USCS). In addition, soil in each core will be field screened for evidence of potential contamination using visual screening, water sheen screening, and headspace vapor screening. Soil field screening and sampling methods are described in the Sampling and Analysis Plan (SAP) (Appendix A).

Up to three soil samples will be collected from each soil boring (four direct-push borings, MW-3-Deep boring and RW-1 boring) for potential chemical analysis. For the direct-push borings, which are anticipated to be advanced to 15 feet bgs, one sample will be collected from each 5-foot-depth interval to further characterize the subsurface soils in the suspected release area (former footprint of dry-cleaning operation). For borings RW-1 and MW-3-Deep, one soil sample from the unsaturated zone, one soil sample at the groundwater interface and one soil sample near the final depth of the boring will be collected. The samples selected for chemical analysis will further be based on the results field screening.

Selected soil samples will be analyzed by a Washington State accredited laboratory for perchloroethene (PCE), trichloroethene (TCE), cis- and trans-1,2- dichloroethane (DCE), 1,1-dichloroethene (1,1-DCE), and vinyl chloride by U.S. Environmental Protection Agency (EPA) Method 8260. The PFD will contact Ecology if the results of initial analysis indicate that supplemental testing (e.g., toxicity characteristic leaching procedure [TCLP]) may be required to adequately characterize and profile soil for future waste disposal purposes.

In addition to the chemical analytical testing described in the previous paragraph, up to six soil samples from borings MW-3-Deep and RW-1 will be analyzed for the following physiochemical parameters:

- Grain size distribution by ASTM International (ASTM) Standard Practices Test Method D 421/D422
- pH by EPA Method 9045D
- Bulk density by ASTM Method D 7263
- TOC by Standard Method (SM) 9060

Borings MW-3-Deep and RW-1 were selected for soil physiochemical analysis based on their locations within the estimated footprint of the dissolved cVOC plume. The six soil samples submitted for physiochemical analyses will be selected in the field based on qualitative observations of soil texture, color, and/or moisture content, with the objective of analyzing samples representative of the predominant soil types within the boundaries of the VOC plume. At least one soil sample from the unsaturated zone at each of these borings will be tested for physiochemical parameters.

### 3.2. Grab Groundwater Sampling – Delineation of Vertical Extent

Deeper groundwater will be evaluated by collecting non-purged grab groundwater samples at discrete vertical depths (it is not practical during drilling to purge the well casing before collecting the grab samples). The boring to access deeper groundwater will be completed using sonic drilling technology, which is required due to the density and hard drilling associated with glacial till soil. The proposed location of boring (MW-3-Deep) is on the PFD property adjacent to well MW-3, which is near likely source areas and where the deepest detections of PCE in soil have been observed. The proposed MW-3-Deep location is south of the bulk of underground utilities (see Figure 2) and at a location that allows for rig access and staging. The exploration work plan is to initially drill MW-3-Deep to a depth of 40 feet bgs, which is the approximate depth of the adjacent well MW-3; at that point, a smaller casing will be advanced through a bentonite seal placed at the bottom of the larger casing to minimize potential for dragging contaminants deeper into the water-bearing unit. Grab groundwater samples will be collected at 10-foot-depth intervals until drilling is discontinued, which will occur when a confining layer is encountered, at 100 feet bgs or refusal, whichever occurs first.

### 3.3. Groundwater Monitoring Well and Remediation Well Installation

A 2-inch-diameter groundwater monitoring well will be installed in MW-3-Deep and RW-1. Each well will be constructed in accordance with Washington state well construction standards (WAC 173-160); resource protection well notification and construction documents will be submitted to Ecology. The well casings will comprise Schedule 40 polyvinyl chloride (PVC) blank casing and machine-slotted screens with 0.010-inch slot width. The wells will generally be screened with 10 feet of screen; the lowest portion of the screen will be set approximately at the maximum depth of the boring, anticipated to be 90 to 100 feet bgs at MW-3-Deep and 35 to 45 feet bgs at RW-1[1]. The annular space between the well screen and the borehole wall will be filled with a clean sand filter pack to 2 feet above the well screen. The annular space above the filter pack will be filled with hydrated bentonite. Each well will be fitted with a locking well cap and completed at the surface with a flush-grade steel monument set in a concrete surface seal.

After the monitoring wells are installed, the wells will be developed as described in the SAP to stabilize the sand filter pack and formation materials surrounding the well screens and to establish a hydraulic connection between the well screens and the surrounding soil. The locations of the monitoring wells will be surveyed, and the well casing rim and monument elevations will be surveyed relative to North American Vertical Datum of 1988 (NAVD 88).

### 3.4. Groundwater Sampling

Groundwater monitoring will be conducted following completion of the new well installation and development activities, and prior to conducting the proposed remediation pilot study (work plan under

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[1] Well RW-1 screen depth is based on the measured depth to groundwater at existing well MW-2, which is approximately 10 feet from the planned location of RW-1. The intent is to minimize the length of RW-1 well screen that is positioned above the seasonal high water table.

separate cover). Depth to groundwater information will be collected from each well prior to sampling, which will be used to calculate groundwater flow at the site and in the case of wells MW-3 and MW-3-Deep a vertical groundwater gradient. Select wells noted below will also be sampled as part of the pilot study, after the pilot test injection activity. Groundwater levels will be measured in the monitoring wells and groundwater samples will be collected for analysis from each well as described in the SAP. Monitoring wells will be purged prior to sampling. The groundwater samples before and after the pilot study injection event will be analyzed by a Washington state accredited laboratory for the following: PCE, TCE, cis- and trans-1,2-DCE, 1,1-DCE and vinyl chloride by EPA Method 8260. In addition, samples collected before and after the pilot study injection from wells MW-2, MW-3, MW-8, MW-14, MW-15, MW-17 and RW-1 will be analyzed for the geochemical indicators listed below. These wells were selected for geochemical indicators based on their proximity to the proposed remediation well RW-1:

- Ammonia by SM 4500-NH3
- TOC by SM 5310B
- BOD by SM 5210B
- Ferrous iron by Hach Method 8146
- Total and dissolved iron and manganese by EPA Method 6010
- Nitrate and nitrite by EPA Method 353.2
- Sulfate by EPA Method 9056
- Dissolved methane, ethane, ethene, and acetylene by Method RSK-175

### 3.5. Sub-Slab Soil Vapor Sampling

Up to eight sub-slab soil vapor samples will be collected using Vapor Pin™ sampling devices or similar and in accordance with Ecology guidance for vapor intrusion assessments (Ecology 2018). The Vapor Pin™ will be installed in general accordance with the manufacturers' standard operating procedures, which involves drilling a hole through the concrete slab to insert the Vapor Pin™ and secure it in place with the silicone gasket. Pre-sampling quality control procedures (shut-in test, leak testing, and purging) and soil vapor sampling will take place at least 30 minutes or more after installation of a given vapor pin. Sub-slab soil vapor samples will be collected using evacuated 1-liter Summa canisters. More details regarding Vapor Pin™ installation procedures and sub-slab soil vapor sampling are included in the SAP in Appendix A. The approximate soil vapor sample locations are shown on Figure 2; sample locations will be field adjusted based on utilities and other encumbrances.

Soil vapor samples will be analyzed for PCE and breakdown products: TCE, 1,1-DCE, cis- and trans 1,2-DCE and vinyl chloride by EPA Method TO-15. To assess sample integrity and for quality control, helium will also be analyzed (ASTM Test Method D 1946).

Relevant meteorological data that can influence soil vapors will be noted prior to and during sampling. These data may be helpful in soil vapor sample data interpretation and in reconciling the variability in soil vapor sample data collected over multiple sampling days or events. Barometric pressure data over a 2-week time span before and after the sampling event will be gathered from readily available data sources (e.g. online data posted from regional weather stations). If feasible, the actual sampling event will take place on a day where the relative atmospheric pressure is dropping. General weather conditions at the time of sampling, such as temperature and precipitation, will also be recorded using direct observation or readily available data sources.

### 3.6. Investigation-Derived Waste Management

Investigation-derived waste (IDW) will include drill cuttings, well development water, sampling equipment decontamination water, pre-sampling purge water from monitoring wells, and incidental waste such as disposable gloves, paper towels, plastic bags, etc.

Drill cuttings, well development water, and pre-sampling purge water will be segregated by boring or monitoring well and stored on site in labeled drums pending waste classification and subsequent disposal. Solids (i.e., drill cuttings) and liquids (i.e., well development water and pre-sampling purge water) will be stored in separate drums. Well development water and pre-sampling purge water from the same monitoring well can be combined in the same drum. Decontamination water will be stored on site in labeled drums separate from other IDW. Incidental waste (disposable gloves, etc.) will be disposed of in a trash receptacle.

Drill cuttings and decontamination/purge water will be characterized for disposal by submitting a representative sample of the drill cuttings from each soil boring and a representative sample of the decontamination/purge water for analysis of PCE, TCE, cis- and trans-1,2-DCE, 1,1-DCE, and vinyl chloride by EPA Method 8260.

IDW will be designated as an F002-listed waste under the state dangerous waste regulations (WAC 173-303) and disposed of off site at a facility permitted to receive hazardous waste. Hazardous waste manifests will be prepared for IDW designated as dangerous waste, and the IDW will be transported to the permitted disposal facility by a licensed hazardous waste hauler. Depending on the quantity of soil IDW, the PFD may apply for a contained in determination (CID) from Ecology for disposal of drummed soil IDW.

## 4.0 DATA EVALUATION AND REPORTING

The data from the RI field program will be evaluated relative to the objectives of the study and the identified data gaps. The results of the grab groundwater cVOC analyses will be used to delineate the vertical extent of groundwater contamination exceeding MTCA cleanup levels. The results of the soil sampling will be used to characterize the near surface soils for remedial alternative evaluation and planning, and cost estimating purposes (e.g., waste classification for soil disposal as hazardous vs. non-hazardous waste). The groundwater monitoring data will be used to evaluate current groundwater conditions, plume stability, seasonal variability of dissolved cVOC concentrations, and as part of the pilot study. The sub-slab soil vapor sample results will be used to evaluate the potential for soil vapor intrusion into the strip mall building on the PFD Property. Sub-slab soil vapor sample results will be compared to the MTCA Method B soil vapor screening levels based on the values presented in the latest version of Ecology's Cleanup Levels and Risk Calculation (CLARC) database.

The RI activities and results will be documented in an RI addendum prepared in accordance with applicable MTCA requirements and Ecology guidance.

