Groundwater Monitoring Plan

BURLINGTON ENVIRONMENTAL, LLC WASHOUGAL FACILITY
WASHOUGAL, WASHINGTON

April 2022

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1.0 INTRODUCTION

Dalton, Olmsted, and Fuglevand, Inc. (DOF), prepared this Groundwater Monitoring Plan (GMP) on behalf of Burlington Environmental, LLC, which was purchased by CleanEarth, a Harsco company, in 2020. The name Burlington is used inthis GMP to refer to these companies. This GMP was prepared pursuant to the Resource Conservation and Recovery Act (RCRA) Permit (No. WAD092300250), and with the requirements of the Washington State Department of Ecology (Ecology), for the Burlington Environmental Washougal Facility located at 632 South 32nd Street in Washougal, Washington. This version of the GMP was finalized following a 2021 public review period (DOF, 2021).

1.1 Background and Objective

The GMP is designed to monitor the groundwater at the Washougal Site. It utilizes existing groundwater monitoring wells installed on and adjacent to the Burlington property. The monitoring wells, analyses conducted, and frequency of sampling are included in Table 1. The monitoring wells are located to provide adequate information on (1) groundwater flow at the site, (2) groundwater units underlying the site; and (3) groundwater leaving the site and flowing to off-site, downgradient and cross-gradient locations.

Hydrogeology at the Washougal Site is characterized by a Shallow Groundwater Zone and Lower Aquifer, separated by a Silt Layer that acts as a somewhat leaky aquitard between these two groundwater-bearing zones. The high organic carbon content in the Silt Layer also adsorbs and retards the migration of organic materials, including many of the contaminants at the Site. The vadose zone exists entirely within a sandy unit present above the Silt Layer, with a depth to groundwater varying from 1 to 4 feet below ground surface during the wet season. The Silt Layer and the sand/gravel unit below are fully saturated and below the water table year-round (DOF,2020).

The Remedial Investigation (AMEC, 2013) and Feasibility Study (DOF,2020) identified chemicals of concern (COCs) in groundwater related to historical releases at the site, primarily in the area of the former hazardous waste management tank farm near the center of the property. An interim action was performed at the site to remove contamination from this source area and groundwater has and will continue to be monitored in and around this area as part of this GMP. Historical quarterly sampling provided a robust seasonal data set for use in the remedial investigation and feasibility study. Monitoring will continue on a semi-annual basis to capture high and low water table periods under this GMP schedule shown in Table 1 and groundwater samples analyzed for COCs shown in Table 2. Monitoring well network inspections will continue on a quarterly basis. A well inspection form is included in Attachment A.

1.2 Scope of Plan

This plan addresses the following major elements:

- Description of the groundwater monitoring network;
- Procedures for completing water-level surveys, groundwater sampling, well evacuation, field decontamination, sample storage and transportation, sample analysis, and quality assurance/quality control;

- Procedures and requirements for new well construction, maintenance, and decommissioning;
- Requirements for reporting and notification;
- Personnel functions and responsibilities;
- Worker health and safety planning;
- How the plan objective will be met; and
- Field and laboratory quality assurance.

2.0 MONITORING NETWORK

The groundwater monitoring well network and maintenance program for the Washougal site are described in this section.

2.1 Monitoring Well Locations

The locations of the full groundwater monitoring network are shown on Figure 1. Figure 1 shows the monitoring wells that will be monitored for both water levels and chemical constituents during sampling events.

2.2 Monitoring Well Numbering System

Several well numbering designation approaches have been used at the Washougal site since installation of the monitoring network started in the 1985. Any new wells will be named with the prefix “MC” (representative of the original McClary Columbia site name), followed by a number designation, as shown on Figure 1. Any replacement wells will use the same prefix and number designation as the abandoned well and an “R” will be assigned to the name to designate the well as a replacement. Wells installed below the silt unit will be assigned a “D” to designate they are screened in the Lower Aquifer, similar to the approach used for the existing wells at the Washougal site.

2.3 Monitoring Well Construction

For all wells in the groundwater monitoring network, well construction details are summarized in Table 2. Well construction details provided in Table 3 include installation date, drilling contractor, total borehole depth, initial total well depth and information on casing, screen, filter pack and seals. Well logs are provided in Attachment B.

2.4 Monitoring Well Survey

In the Public Land Survey System, the facility is located in the Section 17, Township 1N, Range 4E, Willamette Meridian. All survey data are recorded relative to this section, township, and range. All vertical survey data was based on the National Geodetic Vertical Datum (NGVD) of 1929 and converted to the North American Vertical Datum (1988). All horizontal data are provided relative to the Washington State Plane Coordinate System, South Zone (North American Datum, 1983/91). The survey coordinates for each well in the monitoring network are provided in Table 4.

2.5 Monitoring Well Network Inspection, Maintenance, and Replacement

This section describes a program to provide regular inspection, and if necessary, maintenance of the monitoring wells and associated equipment. In addition, well construction and decommissioning procedures are presented in this section. Attachment A contains related Standard Operating Procedures for well maintenance and replacement, and also includes a well inspection field checklist to be used.

2.5.1 Well Inspection

The integrity of monitoring wells at the site will be inspected by the sampling team quarterly. The inspection involves an all-inclusive visual inspection of each well to determine if it has been damaged or tampered with, and verifies the physical condition of the well at the ground surface as well as the internal well casing. Problems discovered during the inspection will be recorded in a field inspection logbook, as well as a well inspection checklist (Attachment A), and a copy will be provided to the Corrective Actions Project Manager. Problems that require immediate attention will be reported to the Project Manager so as to remedy the condition prior to the next sampling event. If a significant problem such as a broken well head, bent casing, or other damage that compromises well access is discovered, it may be necessary to remedy the problem before sampling. A problem with the well integrity may require a modification of the sampling schedule or some other change in the sampling program. All decisions regarding such modifications will be addressed by the Project Manager, who will notify and request approval from the regulatory agencies regarding such issues. The Project Manager will notify Ecology by telephone or in writing within 15 days of any visible damage to or deterioration of wells.

2.5.2 Maintenance

Borehole integrity will be maintained at each well. Borehole integrity is assessed by pulling the dedicated pumps and measuring the total well depths. This procedure was last performed as part of the December 2019 sampling event and will be performed subsequently on a five-year basis. If more than one foot of sediment has built up in the bottom of the well, the well will be redeveloped and the sediment removed, per Burlington's previously approved Standard Operating Procedure (SOP)-121 (Attachment A). The five-year period is based on experiences from annually checking wells at the Burlington site.

All pumps and other sampling equipment used for groundwater monitoring will be maintained regularly by the sampling team member(s) according to the equipment manuals and manufacturers' recommendations.

2.5.3 Monitoring Well Replacement

If any monitoring well in the network must be replaced, efforts will be made to replace the well prior to the next sampling event. The Project Manager will submit to Ecology a written explanation of the rationale for the well's replacement and the time frame and location for the replacement, at least 15 days prior to decommissioning. The replacement will be completed within 45 days of Ecology approval unless otherwise approved by Ecology.

If it is agreed that the well should be replaced, the replacement well will be installed as close as possible to the well being replaced. A monitoring well construction form will be completed for the new well and a copy will be submitted to the agency. When necessary, wells will be decommissioned following the procedures specified in Section 2.5.5.

2.5.4 Monitoring Well Construction

A qualified geologist will inspect the drilling and construction of all new or replacement monitoring wells consistent with SOP 105 and the procedures below. A detailed log of each well will be prepared. The logs and descriptions will include the following information:

- Date and time of construction;
- Drilling method and any drilling fluid used;
- Well location (surveyed to within 0.5 foot);
- Borehole diameter and well casing diameter;
- Well depth (to within 0.1 foot);
- Initial depth to water (to within 0.1 foot);
- Drilling logs and lithologic logs from the field, including a description of soil or rock types, depth to water, color, weathering, texture, structure, and fractures;
- Casing materials;
- Screen material and design, including screen length and slot size;
- Casing and screen joint type;
- Filter pack material, including size, placement method, and approximate volume;
- Composition and approximate volume of sealant material and method of placement;
- Surface seal design and construction;
- Well development procedures;
- Ground surface elevation (to within 0.01 foot);
- Top-of-casing elevation (to within 0.01 foot); and
- Detailed drawing of well, including dimensions.

The logs and descriptions, as-built drawings, and location of the new well will be submitted to Ecology within 30 calendar days of well completion or according to the schedule approved by Ecology in specific work plans.

2.5.5 Monitoring Well Decommissioning

Requests for decommissioning wells will be submitted to Ecology for review and approval. Wells will be decommissioned in accordance with WAC 173-160-460 (Abandonment of Resource Protection Wells), and applicable updates. The selected drilling contractor will file the appropriate notification of well abandonment with Ecology. In addition, the project manager will provide written rationale for the decision to decommission the well at least 30 days prior to the decommissioning. If the well being decommissioned is being replaced, it should be decommissioned no later than 90 days after installation of the replacement well.

Wells not needed for groundwater or water level monitoring will be decommissioned upon request to, and approval by, Ecology. Such wells will be decommissioned within 45 days of receipt of Ecology's approval, or a request from Ecology to decommission.

Minor deviations from the decommissioning procedures that are deemed necessary due to unforeseen events in the field at the time of well abandonment will be noted in the operating record and reported to Ecology, along with an explanation of the need for the deviation. Significant deviations will require prior approval from Ecology.

3.0 GROUNDWATER MONITORING PROCEDURES

The subsections below describe each of the principal components of the groundwater monitoring program. All of the work will be conducted in accordance with the Quality Assurance Project Plan (QAPP) included as Attachment C.

3.1 Water Level Monitoring

Water level measurements will be collected semi-annually in March and September on the Washougal site. Wells monitored include monitoring wells and piezometers across the Washougal site. The wells included in the water level monitoring events are presented in Table 1 and shown on Figure 1.

Water-level measurements will be performed by the sampling team. The procedures for these measurements are provided below.

3.1.1 Schedule

A water-level measurement event will be conducted in accordance with the schedule presented in Table 1. Water level measurements will be conducted prior to the corresponding groundwater sampling event (if applicable), and measurements will be obtained within as short a time as possible prior to sampling, not to exceed one working day.

3.1.2 Procedures

The procedure for measuring water levels is described in SOP-120, presented in Attachment A. Wells will be vented prior to measurement to allow water levels to stabilize before measurement. Water level measurements and well venting times will be recorded in the field on a water level measurement form (Attachment A).

3.1.3 Equipment

Equipment used for the water-level survey is listed in the Ecology-approved SOP-120, as provided in Attachment A. Depth-to-water measurements will be made using an electronic water-level meter. The meter consists of a coaxial cable or plastic-coated flat wire permanently marked with increments of 0.01 foot, a detection probe, and electronic controls contained in a spool or reel. The water-level meter/sounder registers a response when the probe attached to the cable contacts an electrically conductive medium such as water, thereby completing the electrical circuit. The response is visible (e.g., red light), audible (e.g., alarm), or a combination of the two.

3.1.4 Reporting

All water-level data will be recorded in the field on water-level data forms. The water-level data forms facilitate transmission of data from the field to the office. The field form will be provided to the Project

Manager to file with the site field forms. The water level data will be used to create potentiometric contour maps and a summary table of the water-level measurements, which will be included with semi-annual reports.

3.2 Water Quality Monitoring

This section describes the equipment used and the procedures for groundwater sampling, field decontamination, field records preparation, sample identification, and sample storage and transport for water quality testing.

3.2.1 Schedule

Groundwater samples will be collected in accordance with the schedule presented in Table 1. Figure 1 shows the locations of wells used for groundwater sampling.

3.2.2 Groundwater Sampling Procedure

Groundwater samples will be collected following the procedures outlined in Ecology- approved SOP-124, presented in Attachment A. This is a low-flow groundwater sampling methodology based on groundwater sampling guidance and comments from Ecology and the U.S. Environmental Protection Agency under RCRA. The groundwater sampling procedure involves purging groundwater from the monitoring well prior to sampling at a flow rate less than 500 milliliters per minute (mL/min.). During the purging, groundwater quality parameters, including temperature, pH, turbidity, dissolved oxygen, oxidation/reduction potential (ORP), and specific conductivity, will be monitored approximately every 3 minutes, and purging will be conducted until these parameters stabilize within criteria outlined in SOP-124. Once the water quality parameters have stabilized, groundwater samples will be collected using a flow rate of less than 500 mL/min.

3.2.3 Equipment

The monitoring wells included in this plan will be sampled with dedicated bladder pumps or peristaltic pump using dedicated polyethylene tubing. The pump intake will be set at mid-screen for sampling or mid-water column if the top of the screen is above the water table. Other equipment to be used for well evacuation is listed in SOP 124 (Attachment A). This equipment includes a flow-through water quality meter, turbidity meter, water level meter. All meters will be calibrated according to instrument instructions. The calibration results for each parameter will be recorded in the field logbook.

3.2.4 Field Decontamination Procedures

The decontamination procedures for all nondedicated field sampling equipment are outlined in Ecology-approved SOP 200 (provided in Attachment A). This equipment includes any instrument that is placed in a well or comes in contact with the groundwater sample, including the water-level indicator and any non-dedicated pump.

The flow-through water quality meter requires decontamination with deionized water, but not with soaps or solvents, which may adversely affect the probes in the meter. The flow-through cell will be disconnected prior to sample collection; therefore, groundwater collected for laboratory analysis at the laboratory will not contact the flow-through cell.

3.2.5 Field Records

Ecology-approved SOP 400, presented in Attachment A, contains a description of field logbook documentation procedures required for field sampling events. Field observations for well evacuation and groundwater sampling will be recorded in the field in the logbook and on monitoring well water sampling sheets or electronic data forms (Attachment A). The sampling sheet or electronic form will be designed to help the sampling team determine when the water quality parameters are stable enough to collect a sample and also facilitates transmission of data from the field to the office. The following information will be recorded during well evacuation: well identification, date, sampling personnel, beginning and ending water levels, sampling method, equipment used, and samples collected. Readings of water quality parameters (pH, specific conductivity, temperature, turbidity, dissolved oxygen, and ORP) will be recorded on the sheet approximately every 3 minutes, along with flow rate and pump speed.

3.2.6 Sample Label and Identification System

A sample label will be affixed to each sample bottle before sample collection. Each label will include the following information:

- Sample number (see below),
- Sampling event location,
- Date and time of sample collection,
- Preservatives added to the sample, and
- Analytes for which the sample is to be analyzed.

Water samples will be labeled with a unique sample number. The sample number consists of the appropriate monitoring well designation followed by, and separated by a hyphen from, a date identification code. The date identification code consists of a four-digit number that represents the month and year that the sample was collected. For instance, the sample number MC-24-0617 denotes a sample collected in June 2017 from monitoring well MC-24.

Quality control samples will follow a similar nomenclature. Field duplicate samples will be labeled the same as regular samples, except a “9” will be added to the sample number preceding the well number and separated by hyphens on either side (e.g., MC-9-24-0617). Matrix spike and matrix spike duplicate (MS/MSD) samples will be labeled the same as regular samples, but it should be noted on the chain-of-custody form that extra volume was collected for MS/MSD. Field blank samples will be labeled “Field Blank#1-0617” and trip blank samples will be labeled “Trip Blank#1-0617”, with each consecutive blank having a different numeral after “#” sign. The location at which field blanks are collected should be noted in the field logbook and/or field form. Equipment blanks will not normally be collected but might be necessary if non-dedicated tubing or bailers are used during groundwater sampling. If they are collected, equipment blanks will be labeled “Equipment Blank#1-0617” and, if collected, the location should be noted in the field logbook and/or field form.

3.2.7 Sample Storage and Transportation

After sampling is completed for the day, all samples will be packed for shipping and placed in ice cooled transport containers. The transport containers will consist of sturdy, insulated, commercially produced

coolers. All bottle caps will be secured tightly, and all glass containers will be secured into position within the shipping container to avoid breakage. Trip blanks will be included in any transport container that carries water samples being analyzed for VOCs or TPH as gasoline. A custody seal will be affixed to the container prior to laboratory pickup or delivery. The chain-of-custody form should be taped to the top of the cooler or shipping container in most circumstances.

During sample collection or at the end of each day and prior to shipping or storage, chain-of-custody forms will be completed for all samples by a designated field team member. The information on the sample labels will be rechecked and verified against field logbook entries and the chain-of-custody forms. The chain-of-custody form should include information such as sample name, sample time, sample date, type of medium, and analyses requested. Any necessary changes to chain of custody forms, sample container labels, or the field logbook will be made by striking out the error with one line and entering the correct information. The new entries will be initialed and dated. Samples with extra volume for laboratory quality control protocols (MS/MSD and laboratory duplicates) will be designated as such on the chain-of-custody form. The field team should ensure that analyte method numbers and analyte lists required for the project are either listed on the chain-of-custody form, attached to the chain-of-custody form, or referred to on the chain of custody form. Every person who takes possession of the samples while transporting the samples from the field to the laboratory must sign the chain-of-custody form.

For most samples, the field team will ship samples overnight via a national parcel courier service (e.g., FEDEX) for delivery to the laboratory. Upon receipt of the sample transport containers by the analytical laboratory, laboratory personnel will open the containers and examine the contents for problems, such as damaged transport containers, broken custody seals, missing or broken sample bottles, chain-of-custody discrepancies, and documentation errors. Problems will be reported to the Project Manager.

3.2.8 Analytical Procedures

The sampling and analysis schedule for this plan is included in Table 1. Typical detection limits and more detailed information about the analytical methods are provided in the QAPP (Attachment B). Groundwater monitoring analytical data will be analyzed and validated in accordance with the requirements in the QAPP.

The analytical laboratory purchases new and certified clean sample bottles for each sampling event. The recommended specifications for bottle types, volume of sample required for analysis, and types of sample preservative required for analyses are provided in Table 4 of the QAPP. However, these recommendations may be modified by the laboratory as analytical methods are modified and improved.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

All work associated with the Groundwater Monitoring Plan will be conducted in accordance with the QAPP (Attachment C).

5.0 PERSONNEL FUNCTIONS AND RESPONSIBILITIES

All fieldwork will be completed in accordance with a project-specific Health and Safety Plan (HASP) which is included in Attachment D. The specific tasks of key personnel involved in the groundwater monitoring program are summarized below.

5.1 Burlington Corrective Action Project Manager

The function of the Project Manager will be to:

- Maintain correspondence between regulatory agencies and Burlington.
- Verify parameter requirements and modify the groundwater monitoring program if necessary.
- Maintain the groundwater monitoring network in good working condition.

5.2 Sampling Team Members

The functions of the sampling team members will be to:

- Learn and follow all of the procedures in this Groundwater Monitoring Plan.
- Notify the Project Manager of any unresolved problems or deviations from approved procedures.
- Obtain, maintain, and inspect all equipment used to fulfill their responsibilities.
- Oversee field sampling activities and equipment repair.
- Work to prevent sample and/or well contamination.
- Schedule sample analysis services with the analytical laboratory and the field sampling team.
- Verify or arrange for the shipment of sample bottles and sample transport containers, both from the analytical laboratory to the field and from the field to the laboratory.
- Calibrate equipment.
- Examine sample bottles, preservatives, and sample transport containers.
- Assume responsibility for storage and provide security of sample transport containers and sample equipment.
- Conduct health and safety meetings, and implement safety requirements.
- Provide field technical guidance for sampling and maintenance procedures.
- Perform or supervise the water-level survey and well inspection.
- Maintain lines of communication between those personnel involved in the field sampling activities, the Project Manager, and the analytical laboratory.
- Maintain or service all dedicated sampling equipment.
- Take all field measurements.

- Purge monitoring wells.
- Collect and preserve samples.
- Check that samples are correctly identified and packed securely with ice in the sample transport container(s).
- Take neat and complete field notes.
- Update the Washougal site monitoring well information tables.
- Trend Analyses of the significant COCs for the semi-annual sampling.

6.0 SCHEDULE

Ecology will be notified at least seven days in advance of any monitoring events.

Quarterly monitoring events were historically conducted on the Washougal site (typically March, June, September, and December). Following approval of this Groundwater Monitoring Plan, groundwater monitoring will occur semi-annually in the first quarter (typically in March) and third quarter (typically in September). Monitoring well inspections will be conducted quarterly.

7.0 REPORTING

A groundwater data analysis report will be submitted to Ecology after each semi-annual monitoring event is complete and within 30 days of receiving validated groundwater data. The report will summarize the data collected and activities performed with respect to the groundwater monitoring program over the previous two quarters. The report will include the following information:

- A description of groundwater monitoring activities completed during the reporting period;
- A description of any groundwater monitoring activities planned for the following reporting period;
- A summary of any problems, how problems were resolved, deviations from this plan, and a justification for all deviations;
- A summary of significant findings, changes in personnel, and significant contacts with all federal, state, and local governments and community and public interest groups;
- All laboratory analyses in tabulated data format for which quality assurance procedures were completed during the current time period and for upload to Ecology's Environmental Information Management database;
- A summary of constituent concentrations which exceed MTCA cleanup levels;
- All field measurements; and
- A table with measured groundwater elevations for each well as well as groundwater level contour maps.

8.0 REFERENCES

AMEC Environment & Infrastructure, Inc. (AMEC), 2013, Final Remedial Investigation Report, PSC Washougal Facility, Washougal, Washington: Prepared for Burlington Environmental, LLC,September.

DOF, 2020. Final Feasibility Study, Stericycle Washougal Facility, Washougal Washington, May 31.

DOF, 2021. Groundwater Monitoring Plan – Public Review Draft, Burlington Environmental, LLC, Washougal Facility, Washougal, Washington, July.

TABLES

Table 1

Groundwater Monitoring Schedule
Burlington Environmental, LLC Washougal Facility
Washougal, Washington

Well ID	Water Levels	Analyses			
		VOC by 8260D	VOC by 8260D w/SIM	1,4-Dioxane by 8270E w/SIM	Arsenic by 6020B
MC-1	1,3	1,3	1,3	1,3	1,3
MC-2	1,3	1,3	1,3	1,3	1,3
MC-2D	1,3	1,3	1,3	1,3	1,3
MC-8	1,3	1,3	1,3	1,3	1,3
MC-10D	1,3	1,3	1,3	1,3	1,3
MC-12	1,3	1,3	1,3	1,3	1,3
MC-12DR	1,3	1,3	1,3	1,3	1,3
MC-13	1,3	1,3	1,3	1,3	1,3
MC-13D	1,3	1,3	1,3	1,3	1,3
MC-14	1,3	1,3	1,3	1,3	1,3
MC-14D	1,3	1,3	1,3	1,3	1,3
MC-15	1,3	1,3	1,3	1,3	1,3
MC-15D	1,3	1,3	1,3	1,3	1,3
MC-16	1,3	1,3	1,3	1,3	1,3
MC-17	1,3	1,3	1,3	1,3	1,3
MC-17D	1,3	1,3	1,3	1,3	1,3
MC-19D	1,3	1,3	1,3	1,3	1,3
MC-20	1,3	1,3	1,3	1,3	1,3
MC-20D	1,3	1,3	1,3	1,3	1,3
MC-21	1,3	1,3	1,3	1,3	1,3
MC-24	1,3	1,3	1,3	1,3	1,3
MC-24D	1,3	1,3	1,3	1,3	1,3
MC-24D2	1,3	1,3	1,3	1,3	1,3
MC-25	1,3	1,3	1,3	1,3	1,3
MC-25D	1,3	1,3	1,3	1,3	1,3
MC-25D2	1,3	1,3	1,3	1,3	1,3
MC-26D2	1,3	1,3	1,3	1,3	1,3
MC-27D	1,3	1,3	1,3	1,3	1,3
MC-28D	1,3	1,3	1,3	1,3	1,3
MC-30	1,3	1,3	1,3	1,3	1,3
MC-30D	1,3	1,3	1,3	1,3	1,3
MC-31	1,3	1,3	1,3	1,3	1,3
MC-32	1,3	1,3	1,3	1,3	1,3
MC-33	1,3	1,3	1,3	1,3	1,3
MC-107R	1,3	1,3	1,3	1,3	1,3
MC-118D	1,3	1,3	1,3	1,3	1,3
MC-118D2	1,3	1,3	1,3	1,3	1,3
MC-122	1,3	1,3	1,3	1,3	1,3
MC-123	1,3	1,3	1,3	1,3	1,3
MC-124D	1,3	1,3	1,3	1,3	1,3
PZU-4	1,3	1,3	1,3	1,3	1,3
PZU-5R	1,3	1,3	1,3	1,3	1,3

Abbreviations
1 = First Quarter (March)
3 = Third Quarter (September)

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Table 2

Constituents of Concern Analyzed in Groundwater
Burlington Environmental, LLC Washougal Facility
Washougal, Washington

Inorganics		
Arsenic		
SVOCs		
1,4-Dioxane		
VOCs[1]		
1,1,1,2-Tetrachloroethane	1,4-Dichlorobenzene	Dibromochloromethane
1,1,1-Trichloroethane	2-Methylnaphthalene	Dichlorodifluoromethane
1,1,2,2-Tetrachloroethane	Benzene	Hexachloroethane
1,1,2-Trichloroethane	Bromodichloromethane	m,p-Xylenes
1,1-Dichloroethane	Bromoform	Methylene chloride
1,1-Dichloroethene	Bromomethane	Styrene
1,2,3-Trichloropropane	Carbon disulfide	Tetrachloroethene
1,2,4-Trichlorobenzene	Carbon tetrachloride	Toluene
1,2-Dibromo-3-chloropropane	Chlorobenzene	Trans-1,2,-Dichloroethene
1,2-Dibromoethane	Chloroethane	Trichloroethene
1,2-Dichloroethane	Chloroform	Vinyl chloride
1,2-Dichloroethene (total)	Chloromethane	
1,2-Dichloropropane	cis-1,2-Dichloroethene	

Notes

1. VOCs identified in Feasibility Study Table 2-2.

Abbreviations

SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

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Table 3

Well Construction Information [1]

Burlington Environmental, LLC Washougal Facility

Washougal, Washington

						Casing					Screen						Filter Pack			Seals			
						Depth Interval (ft bgs)					Depth Interval (ft bgs)						Depth Interval (ft bgs)			Depth Interval (ft bgs)			
Well ID	Installation Date	Contractor	Drilling Method	Total Borehole Depth (bgs) (ft bgs)	Initial Total Well Depth (bgs) (ft bgs)	Upper	Lower	Material	Nominal Diameter (inch)	Flush or Aboveground Monument	Upper	Lower	Screened Hydro-geologic Unit	Material	Nominal Diameter (inch)	Slot Size (inch)	Upper	Lower	Material	Upper	Lower	Material	Surface Seal
MC-1	22 Mar 1985	Geo-Tech Explorations,	Hollow stem auger	11.5	11.5	0.0	2.5	Sch. 80 PVC	2	Flush mount	2.5	11.5	Shallow	Sch. 80 PVC	2	0.01	2	11.5	No. 1 Monterey	0 0.5	0.5 2	Concrete Bentonite	Concrete, flush mount
MC-2	21 Mar 1985	not available	Hollow stem auger	13.5	13.5	0.0	2.5	Sch. 80 PVC	2	Flush mount	2.5	12.5	Shallow	Sch. 80 PVC	2	0.01	2	12.5	No. 1 Monterey	0 0.5	0.5 2	Concrete Bentonite	Concrete, flush mount
MC-2D	15 Jun 1990	Onwego Drilling Co.	Cable Tool	33	32.8	0.0	28	Sch. 40 PVC	2	Flush mount	28	33	Lower Aquifer	Sch. 40 PVC	2	0.01	25	33	10/20 Silica	0.0 1.5	1.5 25	Concrete Bentonite	Concrete, flush mount
MC-8	20 Mar 1985	Geo-Tech Explorations, Inc.	Hollow stem auger	11.5	11.5	0.0	2.5	Sch. 80 PVC	2	Above grade monument	2.5	11.5	Shallow	Sch. 80 PVC	2	0.01	2	11.5	No. 1 Monterey	0 0.5	0.5 2	Concrete Bentonite	Concrete, standpipe w/ locking cap
MC-10D	26 Jul 1999	Cascade Drilling, Inc.	Hollow stem auger	36	35	0.0	25.0	Sch. 40 PVC	2	Flush mount	25	35	Lower Aquifer	Sch. 40 PVC	2	0.01	23	36	10/20 Silica	0.0 2.0	2.0 23.0	Concrete Bentonite	Concrete, flush mount
MC-12	07 Jun 1985	Geo-Tech Explorations, Inc.	Hollow stem auger	9.5	7.75	0.0	2.5	Sch. 40 PVC	2	Above grade monument	2.5	7.5	Shallow	Sch. 40 PVC	2	0.01	2.0	9.5	No. 1 Monterey	0.0 1.0	1.0 2.0	Concrete Bentonite	Concrete, standpipe w/ locking cap
MC-12DR	13 Dec 2021	Cascade Drilling, Inc.	Sonic	23	22.4	0.0	17.0	Sch. 40 PVC	2	Flush mount	17	22	Lower Aquifer	Sch. 40 PVC	2	0.01	16.0	23.0	2/12 Silica	0.0 3.0	3.0 16.0	Concrete Bentonite	Concrete, flush mount, security bolt
MC-13	07 Jun 1985	Geo-Tech Explorations, Inc.	Hollow stem auger	12	9.2	0.0	2.5	Sch. 80 PVC	2	Above grade monument	2.5	9	Shallow	Sch. 80 PVC	2	0.01	2.0	12.0	No. 1 Monterey	0 0.5	0.5 2	Concrete Bentonite	Concrete, standpipe w/ locking cap
MC-13D	12 Feb 1991	Staco Well Services	Cable Tool	23.5	23.5	0.0	18.0	Sch. 80 PVC	2	Above grade monument	18	23.5	Lower Aquifer	Sch. 80 PVC	2	0.01	16.5	23.5	10/20 Silica	0.0 2.0	2.0 15.7	Concrete Bentonite	Concrete, standpipe w/ locking cap
MC-14	07 Jun 1985	Geo-Tech Explorations, Inc.	Hollow stem auger	16.5	9.3	0.0	4.0	Sch. 80 PVC	2	Above grade monument	4	9	Shallow	Sch. 80 PVC	2	0.01	3.0	16.5	No. 1 Monterey	0 0.5	0.5 3	Concrete Bentonite	Concrete, standpipe w/ locking cap
MC-14D	28 Sep 2007	Cascade Drilling, Inc.	Sonic	34.0	32.0	0.0	22.0	Sch. 40 PVC	2	Above grade monument	22	31.4	Lower Aquifer	Sch. 40 PVC	2	0.01	20	33	10/20 Silica	0.0 1.0	1.0 20.0	Concrete Bentonite	Concrete, standpipe w/ locking cap
MC-15	19 Sep 1985	Geo-Tech Explorations, Inc.	Hollow stem auger	8.5	8.5	0.0	2.5	Sch. 80 PVC	2	Above grade monument	2.5	8.5	Shallow	Sch. 80 PVC	2	0.01	1.5	8.5	No. 1 Monterey	0 0.33	0.33 1.5	Concrete Bentonite	Concrete, standpipe w/ locking cap
MC-15D	08 Jun 1990	Onwego Drilling Co.	Cable Tool	26.2	26.0	0.0	21.0	Sch. 40 PVC	2	Above grade monument	21	26	Lower Aquifer	Sch. 40 PVC	2	0.01	18	26.2	10/20 Silica	0 2	2 18	Concrete Bentonite	Concrete, standpipe w/ locking cap
MC-16	19 Sep 1985	Geo-Tech Explorations, Inc.	Hollow stem auger	7.5	7.5	0.0	2.5	Sch. 80 PVC	2	Above grade monument	2.5	7.5	Shallow	Sch. 80 PVC	2	0.01	2	7.5	No. 1 Monterey	0 0.5	0.5 2	Concrete Bentonite	Concrete, standpipe w/ locking cap
MC-17	19 Sep 1985	Geo-Tech Explorations, Inc.	Hollow stem auger	7.5	7.5	0.0	2.5	Sch. 80 PVC	2	Above grade monument	2.5	7.5	Shallow	Sch. 80 PVC	2	0.01	2	7.5	No. 1 Monterey	0 0.5	0.5 2	Concrete Bentonite	Concrete, standpipe w/ locking cap
MC-17D	28 Jul 1999	Cascade Drilling, Inc.	Hollow stem auger	33	32	0.0	22.0	Sch. 40 PVC	2	Above grade monument	22.0	32.0	Lower Aquifer	Sch. 40 PVC	2	0.01	20.0	33.0	10/20 Silica	0.0 2.0	2.0 20.0	Concrete Bentonite	Concrete, standpipe w/ locking cap