## 5.0 LIMITATIONS

We have prepared this Work Plan for use by the Lynnwood Public Facilities District for RI field activities at the ALDC Site at 3815 196th Street SW in Lynnwood, Washington. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted environmental science practices in this area at the time this Work Plan was prepared. No warranty or other conditions, express or implied, should be understood. This document (email, text, table, and/or figure) and any attachments are only a copy of a master document. The master hard copy is stored by GeoEngineers, Inc. and will serve as the official document of record.

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FIGURES

## Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Mapbox Open Street Map, 2016

Projection: NAD 1983 UTM Zone 10N

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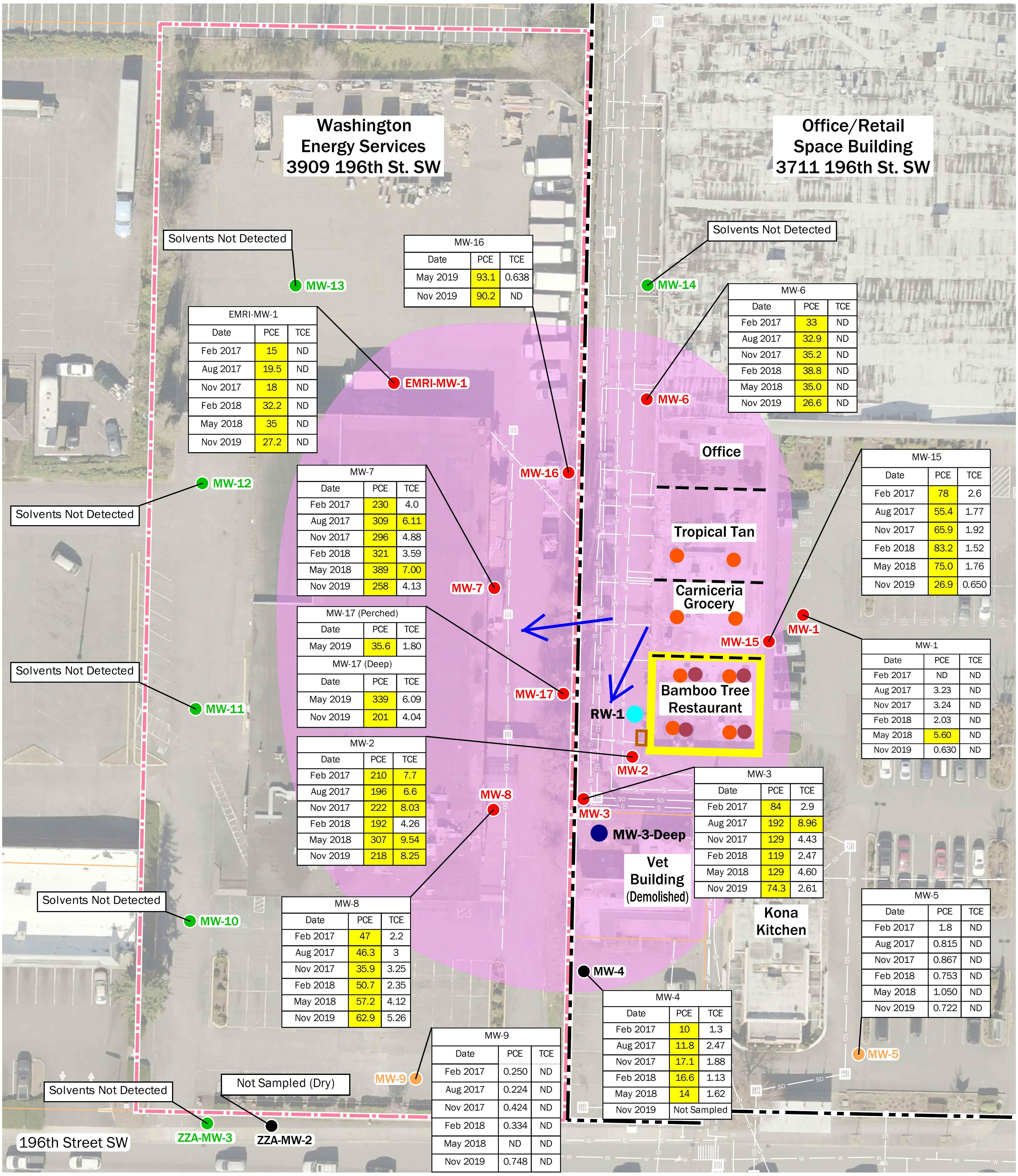
## Vicinity Map

Alderwood Laundry and Dry Cleaners
3815 196th St SW
Lynnwood, Washington

GeoEngineers

**Figure 1**



MW-16

| Date | PCE | TCE |
|---|---|---|
| May 2019 | 93.1 | 0.638 |
| Nov 2019 | 90.2 | ND |

EMRI-MW-1

| Date | PCE | TCE |
|---|---|---|
| Feb 2017 | 15 | ND |
| Aug 2017 | 19.5 | ND |
| Nov 2017 | 18 | ND |
| Feb 2018 | 32.2 | ND |
| May 2018 | 35 | ND |
| Nov 2019 | 27.2 | ND |

MW-6

| Date | PCE | TCE |
|---|---|---|
| Feb 2017 | 33 | ND |
| Aug 2017 | 32.9 | ND |
| Nov 2017 | 35.2 | ND |
| Feb 2018 | 38.8 | ND |
| May 2018 | 35.0 | ND |
| Nov 2019 | 26.6 | ND |

MW-7

| Date | PCE | TCE |
|---|---|---|
| Feb 2017 | 230 | 4.0 |
| Aug 2017 | 309 | 6.11 |
| Nov 2017 | 296 | 4.88 |
| Feb 2018 | 321 | 3.59 |
| May 2018 | 389 | 7.00 |
| Nov 2019 | 258 | 4.13 |

MW-15

| Date | PCE | TCE |
|---|---|---|
| Feb 2017 | 78 | 2.6 |
| Aug 2017 | 55.4 | 1.77 |
| Nov 2017 | 65.9 | 1.92 |
| Feb 2018 | 83.2 | 1.52 |
| May 2018 | 75.0 | 1.76 |
| Nov 2019 | 26.9 | 0.650 |

MW-17 (Perched)

| Date | PCE | TCE |
|---|---|---|
| May 2019 | 35.6 | 1.80 |

MW-17 (Deep)

| Date | PCE | TCE |
|---|---|---|
| May 2019 | 339 | 6.09 |
| Nov 2019 | 201 | 4.04 |

MW-1

| Date | PCE | TCE |
|---|---|---|
| Feb 2017 | ND | ND |
| Aug 2017 | 3.23 | ND |
| Nov 2017 | 3.24 | ND |
| Feb 2018 | 2.03 | ND |
| May 2018 | 5.60 | ND |
| Nov 2019 | 0.630 | ND |

MW-2

| Date | PCE | TCE |
|---|---|---|
| Feb 2017 | 210 | 7.7 |
| Aug 2017 | 196 | 6.6 |
| Nov 2017 | 222 | 8.03 |
| Feb 2018 | 192 | 4.26 |
| May 2018 | 307 | 9.54 |
| Nov 2019 | 218 | 8.25 |

MW-3

| Date | PCE | TCE |
|---|---|---|
| Feb 2017 | 84 | 2.9 |
| Aug 2017 | 192 | 8.96 |
| Nov 2017 | 129 | 4.43 |
| Feb 2018 | 119 | 2.47 |
| May 2018 | 129 | 4.60 |
| Nov 2019 | 74.3 | 2.61 |

MW-8

| Date | PCE | TCE |
|---|---|---|
| Feb 2017 | 47 | 2.2 |
| Aug 2017 | 46.3 | 3 |
| Nov 2017 | 35.9 | 3.25 |
| Feb 2018 | 50.7 | 2.35 |
| May 2018 | 57.2 | 4.12 |
| Nov 2019 | 62.9 | 5.26 |

MW-5

| Date | PCE | TCE |
|---|---|---|
| Feb 2017 | 1.8 | ND |
| Aug 2017 | 0.815 | ND |
| Nov 2017 | 0.867 | ND |
| Feb 2018 | 0.753 | ND |
| May 2018 | 1.050 | ND |
| Nov 2019 | 0.722 | ND |

MW-4

| Date | PCE | TCE |
|---|---|---|
| Feb 2017 | 10 | 1.3 |
| Aug 2017 | 11.8 | 2.47 |
| Nov 2017 | 17.1 | 1.88 |
| Feb 2018 | 16.6 | 1.13 |
| May 2018 | 14 | 1.62 |
| Nov 2019 | Not Sampled | |

MW-9

| Date | PCE | TCE |
|---|---|---|
| Feb 2017 | 0.250 | ND |
| Aug 2017 | 0.224 | ND |
| Nov 2017 | 0.424 | ND |
| Feb 2018 | 0.334 | ND |
| May 2018 | ND | ND |
| Nov 2019 | 0.748 | ND |

## Legend

| | |
|---|---|
| MW-2 ● | Groundwater Sample with MTCA Method A Cleanup Level Exceedance for PCE/TCE |
| MW-1 ● | Groundwater Sample with PCE/TCE less than MTCA Method A or B Cleanup Levels |
| MW-9 ● | Groundwater Sample - Solvents Not Detected |
| MTCA | Model Toxics Control Act |
| HVOC | Halogenated Volatile Organic Compounds |
| ▨ | Interpreted PCE > 5 ug/L in Groundwater |
| **MW-3D** ● | Proposed Deep Groundwater Assessment Boring (Sonic) |
| **RW-1** ● | Proposed Remediation Well |
| **SG-1** ● | Proposed Sub-Slab Soil Gas Sample Locations |
| **DPSS-1** ● | Proposed Direct Push Sub-Slab Boring |

| | |
|---|---|
| — - — | Lynnwood Public Facilities District Property Boundary |
| — · — | West Adjoining Property Boundary |
| — | Parcel Boundary |
| ▬ | Approximate Footprint of Former Alderwood Laundry & Dry Cleaners |
| ▭ | Existing Concrete Grease Trap |
| ▥ | Existing Catch Basin |
| —SD— | Existing Storm Drain |
| —G—G— | Existing Gas Line |
| —S—S— | Existing Sewer Line |
| —W— | Existing Water Line |
| —E—E— | Electric Utility |
| ← | Groundwater Flow Direction (varies from west to south) |

## Data Box Explanation:

| | |
|---|---|
| PCE | Tetrachloroethylene |
| TCE | Trichloroethylene |
| ND | Not Detected |
| ug/L | micrograms per liter |

Data boxes are provided for monitoring wells with detections of PCE/TCE.

Shading indicates concentration greater than MTCA.

All concentrations are in micrograms per liter.

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Aerial from King County dated 2015. Vertical Datum: NAVD 88. Projection: NAD83 Washington State Planes, North Zone, US Foot.

## Groundwater Chemical Analytical Data and Proposed Exploration Locations

Former Alderwood Laundry and Dry Cleaners
3815 196th Street SW, Lynnwood, Washington

GEOENGINEERS

Figure 2

P:\17\1778700I\CAD\11\2019 Groundwater Monitoring Report\177870011_F02_Groundwater Chemical Analytical Data.dwg TAB:F02 Date Exported: 12/31/19 - 8:17 by hmara

APPENDICES

# APPENDIX A
## Sampling and Analysis Plan

# Data Gap Assessment
# Sampling and Analysis Plan

Former Alderwood Laundry and Dry Cleaner
3815 196th Street SW
Lynnwood, Washington
VCP NW3066

*for*
**Lynnwood Public Facilities District**

April 6, 2021

GeoEngineers
Earth Science + Technology

# Data Gap Assessment
# Sampling and Analysis Plan

Former Alderwood Laundry and Dry Cleaner
3815 196th Street SW
Lynnwood, Washington
VCP NW3066

*for*
**Lynnwood Public Facilities District**

April 6, 2021

GeoEngineers

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425.861.6000

# Data Gap Assessment
# Sampling and Analysis Plan

# Former Alderwood Laundry and Dry Cleaner
# 3815 196th Street SW
# Lynnwood, Washington
# VCP NW3066

**Project No. 17787-001-15**

**April 6, 2021**

Prepared for:

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# Table of Contents

**APPENDICES**

## 1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) has been prepared for remedial investigation (RI) data gap assessment activities at the former Alderwood Laundry and Dry Cleaner (ALDC) (“Site”).

## 2.0 REMEDIAL INVESTIGATION PURPOSE AND SCOPE

The purpose of the RI is to characterize shallow soil and soil vapor beneath and surrounding the footprint of the former dry cleaner location, delineate the vertical extent of groundwater contamination, and provide data to prepare a feasibility study (FS) and cleanup action plan (CAP) for the Site. Specific proposed investigation activities are described in the RI Work Plan.

## 3.0 HEALTH AND SAFETY

A site-specific Health and Safety Plan (HASP) will be developed for use during RI field activities. Companies providing services for this project on a subcontracted basis will be responsible for developing and implementing their own HASPs for use by their employees.

The Field Coordinator will be responsible for implementing the HASP during the field activities. The Field Coordinator will conduct a tailgate safety meeting prior to beginning daily field activities. The Field Coordinator has stop work authority should field investigation activities fail to comply with the HASP. The Project Manager will discuss health and safety issues with the Field Coordinator on a routine basis during field activities.

## 4.0 SUBSURFACE INVESTIGATION METHODS

This section describes the investigation methods proposed:

1. Rotosonic core soil sampling and groundwater monitoring well installation, development, and surveying.
2. Groundwater sampling.
3. Sub-slab soil vapor sampling.

### 4.1. Rotosonic Core Soil Sampling and Groundwater Monitoring Well Installation, Development, and Surveying

#### 4.1.1. Rotosonic Core Soil Sampling

Continuous soil cores will be collected during drilling using a 4- to 8-inch-diameter, 5- to 10-foot-long core barrel sampler. The sampler will be advanced into undisturbed soil using a rotary and vibratory drilling head. Upon retrieval, the soil cores will be immediately extruded into sample bags. The sample bag will be cut open only when ready to collect samples for chemical analyses and subsequent lithologic logging. Soil samples at approximate 5-foot-depth intervals will be collected for chemical analysis. Additional soil samples may be collected for chemical analysis based on field screening results. Field screening is described in Section 5.0.

An environmental representative will observe the drilling activities and will maintain a detailed log of soil and groundwater conditions encountered in each boring. The soil samples will be visually examined and classified in general accordance with ASTM International (ASTM) Standard Practices Test Method D 2488.

Soil samples to be analyzed for volatile organic compounds (VOCs) will be collected first following U.S. Environmental Protection Agency (EPA) Method 5035A. The collected soil samples will be placed into a cooler with ice and logged on the chain-of-custody record. Drill cuttings will be stored in marked drums on the Site pending waste characterization and appropriate disposal.

### 4.1.2. Grab Groundwater Sampling

As noted in the RI Work Plan to further assess the groundwater, a series of grab groundwater samples is proposed to generate a vertical contaminant gradient profile. The sampling details are as follows:

- Advance sonic boring MW-3-Deep to 40 feet below ground surface (bgs) and set temporary stainless-steel screen at a position that is 5 feet above the total depth of adjacent MW-3.
- Advance a smaller diameter bore below the casing to continuously sample soil. This will reduce the risks of "dragging" contaminants in shallower soil into deeper groundwater.
- Starting at 40 feet bgs, collect discrete-depth grab groundwater samples at 10-foot-depth intervals to a maximum depth of 100 feet bgs, unless refusal or a confining layer (predominantly silt or clay soils) is encountered first. Based on available information regarding regional conditions, we anticipate that either a confining layer will be encountered within the top 100 feet bgs, and/or sufficient samples will have been collected to document a contaminant profile that would enable determining the maximum depth where perchloroethene (PCE) concentrations in groundwater are greater than the Model Toxics Control Act (MTCA) cleanup level. Further, it is noted that drilling depths beyond 100 feet increases drilling costs dramatically and it is anticipated that the FS will demonstrate that remediation of groundwater beyond this depth is likely to be disproportionate to the cost.
- As drilling advances, groundwater samples will be collected using low-flow sampling methods with a bladder pump inserted into a temporary screen advanced just below the depth of the soil boring casement interval.
- Once each vertical-depth-specific grab groundwater sample is collected, the temporary screen will be removed and the boring advanced deeper by 10 feet. The temporary screen will be decontaminated before and after each use.

### 4.1.3. Well Installation

Drilling and construction of groundwater monitoring wells will be performed by a Washington state licensed driller in accordance with the Minimum Standards for Construction and Maintenance of Wells (Chapter 173-160 Washington Administrative Code [WAC]). Monitoring well installation will be observed by an environmental representative who will maintain a detailed log of the construction materials and well depths. Drillers will submit resource protection well notification and construction documents to the Washington State Department of Ecology (Ecology).

#### 4.1.3.1. MONITORING WELL

The monitoring well will be constructed using 2-inch-diameter, flush-threaded Schedule 40 polyvinyl chloride (PVC) casing with machine-slotted PVC screen (0.010-inch slot width). The well will be constructed with a 10-foot screen at the final depth of the boring. Additional details regarding monitoring well construction are provided in the RI Work Plan.

#### 4.1.3.2. PILOT TEST INJECTION WELL

The pilot test injection well (RW-1) will be constructed using 2-inch-diameter, flush-threaded Schedule 40 PVC casing with machine-slotted PVC screen (0.010-inch slot width). The well will be constructed with a 10-foot screen extending from the seasonal high groundwater elevation based on well monitoring data collected at well MW-2. The actual well screen interval will be based on field conditions observed at the time of drilling. Additional details regarding remediation well construction are provided in the RI Work Plan.

### 4.1.4. Well Development

Each well will be developed by surging the screened interval and purging the well. The turbidity of the purge water will be monitored during well development. Well development will continue until at least five well casing volumes of water are removed and the turbidity of the purge water is less than 500 nephelometric turbidity units (NTU). The purge rate and total volume of groundwater removed from each well will be recorded on field forms during well development. Well development water will be segregated by monitoring well and stored in marked drums on the Site pending waste characterization and appropriate disposal.

### 4.1.5. Groundwater Monitoring Well Surveying

A licensed surveyor will perform an elevation and location survey of the new wells and previously installed wells MW-16 and MW-17, which were not surveyed at the time of installation. Monitoring well elevations will be surveyed relative to North American Vertical Datum of 1988 (NAVD 88) to an accuracy of 0.01 foot.

## 4.2. Groundwater Sampling

The depth to groundwater in each monitoring well will be measured to the nearest 0.01 foot relative to the top of the well casing using an electronic water level indicator before any groundwater samples are collected. The groundwater level measurements will be recorded on field logs.

After the depth to groundwater has been measured, a groundwater sample will be collected from the groundwater monitoring well following the EPA’s low-flow groundwater sampling procedure (EPA 2017). Disposable tubing and a peristaltic pump will be used for groundwater purging and sampling. During purging activities, water quality parameters, including pH, temperature, conductivity, dissolved oxygen (DO), oxidation-reduction potential (ORP). and turbidity, will be measured using a multi-parameter meter equipped with a flow-through cell. Groundwater samples will be collected after either: (1) water quality parameters stabilize; or (2) a maximum purge time of 30 minutes is achieved, whichever happens first. During purging and sampling, drawdown will be monitored and limited to less than 0.3 feet, if possible. The purge rate shall generally be limited to less than 0.5 liters per minute. Water quality parameter stabilization criteria will include the following:

- Turbidity: ±10 percent for values greater than 5 NTU
- Conductivity: ±3 percent
- pH: ±0.1 unit
- Temperature: ±3 percent
- DO: ±10 percent

- ORP: ±10 percent or 10 millivolts (mV) if under 100 mV

Field water quality measurements and depth-to-water measurements will be recorded on a Well Purging-Field Water Quality Measurement form. Groundwater samples will be transferred in the field to laboratory-prepared sample containers and kept cool during transport to the testing laboratory. Chain-of-custody procedures will be observed from the time of sample collection to delivery to the testing laboratory consistent with the Quality Assurance Project Plan (QAPP). Samples will be handled and analyzed in accordance with the project QAPP (Appendix B). Groundwater sampling will be conducted under the supervision of a licensed hydrogeologist.

## 4.3. Sub-Slab Soil Vapor Sampling

Sub-slab soil vapor samples will be collected inside the building using Vapor Pin™ sampling devices. The Vapor Pins™ are installed following the manufacturers' standard operating procedures (SOPs) attached to this appendix. The Vapor Pins™ will be left in place with flush-mounted stainless-steel covers for potential future use if necessary.

### 4.3.1. Sub-Slab Sampling Device Installation

General installation procedures for the sub-slab sampling device are attached in Appendix A and as follows:

- Check for buried obstacles (pipes, electrical lines, etc.) prior to proceeding. A subcontractor will perform a private utility locate to clear the sub-slab soil vapor sample locations.
- Set up vacuum to collect drill cuttings.
- Drill a 1.5-inch-diameter hole at least 1.75 inches into the slab.
- Drill a 5/8-inch-diameter hole through the slab and approximately 1 inch into the underlying soil to form a void.
- Remove the drill bit, brush the hole with the bottle brush, and remove the loose cuttings with the vacuum.
- Place the lower end of sampling device assembly into the drilled hole. Place the small hole located in the handle of the extraction/installation tool over the sampling device to protect the barb fitting and cap and tap the sampling device into place using a dead blow hammer. Make sure the extraction/installation tool is aligned parallel to the sampling device to avoid damaging the barb fitting.
- During installation, the silicone sleeve forms a slight bulge between the slab and the sample device shoulder creating a seal. Place a protective cap on sampling device to prevent vapor loss prior to sampling.
- Cover the sampling device with a stainless-steel secured cover.
- Allow at least 30 minutes for the sub-slab soil vapor conditions to equilibrate prior to sampling.