DOF

Table 3

Well Construction Information [1]

Burlington Environmental, LLC Washougal Facility

Washougal, Washington

Well ID	Installation Date	Contractor	Drilling Method	Total Borehole Depth (bgs) (ft bgs)	Initial Total Well Depth (bgs) (ft bgs)	Casing					Screen						Filter Pack			Seals			
						Depth Interval (ft bgs)		Material	Nominal Diameter (inch)	Flush or Aboveground Monument	Depth Interval (ft bgs)		Screened Hydro-geologic Unit	Material	Nominal Diameter (inch)	Slot Size (inch)	Depth Interval (ft bgs)		Material	Depth Interval (ft bgs)		Material	Surface Seal
						Upper	Lower				Upper	Lower					Upper	Lower		Upper	Lower		
MC-19D	28 Jul 1999	Cascade Drilling, Inc.	Hollow stem auger	39	38	0.0	28.0	Sch. 40 PVC	2	Above grade monument	28.0	38.0	Lower Aquifer	Sch. 40 PVC	2	0.01	26.0	39.0	10/20 Silica	0.0 2.0	2.0 26.0	Concrete Bentonite	Concrete, standpipe w/ locking cap
MC-20	13 Mar 2000	Cascade Drilling, Inc.	Hollow stem auger	11.4	11.4	0.0	4.4	Sch. 40 PVC	2	Above grade monument	4.4	11.4	Shallow	Sch. 40 PVC	2	0.01	2.5	11.4	10/20 Silica	0.0 1.0	1.0 2.5	Concrete Bentonite	Concrete, standpipe w/ locking cap
MC-20D	27 Sep 2007	Cascade Drilling, Inc.	Sonic	37	35.5	0.0	25.5	Sch. 40 PVC	2	Above grade monument	25.5	35.0	Lower Aquifer	Sch. 40 PVC	2	0.01	24.0	37.0	10/20 Silica	0.0 1.0	1.0 24.0	Concrete Bentonite	Concrete, standpipe w/ locking cap
MC-21	13 Mar 2000	Cascade Drilling, Inc.	Hollow stem auger	8.5	7.5	0.0	2.5	Sch. 40 PVC	2	Flush mount	2.5	7.5	Shallow	Sch. 40 PVC	2	0.02	1.0	8.0	10/20 Silica	0.0 0.5	0.5 1.0	Concrete Bentonite	Concrete, flush mount
MC-24	24 Sep 2007	Cascade Drilling, Inc.	Hollow stem auger	9.3	9.2	0.0	4.1	Sch. 40 PVC	2	Above grade monument	4.1	8.9	Shallow	Sch. 40 PVC	2	0.01	3.0	9.3	10/20 Silica	0.0 1.0	1.0 3.0	Concrete Bentonite	Concrete, standpipe w/ locking cap
MC-24D	01 Oct 2007	Cascade Drilling, Inc.	Sonic	33	32.2	0.0	22.0	Sch. 40 PVC	2	Above grade monument	22.0	32.0	Lower Aquifer	Sch. 40 PVC	2	0.01	20.0	33.0	10/20 Silica	0.0 1.0	1.0 20.0	Concrete Bentonite	Concrete, standpipe w/ locking cap
MC-24D2	08 May 2009	Cascade Drilling, Inc.	Sonic	46	44.8	0.0	34.8	Sch. 40 PVC	2	Above grade monument	34.8	44.6	Lower Aquifer	Sch. 40 PVC	2	0.01	33.1	46.0	10/20 Silica	0.0 1.0	1.0 33.1	Concrete Bentonite	Concrete, standpipe w/ locking cap
MC-25	24 Sep 2007	Cascade Drilling, Inc.	Hollow stem auger	9.8	9.1	0.0	4.0	Sch. 40 PVC	2	Flush mount	4.0	8.8	Shallow	Sch. 40 PVC	2	0.01	3.0	9.8	10/20 Silica	0.0 1.0	1.0 3.0	Concrete Bentonite	Concrete, flush mount
MC-25D	02 Oct 2007	Cascade Drilling, Inc.	Sonic	34	33	0.0	23.0	Sch. 40 PVC	2	Flush mount	23.0	32.5	Lower Aquifer	Sch. 40 PVC	2	0.01	21.0	34.0	10/20 Silica	0.0 1.0	1.0 21.0	Concrete Bentonite	Concrete, flush mount
MC-25D2	08 Sep 2008	Cascade Drilling, Inc.	Sonic	46.5	45.8	0.0	35.6	Sch. 40 PVC	2	Flush mount	35.6	45.3	Lower Aquifer	Sch. 40 PVC	2	0.01	32.0	46.5	10/20 Silica	0.0 1.0	1.0 32.0	Concrete Bentonite	Concrete, flush mount
MC-26D2	10 Sep 2008	Cascade Drilling, Inc.	Sonic	41	40.6	0.0	30.5	Sch. 40 PVC	2	Above grade monument	30.5	40.2	Lower Aquifer	Sch. 40 PVC	2	0.01	27.0	41.0	10/20 Silica	0.0 1.0	1.0 27.0	Concrete Bentonite	Concrete, standpipe w/ locking cap
MC-27D	06 May 2009	Cascade Drilling, Inc.	Sonic	36	35.5	0.0	25.2	Sch. 40 PVC	2	Flush mount	25.2	35.1	Lower Aquifer	Sch. 40 PVC	2	0.01	22.6	36.0	10/20 Silica	0.0 1.0	1.0 22.6	Concrete Bentonite	Concrete, flush mount
MC-28D	07 May 2009	Cascade Drilling, Inc.	Sonic	36	35.9	0.0	25.9	Sch. 40 PVC	2	Flush mount	25.9	35.6	Lower Aquifer	Sch. 40 PVC	2	0.01	23.8	36.0	10/20 Silica	0.0 1.0	1.0 23.8	Concrete Bentonite	Concrete, flush mount
MC-30	04 Sep 2008	Cascade Drilling, Inc.	Direct Push	9.6	9.6	0.0	4.5	Sch. 40 PVC (with SS wrapped prepacked screen)	2	Above grade monument	4.5	9.2	Shallow	Sch. 40 PVC (with SS wrapped prepacked screen)	2	0.01	3.7	9.2	10/20 Silica	0.0 1.0	1.0 3.7	Concrete Bentonite	Concrete, standpipe w/ locking cap
MC-30D	09 Sep 2008	Cascade Drilling, Inc.	Sonic	37	35.7	0.0	25.5	Sch. 40 PVC	2	Above grade monument	25.5	35.2	Lower Aquifer	Sch. 40 PVC	2	0.01	22.5	37.0	10/20 Silica	0.0 1.0	1.0 22.5	Concrete Bentonite	Concrete, standpipe w/ locking cap

Table 3

Well Construction Information [1]
Burlington Environmental, LLC Washougal Facility
Washougal, Washington

Well ID	Installation Date	Contractor	Drilling Method	Total Borehole Depth (bgs) (ft bgs)	Initial Total Well Depth (bgs) (ft bgs)	Casing					Screen						Filter Pack			Seals			
						Depth Interval (ft bgs)		Material	Nominal Diameter (inch)	Flush or Aboveground Monument	Depth Interval (ft bgs)		Screened Hydro-geologic Unit	Material	Nominal Diameter (inch)	Slot Size (inch)	Depth Interval (ft bgs)		Material	Depth Interval (ft bgs)		Material	Surface Seal
						Upper	Lower				Upper	Lower					Upper	Lower		Upper	Lower		
MC-31	04 Sep 2008	Cascade Drilling, Inc.	Direct Push	9.6	9.6	0.0	4.4	Sch. 40 PVC (with SS wrapped prepacked screen)	2	Above grade monument	4.4	9.2	Shallow	Sch. 40 PVC (with SS wrapped prepacked screen)	2	0.01	3.0	9.2	10/20 Silica	0.0	1.0	Concrete	Concrete, standpipe w/ locking cap
																				1.0	3.0	Bentonite	
MC-32	11 May 2009	Cascade Drilling, Inc.	Direct Push	14	13.9	0.0	3.9	Sch. 40 PVC (with SS wrapped prepacked screen)	2	Above grade monument	3.9	13.4	Shallow	Sch. 40 PVC (with SS wrapped prepacked screen)	2	0.01	3.9	13.9	10/20 Silica	0.0	1.0	Concrete	Concrete, standpipe w/ locking cap
																				1.0	3.0	Bentonite	
MC-33	11 May 2009	Cascade Drilling, Inc.	Direct Push	13	10	0.0	5.0	Sch. 40 PVC (with SS wrapped prepacked screen)	2	Above grade monument	5.0	9.4	Shallow	Sch. 40 PVC (with SS wrapped prepacked screen)	2	0.01	4.0	10.0	10/20 Silica	0.0	1.0	Concrete	Concrete, standpipe w/ locking cap
																				1.0	4.0	Bentonite	
MC-107R	13 Dec 2021	Cascade Drilling, Inc.	Sonic	10	8.4	0.0	3.0	Sch. 40 PVC	2	Flush mount	3.0	8.0	Shallow	Sch. 40 PVC (with SS wrapped prepacked screen)	2	0.01	2.0	9.0	2/12 Silica	0.0	1.5	Concrete	Concrete, flush mount, security bolt
																				1.5	2.0	Bentonite	
MC-118D	28 Jul 1999	Cascade Drilling, Inc.	Hollow stem auger	22.5	22.5	0.0	15.5	Sch. 40 PVC	2	Flush mount	15.5	22.5	Lower Aquifer	Sch. 40 PVC	2	0.01	13.5	22.5	10/20 Silica	0.0	3.0	Concrete	Concrete, flush mount
																				3.0	13.5	Bentonite	
MC-118D2	11 Sep 2008	Cascade Drilling, Inc.	Sonic	37	35.1	0.0	24.9	Sch. 40 PVC	2	Flush mount	24.9	34.7	Lower Aquifer	Sch. 40 PVC	2	0.01	23.0	37.0	10/20 Silica	0.0	3.0	Concrete	Concrete, flush mount
																				3.0	23.0	Bentonite	
MC-122	01 Dec 2006	Cascade Drilling, Inc.	Hollow stem auger	16	15.5	0.0	5.2	Sch. 40 PVC	2	Above grade monument	5.2	15.2	Shallow	Sch. 40 PVC	2	0.01	3.3	16.0	20/40 Silica	0.0	1.25	Concrete	Concrete, standpipe w/ locking cap
																				1.25	3.25	Bentonite	
MC-123	01 Dec 2006	Cascade Drilling, Inc.	Hollow stem auger	16	15.5	0.0	5.2	Sch. 40 PVC	2	Above grade monument	5.2	15.2	Shallow	Sch. 40 PVC	2	0.01	3.3	16.0	20/40 Silica	0.0	1.25	Concrete	Concrete, standpipe w/ locking cap
																				1.25	3.25	Bentonite	
MC-124D	14 Dec 2021	Cascade Drilling, Inc.	Sonic	35	34.4	0.0	24.0	Sch. 40 PVC	2	Above grade monument	24.0	34.0	Lower Aquifer	Sch. 40 PVC	2	0.01	23.0	35.0	2/12 Silica	0.0	3.0	Concrete	Concrete, standpipe w/ locking cap
																				3.0	23.0	Bentonite	
PZU-4	02 Oct 2007	Cascade Drilling, Inc.	Direct Push	13.6	10	0.0	4.9	Sch. 40 PVC (with SS wrapped prepacked screen)	2	Flush mount	4.9	9.5	Shallow	Sch. 40 PVC (with SS wrapped prepacked screen)	2	0.01	4.0	9.5	20/40 Silica	0.0	1.0	Concrete	Concrete, flush mount
																				1.0	4.0	Bentonite	
PZU-5R [2]	10 Jun 2013	Cascade Drilling, Inc.	Direct Push	15	14.75	0.0	4.5	Sch. 40 PVC (with SS wrapped prepacked screen)	2	Flush mount	4.5	14.25	Shallow	Sch. 40 PVC (with SS wrapped prepacked screen)	2	0.01	3.0	15.0	20/40 Silica	0.0	1.5	Concrete	Concrete, flush mount
																				1.5	3.0	Bentonite	

Notes
1. Data obtained from Table 4-2 of Remedial Investigation (AMEC, 2013)for historically insta
2. Data obtained from boring log (was not included in RI Table)

Abbreviations
Shallow = Shallow Groundwater Zone
PVC = polyvinyl chloride
Sch = Schedule

DOF

TABLE 4

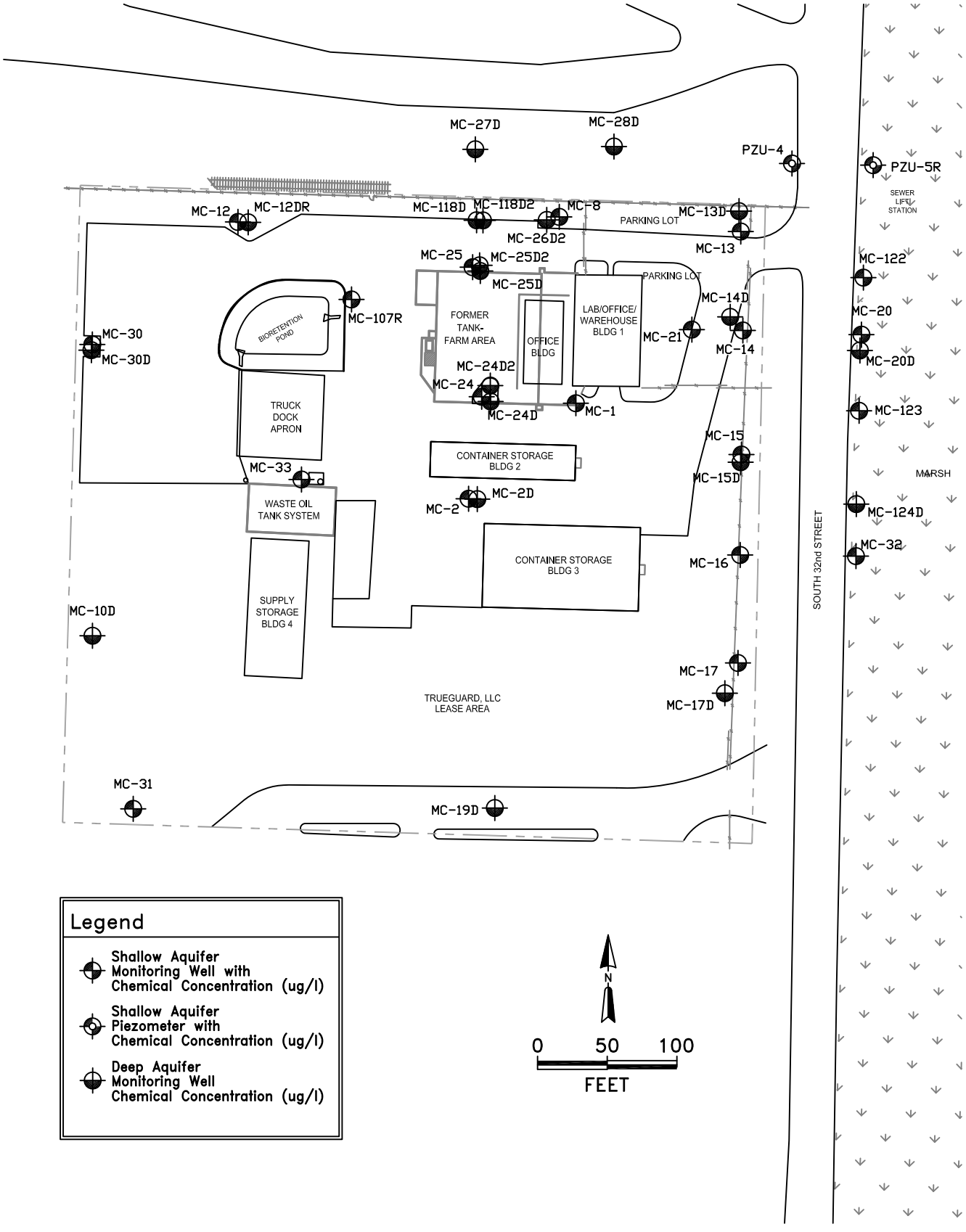
WELL SURVEY DATA
Burlington Environmental, LLC Washougal Facility
Washougal, Washington

Well ID	Survey Date	Northing [2] (feet)	Easting [2] (feet)	Top of Casing (feet) [3]
MC-1	1/4/2007	92590.6	1169832.4	20.52
MC-2	1/4/2007	92522.3	1169755.6	20.37
MC-2D	1/4/2007	92522.0	1169761.8	20.47
MC-8	1/4/2007	92724.6	1169820.7	22.43
MC-10D	1/4/2007	92423.7	1169485.5	24.41
MC-12	1/4/2007	92720.8	1169589.9	22.29
MC-12DR	12/16/2021	92720.7	1169597.4	22.77
MC-13	1/4/2007	92714.1	1169950.9	22.52
MC-13D	1/4/2007	92728.7	1169949.7	23.51
MC-14	1/4/2007	92643.1	1169952.4	21.79
MC-14D	10/24/2007	92652.8	1169943.3	22.71
MC-15	1/4/2007	92554.0	1169951.4	20.84
MC-15D	1/4/2007	92548.5	1169950.8	20.75
MC-16	1/4/2007	92481.9	1169950.5	21.04
MC-17	1/4/2007	92404.4	1169948.9	20.94
MC-17D	1/4/2007	92382.7	1169939.5	23.29
MC-19D	1/4/2007	92300.3	1169774.4	21.42
MC-20	1/4/2007	92640.1	1170037.5	21.18
MC-20D	10/24/2007	92628.7	1170036.4	23.56
MC-21	1/4/2007	92643.7	1169915.8	20.48
MC-24	10/24/2007	92595.5	1169765.0	22.87
MC-24D	10/24/2007	92592.1	1169771.4	22.41
MC-24D2	5/13/2009	92603.5	1169771.2	21.59
MC-25	10/24/2007	92688.2	1169758.3	20.35
MC-25D	10/24/2007	92684.9	1169763.9	20.09
MC-25D2	12/9/2008	92689.5	1169763.4	20.06
MC-26D2	12/9/2008	92722.4	1169811.7	23.45
MC-27D	5/13/2009	92773.1	1169771.2	20.9
MC-28D	5/13/2009	92775.1	1169859.9	21.17
MC-30	12/9/2008	92633.0	1169485.6	23.7
MC-30D	12/9/2008	92628.9	1169484.9	24.15
MC-31	12/9/2008	92299.7	1169514.9	24.4
MC-32	5/13/2009	92481.1	1170033.6	23.67
MC-33	5/13/2009	92536.1	1169635.7	24.24
MC-107R	12/16/2021	92665.3	1169671.5	22.08
MC-118D	1/4/2007	92721.8	1169761.1	20.66
MC-118D2	12/9/2008	92721.7	1169765.7	20.64
MC-122	10/24/2007	92681.0	1170038.9	23.33
MC-123	10/24/2007	92585.4	1170035.8	23.29
MC-124D	12/16/2021	92518.5	1170033.8	24.81
UT-ST-1	1/4/2007	92810.1	1169990.3	22.63
PZU-4	10/24/2007	92762.9	1169987.7	21.96
PZU-5R	10/24/2007	92761.7	1170045.9	21.45

Notes
1. Survey data obtained from Table 4-3 of Remedial Investigation (AMEC, 2013) for historically installed wells.
2. Washington State Plane Coordinate System, South Zone, North American Datum 83/91
3. Elevation datum: North American Vertical Datum 1988 (NAVD88); converted from NGVD 1929.

DOF

FIGURES



CleanEarth	TITLE: Washougal Area Well Map Washougal Facility	DWN: dtb	DES.:	PROJECT NO.:
		CHKD:	APPD:	FIGURE NO.: 1
		DATE: 3/3/22	REV.:	

Attachment A
Forms and SOPs

Example Water Level Measurement Form
Example Monitoring Well Sampling Form
Example Well Inspection Form
SOP 105- Groundwater Monitoring Well Installation
SOP 120- Measuring Water and NAPL Elevations, and Total Depths
SOP 121- Monitoring Well Development
SOP 124- Low-Flow Groundwater Sampling Procedure
SOP 150 – Monitoring Well Inspection Procedure
SOP 200- Equipment Decontamination Procedure
SOP 400- Documentation Procedures

Water Level Field Form

Field Event: _____

Field Staff/organization: _____

WL meter model: _____ S/N: _____ Date: _____

PID model: S/N:

Well ID	Well Venting		Water-level Measurement			Total Well Depth (feet)	Comments / Well Condition Notes
	Time (24hr)	PID (ppm)	Time (24hr)	Depth to Water (feet)	Measuring Point		
MC-1							
MC-2							
MC-2D							
MC-8							
MC-10D							
MC-12							
MC-12DR							
MC-13							
MC-13D							
MC-14							
MC-14D							
MC-15							
MC-15D							
MC-16							
MC-17							
MC-17D							
MC-19D							
MC-20							
MC-20D							
MC-21							
MC-24							

Water Level Field Form

Field Event: _____

Field Staff/organization: _____

WL meter model: _____ S/N: _____ Date: _____

PID model: S/N:

Well ID	Well Venting		Water-level Measurement			Total Well Depth (feet)	Comments / Well Condition Notes
	Time (24hr)	PID (ppm)	Time (24hr)	Depth to Water (feet)	Measuring Point		
MC-24D							
MC-24D2							
MC-25							
MC-25D							
MC-25D2							
MC-26D2							
MC-27D							
MC-28D							
MC-30							
MC-30D							
MC-31							
MC-32							
MC-33							
MC-107R							
MC-118D							
MC-118D2							
MC-122							
MC-123							
MC-124D							
PZU-4							
PZU-5							

Notes: _____

	Monitoring Well Sampling Field Sheet	Well No.
		Facility:
Date:	Sampling Personnel:	Initial Headspace (ppm):
Sampling Method: Low Flow		Begin-Water Level (ft):
Equipment Used:	**MP** = ☐ North Side TOC ☐ other: _____	End-Water Level (ft):
	1 Volume = 0.17 * (total well depth - water level)	Pump Intake Depth below MP:

Abbreviations: **MP**=Measuring Point **TOC**=Top of Casing **PPM**=Parts per Million **ft**=Feet **uS/cm**=microsiemens per centimeter **C**=Celsisus **mg/L**=milligrams per Liter **mV**=millivolts **mL/min**=milliliters per minute **NTU**=nephelometric turbidity units

Time	Water level	Purge Rate	pH	Conductivity	Temperature	Dissoved Oxygen	Redox Potential	Turbidity
(24 hour)	ft	(mL/min)	pH Units	uS/cm	^{0}C	mg/L	mV	(NTU)
	< 0.33 ft from 2nd reading	< 500 mL	< 0.1 unit	</= 3%	< 3%	</= 0.3 mg/L	< 10 mV	< 5 NTU **or** < 10% if >5 NTU

Notes: _____

_____

_____

Bottles and Analyses: ___ (collected in order below)

___ x 40 mL VOA w HCL for 8260D

___ x 40 mL VOA w HCL for 8260D SIM

___ x 500 mL Amber Glass unpreserved for 1,4 Dioxane 8270E SIM

___ x 500 mL HDPE w HNO3 for Metals - Arsenic ☐ field filtered to 0.45 um

Monitoring Well Inspection

Facility Name _____ Inspector(s) and Company_____ Date _____

Well ID	Is well labeled?	Surrounding Impacts?	Well/pump condition	Internal condition (cap secure)	Monument Condition	Well Accessible?	Recent Construction In Area That May Have Caused Changes?	Other problems	Maintenance performed

STANDARD OPERATING PROCEDURE – 120

(SOP-120)

Measuring Water and NAPL Elevations and Total Depths

Written By: Joe Depner: 1998
Revised By: Laura Dell'Olio 4/12/2021
QA Concurrence: Tasya Gray 4/12/2021

This standard operating procedure (SOP) contains the following sections:

1. PURPOSE

The purpose of this SOP is to provide field personnel with the specific information needed to collect and document consistent and representative data on liquid levels at, and total depths of, monitoring wells and piezometers.

2. APPLICATION

This SOP shall be followed by all field personnel who measure liquid levels at, and total depths of, monitoring wells and piezometers.

3. REFERENCES

U.S. EPA. May 2020. Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers. https://www.epa.gov/sites/production/files/201506/documents/gw_sampling_guide.pdf

DOF. May 2021. Site Health and Safety Plan.

4. ASSOCIATED SOPS

SOP-124 – Low-Flow Groundwater Sampling Procedure

SOP-200 – Equipment Decontamination Procedure

SOP-400 – Documentation Procedures

5. TERMINOLOGY

The following terminology is used in this SOP:

"NAPL" means nonaqueous-phase liquid. "DNAPL" and "LNAPL" mean dense and light NAPL (described below), respectively.

"Wells" means groundwater-monitoring wells and piezometers.

"Liquid levels" means the elevations of fluid interfaces in wells. These include the following:

The "LNAPL level" is the elevation of the air/LNAPL interface, if floating LNAPL is present.

The "water level" is either (1) the elevation of the air/water interface if LNAPL is absent, or (2) the elevation of the LNAPL/water interface if LNAPL is present.

The "DNAPL level" is the elevation of the water/DNAPL interface, if DNAPL is present.

The level is measured as the depth of the interface, from the well's measuring point (MP).

6. EQUIPMENT AND SUPPLIES

The following equipment and supplies are necessary to properly measure liquid levels and total depths:

- Equipment required to open the well monuments (e.g., padlock keys, well keys, hand drill, socket set, Allen wrenches or other tools).
- A photoionization detector (PID) or similar instrument to monitor the well headspace.
- An electric water-level indicator and/or an electric oil/water interface detector. Each such instrument must have a chemically inert suspension line that is graduated in 0.01-foot increments and sufficiently long to reach the bottom of the well.
- Fully charged batteries for each battery-powered instrument.
- An accurate and reliable watch that has been properly set.
- Documentation materials as described in SOP-400.
- Health-and-safety equipment and supplies (e.g., personal protective equipment [PPE]) as described in the relevant site health-and-safety plan.
- Decontamination equipment and supplies as specified in SOP-200.

Although not essential, the following items are useful for verifying the correctness of field measurements:

- A construction (as-built) diagram for each well, showing the well's total depth and its screened interval.
- A table or graph (e.g., a well hydrograph) of field measurement results (liquid levels, total depth) from previous monitoring events, for each well.

7. PROCEDURES

7.1. Simultaneity of Measurements

If liquid-level measurements are to be completed at a group of wells at a site, then complete the entire set of measurements for the group within a single business day. In addition, if any of the wells at a site are screened in tide-influenced hydrogeologic units, then complete the set of measurements corresponding to those wells within a single one-hour period, or as short a time as feasible. To facilitate compliance with this requirement, the water-level field form for each site shall identify those wells screened in tide-influenced units.

7.2. Order of Completion

At each well, complete the liquid-level and total-depth measurements in the following order:

1. LNAPL level
2. Water level
3. DNAPL level

4. Total depth

7.2.1. SPECIAL INSTRUCTIONS FOR WELLS WITH DEDICATED PUMPS

The instrument access ports on some dedicated pumps will not accommodate some probes (e.g., most oil/water interface probes). If so, the pump must be removed from the well to measure the DNAPL level and the total depth. At wells with dedicated pumps, complete the measurements in the following order:

1. Measure the water level.
2. Remove the pump from the well and place it in a clean plastic bag.
3. Allow the liquid levels to stabilize.
4. Measure the DNAPL level.
5. Measure the total depth.

7.3. Pre-Measurement Procedures

On arrival at each well, complete the following steps in the order listed:

1. Don appropriate PPE as described in the site health and safety plan.
2. Remove any debris (e.g., soil, vegetation, or refuse) and any standing water from the well opening, to prevent foreign matter from entering the well.
3. Open the well monument.
4. Vent the well by carefully removing the well cap. Record the time at which the well is initially vented to the atmosphere (i.e., the time at which the well cap is removed). If the gas in the well casing appears to have been over-pressurized or under-pressurized relative to the atmosphere, then note this in the field book.

   Caution (1): Never put your face, head, or any other body part over the well when venting it. If possible, vent the well gradually, so the cap does not become airborne.

   Caution (2): Handle monitoring wells with care at all times. If it is necessary to apply lift or torque to a well cap to remove it (e.g., if the casing is airtight and under a vacuum), then be extremely careful to prevent the well casing from being raised or rotated.
5. Immediately after removing the well cap, monitor the headspace within the well using the PID. Do this by placing the instrument probe at the opening of the well and recording the reading in the field book and on the appropriate field forms.
6. Wait at least 20 minutes from the time the well is vented, to allow the liquid levels in the well to equilibrate to the current atmospheric pressure, before measuring liquid levels. At some wells it may be necessary to vent for longer periods.

7.4. General Measurement Procedures

Each liquid level measurement involves lowering an instrument probe into the well, until the instrument emits the appropriate response, indicating the probe has reached the desired fluid interface in the well. Depending on the type (manufacturer and model) of instrument, the response may be audible (e.g., a tone is steadily or intermittently emitted), visible (e.g., an indicator light is steadily or intermittently illuminated), or both. Consult the instrument's operating manual for details. The probe is attached to the body of the instrument by a flexible suspension line consisting of a graduated "tape" or coaxial cable that sheathes an electric conductor. After lowering the probe to the appropriate level in the well (see below), hold the upper end of the graduated tape against the well's MP and read the numeric value off the tape. Record all of the measurements to the nearest 0.01 foot below the well's MP. If the MP is not clearly marked (typically by a notch cut into the top of the well riser), then measure all levels from the top of the north side of the riser or dedicated pump.

Duplicate each liquid-level and total-depth measurement in the field to ensure that the reading is accurate. Record all results (times, measured values, etc.) both in the field book and on the water-level field form.

7.5. Measuring LNAPL Levels

LNAPLs are NAPLs that are less dense than water. In the subsurface, free-phase LNAPL tends to accumulate on the water table. Free-phase LNAPL that enters a well tends to accumulate on the air/water interface. Some wells routinely contain LNAPL. Typically, the thicknesses of the LNAPL layers in such wells are measured at the same time the water levels are measured.

Use an oil/water interface detector for the measurement. Turn the detector on. Then slowly lower the probe into the well. In some cases, a very thin (~ 0.01 foot) layer of LNAPL may accumulate on the air/water interface in the well, so the probe must be lowered very slowly if the LNAPL layer is to be detected and accurately measured. The oil/water interface detector emits one type of response to indicate that the probe has contacted NAPL, and a different type of response to indicate that the probe has contacted water. First, lower the probe until the air/LNAPL interface is detected. Measure the depth to the interface. Record the result. Record "sheen" if the instrument detects an LNAPL layer whose thickness is less than 0.01 foot.

7.6. Measuring Water Levels

Measure water levels using either an oil/water interface detector or, if no LNAPL is present, using an electric water-level indicator.

7.6.1. MEASURING WATER LEVELS USING THE OIL/WATER INTERFACE DETECTOR

After measuring the depth to LNAPL in the well, and before retrieving the probe from the well, slowly lower the probe further into the well. When the LNAPL/water (or air/water) interface is detected, measure the depth to the interface. Record the result.

7.6.2. MEASURING WATER LEVELS USING THE ELECTRIC WATER-LEVEL INDICATOR

Turn the water-level indicator on. Manually adjust the sensitivity to a medium level. Slowly lower the indicator probe into the well until the indicator emits a short audible tone, indicating the probe has contacted the air-water interface. Measure the depth to the interface. Record the result.