### 4.3.2. Sub-Slab Soil Vapor Sampling Procedure

The procedure for collecting sub-slab soil vapor samples is described below and is in general accordance with the Interstate Technology and Regulatory Council guidance (ITRC 2007 and 2014).

- Connect new fluoropolymer (Teflon®) tubing to the sub-slab soil vapor probe, using the barb fitting on the top of the sampling device.
- Connect the tubing (aboveground) to a sampling manifold.
- Vacuum test the sampling manifold (shut-in test) by briefly introducing a vacuum to the aboveground portion of the sampling train and checking for loss of vacuum. If vacuum loss is observed, connections and fittings in the sample train will be checked and adjusted, then vacuum-tested again. This test is repeated until the sampling train has demonstrated that tightness is achieved.
- A tracer gas shroud (clear plastic bag) is placed around the entire sample train (that is, the sub-slab soil vapor probe where it enters the ground surface, the 6-liter Summa canister, and associated tubing and manifold).
    - The shroud is charged (filled) with a tracer gas (spec-grade 99.995 percent helium gas) and the tracer gas concentration within the shroud is measured using a hand-held monitor (Dielectric MGD-2002 Multi-Gas Leak Detector or similar), which is capable of measuring helium in air to a concentration of 0.5 percent) prior to, during and after completion of the sampling event. To charge the shroud a Teflon tube with a ball valve is inserted under the shroud to connect with the compressed helium bottle. This same tube is used to monitor the helium concentration within the shroud periodically throughout the sampling process. The purpose of the periodic monitoring is to make sure helium is in contact with the sample train and the ground surface while the sub-slab vapor sample is collected.
- The sampling train (aboveground and belowground components) is purged using a vacuum purge pump or a multi-gas meter. Purge volumes are calculated based on the flow rate of the purge pump and the volume of the soil vapor probe and sample train. After purging three sampling train volumes, the helium concentration within the sampling train is measured and recorded. If the helium concentration in the sample train is greater than or equal to 5 percent of the helium concentration in the shroud, the bentonite seal is re-applied, fittings re-tightened, and the previous purging and measurement tests are repeated (Cal-EPA/DTSC 2015).
- The soil vapor sample is obtained using a 1-liter evacuated Summa canister (with approximately 30 inches of mercury vacuum set by the laboratory) and tedlar bag (helium analysis) with a regulated flow rate of less than or equal to approximately 200 milliliters per minute (Cal-EPA/DTSC 2015). The canister is filled with soil vapor for approximately 5 minutes or until a vacuum equivalent of approximately 5 inches of mercury remains in the Summa canister, whichever comes first. The initial and final canister vacuums are recorded on a soil vapor sampling field form. Canisters are provided by the subcontracted analytical laboratory.

## 5.0 FIELD SCREENING

### 5.1. General Procedures

Soil samples will be collected for chemical analysis and to document lithology. An environmental representative will classify the soils encountered and prepare a detailed log of each exploration. The field representative will visually classify the soil in general accordance with ASTM Method D 2488 and record soil descriptions and field screening information on the field log. ASTM Method D 2488 is the visual-manual soil description method that corresponds to laboratory ASTM Method D 2487 (Unified Soil Classification System method).

Samples will be placed in a clean plastic-lined cooler with ice following collection. The objective of the cold storage will be to attain a sample temperature of 2 to 6 degrees Celsius. An environmental representative will provide for the security of samples from the time the samples are collected until the samples have been received by the courier service or laboratory personnel. A chain-of-custody form will be completed for each group of samples being delivered to the laboratory using standard chain-of-custody protocol. Samples will be transported and delivered to the analytical laboratory in the sample coolers by field personnel, laboratory personnel, courier service, or a commercial shipping company.

### 5.1.1. Field Screening

Soil samples will be field-screened for evidence of possible contamination. Field screening results will be recorded on field logs and the results will be used as a general guideline to delineate areas and depths of potential contamination. Field screening methods will consist of visual screening, water sheen screening, and headspace vapor screening.

#### 5.1.1.1. VISUAL SCREENING

The soil will be observed for unusual color or staining, or debris that may be indicative of contamination.

#### 5.1.1.2. WATER SHEEN SCREENING

This is a qualitative field screening method that can help identify the presence or absence of petroleum hydrocarbons. A portion of the soil sample will be placed in a plastic sheen pan containing water. The water surface will be observed for signs of sheen. The following sheen classifications will be used during field screening:

| Classification | Identifier | Description |
|---|---|---|
| No Sheen | (NS) | No visible sheen on the water surface |
| Slight Sheen | (SS) | Light, colorless, dull sheen; spread is irregular, not rapid; sheen dissipates rapidly |
| Moderate Sheen | (MS) | Light to heavy sheen; may have some color/iridescence; spread is irregular to flowing, may be rapid; few remaining areas of no sheen on the water surface |
| Heavy Sheen | (HS) | Heavy sheen with color/iridescence; spread is rapid; entire water surface may be covered with sheen |

#### 5.1.1.3. HEADSPACE VAPOR SCREENING

This is a semi-quantitative field screening method that can help identify the presence or absence of volatile chemicals. A portion of the sample is placed in a resealable plastic bag for headspace vapor screening as soon as possible following sample collection. Ambient air is captured in the bag and the bag is sealed and left for approximately 5 minutes. The bag is then gently agitated for approximately 10 seconds to expose the soil to the air trapped in the bag. Vapors present within the sample bag's headspace are measured by inserting the probe of a photoionization detector (PID) through a small opening in the bag.

A PID measures the concentration of organic vapors ionizable by a 10.6 electron volt lamp (standard) in parts per million (ppm) and quantifies organic vapor concentrations in the range between 0.1 ppm and

2,000 ppm (isobutylene-equivalent) with an accuracy of 1 ppm between 0 ppm and 100 ppm. The maximum PID reading for each sample will be recorded on field logs. The calibration of the PID will be checked daily prior to use using 100 ppm isobutylene calibration gas. The calibration check will be performed in fresh air having a similar relative humidity to that at the Site. The PID will be recalibrated if Site conditions (ambient temperature, relative humidity, etc.) change significantly. Calibration records should be maintained in daily field reports.

## 6.0 FIELD DOCUMENTATION

### 6.1. Soil, Soil Vapor and Groundwater Sample Containers and Labeling

The Field Coordinator will manage field protocols related to sample collection, handling, and documentation. Soil, soil vapor and groundwater samples will be placed in appropriate laboratory-prepared containers.

Sample containers will be labeled with the following information at the time of sample collection:

- Project number
- Sample name, which will include a reference to the sample location, and sampling depth (if applicable)
- Date and time of collection
- Sampler's initials
- Preservative type (if applicable)

Sample collection activities will be noted on field logs. The Field Coordinator will monitor consistency between sample containers/labels, field logs, and chain-of-custody forms. Sample naming/labeling conventions are described below:

**Soil Samples** – Each sample will be labeled with the boring number, sample interval start depth, and sample interval end depth. For example, a soil sample collected from 15 to 17 feet bgs from boring MW20 would be labeled MW20-15-17.

**Soil Vapor Samples** – Each sample will be labeled with the location number and the year, month, and day of sample collection. For example, a soil vapor sample collected from monitoring well MW5 on May 23, 2021, would be labeled MW5-210523

**Groundwater Samples** – Each sample will be labeled with the monitoring well number and the year, month, and day of sample collection. For example, a groundwater sample collected from monitoring well MW5 on May 23, 2021, would be labeled MW5-210523.

**Duplicates** – Field duplicate samples collected per the QAPP will be labeled with "Dup"; the date (year, month, and day) of sample collection, and the sequential field blank number collected on that date. For example, the second field duplicate groundwater sample collected on May 23, 2021, would be labeled Dup-210523-2.

**Trip Blanks** – Trip blanks (see QAPP) will be labeled with “TB,” the date (year, month, and day) the trip blank was labeled, and the sequential trip blank number labeled on that date. For example, the first trip blank labeled on May 23, 2021, would be labeled TB-210523-1.

### 6.2. Sample Handling

Samples will be handled and delivered to the laboratory as described in the QAPP.

### 6.3. Field Observations Documentation and Records

Field documentation provides important information about potential problems or special circumstances surrounding sample collection. Field personnel will record soil and groundwater sampling information on field logs and will maintain a daily field report. Entries in the field logs will be made in pencil or water-resistant ink on water-resistant paper, and corrections will consist of line-out deletions with initials. Field logs and field reports will become part of the project files at the conclusion of the fieldwork.

The following information will be recorded during sample collection activities:

- Sample location and description.
- Site or sampling area sketch showing sample location and measured distances, as necessary.
- Sampler's name(s).
- Date and time of sample collection.
- Designation of sample as composite or discrete.
- Type of sample (soil, soil vapor or water).
- Type of sampling equipment used.
- Field instrument readings.
- Field observations and details that are pertinent to the integrity/condition of the samples (e.g., weather conditions, performance of the sampling equipment, sample depth control, sample disturbance, etc.).
- Sample descriptions (e.g., lithology, noticeable odors, color, field screening results).
- Sample preservation.
- Shipping arrangements (overnight air bill number).
- Name of recipient laboratory.

The following specific information will also be recorded in the field log for each day of sampling in addition to the sampling information:

- Team members and their responsibilities.
- Time of arrival/entry on Site and time of Site departure.
- Other personnel present at the Site.
- Summary of pertinent meetings or discussions with regulatory agency or contractor personnel.
- Deviations from sampling plans, site safety plans, and QAPP procedures.

- Changes in personnel and responsibilities with reasons for the changes.
- Levels of safety protection.
- Calibration readings for any equipment used and equipment model and serial number.

The Field Coordinator is responsible for the handling, use, and maintenance of field logs.

### 6.4. Sampling Equipment Decontamination

Reusable sampling and measurement equipment that directly contacts samples or sampled media and could cause cross-contamination between different sampling locations or depths will be decontaminated before each use as follows:

1. Equipment will be brushed with a nylon brush as needed to remove large particulate matter.
2. Equipment will be rinsed with potable water as needed.
3. Equipment will be washed with a solution of Alconox® (or Liquinox®) and potable water.
4. Equipment will be rinsed with potable water.

## 7.0 INVESTIGATION-DERIVED WASTE MANAGEMENT

Investigation-derived waste (IDW) will include drill cuttings, well development water, sampling equipment decontamination water, pre-sampling purge water from monitoring wells, and incidental waste.

Drill cuttings, well development water, decontamination water, and pre-sampling purge water will be stored in sealed drums. The drums will be temporarily stored on the Site pending waste designation and off-site disposal. The drums will be labelled with the following information:

- Material contained in the drum (e.g., drill cuttings, decontamination water, etc.).
- Source of the material (e.g., investigation locations and depths where applicable).
- Date material was generated.
- Name and telephone number of the appropriate contact person.

Incidental waste to be generated during sampling activities includes items such as disposable gloves, plastic sheeting, sample bags, paper towels, and similar expended and discarded field supplies. These materials are considered *de minimis* and will be disposed of in a trash receptacle or county disposal facility.

Additional details regarding IDW management are provided in the RI Work Plan.

## 8.0 REFERENCES

The Interstate Technology & Regulatory Council, Vapor Intrusion Team. 2007. Vapor Intrusion Pathway: A Practical Guideline. January 2007.

The Interstate Technology & Regulatory Council, Petroleum Vapor Team. 2014. Petroleum Vapor Intrusion, Fundamentals of Screening, Investigation and Management. October 2014.

U.S. Environmental Protection Agency. (EPA). 2017. Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells. Revision No. 4.

Washington State Department of Ecology (Ecology). 2018. “Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action, Review Draft,” October 2009, updated April 2018.

# APPENDIX A

## Vapor Pin® Manufacturer Installation Procedures

# Standard Operating Procedure Installation and Extraction of the Vapor Pin®

Updated March 16, 2018

## Scope:

This standard operating procedure describes the installation and extraction of the VAPOR PIN® for use in sub-slab soil-gas sampling.

## Purpose:

The purpose of this procedure is to assure good quality control in field operations and uniformity between field personnel in the use of the VAPOR PIN® for the collection of sub-slab soil-gas samples or pressure readings.

## Equipment Needed:

- Assembled VAPOR PIN® [VAPOR PIN® and silicone sleeve(Figure 1)]; Because of sharp edges, gloves are recommended for sleeve installation;
- Hammer drill;
- 5/8-inch (16mm) diameter hammer bit (hole **must** be 5/8-inch (16mm) diameter to ensure seal. It is recommended that you use the drill guide). (Hilti™ TE-YX 5/8" x 22" (400 mm) #00206514 or equivalent);
- 1½-inch (38mm) diameter hammer bit (Hilti™ TE-YX 1½" x 23" #00293032 or equivalent) for flush mount applications;
- ¾-inch (19mm) diameter bottle brush;
- Wet/Dry vacuum with HEPA filter (optional);
- VAPOR PIN® installation/extraction tool;
- Dead blow hammer;
- VAPOR PIN® flush mount cover, if desired;
- VAPOR PIN® drilling guide, if desired;
- VAPOR PIN® protective cap; and
- VOC-free hole patching material (hydraulic cement) and putty knife or trowel for repairing the hole following the extraction of the VAPOR PIN®.

**Figure 1.** Assembled VAPOR PIN®

## Installation Procedure:

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

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

3) If a flush mount installation is required, drill a 1½-inch (38mm) diameter hole at least 1¾-inches (45mm) into the slab. Use of a VAPOR PIN® drilling guide is recommended.

4) Drill a 5/8-inch (16mm) diameter hole through the slab and approximately 1-inch (25mm) into the underlying soil to form a void. Hole **must** be 5/8-inch (16mm) in diameter to ensure seal. It is recommended that you use the drill guide.

VAPOR PIN® protected under US Patent # 8,220,347 B2, US 9,291,531 B2 and other patents pending

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

6) Place the lower end of VAPOR PIN® assembly into the drilled hole. Place the small hole located in the handle of the installation/extraction tool over the vapor pin to protect the barb fitting, and tap the vapor pin into place using a dead blow hammer (Figure 2). Make sure the installation/extraction tool is aligned parallel to the vapor pin to avoid damaging the barb fitting.

**Figure 2.** Installing the VAPOR PIN®

During installation, the silicone sleeve will form a slight bulge between the slab and the VAPOR PIN® shoulder. Place the protective cap on VAPOR PIN® to prevent vapor loss prior to sampling (Figure 3).

**Figure 3.** Installed VAPOR PIN®

7) For flush mount installations, cover the vapor pin with a flush mount cover, using either the plastic cover or the optional stainless-steel Secure Cover (Figure 4).

**Figure 4.** Secure Cover Installed

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

9) Remove protective cap and connect sample tubing to the barb fitting of the VAPOR PIN®. This connection can be made using a short piece of Tygon™ tubing to join the VAPOR PIN® with the

Nylaflow tubing (Figure 5). Put the Nylaflow tubing as close to the VAPOR PIN® as possible to minimize contact between soil gas and Tygon™ tubing.

**Figure 5.** VAPOR PIN® sample connection

10) Conduct leak tests in accordance with applicable guidance. If the method of leak testing is not specified, an alternative can be the use of a water dam and vacuum pump, as described in SOP Leak Testing the VAPOR PIN® via Mechanical Means (Figure 6). For flush-mount installations, distilled water can be poured directly into the 1 1/2 inch (38mm) hole.

**Figure 6.** Water dam used for leak detection

11) Collect sub-slab soil gas sample or pressure reading. When finished, replace the protective cap and flush mount cover until the next event. If the sampling is complete, extract the VAPOR PIN®.

Extraction Procedure:

1) Remove the protective cap, and thread the installation/extraction tool onto the barrel of the VAPOR PIN® (Figure 7). Turn the tool clockwise continuously, don't stop turning, the VAPOR PIN® will feed into the bottom of the installation/extraction tool and will extract from the hole like a wine cork, DO NOT PULL.

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

**Figure 7.** Removing the VAPOR PIN®

- Prior to reuse, remove the silicone sleeve and protective cap and discard. Decontaminate the VAPOR PIN® in a hot water and Alconox® wash, then heat in an oven to a temperature of 265° F (130° C) for 15 to 30 minutes. For both steps, **STAINLESS – ½ hour, BRASS 8 minutes**

3) Replacement parts and supplies are available online.

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# APPENDIX B
## Quality Assurance Project Plan

# Quality Assurance Project Plan

Former Alderwood Laundry and Dry Cleaner
3815 196th Street SW
Lynnwood, Washington
VCP NW3066

*for*

**Lynnwood Public Facilities District**

April 6, 2021

GeoEngineers
Earth Science + Technology

# Quality Assurance Project Plan

Former Alderwood Laundry and Dry Cleaner
3815 196th Street SW
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VCP NW3066

*for*
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April 6, 2021

GeoEngineers

17425 NE Union Hill Road, Suite 250
Redmond, Washington
425.861.6000

# Quality Assurance Project Plan

# Former Alderwood Laundry and Dry Cleaner
# 3815 196th Street SW
# Lynnwood, Washington
# VCP NW3066

**Project No. 17787-001-15**

**April 6, 2021**

Prepared for:

Lynnwood Public Facilities District
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Signature

Arati Kaza 04/07/2021
Printed Name/Date

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## 1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been prepared to identify the soil, soil vapor and groundwater sampling and analysis methods to be performed during remedial investigation (RI) activities at the former Alderwood Laundry and Dry Cleaner (Site) located in Lynnwood, Washington. Objectives of the RI are discussed in the Work Plan.

Sampling procedures for the RI are outlined in the Sampling and Analysis Plan (SAP). The QAPP serves as the primary guide to integrate Quality Assurance (QA) and Quality Control (QC) functions into the RI field sampling and analyses activities. The QAPP presents the objectives, procedures, organization, functional activities, and specific QA and QC activities designed to achieve data quality goals that have been established for the project. This QAPP is based on guidelines specified in Washington Administrative Code (WAC) 173-340-820 and -830 and U.S. Environmental Protection Agency (EPA) Requirements for Quality Assurance Project Plans (EPA 2004b).

Environmental measurements will be conducted to produce data that are scientifically valid, of known and acceptable quality, and meet established objectives. QA/QC procedures will be implemented so that precision, accuracy, representativeness, completeness, and comparability (PARCC) of data generated meet the specified data quality objectives.

## 2.0 PROJECT ORGANIZATION, ROLES AND RESPONSIBILITIES

Services completed under this QAPP will be in cooperation with the following key project personnel.

| Affiliation | Contact Information |
|---|---|
| Washington State Department of Ecology (Ecology) Site Manager | Sam Meng<br>Same461@ECY.WA.GOV<br>(360) 338-2718<br>Olympia, Washington |
| Lynnwood Public Facilities District Executive Director | Janet Pope<br>jpope@lynnwoodpfd.com<br>(425) 440-0970 |
| Consultant Project Manager (GeoEngineers, Inc.) | Cris J. Watkins<br>cwatkins@geoengineers.com<br>(971) 235-6147<br>Portland, Oregon |
| Field Coordinator (GeoEngineers, Inc.) | To Be Determined |
| QA Leader (GeoEngineers, Inc.) | Denell Warren<br>dwarren@geoengineers.com<br>(253) 722-2792 |
| Subcontracted Analytical Laboratories (Pace National Analytical, Mt. Juliet, Tennessee) | Brian Ford<br>Brian.ford@pacelabs.com<br>(615) 773-9772 |

Descriptions of the responsibilities and communication for the key positions to QA/QC are provided below. This organization facilitates the efficient production of project work, allows for an independent quality review, and permits resolution of QA issues before submittal.

## 2.1. Project Leadership and Management

The Project Manager's (PM) duties consist of providing concise technical work statements for project tasks, selecting project team members, determining subcontractor participation, establishing budgets and schedules, adhering to budgets and schedules, providing technical oversight, and providing overall production and review of project deliverables.

## 2.2. Field Coordinator

The Field Coordinator is responsible for the daily management of activities in the field. Specific responsibilities include the following:

- Provides technical direction to the field staff.
- Develops schedules and allocates resources for field tasks.
- Coordinates data collection activities to be consistent with information requirements.
- Supervises the compilation of field data and laboratory analytical results.
- Assures that data are correctly and completely reported.
- Implements and oversees field sampling in accordance with project plans.
- Supervises field personnel.
- Coordinates work with on-site subcontractors.
- Schedules sample shipment with the analytical laboratory.
- Monitors that appropriate sampling, testing, and measurement procedures are followed.
- Coordinates the transfer of field data, sample tracking forms, and log books to the PM for data reduction and validation.
- Participates in QA corrective actions as required.