7.7. Measuring DNAPL Levels

DNAPLs are NAPLs that are denser than water. In the subsurface, free-phase DNAPL tends to sink below the water table. Free-phase DNAPL that enters a well tends to sink to the bottom of the well. DNAPL levels are measured at some wells at the same time that the water levels are measured. Use an oil/water interface detector to measure the DNAPL level as described below.

If the well does not have a dedicated pump, then after measuring the water level in the well, and before retrieving the probe from the well, slowly lower the probe further into the well. If the well does have a dedicated pump, then after the pump has been removed from the well and the liquid levels in the well have been allowed to stabilize, slowly lower the probe into the well.

When (if) the water/DNAPL interface is detected, measure the depth to the interface. Record the result.

7.8. Measuring Well Total Depths

For measuring well total depths, complete the following steps in the order listed:

1. Lower the instrument (water-level indicator, oil/water interface detector, or weighted tape) to the bottom of the well to measure the well's total depth.
2. Gently bounce the probe on the well bottom to determine when the probe is at the bottom of the well and take up the slack on the suspension line.
3. Measure the total depth. Record the result.

7.9. Post-Measurement Procedures

After all of the measurements have been made at a well, and the results have been recorded, complete the following steps in the order listed:

1. Retrieve the instrument suspension line and probe from the well, and simultaneously decontaminate the instrument suspension line and probe (see below).
2. If the well has a dedicated pump that was removed to complete the measurements, replace the pump.
3. Close (seal) and secure the well.
4. Record any well integrity concerns in the field book and on the well maintenance form.

8. DECONTAMINATION

Decontaminate all equipment that may come in contact with the well water or NAPL, at the following times:

- prior to, or on, arrival at the site,

- on moving from one well to another, on site,
- immediately prior to exit from the site.

Follow the decontamination procedures given in SOP-200.

9. DOCUMENTATION

Record all measurement results (liquid levels, total depth, and time of measurement) on the appropriate field forms and field notebook. Follow the documentation procedures given in SOP-400.

10. MEASURE OF PROFICIENCY

Field personnel will be experienced in measuring water and NAPL elevations and total depths prior to working under this SOP.

STANDARD OPERATING PROCEDURE – 121

(SOP-121)

Monitoring Well Development

Written By: Carolyn Mayer 11/23/1997
Revised By: Laura Dell'Olio 4/12/2021
QA Concurrence: Tasya Gray 4/12/2021

This SOP contains nine sections:

1. PURPOSE

The purpose of this SOP is to provide field personnel with a set of guidelines to assure proper monitoring well development. According to EPA all monitoring wells should be developed to create an effective filter pack around the well screen, to rectify damage to the formation caused by drilling, to remove fine particulates from the formation near the borehole, and to assist in restoring the natural water quality of the aquifer in the vicinity of the well.

2. APPLICATION

This SOP provides a step-by-step guideline to be followed by the field personnel for performing or overseeing monitoring well development.

3. REFERENCES

U.S EPA. April 1992. Ground Water Forum, Monitoring Well Development Guidelines for Superfund Project Managers.

https://www.epa.gov/sites/production/files/2015-06/documents/welldevelp_0.pdf

DOF. May 2021. Site Health and Safety Plan.

4. ASSOCIATED SOPS

SOP-200 – Equipment Decontamination Procedure

SOP-400 – Documentation Procedures

5. EQUIPMENT

The following equipment is necessary to properly develop a ground water monitoring well:

- A well key, hand drill, socket set, pad lock key, or other well access equipment.
- A calibrated photo-ionization detector (PID) to monitor and record the well headspace.[1]
- An electric water meter and oil/water interface probe or weighted tape calibrated to a hundredth of a foot, and sufficiently long to reach the bottom of the well.
- Well purging equipment (e.g. bailer, silicone line, PVC pipe, plug, pump, tubing, power supply, and extension cord), as needed.
- A solid surge block.
- A sufficient number of 55-gallon drums (including lids, gaskets, and fasteners) to contain all purge water, unless other water handling arrangements have been made.
- A calibrated water quality meter that measures temperature, pH, specific conductivity, dissolved oxygen, redox potential, and turbidity.
- All required documentation including sample labels, field books, sampling forms, and chains-of-custody.
- Personal protective equipment as described in the Site Health and Safety Plan.
- Decontamination equipment as specified in the Work Plan.

6. DECONTAMINATION

All equipment that will come in contact with the well water will be decontaminated prior to arrival on site, relocation on site, and site exit. Standard Operating Procedure -200 shall be followed.

[1] Equipment should be calibrated and maintained in accordance with the manufacturer's recommendation.

7. WELL DEVELOPMENT PROCEDURES

Upon arrival at each well, the following procedures shall be followed:

- Suit up in appropriate personal protective equipment as described in the Site Health and Safety Plan.
- Brush any soil or vegetation and pump any standing water away from the well opening.
- Lay plastic sheeting around well to place equipment on and keep cords, tubing and pumps from touching the ground.
- Open the well cap.
- Monitor the headspace within the well using the PID. This is done by placing the instrument probe at the opening of the well and recording the reading in the field book and on the appropriate field forms.
- Measure and record the depth to LNAPL, water, DNAPL, and total depth of the well using a decontaminated oil/water interface probe or water level indicator (depending on the historical presence of NAPLs in the well). All LNAPL and DNAPL measurements are to be made in accordance with SOP-120. Measurements are to be made to the nearest one hundredth of a foot and recorded in the field book and on the appropriate field form.
- Compute the unit purge volume using the following formula and the input values on the attached Well Volumes Sheet.

  1 well volume (including annular space) = [x(total well depth – water level)] + [(y x 0.40)(total well depth – bottom of seal)]

  where "x" is the Casing/Riser Volume per Unit Length, Internal (gal/ft), "y" is the Annular Volume per Unit Length (gal/ft), and 0.40 is a conservative estimate of the porosity of the sand pack.

7.1. New Well Development Procedure

- If a submersible pump is to be used for well development, gently lower the pump to the well bottom. If a non-submersible pump is used, lower the tubing to the bottom of the well.
- Begin to purge the well at a rate sufficient to remove fines, slowly run the pump up and down the well over the length of the screen and initiate physical water quality testing at least every 20% water removed for temperature, pH, conductivity, dissolved oxygen, and turbidity.
- A minimum of three and maximum of five well volumes (including annular space) will be removed. If this is the first time the well has been developed and water was used in the drilling process, the volume of water introduced into the formation during well formation must also be removed during development. *Purging is completed once the following has occurred:*
  - *the minimum purge volume has been removed and the water quality parameters have stabilized by the following screening requirements for three consecutive readings: Turbidity <5 NTU; OR*
  - *the well runs dry; OR*

- *five purge volumes and drilling process water volumes have been removed.*

- Measure total depth of well after development.
- Containerize all purge water in 55-gallon drums, unless other handling arrangements have been made.
- Record additional information such as unique odors or water color, and a description of the suspended particle content in the field notes and on appropriate field forms.
- Upon completion of development, both the well and the purge drums are to be properly sealed and secured.
- All drums are to be permanently labeled as follows:

  Well ID
  Facility Name
  Drum Contents
  Date
  Drum Number

- Close the well appropriately and record any well integrity concerns in the field book and on the sampling form.

7.2. Existing Well Development Procedure

- Remove pump from well.
- Attach one length of twine to the surge block or use a drill rig or tripod and lower it to the bottom of the well.
- Vigorously begin moving the surge block up and down in the well creating a surging action across the screened interval. This action will bring the finer grained materials into suspension.
- Remove the surge block.
- Begin to purge the well at a sufficient rate to remove fines and initiate physical water quality testing at a minimum of every 20% water removed for turbidity.
- Repeat surging and purging to reduce silt presence in water and keep checking total depth measurements.
- A minimum of three and maximum of five well volumes (including annual space) will be removed. *Purging is completed once the following has occurred:*
  - *the minimum purge volume has been removed and the water quality parameters have stabilized by the following screening requirements for three consecutive readings: Turbidity <5 NTU; OR*
  - *the well runs dry; OR*
  - *five purge volumes and drilling process water volumes have been removed.*
- Measure total depth of well after development.

- Containerize all purge water in 55-gallon drums, unless other handling arrangements have been made.
- Record additional information such as unique odors or water color, and a description of the suspended particle content in the field notes and on appropriate field forms.
- Upon completion of development, both the well and the purge drums are to be properly sealed and secured.
- All drums are to be permanently labeled as follows:

    Well ID

    Facility Name

    Drum Contents

    Date

    Drum Number

- Close the well appropriately and record any well integrity concerns in the field book and on the sampling form.

8. DOCUMENTATION

Documentation of all monitoring well development activities including all field forms and the maintenance of a detailed field notebook are described in SOP-400.

9. MEASURE OF PROFICIENCY

Field personnel will be experienced in monitoring well development prior to working under this SOP.

STANDARD OPERATING PROCEDURE – 124

(SOP-124)

Low-Flow Groundwater Sampling Procedure

Written By: Carolyn Mayer 11/23/1997
Revised By: Laura Dell'Olio 4/12/2021
QA Concurrence: Tasya Gray 4/12/2021

This SOP contains nine sections:

1. PURPOSE

This SOP serves to provide field personnel with the specific information needed to consistently collect and document representative groundwater samples for laboratory analyses from monitoring wells using a low-flow groundwater sampling technique.

The purpose of low-flow groundwater sampling is to collect a groundwater sample that is representative of actual site conditions. Therefore, the purge rate is designed to be low enough to simulate actual groundwater flow and to pull water from a discrete zone near the pump intake into the pump rather than pulling groundwater from a large area around the well or outside of the screened area of the well. A low purge rate is also intended to reduce the possibility of stripping volatile organic compounds from groundwater and to reduce the likelihood of mobilizing colloids in the subsurface that are immobile under natural flow conditions.

2. APPLICATION

This SOP applies to groundwater sampling of permanent monitoring wells and temporary monitoring wells where site-specific work plans call for it.

The basis for choosing low-flow sampling methodology for these sites is that all the sites have defined groundwater plumes and wells that are accurately screened in the known plume areas.

3. REFERENCES

U.S. EPA. May 2020. Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers. https://www.epa.gov/sites/production/files/201506/documents/gw_sampling_guide.pdf

U.S. EPA. July 1996. Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells. https://www.epa.gov/sites/production/files/2017-10/documents/eqasop-gw4.pdf

DOF. May 2021. Site Health and Safety Plan.

4. ASSOCIATED SOPS

SOP-120 - Measuring Water and NAPL Elevations and Total Depths

SOP-200 - Equipment Decontamination Procedure

SOP-400 - Documentation Procedures

5. EQUIPMENT

The following equipment is recommended for properly sampling a groundwater monitoring well:

- Relevant work plan that includes a map of well locations, sampling plan, appropriate SOPs and well construction information.
- A well key, hand drill, socket set, padlock key, or other well access equipment.
- A calibrated photoionization detector (PID) or similar device, to monitor volatile constituents in the well headspace and breathing zone.
- An electric water-level indicator and/or oil/water interface detector calibrated. to
- 0.01 foot, and sufficiently long to reach the bottom of the well.
- A weighted tape measure for determining total depths of wells, when required.
- Well purging equipment (e.g.; pump, pump controller, tubing, and power supply).
- A sufficient number of containers (e.g., 55-gallon drums with lids, labels, gaskets, and fasteners) to store all purge water, unless other water handling arrangements have been made.
- Water-quality meter(s) that is calibrated and maintained in accordance with the manufacturer's recommendation using calibration solutions to measure, pH, specific conductivity, dissolved oxygen, and oxidation-reduction potential (ORP).
- Turbidity meter that is calibrated and maintained in accordance with the manufacturer's recommendation using a calibration solution to measure turbidity.

- In-line disposable 0.45 micron filters, if necessary, for metals analyses when dissolved metals analysis is required.
- A sufficient number of sampling containers, including containers for regular samples and quality control samples (e.g., field blanks, equipment blanks, duplicates, trip blanks, and matrix spike/matrix spike duplicates).
- All required documentation including weatherproof sample labels, weatherproof field books, sampling forms, chain-of-custody (COC) forms, weatherproof pens and paper for sampling forms, field computer, and COC seals.
- Personal protective equipment (PPE) described in the site health and safety plan.
- Decontamination equipment as specified in SOP-200.
- Water flow-rate measurement equipment (e.g., flow meter, or graduated container and stopwatch).
- Sampling support equipment and supplies (e.g., sample coolers, clean bagged ice, bubble wrap and VOC bottle holders, clear tape, plastic locking bags, razor knives, garbage bags, paper towels, deionized water, nitrile gloves, five-gallon buckets, clean fold out table for sample bottles and equipment, fabricated foam spill berm equivalent to 5 gallon bucket) as needed.

6. DECONTAMINATION

All reusable equipment that will contact the well and/or water samples will be decontaminated prior to its use, according to the procedures described in SOP-200.

7. WELL SAMPLING PROCEDURES

7.1. Set Up

On arrival at each well, the following procedures shall be followed:

- Don appropriate PPE and safety vests as described in the site health and safety plan.
- Remove any soil or vegetation and standing water from the well monument casing. Check the well condition, making sure the flexible gasket seals are clean and intact. If applicable, also check the condition of the dedicated pump cap. Record any problems in the field book and the appropriate field forms.
- Place fabricated foam spill berm on the ground next to the well and place the sampling equipment and bottles on a clean fold out table to keep them from touching the ground.
- Remove the well cap,
- Monitor the headspace within the well using a PID or similar instrument. Record the reading in the field book and on the appropriate field form(s).
- Set up the pump and water quality meter(s) in preparation for purging. Connect the discharge line from the pump to a flow- through cell. The discharge line from the flow-through cell must be directed to a container to contain the purge water during the purging and sampling of the well.
- Record the depth of the pump intake on the sampling form and/or in the sampling field book. The work plan should specify the pre-determined depths for the pump intakes. The pump intake is set at the interval within the screen where the contamination is known to exist, the center of the screened

interval, or the center of the saturated portion of the screened interval (for wells with screens not fully saturated). Check with the project manager if there is uncertainty regarding this issue. If the well doesn't have a dedicated pump, (e.g.; well with dedicated tubing for use with a Parastaltic Pump) the tubing should be lowered into the well alongside of a weighted measuring tape or water-level indicator to ensure that the intake of the pump is set at the appropriate depth.

- Measure and record the depth to water using a decontaminated water-level indicator or oil/water interface detector to the nearest 0.01 foot, in accordance with SOP-120. Record the reading in the field book and on the appropriate field form(s).
- Before purging, adjust the pumping rate to its lowest setting, and set the data logger in the flow-through cell to record readings every three to five minutes.

7.2. Purging Monitoring Wells

7.2.1. PURGING PROCEDURE

Measure the initial (static) water level in the well and record the reading on the field form(s).

Start the pump at a flow rate of 200 to 500 mL/min. Maintain a steady flow rate while maintaining a drawdown of less than 0.33 foot. The flow rate can be measured using a graduated cup and a stopwatch.

To determine water-level stability, subtract the second water-level reading (not the static water-level reading) from the current water-level reading to determine the current drawdown.

After the flow rate is stable, record the water level and the flow rate every three to five minutes. Record water levels more frequently if the rate is being adjusted. A drawdown less than 0.33 foot is preferred but may not always be possible. If the drawdown exceeds 0.33 foot at low flow rates (<500 mL/min), lower the flow rate as practical (not to drop below 100 mL/min) to reduce the drawdown.[1]

Begin recording water-quality parameters after all water has been purged from the sample tubing, pump, and flow-through cell. Initiate water-quality testing for temperature, pH, specific conductivity, dissolved oxygen (DO), oxidation reduction potential (ORP), and turbidity. Record water-quality parameters every three to five minutes.

7.2.2. PURGING REQUIREMENTS

Sampling cannot begin until the drawdown is no greater than 0.33 foot, and all water- quality parameters are stable. Each water-quality parameter is considered stable when it satisfies the corresponding stability criterion specified in the table below.

[1] The 0.33-foot drawdown goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval and may require adjustment based on site-specific conditions and personal experience. The water levels in water-table wells should not be allowed to drop below the pump intake. In all other cases, the water level should not be allowed to drop below the top of the well screen. If the water table drops below one of these minimum values, the pump should be turned off and the water level should be allowed to recover. See section 7.2.2, fifth bullet for more information.

Water-Quality Parameter	Stability Criterion
Turbidity	{X} < 5 NTU or RPO < 10 % for values {X} > 5 NTU
Dissolved Oxygen	delta $\leq$ 0.3 mg/L
Specific Conductivity	RPD $\leq$ 3%
ORP	delta < 10 mV
Temperature	delta < 3%
pH	delta < 0.1 unit

Where:

{X} = the last three water-quality readings

$$m = \text{mean} = \frac{\text{Max}\{X\} + \text{Min}\{X\}}{2}$$

$$\text{Delta} = \text{Max}\{X\} - \text{Min}\{X\}$$

$$\text{RPD} = \frac{\text{delta}}{m} \times 100\%$$

In some circumstances, the well may not stabilize according to the above criteria, but the well can be sampled if one of the following conditions occurs:

- Wells are unable to meet stability criteria due to equipment accuracy. The accuracy of the instruments will often limit the ability to achieve stabilization on a percentage basis. For example, if the ORP is consistently fluctuating between 1 and 15 mV, then delta = 14 mV, which is not within the requirements for stability. However, the accuracy of the instrument currently used is+/- 20 mV. Therefore, in this case the stability criterion would be considered satisfied within the range of accuracy of the equipment. This is particularly important when the water-quality parameter values are low.[2] Field personnel must consult the instrument's manual to determine its accuracy.
- Wells for which all water-quality parameters have stabilized may be sampled if it is clear that the drawdown will not stabilize before the water level drops below the minimum allowable value (i.e., pump intake, or top of screen if aquifer is confined).
- If collecting metals samples and all water-quality parameters except turbidity stabilize, it is acceptable to collect filtered and unfiltered metals samples without waiting for turbidity to stabilize or for one well volume to be purged. A filtered sample should be collected using a disposable 0.45 micron in-line filter. If there are no directions on the filter for rinsing, then a minimum of 0.5 liter of groundwater from the well should be run through the filter prior to collecting the sample.

[2] ORP may not always be an appropriate stabilization parameter, depending on site conditions. The project manager may designate wells that will not require ORP measurements.

- Water-quality parameters are not stable, but at least one well volume of water has been removed from the well. Calculate the volume of water in the casing and the screened interval as follows.

  The following equation is used to calculate the well volume:

  $V = V_{casing}$ (well depth - static water depth)

  where:

  V_{casing} = casing volume per unit length (e.g., ~0.17 gal/ft for two-inch casing)

- The water level drops below the minimum value (i.e., the pump intake, or the top of the screen if the aquifer is confined) during purging. In this case, the pump should be turned off and the well should be allowed to recover. As long as a minimum of two tubing volumes (including the tubing and pump) has been removed from the well, then the well should be sampled as soon as the water level has recovered sufficiently to collect volume of groundwater necessary for all samples. Use the following equations to determine the minimum volume of groundwater to be removed prior to sampling when this problem occurs:

  Minimum purge volume= 2 [500 mL + M (length of tubing in feet)]
  where M is the volume (in mL) contained in a one-foot length of tubing.
  For tubing of various inner diameters, M is equal to:

Inner Diameter	M
1/8"	2.4
1/4"	9.7
1/2"	39

  This is acceptable even though the water-quality parameters have not stabilized and one well volume has not been removed.

Record in the field book and field form if any monitoring wells did not meet the stabilization and drawdown criteria and describe the rationale for sampling the well at the time it was sampled.

7.3. Sampling Procedure

Do not stop pumping after-the purging requirements have been met. Don clean nitrile gloves. Disconnect the sampling tube from the influent flow-through cell. All wells have dedicated tubing that will be used for both purging and sampling. Collect each sample directly from the dedicated tubing. Minimize the turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container.

The sampling flow rate may remain at the established purge rate or may be adjusted slightly to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Typically, flow rates less than 500 mL/min are appropriate.

When collecting the dissolved gas samples (e.g. volatile organic compounds, total petroleum hydrocarbons - gasoline range, or methane/ethane/ethane) the following procedures should be followed:

- The tubing should be completely filled with water to prevent the groundwater from being aerated as it flows through the tubing.
- A meniscus must be formed over the mouth of the vial to eliminate the formation of air bubbles and headspace prior to capping.

Samples do not have to be collected in a particular order unless unfiltered metals samples are collected, in which case they should be collected last.

7.4. Post-Sampling Procedures

After all of the samples have been collected in containers that are labeled and appropriately treated with preservatives, the following tasks should be completed:

- Measure and record the depth to water to determine total drawdown. Record the estimated total volume of water purged from the well.
- If dedicated equipment is in place at the well, disconnect aboveground tubing and properly seal the well.
- If non-dedicated equipment is used, then remove the equipment. Discard disposable items and decontaminate reusable items according to SOP-200.
- Close and secure the well, and record any well integrity concerns (bolt tightness, etc.) in the field book and on the sampling form.
- Rinse the water-quality meters with deionized water between wells.
- Report if any monitoring wells did not meet the stabilization and drawdown criteria with recommendation on how to conduct the sampling for the next sampling event.

8. DOCUMENTATION

SOP-400 describes the documentation of all monitoring well sampling activities, including all field forms, and the maintenance of a detailed field notebook.

9. MEASURE OF PROFICIENCY

Field personnel will be experienced in low-flow groundwater sampling procedures prior to working under this SOP.

Standard Operating Procedure – 150

(SOP-150)

Monitoring Well Inspection Procedure

Written By: Laura Dell'Olio 4/12/2021
QA Concurrence: Tasya Gray 4/12/2021

This SOP contains eight sections:

1. **Purpose**
2. **Application**
3. **References**
4. **Associated SOPs**
5. **Equipment**
6. **Well Inspection Procedures**
7. **Documentation**
8. **Measure of Proficiency**

1. PURPOSE

This SOP serves to provide field personnel with an outline of the procedure for inspecting monitoring wells.

2. APPLICATION

This SOP provides a step-by-step guideline to be followed by the field personnel to inspect monitoring wells to ensure that well integrity is maintained.

3. REFERENCES

Well Inspection/Well Repair Form (example included in SOP-150).

DOF. May 2021. Site Health and Safety Plan.

4. ASSOCIATED SOPS

SOP-400 – Documentation Procedures

5. EQUIPMENT

The following equipment is necessary to perform a monitoring well inspection:

- Personal protective equipment as described in the Site Health and Safety Plan.
- Appropriate keys and wrenches to open the well, hand brush for clearing debris, and small cup or pump if there is standing water in the monument.
- Other equipment may be needed based on the state of the well.

6. WELL INSPECTION PROCEDURES

- Locate wells associated with work plan and identify if well ID is visible and accurate.
- Ensure the security bolts/padlock are in place and in good working condition.
- Inspect that the well is free from vegetation and that the inside of monument is free of stinging insects.
- Identify if the well monument/stick is secure and that the well lid can be removed without obstruction.
- Inspect that the well dust cap/pressure cap is in place and that the riser is secure.
- Inspect that the concrete surround monument is free from damage and that the wing holes/lid cap and well gasket/concrete seals are in good condition.
- Ensure the bladder pump connections/tubing in good condition.

7. DOCUMENTATION

Documentation of all monitoring well inspection activities including all field forms (see example attached) and the maintenance of a detailed field notebook as described in SOP-400. If any of the inspection findings are unsatisfactory, the field personnel will alert the program manager and coordinate needed repairs.

8. MEASURE OF PROFICIENCY

Field personnel will be experienced in monitoring well inspection procedures prior to working under this SOP.

Monitoring Well Inspection

Facility Name _____ Inspector(s) and Company_____ Date _____

Well ID	Is well labeled?	Surrounding Impacts?	Well/pump condition	Internal condition (cap secure)	Monument Condition	Well Accessible?	Recent Construction In Area That May Have Caused Changes?	Other problems	Maintenance performed

STANDARD OPERATING PROCEDURE – 200

(SOP-200)

Equipment Decontamination Procedure

Written By: Tasya Gray 10/28/1999
Revised By: Laura Dell'Olio 4/12/2021
QA Concurrence: Tasya Gray 4/12/2021

This SOP contains eight sections:

1. PURPOSE

This SOP serves to provide field personnel with an outline of the procedure and frequency of decontaminating equipment that has come into contact with potentially contaminated water.

2. APPLICATION

This SOP provides a step-by-step guideline to be followed by the field personnel to prevent cross-contamination between monitoring wells and preserve well integrity.

3. REFERENCES

U.S. EPA. June 2020. Field Equipment Cleaning and Decontamination.

https://www.epa.gov/sites/production/files/2016-01/documents/field_equipment_cleaning_and_decontamination205_af.r3.pdf

DOF. May 2021. Site Health and Safety Plan.

4. ASSOCIATED SOPS

SOP-120 - Measuring Water and NAPL Elevations

SOP-121 - Monitoring Well Development

SOP-124 – Low-flow Groundwater Sampling Procedure

SOP-150- Monitoring Well Inspection Procedure

SOP-400 – Documentation Procedures

5. EQUIPMENT

The following equipment is necessary to properly decontaminate equipment used with monitoring wells:

- De-ionized water and spray bottle.
- Alconox and spray bottle, hexane and spray bottle, paper towels/rags.
- PVC pipe, capped on one end, 5 feet long.
- A clean hose and tap water source.
- A labeled 55-gallon drum for wastewater and a bucket to use for smaller volume prior to containing in drum.
- Personal protective equipment as described in the Site Health and Safety Plan.

6. GENERAL DECONTAMINATION PROCEDURES

All reusable equipment that will come in contact with the well and/or be used to acquire samples will be decontaminated prior to arrival on site, relocation on site, and site exit.

- Wash the equipment with a solution of nonphosphate detergent (Alconox or equivalent) and water.
- Rinse the equipment with tap water.
- Rinse the equipment with distilled or DI water.

7. SPECIFIC DECONTAMINATION PROCEDURES

7.1. Non-Dedicated Submersible Pump Decontamination Procedure

After sampling or developing a well using a non-dedicated submersible pump, decontaminate the pump as follows:

- Use hose to spray off pump with tap water.
- Place pump into a capped approximately 5’ long, 3” diameter PVC pipe or similar container.
- Fill the PVC pipe with tap water and non-phosphate detergent.
- Run the pump until the pipe is empty, refilling it with tap water 3 times. The discharge decontamination water will be pumped into a 55-gallon drum or other container.

- Remove the pump and wash out the pipe using tap water from the hose.
- Place the pump in the pipe again and fill with tap water.
- Run the pump until it empties, then rinse it with water and refill the pipe with distilled or di-ionized water.
- Run the pump until the pipe empties three times with the distilled or deionized water.

8. DOCUMENTATION

Documentation of all decontamination procedures associated with monitoring well activities including all field forms and the maintenance of a detailed field notebook as described in SOP-400.

9. MEASURE OF PROFICIENCY

Field personnel will be experienced in equipment decontamination procedures prior to working under this SOP.

STANDARD OPERATING PROCEDURE – 400

(SOP-400)

Documentation Procedures

Written By: Carolyn Mayer 11/23/1997
Revised By: Laura Dell'Olio 4/12/2021
QA Concurrence: Tasya Gray 4/12/2021

This SOP contains seven sections:

1. **Purpose**
2. **Application**
3. **References**
4. **Associated SOPs**
5. **Field Books**
6. **Field Forms**
7. **Measure of Proficiency**

1. PURPOSE

This SOP serves to provide field personnel the required documentation needed to maintain accurate logs and files of all field procedures.

2. APPLICATION

This SOP provides documentation guidelines, including examples, required for environmental exploratory and sampling tasks conducted or overseen for corrective actions projects.

3. REFERENCES

None

4. ASSOCIATED SOPS

SOP–120 – Measuring Water, LNAPL, and DNAPL Elevations

SOP–121 – Monitoring Well Development

SOP–124 – Low Flow Groundwater Sampling Procedure

SOP–150– Well Inspection Procedure

SOP–200 – Equipment Decontamination Procedure

5. FIELD BOOKS

All field books should be “Rite in the Rain” or equivalent and should have non-removable pages. These field books are to be dedicated to a project, and the corrective actions’ project manager is responsible for maintaining a field book inventory. This inventory should include a numbering and tracking mechanism for each field book assigned to a particular case.

Each field book is to be maintained as follows:

- Label the outside front cover with the following information: Burlington Environmental, Facility Name, Dates Included, and Book Number. The inside cover should include: Burlington Environmental, project manager, their company name, Applicable address and phone number, Dates Included, and Book Number.
- Inside the cover, list the full names, company, and initials of each person working on the project that will be referred to in the field book.
- Maintain field notes directly in the field books (i.e. notes are not to be taken then transferred to the field books at a later time) or on relevant field forms.
- Record all field notes in permanent ink.
- Initial, date, and number each page upon completion.
- Correction of mistakes are made with a single line and initialing the correction.
- Avoid blank spaces within the notes. Unavoidable blank spaces are to be struck with a single line.

Examples of information required in the field book include:

- The date of entry.
- Time of entry for specific events (in military time).
- A meteorological description of daily changes.
- Personnel present including arrival and departure times and affiliations.
- Make, model and condition of equipment used.
- The time interval and reasons for delays including a detailed description of corrective actions taken by the field crew.
- A detailed description and rationale for any deviations from the Work Plan, Sampling Plan, or Health and Safety Plan.

6. FIELD FORMS

The field forms have been designed to detail all steps, actions, and readings associated with specific field procedures. These forms are to be completed in full. No sections are to be left blank, if a section is “not applicable”, it is to be indicated as such. All forms, including location diagrams, are to be completed in the field with permanent ink. Refer to Table 1 to see which forms are required for specific field procedures. Examples of each form are also attached.

Projects may use electronic field forms, completed via field computer, tablet, or phone in the field. These forms are to be saved and provided to the project manager at the completion of each field event to become part of the project file.

7. MEASURE OF PROFICIENCY

Field personnel will be experienced in documentation procedures prior to working under this SOP.

ATTACHMENT B

WELL LOGS

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT Mc Clary Columbia **Page** 1 **of** 1

Location Area 1 **Boring No.** MC-1

Surface Elevation Top of PVC 17.41 ft. **Drilling Method** 6-in I.D. Hollow Stem Auger

Total Depth 11.5 ft. **Drilled By** Geo-Tech Explorations, Inc.

Date Completed 3/22/85 **Logged By** J. Maul

WELL DETAILS	PENETRATION TIME/RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
Concrete; Granular Bentonite; 2" PVC Riser; Bentonite Pellets; Montreey No. 1 Sand; PVC Cap; 2" Sch. 80 PVC Screen w/0.010" Slots		0						
	6/9/11		S1	SS		SP	3.5-5.0' Sand, gray, clean, medium grained, saturated.	HNU: BG 0.8 DH 2
		5						
	1/1/2						8.5-10.0' Zero retention. Oily sheen on spoon.	
		10					10.0-11.5' Zero retention, oily sheen on spoon.	
	1/2/2					ML	11.5-13.0' Silt, green to tan, oxidized fractures changing color to orange. Slightly brittle.	
		15						

SEA-300-02a

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT Mc Clary Columbia **Page** 1 **of** 1

Location South of ~~Dryer~~ Storage Shed **Boring No.** MC-1
Top of PVC

Surface Elevation 19.22 ft. **Drilling Method** 6-in I.D. Hollow Stem Auger

Total Depth 13.5 ft. **Drilled By** Geo-Tech Explorations, Inc.