## 2.3. QA Leader

The QA Leader is responsible for the project's overall QA and coordinating QA/QC activities as they relate to the acquisition of field data. The QA Leader has the following responsibilities:

- Serves as the official contact for laboratory data QA concerns.
- Responds to laboratory data, QA needs, resolves issues, and answers requests for guidance and assistance.
- Reviews the implementation of the QAPP and the adequacy of the data generated from a quality perspective.
- Maintains the authority to implement corrective actions as necessary.
- Reviews and approves the laboratory QA Plan.

- Evaluates the laboratory's final QA report for any condition that adversely impacts data generation.
- Ensures that appropriate sampling, testing, and analysis procedures are followed and that correct QC checks are implemented.
- Monitors subcontractor compliance with data quality requirements.

### 2.4. Laboratory Management

The subcontracted analytical laboratory that is conducting chemical analyses for this project is required to obtain approval from the QA Leader before the initiation of sample analysis to assure that the laboratory QA plan complies with the project QA objectives. The Laboratory's QA Coordinator administers the Laboratory QA Plan and is responsible for QC. Specific responsibilities of this position include:

- Ensure implementation of the QA Plan.
- Serve as the laboratory point of contact.
- Activate corrective action for out-of-control events.
- Issue the final QA/QC report.
- Administer QA sample analysis.
- Comply with the specifications established in the project plans as related to laboratory services.
- Participate in QA audits and compliance inspections.

The chemical analytical laboratory QA Coordinator will be determined by the laboratory.

## 3.0 DATA QUALITY OBJECTIVES

The QA objective for technical data is to collect environmental monitoring data of known, acceptable, and documentable quality. The QA objectives established for the project are:

- Implement the procedures outlined herein for field sampling, sample custody, equipment operation and calibration, laboratory analysis, and data reporting that will facilitate consistency and thoroughness of data generated.
- Achieve the acceptable level of confidence and quality required so that data generated are scientifically valid and of known and documented quality. This will be performed by establishing criteria for precision, accuracy, representativeness, completeness, and comparability, and by testing data against these criteria.

The sampling design, field procedures, laboratory procedures, and QC procedures are set up to provide high-quality data for use in this project. Specific data quality factors that may affect data usability include quantitative factors (precision, bias, accuracy, completeness, and reporting limits) and qualitative factors (representativeness and comparability).

Quantitative factors such as precision and accuracy will be assessed using control limits, which are specific and internal to the individual laboratory used for this project. If laboratory QC parameters such as surrogates, laboratory control samples, or matrix spike samples are reported to have failed the laboratory's own statistical control limits or the reporting limits do not meet the requirements listed in this QAPP, then the associated batched sample(s) should be immediately re-extracted and re-analyzed by the laboratory. If the QC problem persists after re-extraction and re-analysis has taken place, a representative will decide whether re-sampling is warranted.

## 3.1. Analytes and Matrices of Concern

### 3.1.1. Chemical Analysis

Samples of soil, soil vapor and groundwater will be collected during site characterization activities. The analysis to be performed for soil, soil vapor and groundwater samples during the RI activities are summarized in Table B-1 - Methods of Analysis and Target Reporting Limits for Soil Samples, Table B-2 - Methods of Analysis and Target Reporting Limits for Water Samples, and Table B-3 - Methods of Analysis and Target Reporting Limits for Soil Vapor Samples.

### 3.1.2. Detection Limits

Analytical methods have quantitative limitations at a given statistical level of confidence that are often expressed as the method detection limit (MDL). Individual instruments often can detect but not accurately quantify compounds at concentrations lower than the MDL, referred to as the instrument detection limit (IDL). Although results reported near the MDL or IDL provide insight to site conditions, QA dictates that analytical methods achieve a consistently reliable level of detection known as the practical quantitation limit (PQL). The contract laboratory will provide numerical results for all analytes and report them as detected above the MRL or undetected at the PQL.

Achieving a stated detection limit for a given analyte is helpful in providing statistically useful data. Intended data uses such as comparison to numerical criteria or risk assessments, typically dictate specific project target reporting limits (TRLs) necessary to fulfill stated objectives. The PQL for target analytes are presented in Table B-1 (soil), Table B-2 (groundwater) and Table B-3 (soil vapor). These reporting limits were obtained from an Ecology accredited laboratory (Pace National Analytical); however, another Ecology accredited laboratory that will meet the desired reporting limits may be used. The analytical methods and processes selected will provide PQLs less than the TRLs under ideal conditions. However, the reporting limits in Tables B-1, B-2 and B-3 are considered targets because several factors may influence final detection limits. First, moisture and other physical conditions of soil affect detection limits. Second, analytical procedures may require sample dilutions or other practices to accurately quantify a particular analyte at concentrations above the range of the instrument. The effect is that other analytes could be reported as undetected but at a value much higher than a specified TRL. Data users must be aware that high non-detect values, although correctly reported, can bias statistical summaries and careful interpretation is required to correctly characterize site conditions.

## 3.2. Precision

Precision is the measure of mutual agreement among replicate or duplicate measurements of an analyte from the same sample and applies to field duplicate or split samples, replicate analyses, and duplicate spiked environmental samples (matrix spike duplicates). The closer the measured values are to each other, the more precise the measurement process. Precision error may affect data usefulness. Good precision is indicative of relative consistency and comparability between different samples. Precision will be expressed as the relative percent difference (RPD) for spike sample comparisons of various matrices and field duplicate comparisons for water samples. This value is calculated by:

$$RPD\,(\%) = \frac{|D_1 - D_2|}{(D_1 + D_2)/2} \; X \; 100,$$

Where

$D_1$ = Concentration of analyte in sample.

$D_2$ = Concentration of analyte in duplicate sample.

The calculation applies to split samples, replicate analyses, duplicate spiked environmental samples (matrix spike duplicates), and laboratory control duplicates. The RPD will be calculated for samples and compared to the applicable criteria. Persons performing the evaluation must review one or more pertinent documents (EPA 1999; EPA 2004a) that address criteria exceedances and courses of action. Relative percent difference goals for this effort are between 20 and 35 percent, depending on the analysis, unless the duplicate sample values are within 5 times the reporting limit in which case the absolute value of the quantitation limit shall be used.

### 3.3. Accuracy

Accuracy is a measure of bias in the analytic process. The closer the measurement value is to the true value, the greater the accuracy. This measure is defined as the difference between the reported value versus the actual value and is often measured with the addition of a known compound to a sample. The amount of known compound reported in the sample, or percent recovery, assists in determining the performance of the analytical system in correctly quantifying the compounds of interest. Since most environmental data collected represent one point spatially and temporally rather than an average of values, accuracy plays a greater role than precision in assessing the results. In general, if the percent recovery is low, non-detect results may indicate that compounds of interest are not present when in fact these compounds are present. Detected compounds may be biased low or reported at a value less than actual environmental conditions. The reverse is true when recoveries are high. Non-detect values are considered accurate while detected results may be higher than the true value.

Accuracy will be expressed as the percent recovery of a surrogate compound (also known as “system monitoring compound”), a matrix spike (MS) result, or from a standard reference material where:

$$Recovery\,(\%) = \frac{Sample\ Result}{Spike\ Amount} \; X \; 100$$

Persons performing the evaluation must review one or more pertinent documents (EPA 1999; EPA 2004a) that address criteria exceedances and courses of action. Accuracy criteria for surrogate spikes, MS, and laboratory control spikes (LCS) are to meet the quality objective of the chosen laboratory. If a sample does not meet the laboratory’s control standards, Ecology will be consulted for approval of acceptability or corrective action as it pertains to the RI objectives.

### 3.4. Representativeness, Completeness and Comparability

Representativeness expresses the degree to which data accurately and precisely represent the actual site conditions. The determination of the representativeness of the data will be performed by completing the following:

- Comparing actual sampling procedures to those delineated within the SAP and this QAPP.
- Comparing analytical results of field duplicates to evaluate variability due to sample or laboratory handling.
- Invalidating non-representative data or identifying data to be classified as questionable or qualitative. Only representative data will be used in subsequent data reduction, validation, and reporting activities.

Completeness establishes whether a sufficient number of valid measurements were obtained to meet project objectives. The number of samples and results expected establishes the comparative basis for completeness. Completeness goals are 90 percent useable data for samples/analyses planned. If the completeness goal is not achieved an evaluation will be made to determine if the data are adequate to meet study objectives.

Comparability expresses the confidence with which one set of data can be compared to another. Although numeric goals do not exist for comparability, a statement on comparability will be prepared to determine overall usefulness of data sets, following the determination of both precision and accuracy.

### 3.5. Holding Times

Holding times are defined as the time between sample collection and extraction, sample collection and analysis, or sample extraction and analysis. Some analytical methods specify a holding time for analysis only. For many methods, holding times may be extended by sample preservation techniques in the field. If a sample exceeds a holding time, then the results may be biased low. For example, if the extraction holding time for volatile analysis of soil sample is exceeded, then the possibility exists that some of the organic constituents may have volatilized from the sample or degraded. Results for that analysis will be qualified as estimated to indicate that the reported results may be lower than actual site conditions. Holding times are presented in Table B-4, Test Methods, Sample Containers, Preservation and Holding Time.

### 3.6. Blanks

According to the *National Functional Guidelines for Organic Data Review* (EPA 1999), “The purpose of laboratory (or field) blank analysis is to determine the existence and magnitude of contamination resulting from laboratory (or field) activities. The criteria for evaluation of blanks apply to any blank associated with the samples (e.g., method blanks, instrument blanks, trip blanks, and equipment blanks).” Rinseate (equipment) blanks are created in the field following sampling activities; trip blanks are placed with samples during shipment; method blanks are created during sample preparation and follow samples throughout the analysis process.

Analytical results for blanks will be interpreted in general accordance with *National Functional Guidelines for Organic Data Review* and professional judgment.

# 4.0 SAMPLE COLLECTION, HANDLING AND CUSTODY

## 4.1. Sampling Equipment and Supplies

One-time use sampling equipment and supplies will not be re-used. Care will be exercised when using sample containers, the photo-ionization detector (PID), and other instruments or supplies in order to ensure that contaminants from one sample will not be transferred to other samples. This will be achieved by not reusing one-time-use equipment and supplies, by regularly changing into clean, disposable nitrile gloves, by following field decontamination procedures and by preventing samples and used equipment from contacting other samples.

## 4.2. Sampling Methods, Containers and Labeling

The Field Coordinator will monitor consistency between the SAP, sample containers/labels, field log books, and the chain of custody (COC) form.