Date Completed 3/21/85 **Logged By** J. Maul

WELL DETAILS	PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
Concrete; Granular Bentonite; 4" PVC Riser		0					0-6.0' See soils log from Area 2 soils investigation.	
		2.0						
		2.5						
		3.0						
		4						
		5						
			S1	SS		SP	8.5-10.0' Sand, gray with light felsic grains, medium grained, clean, saturated, 1-in gray silt in tip of spoon. Sampler sunk under weight of hammer.	
Monterey No. 1 Sand; PVC Cap; 2" Sch. 40 PVC Screen w/0.010" slots		10						
	3/2/2		S2	SS		ML		
		11.5					10.0-11.5' Silt and Clayey Silt, gray, cohesive, sticky. Trace of very fine sand. Some oxidation in fractures to tan. Some root stems.	
		12.0						
		12.5						
		13.5						
			S3	SS		ML	13.5-15.0' Silt, gray to green, massive. Traces of organic vegetal matter.	
		15						

SEA-300-02a

LOG OF EXPLORATORY BORING

PROJECT NAME	CHEMPRO	BORING NO.	MC- 2D
LOCATION	Washougal, Washington	PAGE	1 OF 3
DRILLED BY	Onwego Drilling Co.	REFERENCE ELEV.	17.21'
DRILL METHOD	Cable Tool	TOTAL DEPTH	33.00'
LOGGED BY	R. Fredricksen	DATE COMPLETED	6/15/90

SAMPLE NUMBER (SAMPLE TYPE)	RECOVERY PERCENT	BLOW COUNTS	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
#1 (G)	100%	N/A	▼ 2.44'					**0.0-0.3' ASPHALT.**
	0%	1-2-6	▼ Water added below 4.0'	5				**0.3-6.5' SAND (SP),** grayish brown, medium to coarse, non-plastic, loose to medium density, trace amounts of rounded to sub-rounded, gravels approximately 0.25-0.75 inches; 1% gravels, 9% silt, 90% sand. (FILL)
#2 A-B-C 3"(SS)	93%	8-20-20						
#3 (SS)	100%	N/A						**6.5-9.5' SILTY SAND (SP-SM),** medium to fine, non-plastic, slightly moldable, medium density, moist; 5-15% silt, 85% sand. (ALLUVIUM)
	0%	N/A		10				**9.5-18.0' SILT (ML),** dark gray, plastic, damp, soft to stiff, trace of mottling and orange stain (2-5%), woody debris and sub-vertical root structures; 10% sand, 90% silt. (ALLUVIUM)
#4 (SS)	86%	1-1-1						
				15				

REMARKS
(SS) = Split spoon sampler. (G) = Grab sample. A-B-C sample number with sleeve identifier, sleeve A is lower most.
Reference elevation is top of PVC pipe. Blow counts not representative of standard penetration test.

LOG OF EXPLORATORY BORING

PROJECT NAME CHEMPRO
LOCATION Washougal, Washington
DRILLED BY Onwego Drilling Co.
DRILL METHOD Cable Tool
LOGGED BY R. Fredricksen

BORING NO. MC-2D
PAGE 2 OF 3
REFERENCE ELEV. 17.21'
TOTAL DEPTH 33.00'
DATE COMPLETED 6/15/90

SAMPLE NUMBER (SAMPLE TYPE)	RECOVERY PERCENT	BLOW COUNTS	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
	0%	1-2-4						**9.5-18.0' SILT (ML);** continued from previous page.
#5 (SS)	N/A	N/A						**18-18.5' SAND (SP),** greenish tan, medium grain, loose, non-plastic, wet; 5% silt, 95% sand. (ALLUVIUM)
#6 A-B-C 3"(SS)	N/A	N/A		20				**18.5-19.5' SILT (ML),** greenish gray, plastic, soft, moist, abundant woody debris; 10-15% sand, 85-90% silt. (ALLUVIUM)
								19.5-21.0' CLAY (OH), black, medium plasticity, moist, soft; 1-5% sand, 95% clay textured fabric. (ALLUVIUM)
#7 (SS)	73%	2-2-3						**21.0-25.0 SILT (ML),** greenish gray, plastic, soft, damp to slightly moist, some mottling and trace of orange stain, some woody debris. (ALLUVIUM)
#8 (SS)	50%	4-4-6		25				**25.0-25.4' SANDY GRAVEL (GW),** orange brown, loose, wet; gravels are various lithologies, rounded to sub-rounded 0.25 to 1.25 inches; 25% sand, 75% gravel. (ALLUVIUM)
								25.4-33.0' SILTY SAND (SM), orange brown, medium grained, non-plastic, wet, loose to intermittently dense; 15-20% silt, 80-85% sand. (ALLUVIUM)
#9 A-B-C 3"(SS)	100%	23-33-50						
				30				

REMARKS
(SS) = Split spoon sampler. (G) = Grab sample. A-B-C sample number with sleeve identifier, sleeve A is lower most.
Reference elevation is top of PVC pipe. Blow counts not representative of standard penetration test.

LOG OF EXPLORATORY BORING

PROJECT NAME	CHEMPRO	BORING NO.	MC-2D
LOCATION	Washougal, Washington	PAGE	3 OF 3
DRILLED BY	Onwego Drilling Co.	REFERENCE ELEV.	17.21'
DRILL METHOD	Cable Tool	TOTAL DEPTH	33.00'
LOGGED BY	R. Fredricksen	DATE COMPLETED	6/15/90

SAMPLE NUMBER (SAMPLE TYPE)	RECOVERY PERCENT	BLOW COUNTS	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
#10 (SS)	100%	4-6-8		35				25.4-33.0' SILTY SAND (SM): continued from previous page.
				40				Bottom of boring at 33.0 feet.
				45				

REMARKS
(SS) = Split spoon sampler. (G) = Grab sample. A-B-C sample number with sleeve identifier, sleeve A is lower most.
Reference elevation is top of PVC pipe. Blow counts not representative of standard penetration test.

SWEET-EDWARDS/EMCON

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT Mc Clary Columbia **Page** 1 **of** 1

Location _____ **Boring No.** MC-8

Surface Elevation Top of PVC 19.04 ft. **Drilling Method** 6-in I.D. Hollow Stem Auger

Total Depth 11.5 ft. **Drilled By** Geo-Tech Explorations, Inc.

Date Completed 3/22/85 **Logged By** J. Maul

WELL DETAILS	PENETRATION TIME/RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
Concrete; Granular Bentonite; 2" PVC Riser; Bentonite Pellets; 2" Sch. 80 PVC Screen w/0.010" Slots; Monterey No. 1 Sand; PVC Cap		0					0-8.5' For complete lithology see boring log for Area 8.	HNU: BG 7 HNU at 3.5':20
	7/5/5	5				ML	8.5-10.0' Silt, gray-green, some oxidized zones Some roots and vegetation, saturated.	HNU at 8.5': 13
	7/6/6	10				ML	10.0-11.5' Same as above.	
		15						

SEA-300-02a

PROJECT: Remedial Investigation PSC Washougal			**Log of Well No. MC-10D**	
BORING LOCATION:			GROUND SURFACE ELEVATION AND DATUM:	
DRILLING CONTRACTOR: Cascade Drilling, Inc.			DATE STARTED: 7/26/99	DATE FINISHED: 7/27/99
DRILLING METHOD: Hollow-stem auger			TOTAL DEPTH (ft.): 36.0	SCREEN INTERVAL (ft.): 25.0 to 35.0
DRILLING EQUIPMENT:			DEPTH TO WATER: FIRST 3.2 / COMPL.	CASING: 2" Sched. 40 PVC
SAMPLING METHOD: SPT split spoon drive sampler [18" x 2.5"]			LOGGED BY: C. Minton/T. Gray	
HAMMER WEIGHT:	DROP:		RESPONSIBLE PROFESSIONAL:	REG. NO.

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation:	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
0			7 14 18	0	POORLY GRADED SAND (SP): moderate yellowish brown, dry, medium to fine, loose	
1						Quickrete concrete
2			14 21 28	0	dark yellowish brown with white specks, moist, medium dense	
3			13 26 26	0	wet	15" diameter borehole
4						2" diameter Schedule 40 PVC casing
5			14 17 25	0	grayish black	
6			8 14 16	0		
7						Annular Seal (3/8 Bardid holeplug bentonite chips)
8			7 7 8	0	dense	
9			4 6	0	SILT (ML): greenish black, moist, well sorted, medium stiff	
10			8 7 7	0	ORGANIC SOIL (OL): greenish black, moist, very well sorted, medium stiff	
11						8.75" diameter borehole
12			4 5 6	0		
13			4 7 8	0	denser, with orange streaking	Quikgrout bentonite powder
14			4 4			
15						

OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-10D (cont'd)

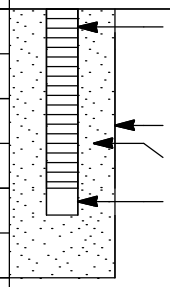
DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
15			4	0	ORGANIC SOIL (OL): (continued)	
16			4 5 7			Quikgrout bentonite powder
17				0		
18			4 5 7	0		
19			3 4 5			2" diameter Schedule 40 PVC casing
20				0		
21			6 6 7	0		
22			4 9 11			Annular Seal (3/8 Bardid holeplug bentonite chips)
23				0	CLAY (CL): greenish black, moist, moderately sorted, medium stiff	
24			5 8 14	0	ORGANIC SOIL (OL): greenish black, moist, very well sorted, medium stiff	10/20 Colorado silica sand
25			50/5"	0		
26						8.75" diameter borehole
27			50/5"	0	SILTY GRAVEL (GM): greenish brown with orange stain around gravel, wet, coarse gravel, poorly sorted, dense	
28			50/5"	0		
29			50/5"	0	siltier	
30						2" diameter Schedule 40 PVC well screen with 0.010-inch slot
31			50/3"	0	very wet, soupy	
32			50/3"	0		
33						

OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-10D (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
33					SILTY GRAVEL (GM): (continued)	
34			50/6"	0		
35			50/6"	0		
36					Bottom of boring at 36.0 feet	
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						



2" diameter Schedule 40 PVC well screen with 0.010-inch slot

8.75" diameter borehole

10/20 Colorado silica sand

2" diameter Schedule 40 PVC end cap

*Finished with steel 6.5" diameter surface casing

*We were unable to collect a shelby tube in the screened portion of the well as per the Work Plan due to the lithology of the screened interval.

OAKWELLV (REV. 9/2007)

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT McCLARY - COLUMBIA

Location NW McClary fence corner

Boring No. MC-12

Surface Elevation 18.90 ft. Top of PVC

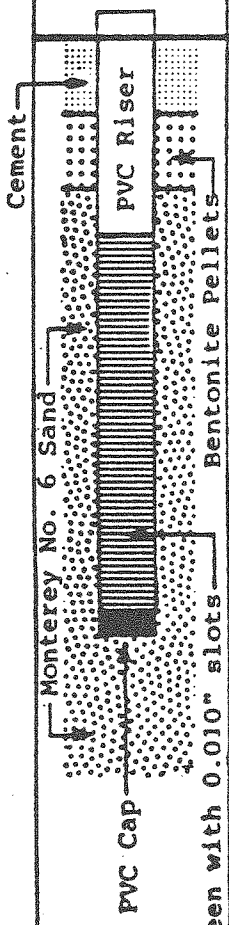
Drilling Method 6" I.D. Hollow Stem Auger

Total Depth 9.5 ft.

Drilled By Geo-Tech Exploration, Inc.

Date Completed 6/7/85

Logged By S. Henshaw



WELL DETAILS	PENETRATION TIME/RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		0						
	3/4/4	5	1	SS		SP	5.0-6.5' SAND, gray, medium grained, clean, poorly graded, some organics, "Dredge Spoils" saturated.	
	4/8/5		2	SS		SP / ML	6.5-8.0' SAND, same as above. 6.5-7.5' SILT, gray-black, abundant organic vegetal matter.	
	5/6/5		3	SS		ML	8.0-9.5' SILT, same as above.	
		10						
		15						

SEA-300-02a

LOG OF EXPLORATORY BORING

PROJECT NAME	CHEMPRO	BORING NO.	MC-12D
LOCATION	Washougal, Washington	PAGE	1 OF 2
DRILLED BY	Stoco Well Services	REFERENCE ELEV.	19.25'
DRILL METHOD	Cable Tool	TOTAL DEPTH	22.50'
LOGGED BY	R. Fredrickson	DATE COMPLETED	2/8/91

SAMPLE NUMBER (SAMPLE TYPE)	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
								0-6.5' SAND (SP); light gray, medium to coarse grained, trace silt (5%), trace gravels (2-5%), rounded to 1-inch and of various lithologies, wet, loose. (fill)
#1 (SS)	73%	2-7-11 (18)	▽ 3.5'					
				5				
#2 (SS)	100%	6-5-6 (11)						
								6.5-8.5' SILTY SAND (SM); dark gray, 20-25% silt, 75-80% fine to medium grained sand, wet, loose. (FILL)
#3 (SS)	80%	2-3-2 (5)						8.5-15.0' SILT (ML); dark gray, trace very fine sand, medium plasticity, wet, soft. (ALLUVIUM)
				10				@ 10-11.5 feet: SANDY SILT (ML); dark gray, 25-30% very fine sand, 70-75% silt, low plasticity, wet, soft, some visible micaceous grains. (ALLUVIUM)
#4 (SS)	100%	1-2-4 (6)						
#5 (SS)	100%	2-2-3 (5)						
				15				

REMARKS

SS=Split spoon sample; sampler driven using a 300lb hammer with a 24-inch stroke. Blow counts may not be representative. Vegetable oil occasionally used for thread lubricant. Approximately 100 gallons of potable water added. 2.2 feet of stick-up, total well assembly 24.7 feet. Reference elevation is top of PVC.

SWEET-EDWARDS/EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME	CHEMPRO	BORING NO.	MC-12D
LOCATION	Washougal, Washington	PAGE	2 OF 2
DRILLED BY	Staco Well Services	REFERENCE ELEV.	19.2'
DRILL METHOD	Cable Tool	TOTAL DEPTH	22.5
LOGGED BY	R. Fredrickson	DATE COMPLETED	2/8/91

SAMPLE NUMBER (SAMPLE TYPE)	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
#6 (SS)	80%	2-4-10 (14)						15-18.5' SAND (SM); gray brown, trace silt (10-15%), 85-90% very fine to fine sand, wet, soft. (ALLUVIUM) @ 16 feet: cobble.
#7 (SS)	0%	50 (50)						
#8 (SS)	67%	100-100-100 (300)		20				18.5-22.5' SANDY SILTY GRAVEL (GW-GM); greenish brown with orange stain around gravel fringe, 10-15% very fine sand, 10-20% silt, 65-75% gravels (angular to subangular to 2-inch, various lithologies but primarily basalt). (ALLUVIUM)
#9 (SS)	0%	50 (50)		25				Bottom of boring at 22.5 feet.
				30				

REMARKS

SS=Split spoon sample; sampler driven using a 300lb hammer with a 24-inch stroke. Blow counts may not be representative. Vegetable oil occasionally used for thread lubricant. Approximately 100 gallons of potable water added. 2.2 feet of stick-up, total well assembly 24.7 feet. Reference elevation is top of PVC.

SWEET-EDWARDS/EMCON

S9405.05.CHEMP.JLG\3.5/28/9

DALTON OLMSTED FUGLEVAND

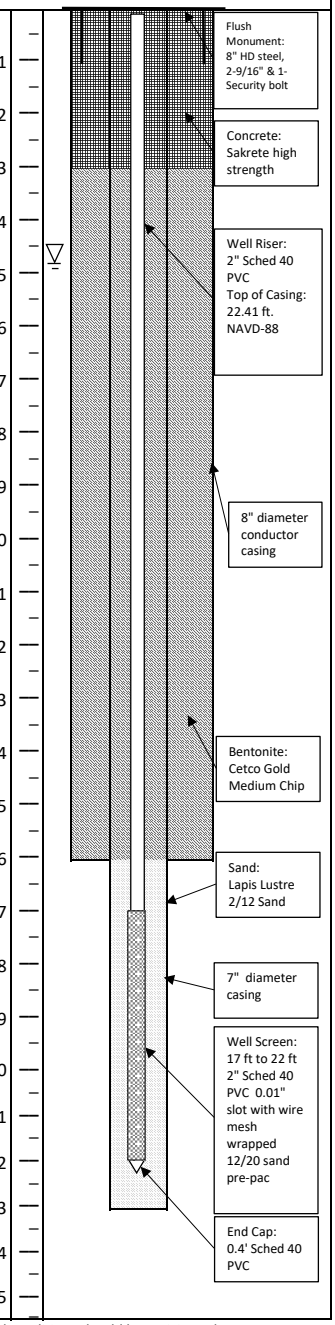
LOG OF MC-12DR

Ecology ID: BNA-479

PROJECT: Clean Earth Washougal	COORDINATES (SPCS): **N**92720.7 **E**1169597.4
LOCATION: Washougal, WA	SURFACE ELEVATION: top of monument (NAVD 88) 22.77 ft.
DRILLING CONTRACTOR: Cascade Drilling	DATE: 12/13/2021
DRILLING EQUIPMENT: DB-100 Sonic Drill Rig	TOTAL DEPTH OF BORING: 23 ft.
DRILLING METHOD: Telescoping Casing - 8" to 7" conductor casing	LOGGED BY: A.Cerruti
SAMPLING METHOD: 6" core sampler	RESPONSIBLE PROF.: A.Cerruti REG. NO.: 21013797

NOTES:

DEPTH (feet)	Sample Recovery	PID (ppm)	USCS Classification	VISUAL SOIL DESCRIPTION Soil Group Name (USCS): color, moisture, density/consistency, grain size, other discriptors
0				Ground surface 0.2' asphalt
1		0.1	SW	**WELL GRADED SAND with GRAVEL** very dark gray (7.5YR 3/1), moist, loose, 60% fine to coarse sand, 30% fine to coarse subangular gravel, 10% fines
2				
3		0.1		
4				
5		0.1		**POORLY GRADED SAND**
		0.1	SP	grayish brown (2.5Y 5/2), moist, loose, 95% fine to medium sand with 5% fines
6				
7				
8		0.1		
9				
10		0.1		
11				
12		0.1		
13				
14		0.1		
15			ML	**SILT** very dark gray (2.5Y 4/1), moist, stiff 95% fines with 5% sand, low plasticity
16		0.1		
17				
18		0.1	ML	**SILT with GRAVEL** very dark gray (2.5Y 4/1), saturated, stiff 85% fines, 15% fine to coarse, subrounded gravel; low plasticity
19				
20			GM	**SILTY GRAVEL** dark gray brown (2.5Y 4/2), saturated, loose, 70% fine to coarse, subrounded gravel, 20% low plasticity fines, 10% fine to coarse sand
21		0.1		
22		0.1		
23				**Bottom of Boring : 23 feet**
24				
25				



WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT McCLARY - COLUMBIA

Location NE McClary fence corner

Boring No. MC-13

Surface Elevation Top of PVC 18.91 ft.

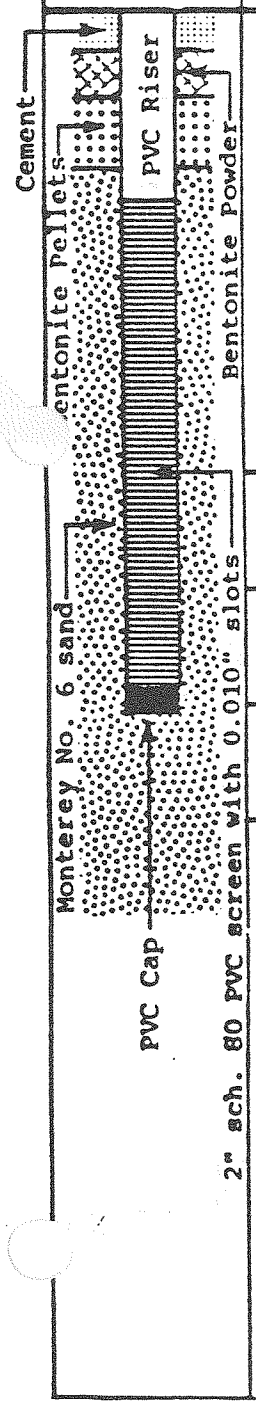
Drilling Method 6" I.D. Hollow Stem Auger

Total Depth 12.0 ft.

Drilled By Geo-Tech Exploration, Inc.

Date Completed 6/7/85

Logged By S. Henshaw



WELL DETAILS	PENETRATION TIME/RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		0						
		2.5						
		5						
	6/7/7	▽	1	SS		SP	6.0-7.5' SAND, gray, medium grained, clean, poorly graded, some organics, "Dredge Spoils" saturated, odor.	
	6/8/5	8.8	2	SS		SP	7.5-9.0' SAND, same as above.	
	2/6/10	10	3	SS		ML	9.0-10.5' SILT, gray-black, abundant organic vegetal matter.	
		15						

LOG OF EXPLORATORY BORING

PROJECT NAME	CHEMPRO	BORING NO.	MC-13D
LOCATION	Washougal, Washington	PAGE	1 OF 2
DRILLED BY	Staco Well Services	REFERENCE ELEV.	20.16'
DRILL METHOD	Cable Tool	TOTAL DEPTH	23.50'
LOGGED BY	R. Fredricksen	DATE COMPLETED	2/12/91

SAMPLE NUMBER (SAMPLE TYPE)	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
#1 (G)	100%	N/A						**0-8.5' SAND (SP);** light gray, medium-coarse grained, trace silt (5%), moist to wet, loose. (FILL)
#2 (SS)	100%	6-5-11 (16)		5				
#3 (SS)	87%	6-9-14 (23)	▽ 6.9'					**8.5-10.0' SILTY SAND (SM);** dark gray, 20-25% silt, 75-80% fine to medium grained sand, wet, loose. (FILL)
#4 (SS)	87%	3-4-4 (8)		10				**10.0-16.0' SILT (ML);** dark gray, trace of very fine sand, medium plasticity, wet, soft. (ALLUVIUM)
#5 (SS)	100%	2-4-6 (10)						@ 14-16 feet: SANDY SILT (ML); dark gray, 25-30% very fine sand, 70-75% silt, low plasticity, wet, soft. (ALLUVIUM)
				15				

REMARKS

G=Grab sample. SS=Split spoon sample; sampler driven using a 300lb hammer with a 24-inch stroke. Blow counts may not be representative. Vegetable oil occasionaly used for thread lubricant. Approximately 100 gallons of potable water added. 1.46 feet of stick-up, total well assembly 24.9 feet. Reference elevation is top of PVC.

LOG OF EXPLORATORY BORING

PROJECT NAME	CHEMPRO	BORING NO.	MC-13D
LOCATION	Washougal, Washington	PAGE	2 OF 2
DRILLED BY	Staco Well Services	REFERENCE ELEV.	20.16'
DRILL METHOD	Cable Tool	TOTAL DEPTH	23.50'
LOGGED BY	R. Fredricksen	DATE COMPLETED	2/12/91

SAMPLE NUMBER (SAMPLE TYPE)	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
#6 (SS)	N/A	6-27-50 (77)						10.0-16.0' SILT (CL); lithologic description continued from previous page.
#7 (SS)	60%	50 (50)						16-23.5' SANDY SILTY GRAVEL (GW-GM); greenish brown with orange stain around gravel fringe, 10-15% gravels angular to subangular to 2-inch, various lithologies but primarily basalt. (ALLUVIUM)
#8 (SS)	40%	50 (50)		20				
#9 (SS)	0%	50 (50)						Bottom of boring at 23.5 feet.
				25				
				30				

REMARKS

G=Grab sample. SS=Split spoon sample; sampler driven using a 300lb hammer with a 24-inch stroke. Blow counts may not be representative. Vegetable oil occasionaly used for thread lubricant. Approximately 100 gallons of potable water added. 1.46 feet of stick-up, total well assembly 24.9 feet. Reference elevation is top of PVC.

Sweet, Edwards & Associates, Inc.

BORING LOG

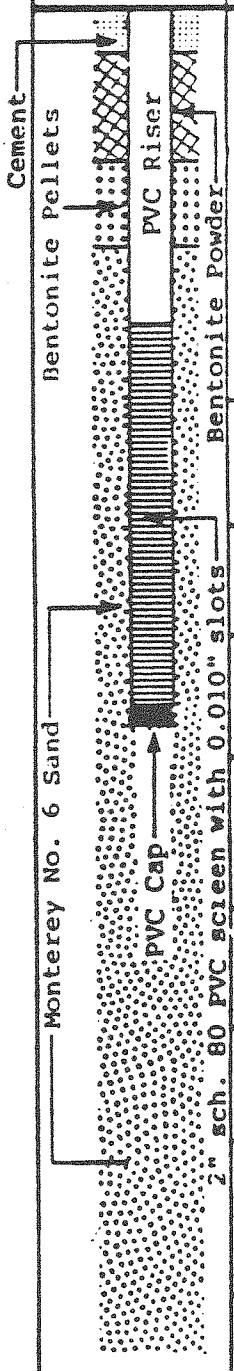
PROJECT McCLARY - COLUMBIA — **Page** 1 **of** 1

Location East side of fence in McClary yard — **Boring No.** MC-14

Surface Elevation Top of PVC 18.38 ft. — **Drilling Method** 6" I.D. Hollow Stem Auger

Total Depth 16.5 ft. — **Drilled By** Geo-Tech Exploration, Inc.

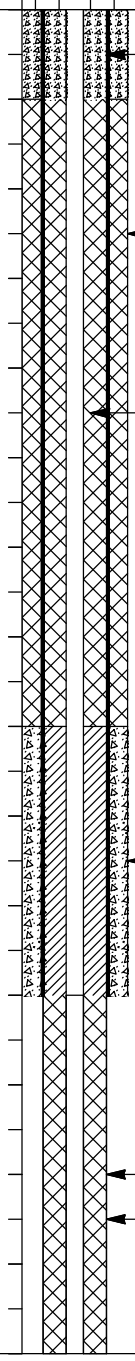
Date Completed 6/7/85 — **Logged By** S. Henshaw



PENETRATION TIME/RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
	0						
6/5/5	5	1	SS		SP	5.0-6.5' SAND, gray, medium grained, clean, poorly graded, some organics, "Dredge Spoils", saturated.	
2/4/2		2	SS		SP	6.5-8.0' SAND, gray, same as above.	
1/1/2		3	SS		SP / ML	8.0-9.5' SAND, same as above. 8.0-9.0' SILT, gray-black to green, abundant vegetal matter, SAND/SILT contact at 9.0'	
	10	4	Shelby Tube		ML	9.5-11.5' SILT, same as above, slightly mottled.	
4/4/5		5	SS		ML	11.5-13.0' SILT, same as above, mottled orange.	
2/3/4		6	SS		ML	13.0-14.5' SILT, same as above.	
	15	7	Shelby Tube		ML	14.5-16.5' SILT, same as above.	

PROJECT: Remedial Investigation PSC Washougal	**Log of Well No. MC-14D**
BORING LOCATION: 92652.8 N, 1169943.3 E	GROUND SURFACE ELEVATION AND DATUM: 17.2' MSL NGVD29(47)
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 9/28/07 / DATE FINISHED: 9/28/07
DRILLING METHOD: Sonic drilling	TOTAL DEPTH (ft.): 34.0 / SCREEN INTERVAL (ft.): 22.0 to 31.4
DRILLING EQUIPMENT: Prosonic	DEPTH TO WATER: FIRST ~6.0 / COMPL. NA / CASING: 2" Sched. 40 PVC
SAMPLING METHOD: Continuous core [10' x 6"]	LOGGED BY: N. Gray
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: N. Gray / REG. NO. L.G. 2557

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. TOC Elevation: 19.33 feet
0					POORLY GRADED GRAVEL with SILT and SAND (SP-SM): surface gravel POORLY GRADED SAND (SP): brown (10YR 5/3), dry, 95% fine to medium sand, 5% fines
1					
2	MC-14D-2-0907			0/0 (HS)	
3					POORLY GRADED SAND with SILT (SP-SM): brown (10YR 5/3), dry, 80% fine to medium sand, 10% fine gravel, 10% non-plastic fines
4	MC-14D-4-0907 and MC-14D-9-4-0907			0/0 (HS)	
5					
6					wet
7				1/1 (HS)	dark greenish gray, 10GY 4/1
8					ELASTIC SILT (MH): dark greenish gray (10GY 4/1), moist, 95% fines, 5% fine sand, medium plasticity, soft, occasional organics (roots, wood)
9					
10				0/1 (HS)	
11					
12				2	
13					
14				6	
15					



WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

- Premix Dry concrete
- 8" boring
- 2" diameter Schedule 40 PVC casing
- *OVM = miniRAE 2000 PID calibrated with 100 ppm isobutylene standard. (HS) indicates reading taken from head space in baggie
- 3/8" Hole Plug coarse grade bentonite
- 6" boring
- Quik Grout- bentonite grout

OAKWELLV_COND CASE (REV 10/99)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-14D (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16				1		
17					SILT (ML): grayish brown (10YR 5/2), wet, 90% fines, 10% fine sand, non-plastic, very soft	3/8" Hole Plug coarse grade bentonite
18					SILT (ML): Cont'd	
19				1	WELL GRADED SAND with SILT and GRAVEL (SW-SM): dark grayish brown (10YR 4/2), wet, 50% fine to coarse sand, 30% fine and coarse gravel, 20% non-plastic fines, cobbles up to 6" in diameter	3/8" Hole Plug coarse grade bentonite
20					50% fine to coarse sand, 40% fine and coarse gravel, 10% non-plastic fines	
21						#10/20 filter pack sand
22				0	Dark gray (10Y 4/1)	
23						
24				0		
25						
26						2" diameter, 0.010" slot, Schedule 40 PVC screen
27						
28						
29					SILT (ML)	
30						
31						
32						2" diameter Schedule 40 PVC end cap
33						

OAKWELLV_COND CASE (REV 10/99)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-14D (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
34					WELL GRADED GRAVEL with SAND (GW): greenish black (10Y 2.5/1), wet, 80% fine and coarse gravel, 15% fine to coarse sand, 5% fines	Native slough
					Bottom of boring at 34.0 feet. Ecology well ID = BAN152.	
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						

OAKWELLV_COND CASE (REV 10/99)

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT McCLARY - COLUMBIA/CHEMICAL PROCESSORS

Location See Map.

Boring No. MC-15

Surface Elevation Top of PVC 17.46' feet

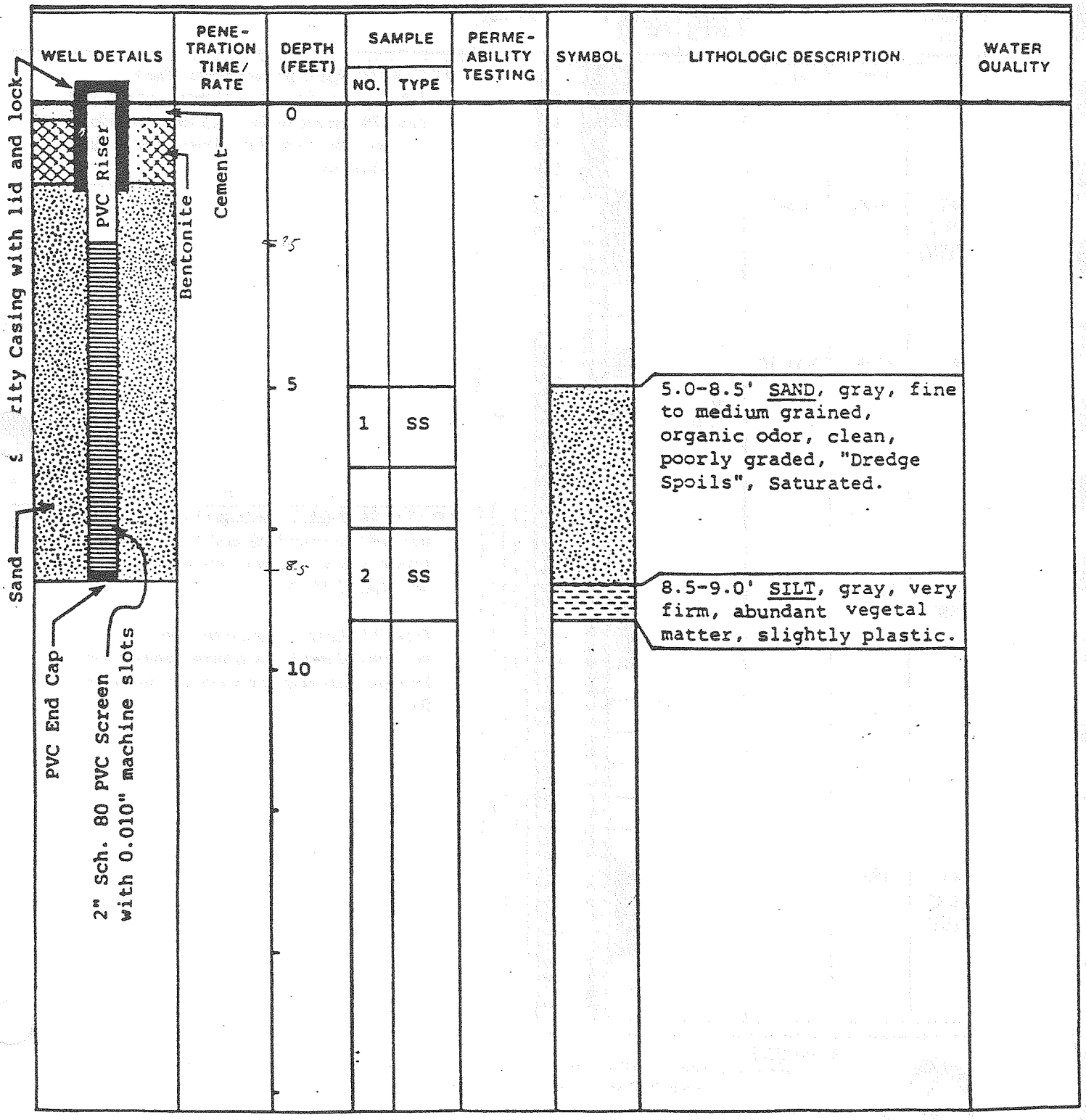
Drilling Method 6" I.D. Hollow Stem Auger

Total Depth 8.5 feet

Drilled By Geo-Tech Explorations, Inc.

Date Completed 9/19/85

Logged By S. Henshaw



SEA-300-02a

LOG OF EXPLORATORY BORING

PROJECT NAME	CHEMPRO	BORING NO.	MC-15D
LOCATION	Washougal, Washington	PAGE	1 OF 2
DRILLED BY	Onwego Drilling Co.	REFERENCE ELEV.	17.46'
DRILL METHOD	Cable Tool	TOTAL DEPTH	26.20'
LOGGED BY	Fredricksen/Udaloy	DATE COMPLETED	6/8/90

SAMPLE NUMBER (SAMPLE TYPE)	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
#1 (G)	100%	N/A						0-7.0' SAND (SP), grayish brown, fine to coarse grain with a trace of coarse gravel; 98% sand, 2% gravel; moist to 5.5 feet, wet below 5.5 feet, loose to medium dense; trace of fine to medium roots. (FILL)
#2 A-B-C 3"(SS)	100%	6-6-7	▼ 3.07'					
#3 (SS)	100%	13-11-10	▽ 5.30'	5				
#4 (SS)	100%	1-1		10				7.0-15.9' SILT (ML), medium olive gray with a trace of fine sand; 10% sand, 90% silt, low plasticity, low dilatancy, very soft to firm, wet. (ALLUVIUM) From 7.5-9.0 feet: trace roots, common sub-vertical root holes to 5mm diameter with brown-orange coatings; sandy silt interbed at 8.0-8.1 feet.
#5 A-B-C 3"(SS)	100%	1-1-1		15				

REMARKS

(SS) = Split spoon sampler. (G) = Grab sample. A-B-C sample number with sleeve identifier sleeve A is lower most. Reference elevation is top of PVC pipe. Blow counts not reprrsentative of standard penetration test. Above ground monument installed over well w/1.2' of casing stick-up.

LOG OF EXPLORATORY BORING

PROJECT NAME	CHEMPRO	BORING NO.	MC-15D
LOCATION	Washougal, Washington	PAGE	2 OF 2
DRILLED BY	Onwego Drilling Co.	REFERENCE ELEV.	17.46'
DRILL METHOD	Cable Tool	TOTAL DEPTH	26.20'
LOGGED BY	Fredricksen/Udaloy	DATE COMPLETED	6/8/90

SAMPLE NUMBER (SAMPLE TYPE)	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
#6 (SS)	100%	1-1-2						7.0-15.9' SILT (ML); continued from previous page.
								15.9-18.3' SANDY SILT (ML), moderate gray brown, fine to medium sand, very soft, wet; orange mottles below 17.5 feet. (ALLUVIUM)
#7 (SS)	100%	1-3-17						@ 17.7-18.0 feet: SAND (SP), orange brown, fine to medium.
								18.3-20.0' GRAVEL (GW), orange brown, fine to coarse, subangular to subrounded, some fine to coarse sand; 95% gravel, 5% sand; dense, wet. (ALLUVIUM)
#8 (SS)	100%	12-38-50		20				20.0-26.2' SANDY GRAVEL (GW-GM), reddish brown, fine to coarse, subangular to subrounded with fine to coarse sand; 85% gravel, 15% sand; trace of cobbles, dense to very dense, wet. (ALLUVIUM)
#9 (SS)	100%	50						
#10 (SS)	100%	50		25				
								Bottom of boring at 26.2 feet.
				30				

REMARKS

(SS) = Split spoon sampler. (G) = Grab sample. A-B-C sample number with sleeve identifier sleeve A is lower most. Reference elevation is top of PVC pipe. Blow counts not reprrsentative of standard penetration test. Above ground monument installed over well w/1.2' of casing stick-up.

Sweet, Edwards & Associates, Inc.

BORING LOG

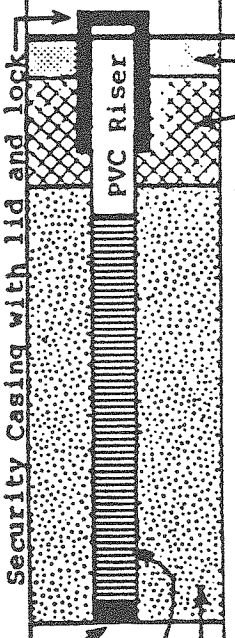
PROJECT McCLARY - COLUMBIA/CHEMICAL REXCESSORS **Page** 1 **of** 1

Location See Map **Boring No.** MC-16

Surface Elevation Top of PVC 17.67 feet **Drilling Method** 6" I.D. Hollow Stem Auger

Total Depth 7.5 feet **Drilled By** Geo-Tech Exploration, Inc.

Date Completed 9/19/85 **Logged By** S. Henshaw



WELL DETAILS	PENETRATION TIME/RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		0						
		5	1	SS		SAND	5.0-7.5' SAND, gray, fine to medium grained, some pebbles, poorly graded, "Dredge Spoils", Saturated.	
			2	SS				
						SILT	7.5-8.0' SILT, gray, very firm, abundant vegetal matter, slightly plastic.	
		10						

SEA-300-02a

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT McCLARY - COLUMBIA/CHEMICAL PROCESSORS

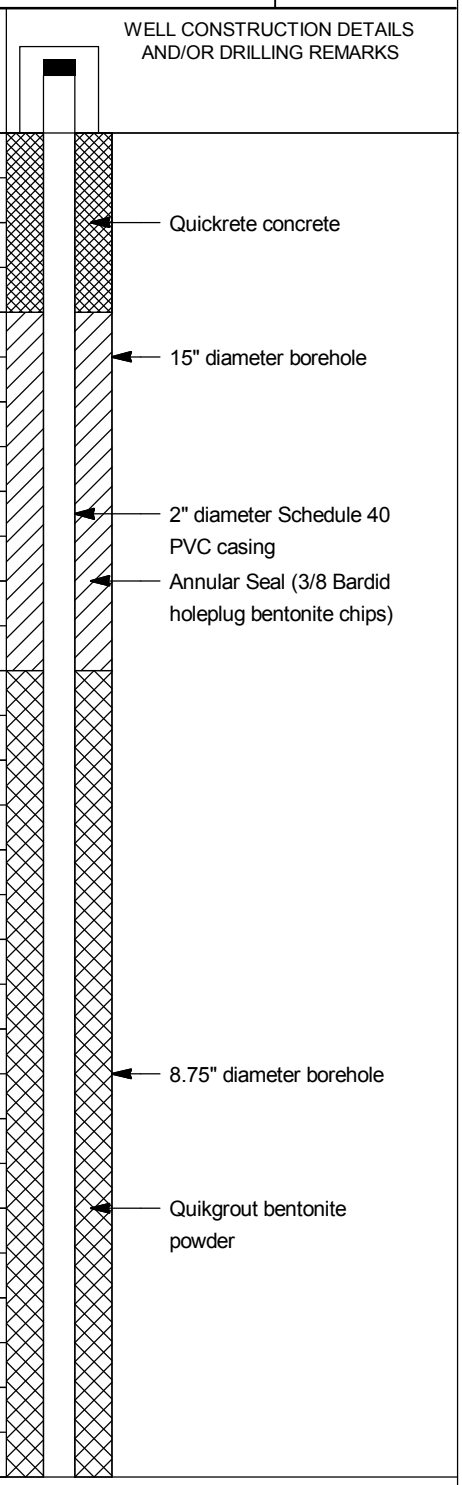
Location See Map
Boring No. MC-17
Surface Elevation 17.54 feet Top of PVC
Drilling Method 6" I.D. Hollow Stem Auger
Total Depth 7.5 feet
Drilled By Geo-Tech Exploration, Inc.
Date Completed 9/19/85
Logged By S. Henshaw

DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	LITHOLOGIC DESCRIPTION
0			
2.5			
5	1	SS	5.0-7.5' SAND, gray, fine to medium grained, poorly graded, "Dredge Spoils" saturated.
7.5	2	SS	7.5-8.0 SILT, gray, very firm, abundant vegetal matter, slightly plastic.
10			

SEA-300-02a

PROJECT: Remedial Investigation PSC Washougal			**Log of Well No. MC-17D**	
BORING LOCATION:			GROUND SURFACE ELEVATION AND DATUM:	
DRILLING CONTRACTOR: Cascade Drilling, Inc.			DATE STARTED: 7/27/99	DATE FINISHED: 7/28/99
DRILLING METHOD: Hollow-stem auger			TOTAL DEPTH (ft.): 33.0	SCREEN INTERVAL (ft.): 22.0 to 32.0
DRILLING EQUIPMENT:			DEPTH TO WATER: FIRST 4.0 / COMPL.	CASING: 2" Sched. 40 PVC
SAMPLING METHOD: SPT split spoon drive sampler [18" x 2.5"] and shelby tube			LOGGED BY: C. Minton/T. Gray	
HAMMER WEIGHT:	DROP:		RESPONSIBLE PROFESSIONAL:	REG. NO.

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation:
0			13 50/6"	0	POORLY GRADED GRAVEL (GP): moderate yellowish brown, dry, fine sands to coarse gravel, loose
1					
2			13 39 25	32.4	POORLY GRADED SAND (SP): dark yellowish brown, dry, fine to medium sand with small amounts of fine gravel, loose
3			24 26 13		moist
4				0	
5			17 13 17	0	
6			8 9 5		
7				0	wet, slightly coarser, greenish black
8	MC-17D-7.5-9.5	S			
9					
10			7 7 8	0	
11					CLAY (CL): greenish black, moist, well sorted, medium stiff
12			4 8 10	0	ORGANIC SOIL (OL): dark greenish gray, moist, well sorted, medium stiff
13			5 4 5	0	
14					
15			3 3		softer



WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-17D (cont'd)

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
15			5	0	ORGANIC SOIL (OL): (continued)	
16			3 6 10			
				0	CLAY (CL): dark greenish gray, wet, very fine to fine sands, sandy silt, soft, well sorted	
17						Quikgrout bentonite powder
			5 8 30			
18				0		
19			4 7 10			8.75" diameter borehole
20				0		
			10 50/5"		higher sand content	
21				0		
22			50/3"	0	SILTY GRAVEL (GM): moderate yellowish brown, very wet, fine silt to fine gravel, poorly sorted, loose	
23					CLAY (CL): moderate yellowish brown, moist, clayey sand, well sorted, dense sand, fine clay, silt, and sand	
			17 50/5"	0		
24						10/20 Colorado silica sand
25			50/5"	0		
				0		
26					CLAYEY SAND (SC): moderate yellowish brown with orange tint, moist, fine clay and sand, well sorted, soft	
			12 50/6"			
27						2" diameter Schedule 40 PVC well screen with 0.010-inch slot
28			50/6"			
				0		
29			50/5"			
30				0		
31			50/6"			
				0		
32						2" diameter Schedule 40 PVC end cap
33						

OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-17D (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
33					Bottom of boring at 33.0 feet	Finished with steel 6.5" diameter surface casing
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						

OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation PSC Washougal			**Log of Well No. MC-19D**	
BORING LOCATION:			GROUND SURFACE ELEVATION AND DATUM:	
DRILLING CONTRACTOR: Cascade Drilling, Inc.			DATE STARTED: 7/26/99	DATE FINISHED: 7/28/99
DRILLING METHOD: Hollow-stem auger			TOTAL DEPTH (ft.): 39.0	SCREEN INTERVAL (ft.): 28.0 to 38.0
DRILLING EQUIPMENT:			DEPTH TO WATER: FIRST 5.0 / COMPL.	CASING: 2" Sched. 40 PVC
SAMPLING METHOD: SPT split spoon drive sampler [18" x 2.5"] and Shelby			LOGGED BY: C. Minton/T. Gray	
HAMMER WEIGHT:	DROP:		RESPONSIBLE PROFESSIONAL:	REG. NO.

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation:	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
0					Debris, wood, scrap metals, dirt	
				0		
1					POORLY GRADED SAND (SP): moderate yellowish brown, dry to moist, fine to medium sand, loose	Quickrete concrete
			50/5"	0		
2						
3			8 16 12	0		15" diameter borehole
4						2" diameter Schedule 40 PVC casing
			10 15 16			
5				0	wet, dark gray	Annular Seal (3/8 Bardid holeplug bentonite chips)
6			5 6 6			
				0	woody debris	
7			6 7 8			
8				0		
					ORGANIC SOIL (OL): greenish black, moist, well sorted, very fine, medium dense, trace wood debris	
9			6 6			
				0		
10			4 5 6			
				1.1		
11						8.75" diameter borehole
			5 4 6		CLAY (CL): soft, moist, with some sand with some mica	
12				2.9		
13			6 6 6		very soft and soupy	
				2.6		
14			3 4			
15						

OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-19D (cont'd)

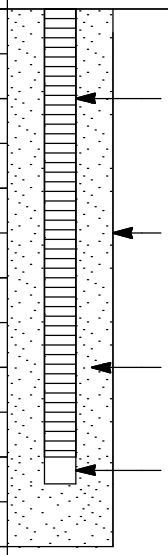
DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
15			5	2.0	CLAY (CL): (continued)	
16			3 3 4	0.5	medium stiff	
17			3 3 3		soft	
18				1.4	medium stiff	8.75" diameter borehole
19			4 4 5		soft	
20				0.1	medium stiff	Annular Seal (3/8 Bardid holeplug bentonite chips)
21			3 4 7	0.2		
22			4 5 7		CLAY (CL): greenish black, moist, well sorted, medium stiff, with some sand	
23				0.6		
24			7 8 13		soft	
25			10 12 12	0.1	medium stiff, orange tint	
26				0.5	stiff	
27			10 50/3"		moderate yellowish brown, soft	10/20 Colorado silica sand
28			50/5"	0	stiff	
29				0	CLAYEY GRAVEL (GC): moderate brown, wet, fine to medium, fine clays, fine to coarse sands, poorly sorted, medium dense	
30			50/4"	0	POORLY GRADED GRAVEL (GP): moderate brown, wet, fine sand, coarse gravel, little or no clay, medium dense	2" diameter Schedule 40 PVC well screen with 0.010-inch slot
31			50/6"	0		
32			50/5"			
33						

OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-19D (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION: NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
33				0	POORLY GRADED GRAVEL (GP): (continued)
34			50/6"	0	increased sand content
35					
36			50/5"	0	SILTY SAND (SM): dark yellowish brown, wet, sands and some silts, fine gravel, fine sand, medium dense, poorly sorted
37			50/6"	0.1	
38	MC-19D-38.5-39	S			
39					Bottom of boring at 39.0 feet
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					



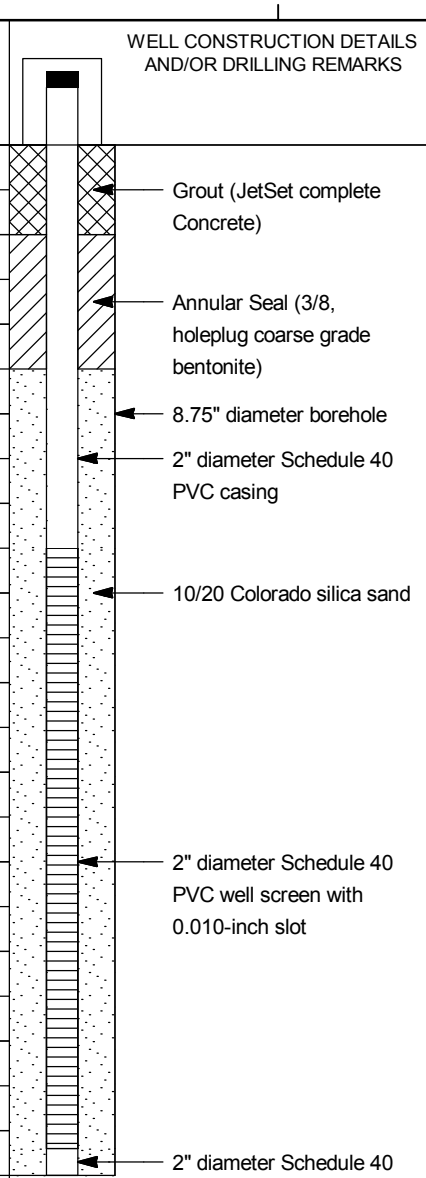
WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

- 2" diameter Schedule 40 PVC well screen with 0.010-inch slot
- 8.75" diameter borehole
- 10/20 Colorado silica sand
- 2" diameter Schedule 40 PVC end cap
- Finished with steel 6.5" diameter surface casing

*Attempt to take a shelby tube at 38.5 feet. We were only able to drive it 6" - 0930 collect sample MC-19D-39.5 to 39. No geological description.

PROJECT: Remedial Investigation PSC Washougal	**Log of Well No. MC-20**
BORING LOCATION:	GROUND SURFACE ELEVATION AND DATUM: 19.70 feet
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 3/13/00 / DATE FINISHED: 3/13/00
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 11.5 / SCREEN INTERVAL (ft.): 4.4 to 11.4
DRILLING EQUIPMENT:	DEPTH TO WATER: FIRST 5.3 / COMPL. / CASING: 2" Sched. 40 PVC
SAMPLING METHOD: SPT split spoon drive sampler [18" x 2.5"] and Shelby	LOGGED BY: T. Gray/S. Magnuson
HAMMER WEIGHT: / DROP:	RESPONSIBLE PROFESSIONAL: / REG. NO.

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 19.70 feet
0					ASPHALT
1			3 2 3	0	POORLY GRADED SAND (SP): dark yellowish brown, dry, loose
2					with coarse gravel; orange spots
3			3 3 2	0	
4			4 3 4	0	wet
5					
6			3 3 4	0	
7					
8		S			
9			1 4 12	0	woody debris
10			1 1		ORGANIC SOIL (OL): dark gray, wet, with fine sand, medium stiff
11				0	CLAYEY SAND (SC): silt/sand mixture, soft
12					Bottom of boring at 11.5 feet
13					
14					
15					



PROJECT: Remedial Investigation PSC Washougal	**Log of Well No. MC-20D**
BORING LOCATION: 92628.7 N, 1170036.4 E	GROUND SURFACE ELEVATION AND DATUM: 17.8' MSL NGVD29(47)
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 9/27/07 / DATE FINISHED: 9/27/07
DRILLING METHOD: Sonic drilling	TOTAL DEPTH (ft.): 37.0 / SCREEN INTERVAL (ft.): 25.5 to 35.0
DRILLING EQUIPMENT: Prosonic	DEPTH TO WATER: FIRST ~6.0 / COMPL. NA / CASING: 2" Sched. 40 PVC
SAMPLING METHOD: Continuous core [10' x 6"]	LOGGED BY: C. Brown
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: N. Gray / REG. NO. L.G. 2557

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
					TOC Elevation: 20.18 feet	
0					POORLY GRADED SAND with SILT (SP-SM): brown (7.5YR 5/2), dry, 80% fine to coarse sand, 10% fine gravel, 10% non-plastic fines	Premix Dry concrete
2	MC-20D-2-0907			0/1 (HS)	scattered gravel	8" boring
4	MC-20D-4-0907			0/1 (HS)		2" diameter Schedule 40 PVC casing
6					scattered organics (roots)	Quik Grout- bentonite grout
7				0/1 (HS)	orange mottling	
8					ELASTIC SILT (MH): very dark gray (N 3/), moist, 95% fines, 5% fine sand, medium to high plasticity, very soft	
10				0/1 (HS)		3/8" Hole Plug coarse grade bentonite
11					SILT (ML): very dark gray (N 3/)	
13				0/0 (HS)		6" boring
14						*OVM = miniRAE 2000 PID calibrated with 100 ppm isobutylene
15				0/1		

OAKWELLV_COND CASE (REV 10/99)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-20D (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16				(HS)		standard. (HS) indicates reading taken from head space in baggie
17				0/1 (HS)	SILT with SAND (ML): light greenish gray (10GY 7/1), moist, 75% fines, 25% fine to medium sand, low plasticity, hard	
18					SILT with SAND (ML): cont'd	
19				0/0 (HS)		Quik Grout- bentonite grout
20				0/1 (HS)		
21					WELL GRADED SAND with SILT (SW-SM): very dark greenish gray (10BG 3/1), wet, 65% fine to coarse sand, 35% fine and coarse gravel, 10% nonplastic fines	
22						3/8" Hole Plug coarse grade bentonite
23				0/1 (HS)		
24				0/1 (HS)		
25						#10/20 filter pack sand
26						
27						2" diameter, 0.010" slot, Schedule 40 PVC screen
28				0/0 (HS)		
29					SILTY SAND with GRAVEL (SM): very dark greenish gray (10BG 3/1), wet, 55% fine to coarse sand, 25% fine and coarse gravel, 20% non-plastic fines	
30				0/0 (HS)		
31				0/0 (HS)		
32						
33						

OAKWELLV_COND CASE (REV 10/99)

PROJECT: Remedial Investigation
PSC Washougal

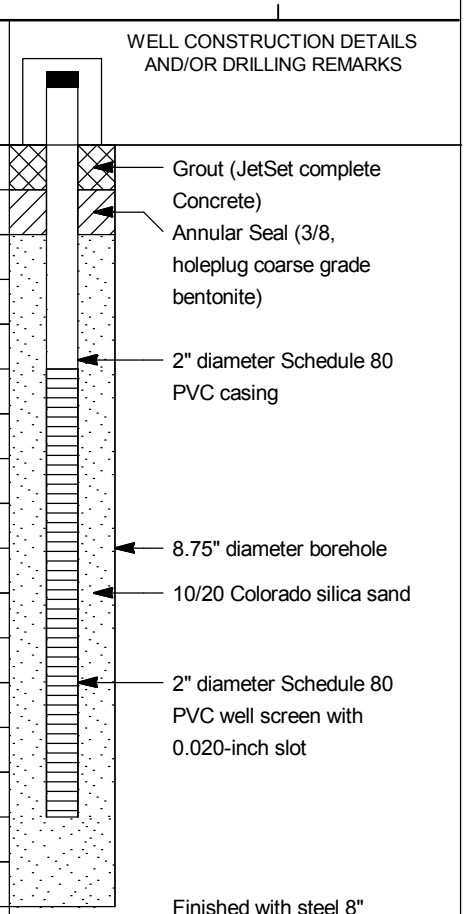
Log of Well No. MC-20D (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
34				0/1 (HS)		
				0/1 (HS)		
35						2" diameter Schedule 40 PVC end cap
36				0/0 (HS)		
37					Bottom of boring at 37.0 feet. Ecology well ID = BAN151.	
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						

OAKWELLV_COND CASE (REV 10/99)

PROJECT: Remedial Investigation PSC Washougal	**Log of Well No. MC-21**
BORING LOCATION:	GROUND SURFACE ELEVATION AND DATUM: 16.79 feet
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 3/13/00 / DATE FINISHED: 3/13/00
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 8.5 / SCREEN INTERVAL (ft.): 2.5 to 7.5
DRILLING EQUIPMENT:	DEPTH TO WATER: FIRST 4.5 / COMPL. / CASING: 2" Sched. 80 PVC
SAMPLING METHOD: SPT split spoon drive sampler [18" x 2.5"]	LOGGED BY: T. Gray/S. Magnuson
HAMMER WEIGHT: / DROP:	RESPONSIBLE PROFESSIONAL: / REG. NO.

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 16.79 feet
0					ASPHALT
1			9 10 17	0	POORLY GRADED SAND (SP): dark yellowish brown, dry, no fines, medium grain, loose
2			4 8 10	0	with fine gravel 3/4"
3					
4			4 4	0	wet
5					
6		S			
7			1 2 2	14.5	SILT (ML): olive gray, wet, no organics, stiff
8					CLAY (CL): olive gray, wet, with fine sand, medium stiff Bottom of boring at 8.5 feet.
9					
10					
11					
12					
13					
14					
15					



WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-24

BORING LOCATION: 92595.5 N, 1169765.0 E

GROUND SURFACE ELEVATION AND DATUM: 16.8' MSL NGVD29(47)

DRILLING CONTRACTOR: Cascade Drilling, Inc.

DATE STARTED: 9/24/07 | DATE FINISHED: 9/24/07

DRILLING METHOD: Hollow-stem auger

TOTAL DEPTH (ft.): 9.2 | SCREEN INTERVAL (ft.): 4.1 to 8.9

DRILLING EQUIPMENT: CME-75

DEPTH TO WATER: FIRST 6.0 | COMPL. NA | CASING: 2" Sched. 40 PVC

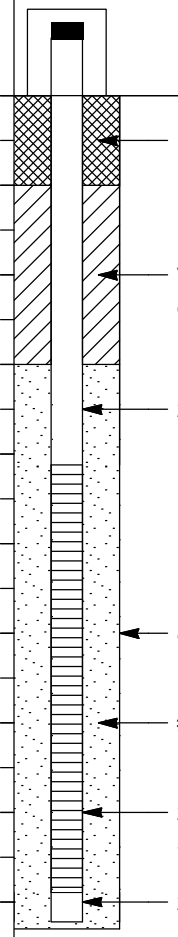
SAMPLING METHOD: SPT split spoon drive sampler [18" x 1.5"]

LOGGED BY: C. Brown

HAMMER WEIGHT: 300 lb | DROP: 30 inches

RESPONSIBLE PROFESSIONAL: N. Gray | REG. NO. L.G. 2557

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION: NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
					Surface Elevation: 19.49 feet
0	MC-24-1.5-0907		32	0/0 (HS)	POORLY GRADED SAND with SILT (SP-SM): grayish brown (10YR 5/2), dry, 80% fine to coarse sand, 10% fine gravel, 10% nonplastic fines
2	MC-24-3-0907		27	0/2 (HS)	
3	MC-24-4.5-0907		7	0/2 (HS)	POORLY GRADED SAND with SILT and GRAVEL (SP-SM): very dark grayish brown (10YR 3/2), moist, 75% fine to coarse sand, 15% fine gravel, 10% nonplastic fines
5			9	0/2 (HS)	wood fragments
6			5	0/2 (HS)	POORLY GRADED SAND with SILT (SP-SM): very dark gray (N 3/), wet, 90% fine to medium sand, 10% nonplastic fines SILT (ML): medium plasticity
8			4	0/2 (HS)	ELASTIC SILT (MH): very dark gray (N 3/), moist, 95% fines, 5% fine sand, medium plasticity, firm
9					Bottom of boring at 9.3 feet. Ecology well ID = APS714.
10					
11					
12					
13					
14					
15					



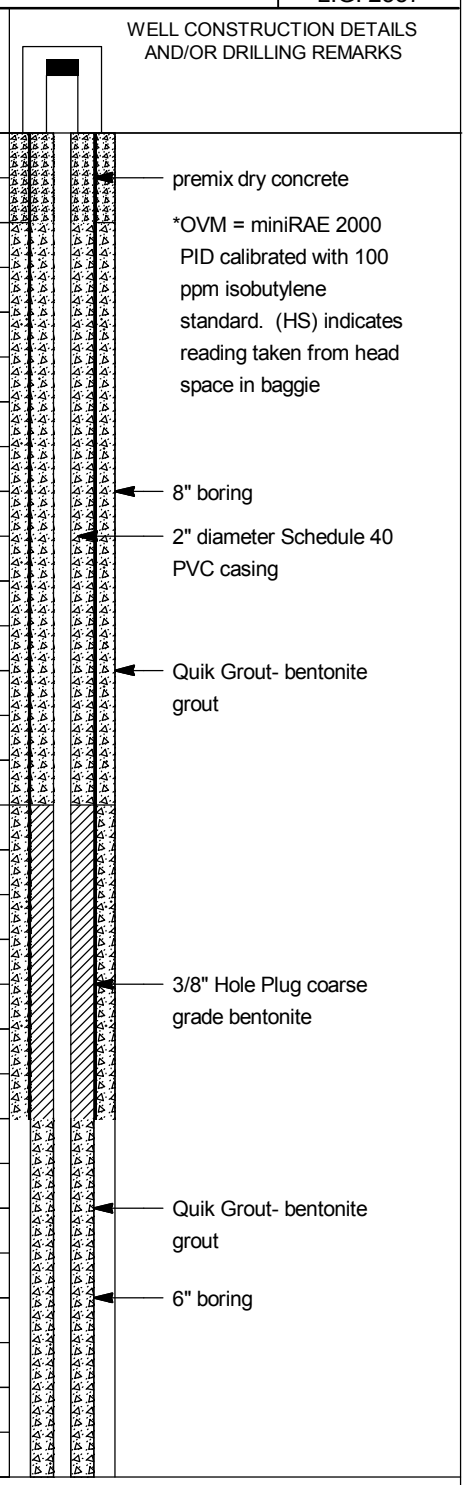
WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

*OVM = miniRAE 2000 calibrated with 100 ppm isobutylene standard. (HS) indicates reading taken from head space in baggie

OAKWELLV (REV. 4/00)

PROJECT: Remedial Investigation PSC Washougal	**Log of Well No. MC-24D**
BORING LOCATION: 92592.1 N, 1169771.4 E	GROUND SURFACE ELEVATION AND DATUM: 16.9' MSL NGVD29(47)
DRILLING CONTRACTOR: Boart Longyear	DATE STARTED: 10/1/07 / DATE FINISHED: 10/1/07
DRILLING METHOD: Sonic drilling	TOTAL DEPTH (ft.): 33.0 / SCREEN INTERVAL (ft.): 22.0 to 32.0
DRILLING EQUIPMENT: Prosonic	DEPTH TO WATER: FIRST ~0.0 / COMPL. NA / CASING: 2" Sched. 40 PVC
SAMPLING METHOD: Continuous core [10' x 6"]	LOGGED BY: N. Gray
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: N. Gray / REG. NO. L.G. 2557

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 19.03 feet
0					POORLY GRADED SAND with SILT and GRAVEL (SP-SM): brown (10YR 4/3), wet, 50% fine to coarse sand, 40% fine gravel, 10% non-plastic fines
1	MC-24D-1.5-1007			0 (HS)	
2					60% sand, 30% fine gravel, 10% fines
3					POORLY GRADED SAND (SP): brown (10YR 4/3), wet, 95% fine to coarse sand, 5% fines
4	MC-24D-4-1007			0 (HS)	
5					dark greenish gray (10Y 4/1)
6				0 (HS)	
7				0 (HS)	
8					ELASTIC SILT (MH): dark greenish gray (10Y 4/1), wet, 95% fines, 5% fine sand, medium plasticity, very soft, organic matter throughout
9				0 (HS)	
10					less organic matter, moist
11					
12					
13					
14					orange mottling
15					



WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-24D (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
15					greenish mottling	
16						
17					low plasticity	
18				0 (HS)	ELASTIC SILT (MH): Cont'd	
19					90% fines, 10% fine sand	
20				0 (HS)	SILTY GRAVEL with SAND (GM): dark yellowish brown (10YR 4/4), wet, 55% fine and coarse well graded gravel, 30% fine to coarse sand, 15% medium plasticity fines	3/8" Hole Plug coarse grade bentonite
21						#10/20 filter pack sand
22				0 (HS)		
23						
24				0 (HS)		
25						
26						2" diameter, 0.010" slot, Schedule 40 PVC screen
27				0 (HS)		
28						
29						
30				0 (HS)	POORLY GRADED SAND (SP): dark yellowish brown (10YR 4/4), wet, 95% fine to coarse sand, 5% fines	
31					dark orange black	
32						2" diameter Schedule 40 PVC end cap
33						

OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-24D (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
33					Bottom of boring at 33.0 feet. Ecology well ID = BAN153.	
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						

OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-24D2

BORING LOCATION: 92603.5 N, 1169771.2 E

GROUND SURFACE ELEVATION AND DATUM: 16.4' MSL NGVD29(47)

DRILLING CONTRACTOR: Cascade Drilling, Inc.