### 4.2.1. Sampling Methods and Containers

The Field Coordinator will establish field protocol to manage field sample collection, handling, and documentation. Soil, soil vapor and groundwater samples obtained during this study will be placed in appropriate laboratory-prepared containers. Sufficient sample volume will be obtained for the laboratory to complete the method-specific QC analyses. Additional volumes of soil will need to be collected from appropriate borings for physical testing; sample volumes needed will be provided by the chosen laboratory. Sample containers and preservatives are listed in Table B-4.

### 4.2.2. Sample Labeling

Sample containers will be labeled as described in the SAP.

## 4.3. Sample Handling

Soil and groundwater samples will be placed in a cooler with “blue ice” or double-bagged “wet ice” immediately after they are collected. The objective of the cold storage will be to attain a sample temperature of 4 degrees Celsius. Soil-vapor samples will be placed in the laboratory provided shipping boxes and not stored or shipped in a cooler. Holding times will be observed during sample storage. Holding times for the project analyses are summarized in Table B-4.

The samples will be transported and delivered to the analytical laboratory in the coolers by field personnel, laboratory personnel, by courier service or shipping company. The Field Coordinator will monitor that the shipping container (cooler) has been properly secured using clear plastic tape and custody seals.

Measures will be implemented to minimize the potential for sample breakage, which includes packaging materials and placing sample bottles in the cooler in a manner intended to minimize damage. Sample bottles will be appropriately wrapped with bubble wrap or other protective material before being placed in coolers. Trip blanks will be included in coolers with samples.

## 4.4. COC Records

The Field Coordinator is responsible for the security of samples from the time the samples are taken until the samples have been received by the shipper or laboratory. A COC form will be completed at the end of each field day for samples being shipped to the laboratory. Information to be included on the COC form include the following.

- Project name and number.
- Sample identification number.
- Date and time of sampling.
- Sample matrix (soil, water, etc.) and number of containers from each sampling point, including preservatives used.
- Analyses to be performed.
- Names of sampling personnel and transfer of custody acknowledgment spaces.
- Shipping information including shipping container number.

The original COC record will be signed by a member of the field team and bear a unique tracking number. Field personnel shall copy or scan the COC and place the original and remaining copies in a plastic bag, placed within the cooler or taped to the inside lid of the cooler before sealing the container for shipment. This record will accompany the samples during transit by carrier to the laboratory.

### 4.5. Laboratory Custody Procedures

The laboratory will follow their standard operating procedures (SOPs) to document sample handling from time of receipt (sample log-in) to reporting. The COC will be signed by the laboratory personnel, and the conditions of the samples will be recorded on the form. Documentation by the laboratory will include, at a minimum, the analyst's name or initials, and the time and date at which the samples are received, and the temperature of the samples at receipt. The original chain-of-custody form will remain with the laboratory and copies will be returned to the relinquishing party.

### 4.6. Field Documentation

Field documentation provides important information about potential problems or special circumstances surrounding sample collection. Field personnel will maintain daily field logs while on-site as described in the SAP. The Field Coordinator is responsible for the field log books.

## 5.0 CALIBRATION PROCEDURES

### 5.1. Field Instrumentation

Equipment and instrumentation calibration facilitates accurate and reliable field measurements. Field and laboratory equipment used on the project will be calibrated and adjusted in general accordance with the manufacturer's recommendations. Methods and intervals of calibration and maintenance will be based on the type of equipment, stability characteristics, required accuracy, intended use, and environmental conditions. The basic calibration frequencies are described below.

The PID used for vapor measurements will be calibrated daily, if required (based on the model used), for site safety monitoring purposes in general accordance with the manufacturer's specifications. If daily calibration is not required for a specific PID model, calibration of the PID will be checked to make sure it is up to date. The calibration results will be recorded in the field logbook.

The YSI water quality measuring system will be calibrated or calibration-checked prior to each monitoring event in accordance with the manufacturer's specifications. Results will be recorded in the field report.

### 5.2. Laboratory Instrumentation

For analytical chemistry, calibration procedures will be performed in accordance with the methods cited and laboratory SOPs. Calibration documentation will be retained at the laboratory and readily available for a period of six months.

## 6.0 DATA REPORTING AND LABORATORY DELIVERABLES

Laboratory data reports will include internal laboratory quality control checks and sample results. Analytical data will be supplied in both electronic data deliverable (EDD) format and PDF format. The PDF will serve as the official record of laboratory results. The EDDs will contain only data reported in the hard copy reports (e.g., only reportable results).

## 7.0 INTERNAL QC

The types and frequency of QC samples to be collected during the site characterization including both field QC and Laboratory QC samples are summarized in Table B-5 - Quality Control Samples Type and Frequency.

### 7.1. Field QC

Field QC samples serve as a control and check mechanism to monitor the consistency of sampling methods and how background conditions, such as background volatile organic compounds (VOCs) in ambient air, influence environmental samples.

#### 7.1.1. Field Duplicates

In addition to replicate analyses performed in the laboratory, field duplicates also serve as measures for precision. Field duplicates (referred to as split samples) are created under ideal field conditions when a volume of the sample matrix is thoroughly mixed, placed in separate containers and identified as different samples. Field duplicates allow evaluation of both the precision and consistency of laboratory analytical procedures and methods, and the consistency of the sampling techniques used by field personnel.

One field duplicate will be collected for every 10 groundwater samples or one per sampling event when less than 10 samples are collected. One field duplicate will be collected for every 10 soil samples or one per sampling event when less than 10 samples are collected. One field duplicate will be collected for every 10 soil vapor samples or one per event when less than 10 samples are collected.

#### 7.1.2. Trip Blanks

Trip blanks accompany groundwater sample containers used for VOC analyses during shipment and sampling periods. One trip blank will be used per cooler when samples are tested for VOCs. Trip blanks will be analyzed for VOCs.

### 7.1.3. Rinseate Blanks

Field rinseate blanks will consist of deionized water, passed over and through decontaminated sampling equipment (if disposable equipment is not used). Surfaces and materials exposed during actual sampling will be decontaminated per the SAP, and then rinsed with deionized water and the rinseate sampled to evaluate effectiveness of equipment decontamination procedures and the potential for equipment cross contamination. Rinseate samples will be collected at a rate of one for every 20 field samples with minimum of one sample per day of field sampling.

## 7.2. Laboratory QC

Laboratory QC procedures will be evaluated through a formal data verification process. The analytical laboratory will follow standard method procedures that include specified QC monitoring requirements. These requirements will vary by method but generally include the following.

- Laboratory method blanks.
- Internal standards.
- Calibrations.
- MS/matrix spike duplicates (MSD).
- LCS/laboratory control spike duplicates (LCSD).
- Laboratory replicates or duplicates.
- Surrogate spikes.

### 7.2.1. Laboratory Method Blanks

Laboratory procedures employ the use of several types of blanks but the most commonly used blank for QA/QC assessments are method blanks. Method blanks are laboratory QC samples that consist of either HPLC water or a soil-like material having undergone a contaminant destruction process.. Method blanks are extracted and analyzed with each batch of environmental samples undergoing analysis. Method blanks are particularly useful during volatiles analysis since VOCs can be transported in the laboratory through the vapor phase. If a substance is found in the method blank then one (or more) of the following may have occurred:

- Measurement apparatus or containers were not properly cleaned and contained contaminants.
- Reagents used in the process were contaminated with a substance(s) of interest.
- Contaminated analytical equipment was not properly cleaned.
- Volatile substances in the air with high solubility or affinities toward the sample matrix contaminated the samples during preparation or analysis.

It is difficult to determine which of the above scenarios took place if blank contamination occurs. However, it is assumed that the conditions that affected the blanks also likely affected the project samples. Given method blank results, validation rules assist in determining which substances in samples are considered "real," and which ones are attributable to the analytical process. Furthermore, the guidelines state, "there may be instances where little or no contamination was present in the associated blank, but qualification of the sample is deemed necessary. Contamination introduced through dilution water is one example."

### 7.2.2. Calibrations

Several types of calibrations are used, depending on the method, to determine whether the methodology was 'in control' by verifying the linearity of the calibration curve and to assure that the sample results reflect accurate and precise measurements. The main calibrations used are initial calibrations, daily calibrations, and continuing calibration verification.

### 7.2.3. MS/MSD

MS/MSD samples are used to assess influences or interferences caused by the physical or chemical properties of the sample itself. For example, extreme pH affects the results of semivolatile organic compounds (SVOCs), or, the presence of a particular compound may interfere with accurate quantitation of another analyte. MS/MSD data are reviewed in combination with other QC monitoring data to determine matrix effects. In some cases, matrix affects cannot be determined due to dilution and/or high levels of related substances in the sample. A MS is evaluated by spiking a known amount of one or more of the target analytes ideally at a concentration of 5 to 10 times higher than the sample result. A percent recovery is calculated by subtracting the sample result from the spike result, dividing by the spiked amount, and multiplying by 100.

The samples for the MS and MSD analyses should ideally be from a boring or sampling location that is believed to exhibit low-level contamination. A sample from an area of low-level contamination is needed because the objective of MS/MSD analyses is to determine the presence of matrix interferences, which can best be evaluated where contaminant levels are low. MS/MSD samples will be homogenized to achieve a level of representativeness and reproducibility in the data.

### 7.2.4. LCS/LCSD

Also known as blank spikes, LCSs are similar to MSs in that a known amount of one or more of the target analytes are spiked into a prepared media and the percent recovery of the spiked substances is calculated. The primary difference between a MS and LCS is that the LCS media is considered "clean" or contaminant free. For example, HPLC water is typically used for LCS water analyses. The purpose of an LCS is to help assess the overall accuracy and precision of the analytical process including sample preparation, instrument performance, and analyst performance. LCS data must be reviewed in context with other controls to determine if out-of-control events occur.

### 7.2.5. Laboratory Replicates/Duplicates

Laboratories often utilize MS/MSDs, LCS/LCSDs, and/or replicates to assess precision. Replicates are a second analysis of a field collected environmental sample. Replicates can be split at varying stages of the sample preparation and analysis process, but most commonly occur as a second analysis on the extracted media.

### 7.2.6. Surrogate Spikes

The purpose of using a surrogate is to verify the accuracy of the instrument being used and extraction procedures. Surrogates are substances similar to but not one of the target analytes. A known concentration of surrogate is added to the sample and passed through the instrument noting the surrogate recovery. Each surrogate used has an acceptable percent recovery range. Sample results may be biased low if a surrogate recovery is low. A possibility of false negatives may exist depending on the recovery value. Conversely, when recoveries are above the specified range of acceptance, a possibility of false positives exists, although non-detected results are considered accurate.

## 8.0 DATA REDUCTION AND ASSESSMENT PROCEDURES

### 8.1. Data Reduction

Data reduction involves the conversion or transcription of field and analytical data to a useable format. The laboratory personnel will reduce the analytical data for review by the QA Leader and PM.