DATE STARTED: 5/8/09

DATE FINISHED: 5/8/09

DRILLING METHOD: Sonic drilling

TOTAL DEPTH (ft.): 46.0

SCREEN INTERVAL (ft.): 34.8 to 44.6

DRILLING EQUIPMENT: Sonicor 50k

DEPTH TO WATER: FIRST 3.0 COMPL. 4.35

CASING: 2" Sched. 40 PVC

SAMPLING METHOD: Continuous core [10' x 6"]

LOGGED BY: C. Brown

HAMMER WEIGHT: NA

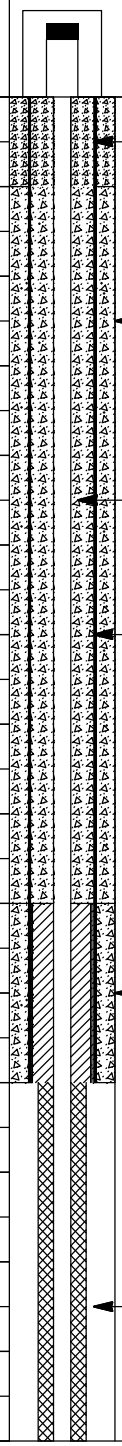
DROP: NA

RESPONSIBLE PROFESSIONAL: N. Gray

REG. NO. L.G. 2557

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
					Surface Elevation: 16.4 feet
0					POORLY GRADED SAND with SILT and GRAVEL (SP-SM): brown (10YR 4/3), wet, 50% fine to coarse sand, 40% fine gravel, 10% non-plastic fines
2					60% sand, 30% fine gravel, 10% fines
3					POORLY GRADED SAND (SP): brown (10YR 4/3), wet, 95% fine to coarse sand, 5% fines
5					dark greenish gray (10Y 4/1)
7					ELASTIC SILT (MH): dark greenish gray (10Y 4/1), wet, 95% fines, 5% fine sand, medium plasticity, very soft, organic matter throughout
9					less organic matter, moist
13					orange mottling

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-24D2 (cont'd)

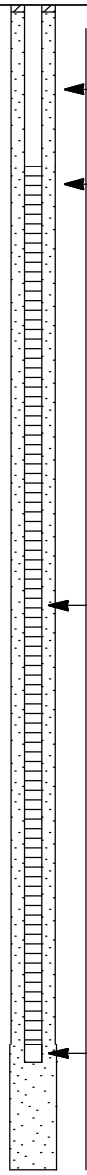
DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
15					greenish mottling (MH) cont.	6" boring
16						
17					low plasticity	2" diameter Schedule 40 PVC casing
18						
19					90% fines, 10% fine sand	
20					SILTY GRAVEL with SAND (GM): dark yellowish brown (10YR 4/4), wet, 55% fine and coarse well graded gravel, 30% fine to coarse sand, 15% medium plasticity fines	Volclay Grout
21						
22						
23						
24						
25						
26						
27						
28						
29						
30					POORLY GRADED SAND with SILT and GRAVEL (SP-SM): dark yellowish brown (10YR 3/4), wet, 75% fine to coarse sand, 15% rounded fine gravel, 10% fines	
31						
32					dark orange black	3/8" HydroPlug bentonite chips
33						

OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-24D2 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
33					(SP-SM) cont.	
34						Cemex Lapis Lustre #10/20 filter sand
35						6" boring
36						
37					dark grayish brown (10YR 4/2)	
38						
39					POORLY GRADED SAND with SILT (SP-SM): dark grayish brown (10YR 4/2), wet, 90% fine to medium sand, 10% low plasticity fines	
40						2" diameter, 0.010" slot, Schedule 40 PVC screen
41						
42						
43						
44						
45						2" diameter Schedule 40 PVC end cap
46					Bottom of boring at 46.0 feet. Ecology well tag number: BBA-758.	
47						
48						
49						
50						
51						



OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-25

BORING LOCATION: 92688.2 N, 1169758.3 E

GROUND SURFACE ELEVATION AND DATUM: 17.4' MSL NGVD29(47)

DRILLING CONTRACTOR: Cascade Drilling, Inc.

DATE STARTED: 9/24/07

DATE FINISHED: 9/24/07

DRILLING METHOD: Hollow-stem auger

TOTAL DEPTH (ft.): 9.8

SCREEN INTERVAL (ft.): 4.0 to 8.8

DRILLING EQUIPMENT: CME-75

DEPTH TO WATER: FIRST 3.8 | COMPL. NA

CASING: 2" Sched. 40 PVC

SAMPLING METHOD: SPT split spoon drive sampler [18" x 1.5"]

LOGGED BY: N. Gray

HAMMER WEIGHT: 300 lb

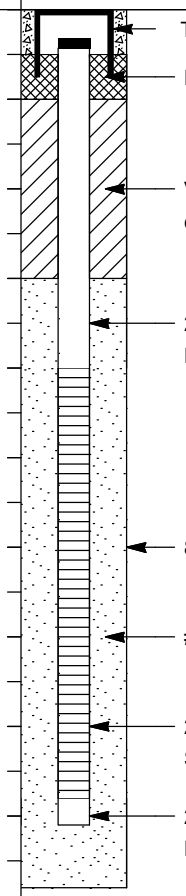
DROP: 30 inches

RESPONSIBLE PROFESSIONAL: N. Gray

REG. NO. L.G. 2557

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
					Surface Elevation: 16.97 feet
0				0/0 (HS)	POORLY GRADED SAND (SP): light olive brown (2.5Y 5/3), dry, 90% fine to coarse sand, 5% fine gravel, 5% fines
1	MC-25-1.5-0907		24		
1				0/0 (HS)	olive brown (2.5Y 4/3), 95% fine to coarse sand, 5% fines
2	MC-25-3-0907		25		small wood fragment
3				0/1 (HS)	
4	MC-25-4-0907		19		gray (2.5Y 5/1), banded coloring, wet
4				0/1 (HS)	
5			18		
6					very dark gray (N 4/)
6				0/1 (HS)	
7			7		
7				0/2 (HS)	
8			2		ELASTIC SILT (MH): dark greenish gray (10Y 4/1), moist, 95% fines, 5% fine sand, medium plasticity, firm
9					
10					Bottom of boring at 9.8 feet. Ecology well ID = APS715.
11					
12					
13					
14					
15					

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



*OVM = miniRAE 2000 PID calibrated with 100 ppm isobutylene standard. (HS) indicates reading taken from head space in baggie

OAKWELLV (REV. 4/00)

PROJECT: Remedial Investigation PSC Washougal	**Log of Well No. MC-25D**
BORING LOCATION: 92684.9 N, 1169763.9 E	GROUND SURFACE ELEVATION AND DATUM: 17.0' MSL NGVD29(47)
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 10/2/07 / DATE FINISHED: 10/2/07
DRILLING METHOD: Sonic drilling	TOTAL DEPTH (ft.): 34.0 / SCREEN INTERVAL (ft.): 23.0 to 32.5
DRILLING EQUIPMENT: Prosonic	DEPTH TO WATER: FIRST ~3.0 / COMPL. NA / CASING: 2" Sched. 40 PVC
SAMPLING METHOD: Continuous core [10' x 6"]	LOGGED BY: N. Gray
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: N. Gray / REG. NO. L.G. 2557

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
					TOC Elevation: 16.71 feet	
1	MC-25D-1.5-1007			0/0 (HS)	POORLY GRADED SAND with SILT and GRAVEL (SP-SM): brown (10YR 4/3), wet, 50% fine to coarse sand, 40% fine gravel, 10% non-plastic fines	Traffic Box Premix Dry concrete
2						
3						8" boring
4	MC-25D-4-1007					
5				0/0 (HS)	POORLY GRADED SAND (SP): brown (10YR 4/3), wet, 95% fine to coarse sand, 5% fines	2" diameter Schedule 40 PVC casing
6						Quik Grout- bentonite grout
7					POORLY GRADED SAND with SILT (SP-SM): dark greenish gray (10Y 4/1), wet, 90% fine to medium sand, 10% non-plastic fines	
8				0/1 (HS)		
9					ELASTIC SILT (MH): dark greenish gray (10Y 4/1), moist, 95% fines, 5% fine sand, medium plasticity, soft, organic matter throughout	3/8" Hole Plug coarse grade bentonite
10				0/1 (HS)	very soft	
11					greenish mottling, no organic matter	
12						
13				3/16 (HS)	low plasticity	6" boring
14						
15						*OVM = miniRAE 2000 PID calibrated with 100

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-25D (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16				1/45 (HS)		ppm isobutylene standard. (HS) indicates reading taken from head space in baggie
17						
18				0	SILTY GRAVEL (GM): dark grayish brown (10YR4/2), moist, 60% fine and coarse gravel, 30% low plasticity fines, 10% fine to medium sand	
19					rock, cored through	3/8" Hole Plug coarse grade bentonite
20						
21				0	rock, cored through	
22					POORLY GRADED GRAVEL with SILT and SAND (GP-GM): dark grayish brown (10YR 4/2), wet, 55% fine and coarse rounded gravel, 35% fine to coarse sand, 10% non-plastic fines, cobbles 6" and greater	#10/20 filter pack sand
23						
24						
25				0		
26						2" diameter, 0.010" slot, Schedule 40 PVC screen
27				0		
28						
29						
30				0		
31						
32					rock	
33						2" diameter Schedule 40

OAKWELLV_COND CASE (REV 10/99)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-25D (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
				0		PVC end cap
34					Bottom of boring at 34.0 feet. Ecology well ID = BAN154.	
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						

OAKWELLV_COND CASE (REV 10/99)

PROJECT: Remedial Investigation PSC Washougal	**Log of Well No. MC-25D2**
BORING LOCATION: 92689.5 N, 1169763.4 E	GROUND SURFACE ELEVATION AND DATUM: 16.68 MSL NGVD29(47)
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 9/8/08 / DATE FINISHED: 9/8/08
DRILLING METHOD: Sonic drilling	TOTAL DEPTH (ft.): 46.5 / SCREEN INTERVAL (ft.): 35.6 to 45.3
DRILLING EQUIPMENT: Sonicor 50k	DEPTH TO WATER: FIRST 4.5 / COMPL. NA / CASING: 2" Sched. 40 PVC
SAMPLING METHOD: Continuous core [10' x 6"]	LOGGED BY: C. Brown
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: N. Gray / REG. NO. L.G. 2557

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. TOC Elevation: 17.2 feet	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
1					*See log of MC-25D	Traffic Box Quickrete dry concrete *OVM = Photovac 2020 PID calibrated with 100 ppm isobutylene standard.
2				0/0 HS		8" boring
3						
4						2" diameter Schedule 40 PVC casing
5						
6						Volclay High Solids Bentonite Grout
7				0		
8						
9						PureGold Medium Bentonite Chips
10						
11						
12				0		Volclay High Solids Bentonite Grout
13						6" boring
14						
15						

OAKWELLV_COND CASE (REV 10/99)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-25D2 (cont'd)

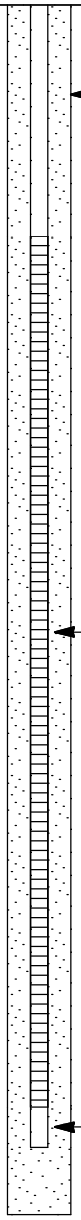
DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16				0/0 HS	*See log of MC-25D	Volclay High Solids Bentonite Grout
17						2" diameter Schedule 40 PVC casing
18						
19				0		
20						
21						
22						
23						
24				0		
25						
26						
27				0		
28						
29						
30						PureGold Medium Bentonite Chips
31						
32				0/0 HS		Oglebay Norton Colorado Silica #10/20 filter pack
33						

OAKWELLV_COND CASE (REV 10/99)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-25D2 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
34						sand Oglebay Norton Colorado Silica #10/20 filter pack sand
35						
36				0	POORLY GRADED SAND (SP): dark yellowish brown (10YR 3/4), moist, 95% fine to medium sand, <5% fines, iron oxide mottling	
37						
38						
39						
40						2" diameter, 0.010" slot, Schedule 40 PVC screen
41						
42				0		
43						
44						
45						
46					POORLY GRADED SAND with SILT (SP-SM): dark gray (10YR 4/1), moist, 90% fine to medium sand, 10% non-plastic fines	2" diameter Schedule 40 PVC end cap
47					Bottom of boring at 46.5 feet.	
48						
49						
50						
51						



OAKWELLV_COND CASE (REV 10/99)

PROJECT: Remedial Investigation PSC Washougal	**Log of Well No. MC-26D2**
BORING LOCATION: 92722.4 N, 1169811.7 E	GROUND SURFACE ELEVATION AND DATUM: 20.07 MSL NGVD29(47)
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 9/9/08 / DATE FINISHED: 9/10/08
DRILLING METHOD: Sonic drilling	TOTAL DEPTH (ft.): 41.0 / SCREEN INTERVAL (ft.): 30.6 to 40.2
DRILLING EQUIPMENT: Sonicor 50k	DEPTH TO WATER: / FIRST: 5.5 / COMPL.: NA / CASING: 2" Sched. 40 PVC
SAMPLING METHOD: Continuous core [10' x 6"]	LOGGED BY: C. Brown
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: N. Gray / REG. NO. L.G. 2557

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. TOC Elevation: 17.6 feet	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
1					*See Log of GP-97	Quickrete dry concrete
2				0/0 HS		PureGold Medium Bentonite Chips
3						8" boring
4				10/12 HS	odor noted	*OVM = Photovac 2020 PID calibrated with 100 ppm isobutylene standard.
5						2" diameter Schedule 40 PVC casing
6						Volclay High Solids Bentonite Grout
7				2		
8						
9						
10						PureGold Medium Bentonite Chips
11						
12				0		Volclay High Solids Bentonite Grout
13						6" boring
14						
15						

OAKWELLV_COND CASE (REV 10/99)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-26D2 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16				0/0 HS	*See log of GP-97	Volclay High Solids Bentonite Grout
17					SILTY GRAVEL (GM): dark grayish brown (10YR 4/2), moist, 60% fine and coarse gravel, 30% low plasticity fines, 10% fine to coarse sand	6" boring
18						2" diameter Schedule 40 PVC casing
19					solid rock cored	
20				0		
21						
22					fractured rock	
23						
24				0		
25						PureGold Medium Bentonite Chips
26					POORLY GRADED GRAVEL with SILT and SAND (GP-GM): dark grayish brown (10YR 4/2), wet, 50% fine and coarse gravel, 40% fine to coarse sand, 10% non-plastic fines	
27						
28				0		
29						Oglebay Norton Colorado Silica #10/20 filter pack sand
30						
31						2" diameter, 0.010" slot, Schedule 40 PVC screen
32						
33						

OAKWELLV_COND CASE (REV 10/99)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-26D2 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
34				0/0 HS	(GP-GM) cont.	6" boring Oglebay Norton Colorado Silica #10/20 filter pack sand
35						2" diameter, 0.010" slot, Schedule 40 PVC screen
36				0	solid rock	
37						
38						
39				0		
40					fractured rock	2" diameter Schedule 40 PVC end cap
41					Bottom of boring at 41.0 feet.	
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						

OAKWELLV_COND CASE (REV 10/99)

PROJECT: Remedial Investigation PSC Washougal	**Log of Well No. MC-27D**
BORING LOCATION: 92773.1 N, 1169760.4 E	GROUND SURFACE ELEVATION AND DATUM: 17.8' MSL NGVD29(47)
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 5/6/09 / DATE FINISHED: 5/6/09
DRILLING METHOD: Sonic drilling	TOTAL DEPTH (ft.): 36.0 / SCREEN INTERVAL (ft.): 25.2 to 35.1
DRILLING EQUIPMENT: Sonicor 50k	DEPTH TO WATER: FIRST 4.5, COMPL. 4.03 / CASING: 2" Sched. 40 PVC
SAMPLING METHOD: Continuous core [10' x 6"]	LOGGED BY: C. Brown
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: N. Gray / REG. NO. L.G. 2557

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
					Surface Elevation: 17.8 feet	
0					POORLY GRADED SAND (SP): dark grayish brown (10YR 4/2), moist, 95% fine to coarse sand, 5% non-plastic fines	Traffic Box Quikrete concrete
1						
2						8" boring
3						
4						2" diameter Schedule 40 PVC casing
5					POORLY GRADED SAND with SILT (SP-SM): dark grayish brown (10YR 4/2), moist, 90% fine to coarse sand, 10% low-plasticity fines	
6					POORLY GRADED SAND (SP): dark grayish brown (10YR 4/2), moist, 95% fine to coarse sand, 5% non-plastic fines	Volclay Grout
7						
8					greenish black (5GY 2.5/1)	
9						3/8" HydroPlug bentonite chips
10					organics SILT (ML): greenish black (5GY 2.5/1), moist, 95% fines, 5% fine sand, medium plasticity, stiff, iron oxide mottling	
11						
12						
13					wet	6" boring
14						
15						

OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation
PSC Washougal

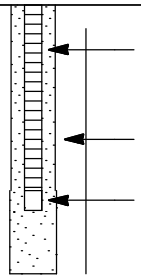
Log of Well No. MC-27D (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
15					(ML) cont.	
16						Volclay Grout
					fractured rock	
17					POORLY GRADED SAND with SILT and GRAVEL (SP-SM): light gray (2.5Y 7/1), moist, 65% fine to coarse sand, 25% fine and coarse sub-rounded gravel, 10% low plasticity fines	2" diameter Schedule 40 PVC casing
18						6" boring
19					SILTY SAND with GRAVEL (SM): very dark gray (N 3/), moist, 40% fine to coarse sand, 35% low plasticity fines, 25% fine and coarse gravels, cored cobbles in places	
20						
21						3/8" HydroPlug bentonite chips
22					SILTY GRAVEL with SAND (GM): very dark gray (N 3/), wet, 40% fine and coarse gravel, 30% fine to coarse sand, 20% low plasticity fines, round to sub-round gravels to 4-6"	
23						Cemex Lapis Lustre #10/20 filter sand
24						
25					40% fine and coarse gravel, 30% fine to coarse sand, 20% low-plasticity fines	
26					dark brown sand, with gray silt	2" diameter, 0.010" slot, Schedule 40 PVC screen
27						
28						
29						
30						
31						
32						
33						

OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-27D (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
33					(GM) cont.	 Cemex Lapis Lustre #10/20 filter sand; 6" boring; 2" diameter Schedule 40 PVC end cap
34						
35						
36					Bottom of boring at 36.0 feet. Ecology well tag number BAL-141.	
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						

OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation PSC Washougal	**Log of Well No. MC-28D**
BORING LOCATION: 92775.1 N, 1169859.9 E	GROUND SURFACE ELEVATION AND DATUM: 18.1' MSL NGVD29(47)
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 5/7/09 / DATE FINISHED: 5/7/09
DRILLING METHOD: Sonic drilling	TOTAL DEPTH (ft.): 37.0 / SCREEN INTERVAL (ft.): 25.9 to 35.6
DRILLING EQUIPMENT: Sonicor 50k	DEPTH TO WATER: FIRST 5.0 COMPL. 4.34 / CASING: 2" Sched. 40 PVC
SAMPLING METHOD: Continuous core [10' x 6"]	LOGGED BY: C. Brown
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: N. Gray / REG. NO. L.G. 2557

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
					Surface Elevation: 18.1 feet	
0					WELL GRADED SAND (SW): very dark gray (10YR 3/1), moist, 95% fine to coarse sand, 5% non-plastic fines	Traffic Box Quikrete concrete
1						
2						8" boring
3						
4						2" diameter Schedule 40 PVC casing
5					wet	
6						Volclay Grout
7						
8					slightly siltier	
9						
10					organics, roots, wood waste	
11					SILT (ML): very dark gray (N 3/), moist, 95% fines, 5% fine sand, medium plasticity, soft	3/8" HydroPlug bentonite chips
12						
13					GRAVELLY SILT (ML): very dark gray (N 3/), wet, 55% fines, 35% fine gravel, 10% fine to coarse sand, low plasticity, medium stiff	6" boring
14						
15						

OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-28D (cont'd)

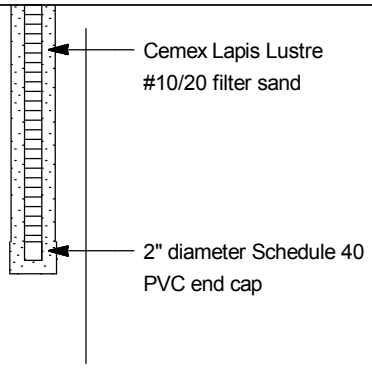
DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
15					(ML) cont.	
16						Volclay Grout
17					SILTY GRAVEL with SAND (GM): very dark gray (N 3/), wet, 50% fine and coarse gravel, 30% low plasticity fines, 20% fine to coarse sand, sub-rounded gravel	2" diameter Schedule 40 PVC casing
18						
19					fractured, crushed rock	
20						
21					rounded gravel, medium to coarse sand	
22						3/8" HydroPlug bentonite chips
23						
24					SILTY SAND with GRAVEL (SM): very dark gray (N 3/), wet, 50% fine to coarse sand, 35% fine and coarse, sub-rounded gravel, 15% low plasticity fines, sand is dark brown with very dark gray silt	Cemex Lapis Lustre #10/20 filter sand
25						
26						2" diameter, 0.010" slot, Schedule 40 PVC screen
27					solid rock in shoe	
28					fractured, ground rock	
29					solid rock in shoe	
30					less coarse gravel, iron oxide mottling	
31						
32					45% fine to coarse sand, 35% fine and coarse gravel, 20% low plasticity fines	
33						

OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-28D (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
33					(SM) cont.	
34					45% fine and coarse gravel, 40% medium to coarse sand, 15% low plasticity fines	
35						
36						
37					Bottom of boring at 37.0 feet. Ecology well tag number BBA-757.	
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						



OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-30

BORING LOCATION: 92633.0 N, 1169485.6 E

GROUND SURFACE ELEVATION AND DATUM: 20.32 MSL NGVD29(47)

DRILLING CONTRACTOR: Cascade Drilling, Inc.

DATE STARTED: 9/4/08 | DATE FINISHED: 9/4/08

DRILLING METHOD: Direct push

TOTAL DEPTH (ft.): 9.0 | SCREEN INTERVAL (ft.): 4.5 to 9.2

DRILLING EQUIPMENT: Geoprobe 7730 DT

DEPTH TO WATER: FIRST 4.5 | COMPL. NA | CASING: 2" Sched. 40 PVC

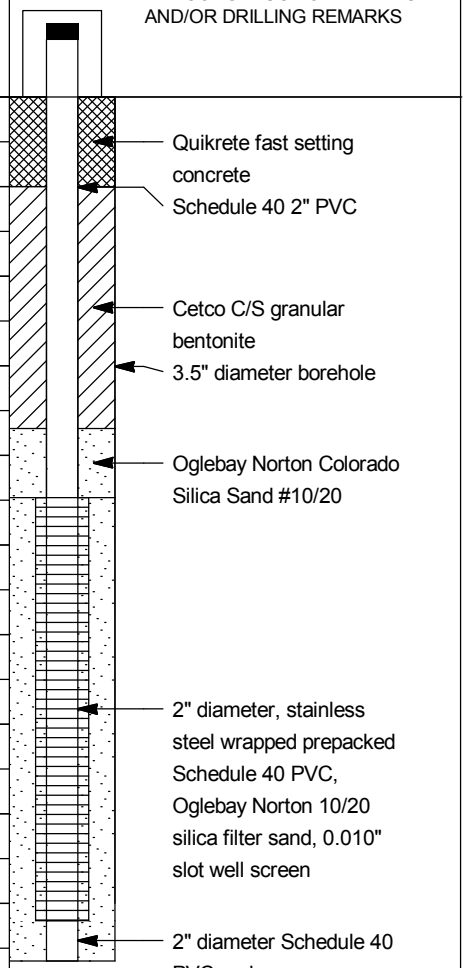
SAMPLING METHOD: Geoprobe macro-core sampler [5' x 1.5"]

LOGGED BY: C. Brown

HAMMER WEIGHT: NA | DROP: NA

RESPONSIBLE PROFESSIONAL: N. Gray | REG. NO. L.G. 2557

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION: NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
					Surface Elevation: 18.2 feet
0				0	POORLY GRADED SAND (SP): dark grayish brown (10YR 4/2), moist, 95% fine to coarse sand, 5% fines
1	MC-30-2.0-0908				
2				0	
3					
4					very dark greenish gray (10Y 3/1)
5				0	wet
6					
7				0	
8					ELASTIC SILT (MH): very dark greenish gray (10Y 3/1), moist, 100% fines, firm, medium plasticity
9					Bottom of boring at 9.0 feet
10					
11					
12					
13					
14					
15					



WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

*OVM = Photovac 2020 Pro calibrated with 100 ppm isobutylene standard.

OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation PSC Washougal	**Log of Well No. MC-30D**
BORING LOCATION: 92628.9 N, 1169484.9 E	GROUND SURFACE ELEVATION AND DATUM: 20.77 MSL NGVD29(47)
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 9/9/08 / DATE FINISHED: 9/9/08
DRILLING METHOD: Sonic drilling	TOTAL DEPTH (ft.): 37.0 / SCREEN INTERVAL (ft.): 25.5 to 35.2
DRILLING EQUIPMENT: Sonicor 50k	DEPTH TO WATER: FIRST 4.25 / COMPL. NA / CASING: 2" Sched. 40 PVC
SAMPLING METHOD: Continuous core [10' x 6"]	LOGGED BY: C. Brown
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: N. Gray / REG. NO. L.G. 2557

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. TOC Elevation: 18.2 feet	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
1					POORLY GRADED SAND (SP): dark grayish brown (10YR 4/2), moist, 95% fine to coarse sand, 5% non-plastic fines	Quickrete concrete *OVM = Photovac 2020 PID calibrated with 100 ppm isobutylene standard.
2				0/0 HS		8" boring
3						
4					very dark greenish gray (10Y 3/1), wet	2" diameter Schedule 40 PVC casing
5						
6				0		Volclay high solids bentonite grout
7					ELASTIC SILT (MH): very dark greenish gray (10Y 3/1), moist, 100% medium plastic silt, medium stiff	
8						
9						PureGold medium bentonite chips
10				0		
11						
12						
13					very dark gray (10YR 3/1)	6" boring
14						
15						

OAKWELLV_COND CASE (REV 10/99)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-30D (cont'd)

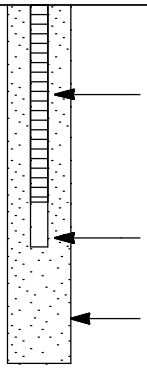
DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16				0/0 HS	(MH) cont.	6" boring
17						
18						
19						
20				0	SILTY GRAVEL (GM): very dark gray (10YR 3/1), moist, 60% fine and coarse gravel, 30% non-plastic fines, 10% fine to coarse sand fractured rock (cored)	PureGold medium bentonite chips
21						
22				8.1/9 HS	rounded fine and coarse gravel, some larger than 4", 30% fine gravel	Oglebay Norton Colorado Silica sand #10/20 filter pack sand
23						
24						
25						
26				13	SILTY SAND (SM): brown (10YR 4/3), moist, 80% fine to medium sand, 20% low plasticity fines	2" diameter, 0.010" slot, Schedule 40 PVC screen
27						
28						
29						
30						
31					POORLY GRADED SAND with SILT (SP-SM): dark yellowish brown (10YR 4/4), moist, 90% fine to coarse sand, 10% low plasticity fines, rust colored mottling	
32						
33						

OAKWELLV_COND CASE (REV 10/99)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-30D (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
34				0	(SP-SM) cont.	
35						
36						
37					Bottom of boring 37.0 feet.	
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						



OAKWELLV_COND CASE (REV 10/99)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-31

BORING LOCATION: 92299.7 N, 1169514.9 E

GROUND SURFACE ELEVATION AND DATUM: 21.03 MSL NGVD29(47)

DRILLING CONTRACTOR: Cascade Drilling, Inc.

DATE STARTED: 9/4/08

DATE FINISHED: 9/4/08

DRILLING METHOD: Direct push

TOTAL DEPTH (ft.): 9.0

SCREEN INTERVAL (ft.): 4.4 to 9.2

DRILLING EQUIPMENT: Geoprobe 7730 DT

DEPTH TO WATER: FIRST 4.0 COMPL. NA

CASING: 2" Sched. 40 PVC

SAMPLING METHOD: Geoprobe macro-core sampler [5' x 1.5"]

LOGGED BY: C. Brown

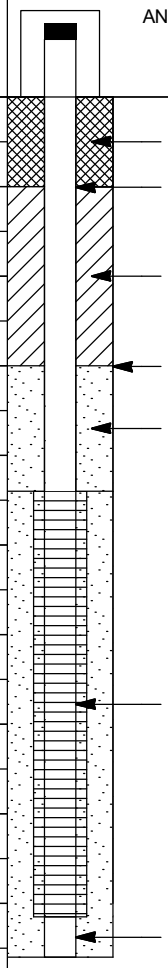
HAMMER WEIGHT: NA

DROP: NA

RESPONSIBLE PROFESSIONAL: N. Gray

REG. NO. L.G. 2557

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION: NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
					Surface Elevation: 17.9 feet
0	MC-31-1-0908			0	POORLY GRADED SAND (SP): dark brown (10YR 3/3), moist, 95% fine to medium sand, 5% fines
1					
2				0	
3					
4					wet
				0	very dark greenish gray (10Y 3/1)
5					
6					
				0	
7					
8					ELASTIC SILT (MH): dark greenish gray (10Y 4/1), moist, 100% fines, firm, medium plasticity
9					Bottom of boring at 9.0 feet
10					
11					
12					
13					
14					
15					



WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

*OVM = Photovac 2020 Pro calibrated with 100 ppm isobutylene standard.