### 8.2. Field Measurement Evaluation

Field data will be reviewed by the Field Coordinator at the end of each day by following the QC checks outlined below and procedures in the SAP. Field data documentation will be checked against the applicable criteria as follows:

- Sample collection information.
- Field instrumentation and calibration.
- Sample collection protocol.
- Sample containers, preservation and volume.
- Field QC samples collected at the frequency specified.
- Sample documentation and COC protocols.
- Sample shipment.

Cooler receipt forms and sample condition forms provided by the laboratory will be reviewed for out-of-control incidents. The consultant report will identify discrepancies that may affect data quality. Sample collection information will be reviewed for accuracy before inclusion in a final report.

### 8.3. Field QC Evaluation

A field QC evaluation will be conducted by reviewing field log books and daily reports, discussing field activities with field staff, and reviewing field QC samples (trip blanks and field duplicates). Trip blanks will be evaluated using the same criteria as method blanks.

### 8.4. Laboratory Data QC Evaluation

The laboratory data assessment will consist of a formal review of the following QC parameters:

- Holding times
- Method blanks
- MS/MSD
- LCS/LCSD
- Surrogate spikes

- Replicates

Other documentation such as cooler receipt forms and case narratives will be reviewed to fully evaluate laboratory QA/QC in addition to these QC mechanisms.

### 8.5. Environmental Information Management System Submittal

Chemical analytical results for soil and groundwater samples collected will be submitted to the Ecology Environmental Information Management (EIM) database.

## 9.0 REFERENCES

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# Table B-1

## Methods of Analysis and Target Reporting Limits for Soil Samples

### Former Alderwood Laundry and Dry Cleaners
### Lynnwood, Washington

| Analyte | Soil Screening Level[1] (mg/kg) | | Target Reporting Limit (mg/kg)[2] |
|---|---|---|---|
| | Vadose Zone | Saturated Zone | |
| **Volatile Organic Compounds by EPA Method 8260D** | | | |
| Tetrachloroethene | 0.050 | 0.0028 | 0.0025 |
| Trichloroethene | 0.025 | 0.002 | 0.001 |
| 1,1-Dichloroethene | 0.460 | 0.0025 | 0.0025 |
| cis-1,2-Dichloroethene | 0.078 | 0.005 | 0.0025 |
| trans-1,2-Dichloroethene | 0.520 | 0.032 | 0.0050 |
| Vinyl Chloride | 0.0017 | 0.000089 | 0.00116 |

**Notes:**

[1] Target screening level is based on Model Toxics Control Act Method B criteria protective of groundwater.
Vadose zone versus saturated zone samples will be based on field conditions.

[2] Target reporting limits were obtained from Pace National, a Washington State Department of Ecology (Ecology) accredited laboratory.

mg/kg = milligram per kilogram

EPA = U.S. Environmental Protection Agency

MTCA = Model Toxics Control Act

SM = standard method

# Table B-2

## Methods of Analysis and Target Reporting Limits for Water Samples

### Former Alderwood Laundry and Dry Cleaners

### Lynnwood, Washington

| Analyte | Groundwater Screening Level (µg/L)[1] | Target Reporting Limit (µg/L)[2] |
|---|---|---|
| **Conventionals and Other Organics** | | |
| Ammonia by SM 4500-NH3 | NE | 250 [3] |
| Biological Oxygen Demand (BOD) by SM 5210B | NE | 1,000 |
| Nitrate+Nitrite by EPA 353.2 | 1,600 | 10 [3] |
| Sulfate by EPA 9056 | NE | 500 |
| Total Organic Carbon (TOC) by SM 5310B | NE | 0.5 |
| **Metals by EPA 6010/200.7** | | |
| Total and Dissolved Iron | 11,000 | 100 |
| Total and Dissolved Manganese | 750 | 10 |
| **Volatile Organic Compounds by EPA Method 8260D** | | |
| Tetrachloroethene | 5 | 1 |
| Trichloroethene | 5/1.6 | 1 |
| 1,1-Dichloroethene | 400 | 1 |
| cis-1,2-Dichloroethene | 16 | 1 |
| trans-1,2-Dichloroethene | 160 | 1 |
| Vinyl Chloride | 0.2 | 0.0273 |
| **Dissolved Gases by RSK-175** | | |
| Methane | NE | 0.654 |
| Ethane | NE | 1.23 |
| Ethene | NE | 1.14 |
| Acetylene | NE | 1.06 |

**Notes:**

[1] Target screening level is based on MTCA Method A cleanup level or the MTCA Method B screening level. MTCA Method B screening level protective of indoor air is shown if lower than MTCA Method A cleanup level.

[2] Target reporting limits were obtained from Pace National, a Washington State Department of Ecology (Ecology) accredited laboratory.

[3] Lab results are presented in mg-N/L. Expressed as total nitrogen and ammonia.

NE = not established

SM = standard method

µg/L = microgram per liter

EPA = U.S. Environmental Protection Agency

MTCA = Model Toxics Control Act

SM = standard method

# Table B-3

## Methods of Analysis and Target Reporting Limits for Soil Vapor Samples

### Former Alderwood Laundry and Dry Cleaners

### Lynnwood, Washington

| **Matrix** | **Soil Vapor** | |
|---:|---|---|
| **Analysis Method** | **EPA TO-15** | |
| **Analyte** | **MTCA Method B Soil Vapor Screening Level ($\mu g/m^3$)** | **Target Reporting Limit - 1 L ($\mu g/m^3$)[1]** |
| Tetrachloroethene (PCE) | 321 | 2.8 |
| Trichloroethene (TCE) | 12.3 | 2.2 |
| 1,1-Dichloroethene | 3,050 | 1.58 |
| cis-1,2-Dichloroethene | not available | 1.58 |
| trans-1,2-Dichloroethene | not available | 1.58 |
| Vinyl chloride | 9.33 | 1.4 |

**Notes:**

[1] Laboratory reporting limits were obtained from Pace Analytical, a Washington State Department of Ecology accredited laboratory.

$\mu g/m^3$ = microgram per cubic meter

EPA = United States Environmental Protection Agency

# Table B-4

## Test Methods, Sample Containers, Preservation and Hold Times

### Former Alderwood Laundry and Dry Cleaners
### Lynnwood, Washington

| | | Soil | | | | Groundwater | | | | Soil Vapor | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Analysis | Method | Minimum Sample Size | Bottle Size | Preservation | Holding Times | Minimum Sample Size | Bottle Size | Preservation | Holding Times | Minimum Sample Size | Bottle Size | Preservation | Holding Times |
| Nitrogen (Nitrate and Nitrite) | EPA 353.2 | NA | NA | NA | NA | 500 ml | 500 amber bottle | ≤ 6°C; No Preservative | 28 days | NA | NA | NA | NA |
| Ammonia ($NH_3$) | SM 4500-NH3 | NA | NA | NA | NA | 500 ml | 500 ml HDPE | $H_2SO_4$ pH<2, ≤ 6°C | 28 days | NA | NA | NA | NA |
| Biological Oxygen Demand (BOD) | SM 5210B | NA | NA | NA | NA | 1000 ml | 1-Liter HDPE | ≤ 6°C | 2 days | NA | NA | NA | NA |
| Sulfate | EPA 9056 | NA | NA | NA | NA | 125 ml | 125 ml HDPE | ≤ 6°C | 28 days | NA | NA | NA | NA |
| Total Organic Carbon (TOC) | SM 5310B | NA | NA | NA | NA | 250 ml | 250 ml amber bottle | pH<2; $H_2SO_4$, ≤ 6°C | 28 days | NA | NA | NA | NA |
| Total Iron and Manganese | 6010 | NA | NA | NA | NA | 250 ml | 250 ml HDPE | pH<2; $HNO_3$, ≤ 6°C | 180 days | NA | NA | NA | NA |
| Dissolved Iron and Manganese | 6010 | NA | NA | NA | NA | 250 ml | 250 ml HDPE | ≤ 6°C | 180 days | NA | NA | NA | NA |
| Dissolved Gases (methane, ethane, ethene and acetylene) | RSK-175 | NA | NA | NA | NA | 40 ml | 2-40 ml VOA | pH<2; HCL, ≤ 6°C | 14 days | NA | NA | NA | NA |
| Volatile Organic Compounds (VOCs)/Helium | EPA 8260D/TO-15/ASTM-D1946 | Three 40 ml VOAs, | 4 oz glass with Teflon-lined lid, 40 ml VOA (pre-weighted) | ≤ 6°C | 48 Hours to Freeze/14 days | 40 ml | 2-40 ml VOA vial | HCl pH<2, ≤ 6°C | 14 days | NA | 1 Liter Summa Canister | None | 30 days |

**Notes:**

Extraction holding time is based on elapsed time from date of sample collection.
Poly = polycarbonate
HDPE = high-density polyethylene
SM = standard method
EPA = U.S. Environmental Protection Agency
°C = degree Celsius
oz = ounce
ml = milliliter

g = grams
NA = not applicable
SM = standard method
ASTM = ASTM International
HCl = hydrochloric acid
H2SO4 = sulfuric acid
VOA = volatile organic analysis

# Table B-5

## Quality Control Samples - Type and Frequency

### Former Alderwood Laundry and Dry Cleaners

### Lynnwood, Washington

| Samples Collected for Chemical Analytical Testing | Field QC | | | Laboratory QC | | | |
|---|---|---|---|---|---|---|---|
| | Field Duplicates | Trip Blank | Rinseate Blank | Method Blanks | LCS | MS/MSD | Lab Duplicates |
| Soil | 1 in 10 samples | None | One every 10 field samples with a minimum of one per sampling day | 1 per batch | 1 per batch | 1 per batch | 1 per batch[1] |
| Soil Gas | 1 in 10 samples | None | None | 1 per batch | 1 per batch | 1 per batch | 1 per batch[1] |
| Groundwater | 1 in 10 samples | One per sample storage cooler used for samples analyzed for VOCs | One every 10 field samples with a minimum of one per sampling day | 1 per batch | 1 per batch | 1 per batch [2] | 1 per batch[1] |

**Notes:**

[1] Lab duplicates are not completed on volatile organic compounds (VOCs) analysis because the MS/MSD serves as the lab duplicate sample.

[2] Two times the sample volume will be collected to provide adequate sample volume to perform MS/MSD analyses.

An analytical batch is defined as a group of samples taken through a preparation procedure and sharing a method blank, LCS, and MS/MSD (or MS and lab duplicate).

One batch will comprise no more than 30 field samples.

LCS = laboratory control sample

MS = matrix spike sample

MSD = matrix spike duplicate sample

VOCs = volatile organic compounds

QC = quality control

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