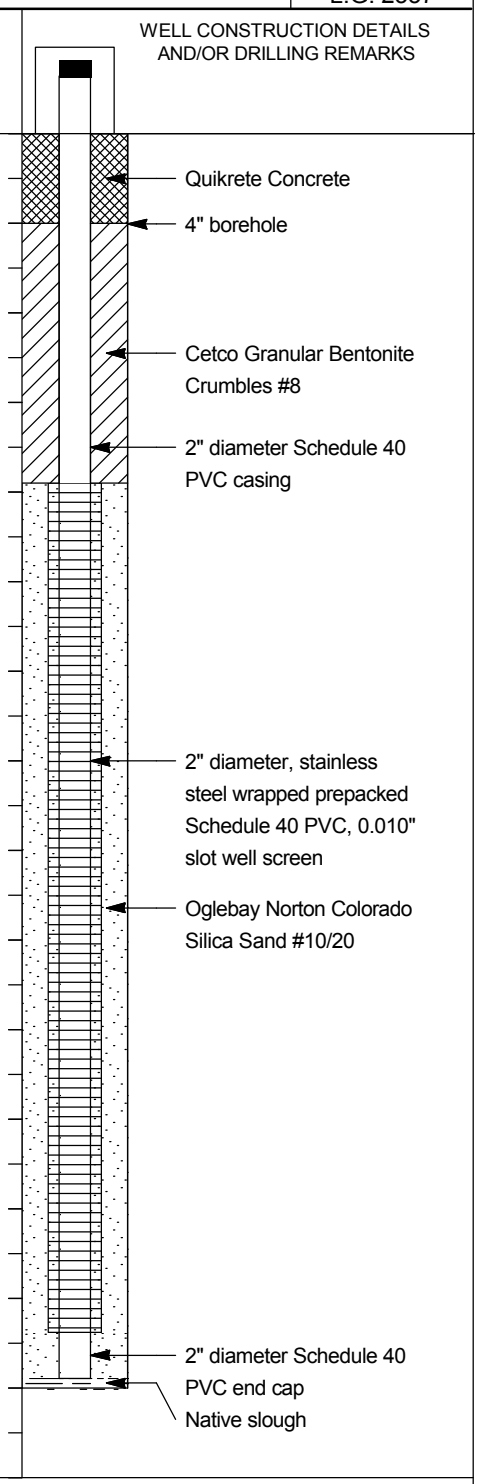
OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-32

BORING LOCATION: 92481.1 N, 1170033.6 E	GROUND SURFACE ELEVATION AND DATUM: 17.4' MSL NGVD29(47)			
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 5/11/09		DATE FINISHED: 5/11/09	
DRILLING METHOD: Direct push	TOTAL DEPTH (ft.): 14.0		SCREEN INTERVAL (ft.): 3.9 to 13.4	
DRILLING EQUIPMENT: Geoprobe 7730 DT	DEPTH TO WATER:	FIRST 8.5	COMPL. 10.15	CASING: 2" Sched. 40 PVC
SAMPLING METHOD: Geoprobe macro-core sampler [5' x 1.5"]	LOGGED BY: C. Brown			
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: N. Gray		REG. NO. L.G. 2557	

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
					Surface Elevation: 17.4 feet
0					WELL GRADED SAND (SW): dark grayish brown (10YR 4/2), moist, 95% fine to coarse sand, 5% non-plastic fines
5	MC-32-7-0509				SILT (ML): very dark grayish brown (10YR 3/2), moist, 90% fines, 10% fine sand, medium stiff, dark orange mottling, scattered organics
8					wet, very few organics
9					no organics
13					stiff, moist
14					Bottom of boring at 14.0 feet.



OAKWELLV (REV. 9/2007)

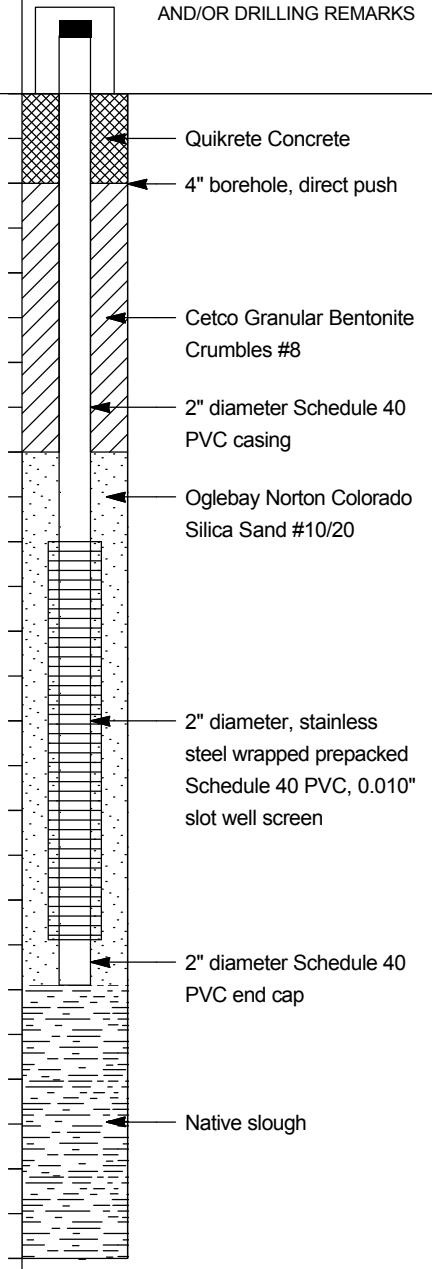
PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-33

BORING LOCATION: 92536.1 N, 1169635.7 E	GROUND SURFACE ELEVATION AND DATUM: 17.9' MSL NGVD29(47)			
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 5/11/09		DATE FINISHED: 5/11/09	
DRILLING METHOD: Direct push	TOTAL DEPTH (ft.): 13.0		SCREEN INTERVAL (ft.): 5.0 to 9.4	
DRILLING EQUIPMENT: Geoprobe 7730 DT	DEPTH TO WATER:	FIRST 4.5	COMPL. 4.81	CASING: 2" Sched. 40 PVC
SAMPLING METHOD: Geoprobe macro-core sampler [5' x 1.5"]	LOGGED BY: C. Brown			
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: N. Gray		REG. NO. L.G. 2557	

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
					Surface Elevation: 17.9 feet
0					WELL GRADED SAND (SW): very dark gray (10YR 3/1), moist, 95% fine to coarse sand, 5% non-plastic fines
1					
2					
3					
4					
4.5					wet
5					
6					
7					WELL GRADED SAND with SILT (SW-SM): greenish black (10GY 2.5/1), wet, 90% fine to coarse sand, 10% non-plastic fines
8					
9					
10					
11					ELASTIC SILT (MH): dark greenish gray (10Y 4/1), wet, 95% fines, 5% fine sand, medium to high plasticity, soft
12					
13					Bottom of boring at 13.0 feet.
14					
15					

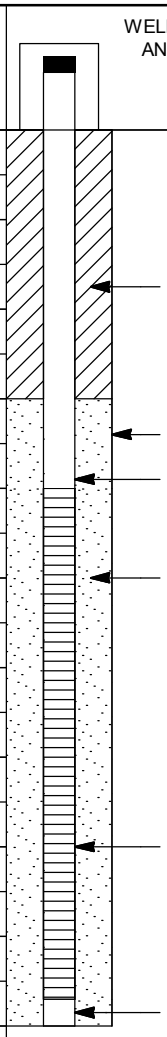
WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation PSC Washougal	**Log of Well No. MC-107**
BORING LOCATION: 92666.3 N, 1169648.6 E	GROUND SURFACE ELEVATION AND DATUM: 20.13 MSL NGVD29(47)
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 7/27/99 / DATE FINISHED: 7/27/99
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 10.0 / SCREEN INTERVAL (ft.): 4.0 to 10.0
DRILLING EQUIPMENT:	DEPTH TO WATER: FIRST 2.2 / COMPL. / CASING: 2" Sched. 40 PVC
SAMPLING METHOD: SPT split spoon drive sampler [18" x 2.5"] and Shelby	LOGGED BY: C. Minton/T. Gray
HAMMER WEIGHT: / DROP:	RESPONSIBLE PROFESSIONAL: / REG. NO.

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION: NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
					Surface Elevation: 17.3 feet
0			23 25 20	0	POORLY GRADED SAND (SP): moderate yellowish brown, dry, fine to medium sand, loose, roots in top 4 inches
1					
2			10 18 22	0	moist
3			9 12 15		medium dense, brownish black
4				0	
5			10 13 15	0	
6					
7					
8					
9	MC-107-8-10	S			
10					silt in bottom of shelby tube Bottom of boring at 10.0 feet.
11					
12					
13					
14					
15					



WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

- Annular Seal (3/8, holeplug coarse grade bentonite)
- 8.75" diameter borehole
- 2" diameter Schedule 40 PVC casing
- 10/20 Colorado silica sand
- *Failed attempt to to collect shelby tube sample. Sediment in tube fell through.
- 2" diameter Schedule 40 PVC well screen with 0.010-inch slot
- 2" diameter Schedule 40 PVC end cap
- Finished with steel 6.5" diameter surface casing

OAKWELLV (REV. 9/2007)

LOG OF MC-107R

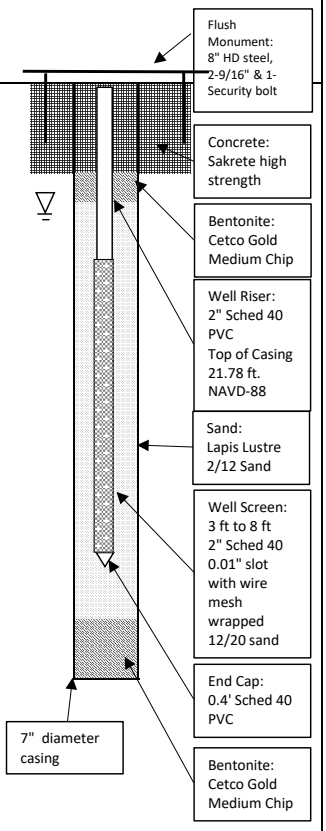
Ecology ID: BNA-478

Sheet 1 of 1

PROJECT: Clean Earth Washougal	COORDINATES (SPCS): **N**92665.3, **E**1169671.5
LOCATION: Washougal, WA	SURFACE ELEVATION: top of monument (NAVD 88) 22.08 ft.
DRILLING CONTRACTOR: Cascade Drilling	DATE: 12/13/2021
DRILLING EQUIPMENT: DB-100 Sonic Drill Rig	TOTAL DEPTH OF BORING: 10 ft.
DRILLING METHOD: 7" diameter conductor casing	LOGGED BY: A.Cerruti
SAMPLING METHOD: 6" core sampler	RESPONSIBLE PROF.: A.Cerruti REG. NO.: 21013797

NOTES:

DEPTH (feet)	Sample Recovery	PID (ppm)	USCS Classification	VISUAL SOIL DESCRIPTION Soil Group Name (USCS): color, moisture, density/consistency, grain size, other discriptors
0				Ground surface 0.2' asphalt
1		0.1	SW	**WELL GRADED SAND with GRAVEL** very dark gray (7.5YR 3/1), moist, loose, 60% fine to coarse sand, 30% fine to coarse subangular gravel, 10% fines
3		0.1	SP	**POORLY GRADED SAND** grayish brown (2.5Y 5/2), moist, loose, 95% fine to medium sand with 5% fines
5		0.1 0.1	SW	**WELL GRADED SAND with GRAVEL** very dark gray (7.5YR 3/1), moist, loose, 60% fine to coarse sand, 35% fine to coarse subangular gravel, 5% fines
6			ML	**SILT with SAND** very dark gray(2.5Y 4/1), moist, 100% fines, low to medium plasticity 5' - 5.5' : fine to medium sandy lense with organics
8		0.1		9.2' - 9.8': fine to medium sandy lense 9.6' - 10': mottled gley (3/10GY)
10		0.1		**Bottom of Boring : 10 feet**



Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

PROJECT: Remedial Investigation PSC Washougal	**Log of Well No. MC-118D**
BORING LOCATION: 92721.8 N, 1169761.1 E	GROUND SURFACE ELEVATION AND DATUM: 17.28 MSL NGVD29(47)
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 7/28/99 / DATE FINISHED: 7/28/99
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 22.5 / SCREEN INTERVAL (ft.): 15.5 to 22.5
DRILLING EQUIPMENT:	DEPTH TO WATER: FIRST 3.0 / COMPL. / CASING: 2" Sched. 40 PVC
SAMPLING METHOD: SPT split spoon drive sampler [18" x 2.5"] and Shelby	LOGGED BY: C. Minton/T. Gray
HAMMER WEIGHT: / DROP:	RESPONSIBLE PROFESSIONAL: / REG. NO.

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 17.7 feet	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
0			20 25 28	0.3	ASPHALT POORLY GRADED SAND (SP): dark yellowish brown, dry, fine to coarse sand, some fine gravel, loose	
1			5 16 24	0.5		Quickrete concrete
2						
3			14 23 25	0	moist, no gravel	15" diameter borehole
4			14 16 24	0	medium dense	2" diameter Schedule 40 PVC casing
5						
6			10 14 9	0	fine to medium sand, grayish black wet	
7			7 10 17	0		Annular Seal (3/8 Bardid holeplug bentonite chips)
8						
9	MC-118D-9-11	S			SILTY SAND (SM): olive black, moist, sandy silt, some coarse gravel, stiff, well sorted	
10						
11			27 9 10	0	SILT (ML): greenish black, moist, very fine silts, some fine sands, well sorted, medium stiff	8.75" diameter borehole
12						
13			4 4 5	0	CLAY (CL): dark greenish gray, moist, well sorted, some silt and sand, medium stiff	
14			4 5		wet and soft	10/20 Colorado silica sand
15						

OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-118D (cont'd)

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
15			8	0	CLAY (CL): (continued)	
16			8 12 21		stiff	10/20 Colorado silica sand
17				0	CLAYEY GRAVEL (GC): moderate brown, wet, fine clay and silt to fine gravel, poorly sorted, medium dense	
18			50/3"	0	clayier, soft, dark greenish gray	8.75" diameter borehole
19			50/3"	0	gravel is possibly basalt (2" diameter)	2" diameter Schedule 40 PVC well screen with 0.010-inch slot
20						
21			50/2"	0		
22			50/3"	0	one large rock (3" x 2") in sampler	2" diameter Schedule 40 PVC end cap
23					Bottom of boring at 22.5 feet	Finished with steel 6.5" diameter surface casing
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						

OAKWELLV (REV. 9/2007)

PROJECT: Remedial Investigation PSC Washougal	**Log of Well No. MC-118D2**	
BORING LOCATION: 92721.7 N, 1169765.7 E	GROUND SURFACE ELEVATION AND DATUM: 17.26 MSL NGVD29(47)	
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 9/10/08	DATE FINISHED: 9/11/08
DRILLING METHOD: Sonic drilling	TOTAL DEPTH (ft.): 37.0	SCREEN INTERVAL (ft.): 25.0 to 34.7
DRILLING EQUIPMENT: Sonicor 50k	DEPTH TO WATER: FIRST ~4.0 / COMPL. NA	CASING: 2" Sched. 40 PVC
SAMPLING METHOD: Continuous core [10' x 6"]	LOGGED BY: C. Brown	
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: N. Gray	REG. NO. L.G. 2557

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. TOC Elevation: 17.6 feet	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
1					POORLY GRADED SAND (SP): dark brown (10YR 3/3), moist, 95% fine to coarse sand, 5% fines	Traffic Box Quickrete concrete
2				0.5		*OVM = Photovac 2020 PID calibrated with 100 ppm isobutylene standard.
3				0/0 HS		8" boring
4					very dark greenish gray (10Y 3/1), wet	
5						2" diameter Schedule 40 PVC casing
6				0		Volclay high solids bentonite grout
7					ELASTIC SILT (MH): greenish black (10Y 2.5/1), moist, 100% fines, firm, medium plasticity, scattered organics at top of contact	
8						
9				0		
10						PureGold medium bentonite chips
11					rust colored mottling, firm	
12				0/0 HS		
13						6" boring
14						
15						

OAKWELLV_COND CASE (REV 10/99)

PROJECT: Remedial Investigation
PSC Washougal

Log of Well No. MC-118D2 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION: NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16				1.8	(MH) cont.	
17					SILTY GRAVEL with SAND (GM): dark yellowish brown (10YR 4/4), moist, 50% fine and coarse gravel, 30% low plasticity fines, 20% fine to coarse sand, some gravel greater than 4", rounded to sub-rounded	Volclay high solids bentonite grout
18						6" boring
19				0	dark greenish gray (10Y 4/1)	2" diameter Schedule 40 PVC casing
20						
21						PureGold medium bentonite chips
22						
23				0	POORLY GRADED GRAVEL with SILT and SAND (GP-GM): very dark grayish brown (10YR 3/2), wet, 60% fine and coarse gravel, 30% fine to coarse sand, 10% low plasticity fines	
24						Oglebay Norton Colorado Silica sand #10/20 filter pack sand
25						
26				0/0 HS		2" diameter, 0.010" slot, Schedule 40 PVC screen
27					solid rock cored	
28						
29					very dark greenish gray (10Y 3/1)	
30				0		
31						
32						
33				0		

OAKWELLV_COND CASE (REV 10/99)

PROJECT: Remedial Investigation
PSC Washougal

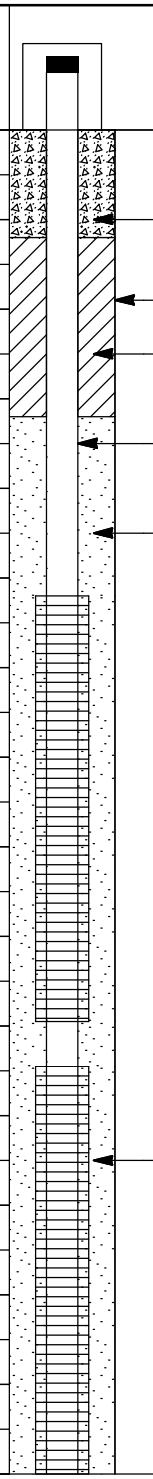
Log of Well No. MC-118D2 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
34				0	(GP-GM) cont.	2" diameter, 0.010" slot, Schedule 40 PVC screen
35						2" diameter Schedule 40 PVC end cap
36						Oglebay Norton Colorado Silica sand #10/20 filter pack sand
37					Bottom of boring at 37.0 feet.	
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						

OAKWELLV_COND CASE (REV 10/99)

PROJECT: Monitoring Well Replacement PSC Washougal	**Log of Well No. MC-122**
BORING LOCATION: 92681.1 N, 1170038.9 E	TOP OF CASING ELEVATION AND DATUM: 19.95 NGVD29(47)
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 12/1/06 / DATE FINISHED: 12/1/06
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 16.0 / SCREEN INTERVAL (ft.): 5.2 to 15.2
DRILLING EQUIPMENT: CME-75	DEPTH TO WATER (ft.): FIRST ~10.5 / COMPL. NA / CASING: 2" Sched. 40 PVC
SAMPLING METHOD: SPT split spoon drive sampler [18" x 1.5"]	LOGGED BY: N. Bacher
HAMMER WEIGHT: 300 lb / DROP: 30 inch	RESPONSIBLE PROFESSIONAL: N. Bacher / REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation: 17.6 feet
0			3 4 15 N=19	0	POORLY GRADED SAND (SP): brown (7.5YR 4/2), dry, 95% fine to medium sand, 5% fines, trace roots, loose
1			5 3 1 N=8	0	no roots
2			2 2 2 N=4	0	
3			3 2 1 N=3	0	trace orange 1/16" material (1 to 3 pieces), brick fragments
4			2 1 1 N=2	0	
5			1 1 2 N=3	0	SILTY CLAY (CL): olive gray with orange mottling (5Y 5/2), dry to moist, 100% fines, low to medium plasticity, soft, trace twigs, trace decomposing organic material
6			1 2 4 N=6	0	SILT (ML): gray (2.5Y 5/1), moist, 100% fines, nonplastic to low plasticity, soft, trace fine sand stringers, blocky texture
7			2 4 5 N=9	0	no sand stringers
8			2 4 5 N=9	0	low plasticity
9			13 16 16 N=32	0	angular, orange cobble pieces, moist
10					
11					
12					
13					
14					
15					



WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

*OVM = ThermoEnvironmental 580B PID calibrated with 100 ppm isobutylene standard.

*PID won't start after 5-6.5 foot sample, moisture in the air. All remaining PID readings were collected from ziploc bagged samples later in the day.

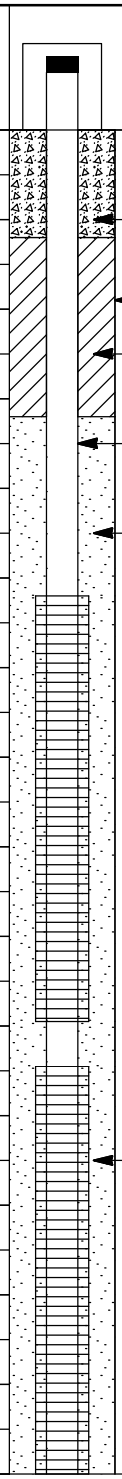
PROJECT: Monitoring Well Replacement
PSC Washougal

Log of Well No. MC-122 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16					Bottom of boring at 16.0 feet.	Schedule 40 PVC end cap
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						

PROJECT: Monitoring Well Replacement PSC Washougal	**Log of Well No. MC-123**
BORING LOCATION: 92585.5 N, 1170035.7 E	TOP OF CASING ELEVATION AND DATUM: 19.91 NGVD29(47)
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 12/1/06 / DATE FINISHED: 12/1/06
DRILLING METHOD: Hollow-stem auger	TOTAL DEPTH (ft.): 16.0 / SCREEN INTERVAL (ft.): 5.2 to 15.2
DRILLING EQUIPMENT: CME-75	DEPTH TO WATER (ft.): FIRST ~10.5 / COMPL. NA / CASING: 2" Sched. 40 PVC
SAMPLING METHOD: SPT split spoon drive sampler [18" x 1.5"]	LOGGED BY: N. Bacher
HAMMER WEIGHT: 300 lb / DROP: 30 inch	RESPONSIBLE PROFESSIONAL: N. Bacher / REG. NO. L.G. 2528

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.
					Surface Elevation: 17.2 feet
0			2 15 19 N=34	0	POORLY GRADED SAND with GRAVEL (SP): brown (7.5YR 4/2), dry, 75% medium sand, 25% fine gravel, loose
1			3 4 5 N=9	0	POORLY GRADED SAND (SP): brown (7.5YR 4/2), dry, 100% fine to medium sand, loose
2			2 1 1 N=2	0	
3			2 6 9 N=15	0	SILT (ML): olive gray (5Y 5/2), dry to moist, 100% fines, non plastic, trace orange mottling, trace decomposing organic material
4			1 1 1 N=2	0	soft
5			1 1 1 N=2	0	
6			2 3 5 N=8	0	gray (2.5Y 5/1), blocky texture, trace fine sand (5%)
7			2 1 1 N=2	0	moist to wet, trace clay, trace decomposing organic material, blocky texture
8			2 1 1 N=2	0	(Interval 12-13.5' bgs not visually observed)
9			3 6 6 N=12	0	sand stringers
10					
11					
12					
13					
14					
15					



WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

*OVM = ThermoEnvironmental 580B PID calibrated with 100 ppm isobutylene standard.

*All PID readings were collected from ziploc bagged samples later in the day.

PROJECT: Monitoring Well Replacement
PSC Washougal

Log of Well No. MC-123 (cont'd)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
16					Bottom of boring at 16.0 feet.	Schedule 40 PVC end cap
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						

DALTON OLMSTED FUGLEVAND

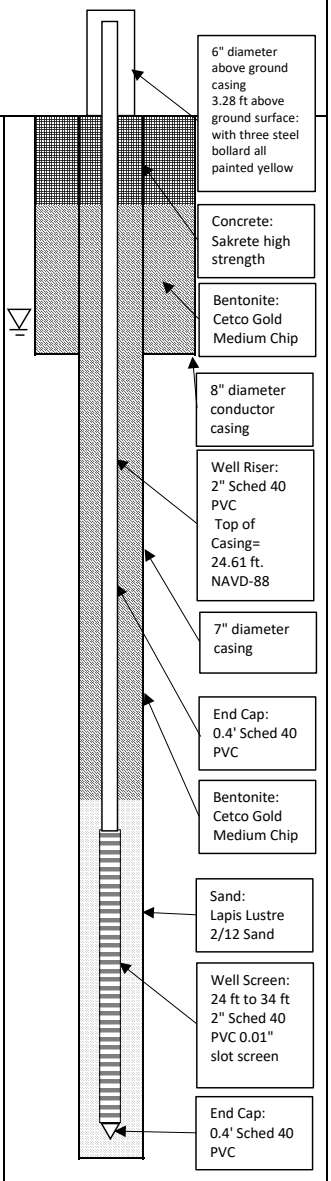
LOG OF MC-124D

Ecology ID: BNA-480

PROJECT: Clean Earth Washougal	COORDINATES (SPCS): **N**92518.5, **E**1170033.8
LOCATION: Washougal, WA	SURFACE ELEVATION: ground surface (NAVD 88) 21.33 ft
DRILLING CONTRACTOR: Cascade Drilling	DATE: 12/14/2021
DRILLING EQUIPMENT: DB-100 Sonic Drill Rig	TOTAL DEPTH OF BORING: 35 ft.
DRILLING METHOD: Telescoping Casing - 8" to 7" conductor casing	LOGGED BY: A.Cerruti
SAMPLING METHOD: 6" core sampler	RESPONSIBLE PROF.: A.Cerruti REG. NO.: 21013797
NOTES:	

DEPTH (feet)	Sample Recovery	PID (ppm)	USCS Classification	VISUAL SOIL DESCRIPTION Soil Group Name (USCS): color, moisture, density/consistency, grain size, other discriptors
0		0.1		boring cleared to 5' with airknife and vac - gravel at surface
2			SP	**POORLY GRADED SAND with SILT**
4		0.1		brown (7.5YR 5/2), moist, loose, 90% fine to medium sand, 10% fines and trace scattered fine gravel
6		0.1		5-6' : silty clasts brown (7.5YR 5/3)
8		0.1	ML	**SILT** brown (7.5YR 5/3) mottled with reddish brown (5YR 5/3), moist, medium stiff, 100% fines, low to medium plasticity with trace fine to 1" roots. Grades to dark gray (10YR 4/1) at 8' mottled with reddish brown (5YR 5/3)
10		0.1		
12		0.1		10' to 11.7' : trace organics and black grasses
14		0.1		grades to gray (10YR 5/1) and becomes micaceous
16		0.3		**SILT with SAND**
18		0.1	ML	gray (10 YR 5/1) becomes mottled gley (3/5G) and (5YR 5/3) at 18.7'; moist, 85% low plasticity silt, with 15% fine to medium sand includes micaceous grains
20		0.1		
22		0.1	SM	**SILTY SAND with GRAVEL** dark brown (7.5YR 3/2), moist, medium dense, 60% fine to medium sand, 25% fines, 15% fine subrounded gravel
24		0.0	GM	**SILTY GRAVEL with SAND** dark brown (7.5YR 3/2), moist, dense, 50% fine, subrounded gravel
26				30% fine to coarse sand, 15% non-plastic fines
28		0.0		becomes wet at 25'
30		0.5	SM	**SILTY SAND with GRAVEL** gray (10YR 5/1), wet, dense, 60% fine sand, 20% fine gravel, 20% non-plastic fines
32		0.1		cored boulder at 30'
34		0.1 0.2		sand grades to fine to medium
36				**Bottom of Boring : 35 feet**
38				
40				

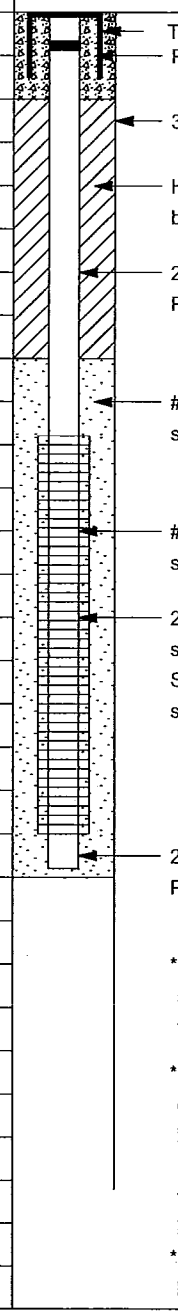
WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



Note: The summary log is an interpretation based on samples, drill action, and interpolation. Variations between what is shown and actual conditions should be anticipated.

PROJECT: Remedial Investigation PSC Washougal	**Log of Well No. PZU-4**
BORING LOCATION:	GROUND SURFACE ELEVATION AND DATUM:
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 10/2/07 / DATE FINISHED: 10/2/07
DRILLING METHOD: Direct push	TOTAL DEPTH (ft.): 13.6 / SCREEN INTERVAL (ft.): 4.9 to 9.5
DRILLING EQUIPMENT: Geoprobe 6600	DEPTH TO WATER: FIRST 6.0, COMPL. NA / CASING: 2" Sched. 40 PVC
SAMPLING METHOD: Geoprobe macro-core sampler [5' x 1.5"]	LOGGED BY: Z. Satterwhite
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: N. Gray / REG. NO. L.G. 2557

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation:
1	dug out			0/0 (HS)	POORLY GRADED SAND with GRAVEL (GP): dark brown (10YR 3/3), moist, 55% fine to coarse sand, 40% fine gravel, 5% fines
2	PZU-4-3.0-1007				POORLY GRADED SAND with SILT (SP-SM): dark grayish brown (10YR 4/2), moist, 90% fine to medium sand, 10% non plastic fines
3					silt inclusions (1-2")
4					
5				0/1 (HS)	iron oxide mottling
6	PZU-4-6.0-1007				very dark gray (10YR 3/1), wet
7					SILT (ML): very dark gray (10YR 3/1), wet, 90% fines, 10% fine sand, low plasticity, firm, scattered organic matter.
8					
9					
10				0/0 (HS)	
11					SILTY GRAVEL (GM)
12					
13					
14					Bottom of boring at 13.6 feet (first attempt). Ecology well ID = BAL102.
15					



WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

- Traffic Box
- PreMix Dry concrete
- 3.5" diameter borehole
- Hole Plug granular bentonite
- 2" diameter Schedule 40 PVC casing
- #10/20 Silica filter pack sand
- #20/40 Silica filter pack sand
- 2" diameter, stainless steel wrapped prepacked Schedule 40 PVC, 0.010" slot well screen
- 2" diameter Schedule 40 PVC end cap

*Piezometer installed on second attempt of boring to 10.0 feet.

*OVM = miniRAE 2000 calibrated with 100 ppm isobutylene standard. (HS) indicates reading taken from head space in baggie.

*Driller: hit something hard at 14.0 feet.

OAKWELLV (REV. 4/00)

PROJECT: PSC Washougal Washougal, WA	**Log of Well No. PZU-5R**
BORING LOCATION: S. 32nd St., Washougal, WA	TOP OF CASING ELEVATION AND DATUM:
DRILLING CONTRACTOR: Cascade Drilling, Inc.	DATE STARTED: 6/10/13 / DATE FINISHED: 6/10/13
DRILLING METHOD: Direct push	TOTAL DEPTH (ft.): 15.0 / SCREEN INTERVAL (ft.): 4.5 - 14.2
DRILLING EQUIPMENT: Geoprobe 7700 track LAR	DEPTH TO WATER (ft.): FIRST 6.1, COMPL. / CASING: PVC
SAMPLING METHOD: Geoprobe macro-core sampler [5' x 1.75"]	LOGGED BY: N. Moxley
HAMMER WEIGHT: NA / DROP: NA	RESPONSIBLE PROFESSIONAL: N. Gray / REG. NO. L. G. 2557

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS): color, moist, % by wt., plast. density, structure, cementation, react. w/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
					Surface Elevation:	
1					POORLY-GRADED SAND with GRAVEL (SP): brown, moist, 60% fine to medium SAND, 30% rounded gravel, 10% non plastic fines (Roadbase)	Traffic Rated Well Box concrete
2					POORLY-GRADED SAND with SILT (SP-SM): grayish brown, moist, 90% fine to medium SAND, 10% non plastic fines, with plant roots	3.5" diameter borehole granular bentonite
3						2" diameter, schedule 40 PVC casing
4						#10/12 filter pack sand
5					silt content decreases	
6					SILTY SAND (SM): brown with orange mottles, wet, 70% fine to medium SAND, 30% low plastic fines	#20/40 prepacked filter sand
7					POORLY-GRADED SAND with SILT (SP-SM): gray, wet, 85% fine to medium SAND, 15% low plastic fines, with plant roots	2" diameter, stainless steel wrapped, prepacked schedule 40 PVC, 0.010" slot well screen
8						
9						
10						
11					silt content decreases	
12					GRAVELLY SILT (ML): yellowish brown, wet, 70% organic low plastic fines, 20% fine angular gravel, 10% fine to medium sand, soft	
13						
14						2" diameter schedule 40 PVC end cap native sand
15					boring terminated at 15 ft. Ecology Well Tag ID = BHL220	
16						

OAKWELLV_TOC (REV. 8/2011)

Attachment C
Quality Assurance Project Plan

Quality Assurance Project Plan

BURLINGTON ENVIRONMENTAL, LLC WASHOUGAL FACILITY GROUNDWATER MONITORING PLAN
WASHOUGAL, WASHINGTON

April 2022

Prepared by:

DALTON, OLMSTED, & FUGLEVAND
1001 SW Klickitat Way, Suite 200B
Seattle, Washington 98134

Prepared for:

BURLINGTON ENVIRONMENTAL, LLC, now owned by CleanEarth
Corrective Actions Group
1701 Alexander Avenue
Tacoma, WA 98421

DOF DALTON OLMSTED FUGLEVAND

Approvals

Signature:	Date:
Tasya Gray, Principal Geologist, Dalton, Olmsted & Fuglevand, Inc Signature:	 Date:
Laura Dell'Olio, Project Manager, CleanEarth, Inc. Signature:	 Date:
Kelly Bottem, Client Services Manager, Analytical Resources, LLC Signature:	 Date:
Kaia Petersen, Ecology project manager, Hazardous Waste and Toxics Reduction Program, Washington State Department of Ecology	

Table of Contents

Tables

Distribution List

This list identifies all individuals to receive a copy of the approved Quality Assurance Project Plan, either in hard copy or electronic format, as well as any subsequent revisions.

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Burlington Environmental Project Manager:	Laura Dell'Olio Clean Earth, Inc. 20245 77th Avenue South Kent, WA 98032 ldellolio@harsco.com
Quality Assurance Leader:	Cari Sayler Sayler Data Solutions 14257 93rd Ct NE Kirkland, WA 98034 (425) 820-75048 cari.say@saylerdata.com
Field Coordinator:	Tasya Gray Dalton, Olmsted, and Fuglevand, Inc. 1001 SW Klickitat Way, Suite 200B Seattle, WA 98134 ngray@dofnw.com

1.0 ABSTRACT

Dalton, Olmsted, and Fuglevand, Inc. (DOF), has prepared this Quality Assurance Project Plan (QAPP) for the Washougal Facility on behalf of Burlington Environmental, LLC, now owned by CleanEarth. This QAPP was prepared as an attachment to the Groundwater Monitoring Plan following approval of the Feasibility Study in 2022. The purpose of this QAPP is to provide protocols and procedures related to groundwater monitoring at the site to monitor constituents of concern (COCs) historically released. Groundwater monitoring is expected to continue throughout future remedial action design at the Facility and monitoring data will be used to determine effectiveness of the remedy and provide compliance and confirmation monitoring data necessary for site closure under the Dangerous Waste Regulations, Washington Administrative Code 173-303.

2.0 BACKGROUND

The project description and background are described in the Groundwater Monitoring Plan (DOF, 2020).

This QAPP outlines quality assurance (QA) and quality control (QC) protocols to be followed in implementing the Groundwater Monitoring Plan.

3.0 PROJECT DESCRIPTION

The Groundwater Monitoring Plan outlines a program to monitor the groundwater emanating from the Washougal site. The objective of the Groundwater Monitoring Plan is to track the concentrations of known contaminants at the facility. The monitoring wells are located to provide adequate information on (1) groundwater flow at the site, (2) groundwater underlying the site; and (3) groundwater leaving the site and flowing to off-site, downgradient locations.

4.0 ORGANIZATION

The individuals responsible for planning and implementing field and laboratory operations and QA/QC procedures for this project are identified in Table 1, along with contact information and a summary of each individual's responsibilities for project management and QA procedures.

4.1 MANAGEMENT RESPONSIBILITIES

Project management responsibilities are shown in Table 1. Detailed descriptions of the management and QA responsibilities of laboratory personnel are described in the laboratory QA Manual (available upon request or on the laboratory's website).

4.2 QUALITY ASSURANCE

The personnel responsible for review and approval of the QAPP and for data verification, validation, and data quality assessment are described in Table 1.

4.3 FIELD RESPONSIBILITIES

Field Responsibilities for collection of the samples are provided in the Groundwater Monitoring Plan and in Section 9.2 of this QAPP.

4.4 LABORATORY RESPONSIBILITIES

Analytical Resources, LLC (ARI) in Tuklwila, Washington will provide analytical services for the groundwater monitoring program. The laboratory QA officer, as described in Table 1, will ensure that

appropriate procedures are followed during sample analysis and preparation of the data packages and electronic deliverables. ARI's QA Manual will be provided to the QA/QC coordinator. The QA Manual includes descriptions of the laboratory organization, personnel, and responsibilities; facilities and equipment, analytical methods and QA/QC protocols; and routine procedures for sample custody and data handling.

4.5 PROJECT SCHEDULE

The project schedule is provided in the Groundwater Monitoring Plan.

5.0 QUALITY OBJECTIVES

The sampling design, field procedures, laboratory procedures, and QC procedures are set up to provide high-quality data for use in the groundwater monitoring program. 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). The measurement quality objectives (MQOs) associated with these data quality factors are summarized in Table 2 and discussed below.

5.1 PRECISION

Precision is the agreement among a set of replicate measurements without assuming knowledge of the true value. Precision is measured for this project by calculating the relative percentage difference (RPD) for analytical results from field duplicate and lab duplicate samples. Precision is optimized by collecting data at multiple locations and adhering to strict procedural guidelines that minimize possible sample contamination. RPD results that are outside the control limits listed in Table 2 for laboratory split samples will be qualified appropriately during data validation.

Field precision will be assessed through the collection and analytical testing of field duplicates at a rate of one duplicate per 20 field samples, or a minimum of 1 per sampling event for events with more than five samples. These analyses measure both field and laboratory precision. The results, therefore, may have more variability than laboratory- generated duplicates.

Laboratory precision is assessed through analysis of duplicate spiked and/or unspiked samples, as specified by the analytical method. Specific discussion of the different types of laboratory duplicate samples is found in Section 9.1.

The RPD value will be calculated according to the following formula:

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

Where:

D1 = Concentration of analyte in sample.

D2 = 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. Precision may also be expressed as the percent difference (%D)

between replicate analyses. During data validation, the data validator will evaluate all RPD values and take action as described in U.S. Environmental Protection Agency (EPA) guidance (EPA, 2020a, 2020b).

5.2 BIAS

Bias is systematic deviation of a measured value from the true value. Bias can be assessed by comparing a measured value to an accepted reference value in a sample of known concentration or by determining the recovery of a known amount of contaminant spiked into a sample. Contamination in the field and laboratory are potential sources of bias. Bias is minimized for this project by standardizing field activity methodologies, following approved methods for: equipment decontamination, instrument maintenance and calibration, sample collection, field observation and documentation, sample transport, chain-of-custody control and following laboratory SOPs. Descriptions of these methodologies are included in the Groundwater Monitoring Plan.

5.3 ACCURACY

Accuracy is the degree of agreement between an observed value and an accepted reference value. When applied to a set of observed values, accuracy will depend on a combination of random error and of common systematic error (or bias). Accuracy will be evaluated for this project by evaluating laboratory spike sample recoveries that represent the difference between an observed value and an accepted reference value. Control limits for spike recoveries have been documented by the project laboratory and are found in Table 2. Results showing noncompliant recoveries will be qualified appropriately during data validation. In general, if percent recoveries are consistently low, nondetect 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 consistently high. In such case, results for detected analytes may be higher than the true value. Accuracy will be optimized for this project by using procedures designed to reduce potential error that might impact the accuracy of results. Proper decontamination methods and equipment will be used during field activities to ensure accurate results. The laboratory QC procedures, described in Section 9.1, also reduce error to improve accuracy.

Accuracy will be assessed by the percent recovery (%R) of surrogate compounds (also known as “system monitoring compounds”), matrix spike/matrix spike duplicate results, and/or results from laboratory control samples where:

$$Recovery(\%) = \frac{Spiked\ Sample\ Result - Paret\ Sample\ Result}{Spike\ Amount} * 100$$

The data validator will evaluate all %R values and take action as described in EPA guidance (EPA, 2020a, 2020b). The lab may use laboratory control sample duplicates if there is insufficient volume for matrix spike/matrix spike duplicate samples.

5.4 REPRESENTATIVENESS

Representativeness is the measure of how well data reflect the actual environment and the conditions under which the data are collected. Representativeness will be optimized for this project by using general historical and investigative information to determine proper locations of new sampling points that represent the areas of concern. The methodologies used to collect samples and measurements, as

detailed in the Groundwater Monitoring Plan, are also designed to collect representative data with minimal disturbance of the environment from which they are collected.

To be considered representative, a data set should accurately and precisely represent the actual field conditions. Determination of the representativeness of the data will be performed by:

- Comparing actual sampling procedures to those prescribed in the Groundwater Monitoring Plan and this QAPP;
- Comparing analytical results from field duplicates to determine variation in the analytical results; and
- Flagging nonrepresentative data as invalid or identifying data that are noncompliant with project specifications.

Only representative data will be used in subsequent data reduction, validation, and reporting activities.

5.5 COMPARABILITY

Comparability is how well multiple data sets can be used for a common interpretation. Comparability will be optimized for this project by using the same standards for data collection at each location, and the same analytical procedures and QA procedures during each sampling event.

Comparability expresses the confidence with which one set of data can be compared to another. Since numeric goals do not exist for comparability, a statement of comparability will be prepared to determine overall usefulness of data sets, following the determination of both precision and accuracy. This statement will be included in the Data Review Reports (see Section 11.2.3).

5.6 COMPLETENESS

Completeness is a measure of the amount of data collected that are found to be valid in relation to the total amount of data intended to be collected according to the sampling design. Completeness will be optimized for this project by having all analytical results validated or reviewed by a data validator to assess the validity of the data.

The number of samples and results expected establishes the comparative basis for completeness and is defined as a ratio of acceptable measurements (including estimated data) obtained to the total number of planned measurements for an activity. Completeness (C) can be calculated as follows:

$$\%C = \frac{(number\ of\ acceptable\ data\ points)}{(total\ number\ of\ data\ points)} * 100$$

The data quality objective (DQO) for completeness for this project is 100 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. Completeness below 100 percent will require review of the sampling objectives to determine whether further sampling and analyses may be required.

5.7 REPORTING LIMITS

Analytical methods have quantitative limitations at a given statistical level of confidence that are often expressed as the method detection limit (MDL). Quality assurance requires that analytical methods achieve a consistently reliable level of quantitation known as the practical quantitation limit (PQL). The

laboratory will provide numerical results for all analytes and report them as detected above the MDL or undetected at the PQL.

Ideally, the laboratory's reporting limits (PQLs) should be low enough to compare to the applicable Model Toxics Control Act (MTCA) Method B screening levels. A reasonable level of effort will be exercised to achieve these goals.

Several factors may influence laboratory PQLs and individual sample quantitation limits. Changes in laboratory protocols may change the applicable PQL that the laboratory can achieve. The most recent laboratory QA Manual will provide the current applicable PQL. Analytical procedures may also require dilution and/or cleanup of samples and subsequent reanalysis to accurately quantify a particular analyte at concentrations above the range of the instrument. The effect is that other analytes may be reported as undetected at a PQL much higher than a specified screening level. The lab should make a reasonable effort to report the lowest possible PQL for each analyte. Data users must be aware that nondetected analytes with a high stated reporting limit, although correctly reported, can bias statistical summaries, and careful interpretation is required to correctly characterize site conditions. During data validation, evaluation will be made and the most appropriate result for each analyte will be reported.

6.0 SAMPLING PROCESS DESIGN

The sampling design, including figures showing field work locations, tables of samples to be collected, and the sample collection schedule, are included in the Groundwater Monitoring Plan.

7.0 SAMPLING PROCEDURES

Procedures for all field activities are described in the Groundwater Monitoring Plan. All field personnel will have completed 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Site Operations (HAZWOPER) training.

All instruments used in the collection of samples will be properly calibrated according to the manufacturer's recommendations and decontaminated between samples if the instrument is reusable and comes in contact with samples. All samples will be placed in iced coolers immediately following sample collection, and strict chain-of-custody control will be maintained at all times. Samples will be delivered or shipped to the project laboratory.

7.1 SAMPLE IDENTIFICATION

Each sample will be assigned a unique alphanumeric identification code (identifier) that contains sufficient information to identify the sample location and date. The sample labeling procedure is described in the Groundwater Monitoring Plan.

7.2 SAMPLE LABELING

A label will be securely attached to every sample container. Each label will include the following information:

- sample identifier;
- project name;
- date and time of collection (using 24-hour time clock to minimize potential confusion about a.m. and p.m.; e.g., "1300" vs. "1:00 p.m."); and

- analyses to be performed.

7.3 FIELD LOG MAINTENANCE

All sample location descriptions, sample identifiers, and analyte lists will be recorded in the field log. The field log will include, but not be limited to, the following information:

- all incidents observed during each sampling event;
- the names of all personnel present involved in the sampling event;
- the major events that occurred during the day;
- details about field procedures conducted; and
- details about samples collected or problems that occurred.

Procedures for maintaining the field log are described in the Groundwater Monitoring Plan.

7.4 SAMPLE CONTAINERS AND PRESERVATIVES

Table 3 specifies the required containers as well as the sample size, preservation protocol, and holding times for the list of analyses to be performed. All sample containers will be provided by the laboratory and will include the appropriate preservatives.

Sample containers will be placed in opaque, insulated coolers packed with ice to minimize their exposure to light and to cool them approximately to the recommended temperature. The coolers will be packed with sufficient packing material to prevent sample container breakage and/or leakage during transport.

The Project Manager and field personnel will plan sampling activities and coordinate sample delivery with laboratory personnel so that the sample holding time limits and temperatures specified in Table 3 are not exceeded.

7.5 SAMPLE STORAGE AND TRANSPORTATION

The exteriors of all sample containers will be wiped clean after they have been closed. Blank (QC) samples will be packaged with the primary samples that they control. Any vacant space in the cooler will be filled with ice or packing material. If the cooler has a drain, it will be taped shut. Then each cooler will be secured.

7.6 SAMPLE CHAIN-OF-CUSTODY

Chain-of-custody procedures will be followed by all project personnel to document sample transfer, sample possession, and sample integrity, from the time of sample collection through the completion of sample analysis. A chain-of-custody form will be initiated at the time of sampling, and will accompany the samples at all times including upon receipt at the project laboratory. The project laboratory maintains an internal custody protocol. The chain-of-custody form has blank fields for entering the sample identifier, the date and time of sample collection, the name of the person who collected the sample, and the requested laboratory analyses. Each chain-of-custody form will be signed by every person who handles the sample containers. Sample transfers will be noted on the chain-of-custody form for each sample.

The chain-of-custody form documents sample identifications, locations, sample times, and the analyses required for each sample. This is the principal document shared by the sample generator and the project laboratory. Therefore accuracy and completeness are extremely important.

Personnel initiating the chain-of-custody form will refer to the field forms and the field log (described below) to access the required information. This continuity will help make the various forms of documentation consistent and reduce the risk of error. The chain-of-custody form will accompany all samples during transport. The field sampler also will keep a copy of the chain-of-custody form for the project file.

All samples will be delivered directly to laboratory personnel authorized to receive samples (sample custodians). When the laboratory receives the samples, the sample custodian will inspect the exterior condition of the shipping container. Then the sample custodian will open and examine the interior of the shipping container. Next the sample custodian will examine the sample containers and check the contents of the shipping container against the chain-of-custody form. The sample custodian will record any inconsistencies or problems with the sample shipment (breakage or signs of leakage, and missing or extra samples) on the chain-of-custody record and notify the Project Manager or the QA Leader for immediate resolution. Official acceptance of sample custody will be documented by the sample custodian's signature on the chain-of-custody form. The samples will then be tracked through the laboratory by the laboratory's internal custody procedures.

8.0 MEASUREMENT PROCEDURES

The analytical and QA/QC procedures used by the laboratory are described in the laboratory QA Manual and SOPs.

8.1 LABORATORY MEASUREMENT PROCEDURES

Groundwater samples will be analyzed for the list of analytes as identified in the Groundwater Monitoring Plan. Chemical laboratory analyses will be performed using the following sets of standard laboratory methods:

- Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd edition (EPA, 2007);
- Ecology method NWTPH (for total petroleum hydrocarbons).

8.2 FIELD MEASUREMENT PROCEDURES

Field equipment will be used in general accordance with the manufacturer's recommendations. More details on field procedures are provided in the Groundwater Monitoring Plan.

9.0 QUALITY CONTROL

This section outlines QC procedures to be followed by both the field personnel and the analytical laboratory. Following these QC procedures will support the development of a complete and accurate data set following laboratory analysis and data validation. In this section, a sampling event is defined as consecutive days of sampling not separated by more than 2 days of inactivity.

9.1 ANALYTICAL LABORATORY QUALITY CONTROL

The project laboratories are required to adhere to specified criteria in the following areas to verify the validity of data being produced:

- Holding times;
- Instrument tuning;

- Initial calibrations and continuing calibration verification;
- Method blanks;
- Surrogate spike compounds;
- Matrix spike samples and matrix spike duplicates (MS/MSD);
- Laboratory control samples (LCS);
- Laboratory duplicates; and
- Internal standards.

9.1.1 Holding Times

Holding time constraints for each method will be met to ensure the validity of the results report. Holding times are outlined in Table 3.

9.1.2 Instrument Tuning

Instrument tuning for analyses by gas chromatography/mass spectrometry (GC/MS) will be completed to ensure that mass resolution, identification, and, to some degree, sensitivity of the analyses are acceptable. Instrument tuning will be completed each 12-hour period during which samples or standards are analyzed. In the event that an instrument tuning does not meet control limits, analyses of project samples will be suspended until the source of the control failure is either eliminated or reduced to within control specifications. Any project samples analyzed while the instrument is out of calibration will be reanalyzed.

9.1.3 Laboratory Instrument Calibration

Initial calibration of instruments, as applicable, will be performed at the start of the project and when any ongoing calibration does not meet control criteria. The number of points used in the initial calibration is defined in each analytical method. Continuing calibration verification will be performed as specified in the analytical methods to track instrument performance. In the event that continuing calibration verification does not meet control limits (as specified by the method requirements), analysis of project samples will be suspended until the source of the control failure is either eliminated or reduced to within control specifications. Any project samples analyzed while the instrument was out of calibration will be reanalyzed. Calibration documentation will be retained at the laboratory and readily available for review.

9.1.4 Laboratory Method Blanks

According to the EPA (2020a, 2020b), “the purpose of laboratory (or field) blank analyses 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).”

Method blanks are laboratory QC samples that consist of either a contaminant-free, soil-like material or deionized water. Method blanks are created in the laboratory during sample preparation and follow samples throughout the analysis process. The frequency of method blanks will be at least one per analytical batch for each matrix. No more than 20 non-QC field samples can be contained in one batch.

If a substance is found in the method blank then one (or more) of the following events occurred.

- The 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 contaminated the samples during preparation or analysis.

Given method blank results, validation guidelines aid in determining which substances in samples are considered "real" and which ones are inadvertent contaminants of the analytical process. During data validation, the data validator will evaluate all method and field blank sample results and take action as described in EPA reference documents (EPA, 2020a, 2020b); professional judgment will be applied as necessary.

9.1.5 Surrogate Spikes

Surrogate spike compounds are used during analysis for organic analytes to assess extraction efficiency and to measure the matrix effect. Surrogates are substances similar to, but not one of, the target analytes. A known concentration of surrogate compound is added to the sample and passed through the instrument, and the surrogate compound recovery is recorded. Each surrogate compound used has an established range of acceptable percent recoveries, as summarized in Table 2. If a surrogate recovery is low, sample results may be biased low, and, depending on the recovery value, a possibility of false negatives may exist. Conversely, when recoveries are above the specified range of acceptance a possibility of false positives exists, although nondetected results are considered accurate.

9.1.6 Matrix Spike/Matrix Spike Duplicates

Laboratory precision will be determined by spiking separate sample aliquots (MS/MSD, LCS/LCSD). MS/MSD sample analyses are used to determine accuracy and precision and to assess interferences caused by the physical or chemical properties of the sample itself. The analyst uses this information to determine the precision of the preparation and analytical techniques used to analyze the duplicate sample.

MS samples are preselected by field personnel and labeled accordingly on the chain-of-custody. The laboratory divides the sample into equal aliquots (separate vials for VOCs and separate sample containers for SVOCs), and then spikes each of the aliquots with a known concentration of target analytes. Matrix spike samples are prepared by spiking a known amount of all target analytes at a concentration of 5 to 10 times higher than the expected sample result. Matrix spikes will be prepared and analyzed at a minimum frequency of 5 percent or one for each batch of 20 or fewer samples for each matrix. Some analyses (such as total petroleum hydrocarbons) do not require MS/MSDs, as shown on Table 4. In addition, some analyses only require an MS sample and not an MSD.

MS/MSD data are reviewed in combination with other data quality indicators (e.g., LCS/LCS duplicate [LCSD]) to determine matrix effects. In some cases, matrix effects cannot be determined due to dilution and/or high levels of related substances in the sample.

9.1.7 Laboratory Control Spikes/Laboratory Control Spike Duplicates

The purpose of the laboratory control spike samples (also known as blank spikes) is to aid in assessment of overall accuracy and precision of the entire analytical process (e.g., sample preparation, instrument performance, and analyst performance). An LCS will be prepared and analyzed at a minimum of one LCS with each batch of 20 samples or fewer for each matrix. LCS are similar to matrix spikes; however, the LCS spike medium is "clean" or contaminant free.

9.1.8 Laboratory Replicates/Duplicates

Precision for inorganic analytes is monitored by analysis of [nonspiked] sample replicates/duplicates. Laboratory duplicate sample analysis, for inorganic analytes, will be prepared and analyzed at a minimum frequency of 5 percent or one laboratory duplicate with each batch of 20 samples or fewer for each matrix.

9.1.9 Internal Standards

Internal standards are added to all field and QC samples immediately prior to analysis for analyses completed by GC/MS. The internal standards are used to quantify target compounds and to ensure that the instrument is stable and functioning as calibrated.

No special QC procedures will be required for this project. Ranges of laboratory-established control limits for surrogates, MS/MSD recoveries, LCS recoveries, and laboratory duplicate RPDs, as applicable, are provided in Table 2. The most current laboratory control limits will be used to evaluate results during data review and may be obtained directly from the laboratory Project Manager.

9.2 FIELD QUALITY CONTROL

Field QC samples are collected and analyzed to assess sample collection techniques, possible sources of contamination, interferences that may be attributed to the sample matrix, and, to some degree, the bias and precision of the reported results. Field QC will be evaluated, along with laboratory QC, by the data validator during data review and validation. Affected data will be qualified in accordance with EPA (2020a and 2020b) guidelines. A description of each type of QC sample is described below. For the purpose of this discussion, the term “primary sample” is defined to be a field sample of environmental medium (e.g., soil) other than a field QC sample.

9.2.1 Field Equipment Calibration Procedures

Field equipment requiring calibration will be calibrated to known standards in accordance with manufacturer’s recommended schedules and procedures for each instrument. Calibration (or drift) checks of the vapor measurement equipment will be conducted daily, and the instruments will be recalibrated as required. Calibration measurements will be recorded in the daily field logs. If field equipment becomes inoperable, it will be replaced with a properly calibrated instrument.

9.2.2 Equipment (Rinsate) Blanks

Equipment rinsate blanks will be collected whenever nondedicated or nondisposable sampling equipment will be used. Equipment rinsate blanks will be used to identify possible contamination from the sampling environment or from sampling equipment. These blanks will be collected by pouring deionized and distilled water over (or through) the decontaminated sampling equipment and into a sample jar. One equipment rinsate blank will be collected for each type of sampling equipment used during the sampling event and will be analyzed for all analytes except conventional analytes. The frequency of collection will be 1 per 20 samples collected. These are typically not required during routine sampling since dedicated or disposable equipment is used for sampling wells, but would be required if that were ever not the case.

9.2.3 Field Blanks

Sampling personnel will collect field blanks and submit the blanks to the laboratory as natural samples. Field blanks will be used to identify possible contamination occurring from the sampling environment.

These blanks will consist of deionized and distilled water from the analytical laboratory in clean and preserved sampling containers. In the field, this water will be transferred to an empty sampling container at a specified sampling location. The sample will be preserved for the applicable analysis to be completed. The frequency of collection will be 1 per 20 samples collected. Field blanks will be analyzed for all analytes.

9.2.4 Trip Blanks

Trip blank samples, consisting of organic-free water poured into 40-milliliter (ml) sample vials at the laboratory under contaminant-free conditions, will be provided by the laboratory for each sampling event that includes analysis of volatile organic compounds (VOCs). Trip blanks remain sealed during sampling and are kept in the sample transport container at all times. Trip blank samples are analyzed for VOCs and gasoline-range organics and will provide a measure of potential cross-contamination with VOCs during shipment and handling.

Trip blanks will be included at a rate of one per cooler for analyses of all volatile constituents (e.g., VOCs, and gasoline-range organics). Results of trip blank samples are used to assess potential contamination that may impact groundwater samples during transport.

9.2.5 Field Duplicates

Field duplicates are used to assess the homogeneity of samples collected in the field and the precision of sampling methods. Field duplicates are prepared by collecting two aliquots (i.e., splits) of sample from the same sampling location using the same sampling equipment and technique, then submitting them for analysis as separate samples. Results from the analysis of field duplicates are used to evaluate the precision and consistency of laboratory analytical procedures and methods, and the consistency of the sampling techniques used by field personnel. Groundwater field duplicates will be collected at a rate of 1 per 20 samples per sampling event. Field duplicates will be collected at locations with suspected contamination. Any well with detections the previous sampling round would be eligible to be a field duplicate location the following round. The field duplicate RPD should be less than the percentage given for each respective analyte for groundwater samples shown on Table 4 and assessed for potential qualification as part of data validation.

9.2.6 Matrix Spike/Matrix Spike Duplicate

Extra sample volume must be collected by field staff to enable the lab to run MS/MSD analyses for the designated analyses listed in Table 4. MS/MSD sample volume should be submitted at a rate of 1 per 20 samples collected, or one per field mobilization (lab batch) at a minimum. All MS/MSD samples should be noted on the chain-of-custody form. MS samples should be collected at relatively “clean” locations and are analyzed to assess the effects of the sample matrix on the accuracy of analytical measurements. Any well without COC detections the previous sampling round would be eligible to be a field duplicate location the following round. MSD samples are used to assess both accuracy and precision.

9.3 CORRECTIVE ACTION

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or QC performance outside established criteria. Corrective action can occur during field activities, laboratory analyses, data validation, or data assessment.

Corrective actions should be designed to correct the problem and to minimize the possibility of recurrence. Examples of corrective actions include modifying nonconforming procedures, forms, or

worksheets; instituting a quality check; and the like. Proposed corrective actions should be reviewed and approved by the QA Leader prior to implementation. Significant noncompliance and corrective actions will be discussed in QA reports to the Project Manager and Washington State Department of Ecology (Ecology), as appropriate.

9.3.1 Field Corrective Action

Project personnel will be responsible for reporting technical or QA nonconformances or deficiencies of any activity or issued document to the Field Coordinator. The Field Coordinator will consult with the QA Leader to determine whether the situation warrants a reportable nonconformance and subsequent corrective action. If so, a Corrective Action Report (CAR) will be initiated by the QA Leader.

Corrective actions will be implemented and documented in the field record log. No staff member will initiate corrective action without prior communication of findings using the process described above.

9.3.2 Laboratory Corrective Action

Corrective action by the laboratory may occur prior to or during initial analyses. Conditions such as broken sample containers, multiple phases, low/high pH readings, and potentially high-concentration samples may be identified during sample log-in or prior to analysis.

Laboratory corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, and who checks potential sources of error, such as instrument calibration, spike and calibration mixes, and instrument sensitivity. If the problem persists, or cannot be identified, the problem should be referred to the supervisor, manager, and/or Laboratory Project Manager for further investigation and possible formal corrective action.

The contracted laboratory's QA Manual includes specific procedures for identification and documentation of nonconformance and implementation and reporting of corrective actions.

9.3.3 Corrective Actions Resulting From Data Validation

If necessary, the data validator will contact the laboratory for further information, clarification, or needed resubmissions and/or corrective actions. All communications will be documented and included with the data validation report as an appendix.

In cases where a deficiency or problem is a recurring nonconformance requiring more extensive corrective action, it should be documented on a formal CAR. The CAR will be sent to the organization responsible for the corrective action, and a copy routed to the QA Leader. When the corrective action is complete, the data validator will complete the CAR.

10.0 DATA MANAGEMENT PROCEDURES

Computerized systems will be used to record, store, and sort the technical data that will support the site investigation. The data record will include a unique sample code, station ID, sample type (matrix), analyte, analyte concentration, and concentration units. Automated data handling increases the data integrity by reducing errors, omissions, and ambiguities that can be introduced by manual procedures. In addition, automated procedures will generally be used by the laboratories to capture and summarize analytical results. Sampling location coordinates will be entered into the database to enable the generation of maps and figures and upload to Ecology's Environmental Information Management System.

Field logbooks, station/sample forms, and chain-of-custody/sample analysis request forms are prepared by the field team while sample collection activities are in progress. Sample information from the field, such as water elevation data, is entered manually. Data from the laboratories are entered directly from the electronic data deliverables (EDDs). A small portion of the laboratory data may be entered manually if electronic data cannot be supplied. Data qualifiers are entered into the database when data validation is completed and verified, and the data set is approved as final. All manual and electronic entries are verified by the data manager or validation personnel.

10.1 LABORATORY DATA REPORTS

The project laboratory will complete all analyses as described in the Groundwater Monitoring Plan and present the following, at a minimum, in a report to the QA Leader within approximately 30 days of the receipt of samples, unless a shorter turnaround time is requested.

- Case narrative: The case narrative will describe the analytical methods used and discuss any irregularities encountered during sample analyses and any resulting data qualification.
- Analyte concentrations: A summary of analytical results will be presented for each sample.
- Method reporting limits: Method reporting limits achieved by the laboratory will be presented with the analyte concentrations.
- Laboratory data qualifier codes and a summary of code definition: Data qualifiers will appear next to analyte concentrations, and associated definitions will be summarized in the report.
- Lab QC results: Results for method blanks, MS/MSD, LCS/LCSD, lab duplicates, and surrogate recoveries will be provided with final results.
- EDD version of results: A full set of results will be provided in database format.

10.2 PROJECT DATABASE

Data validation will be performed on specified analytical data for this project, and the data validator will enter validation qualifiers and comments into the data set as necessary.

The QA Leader will then transmit the validated EDD along with the validation report to the database uploader, who will upload it into Ecology's Environmental Information Management System. Tables from the EDD/database will then be backchecked against hard copy results. Any corrections will be made to the database based on backcheck findings. The data will then be considered final, and EDDs or tables will be created from the EDD/database as necessary for use in data analysis and reporting.

10.3 RECORDS MANAGEMENT

The QA Leader will inventory and store all analytical data, including all resubmissions collected during data validation efforts, worksheets, and original data validation reports.

11.0 AUDITS AND REPORTS

11.1 AUDITS

Any deviations from the Groundwater Monitoring Plan that occur during the reporting period will be included in the semiannual reports provided to Ecology.

11.2 REPORTS

Procedures, observations, and test results will be documented for all sample collection, laboratory analysis and reporting, and data validation activities. In addition to data reports provided by the laboratories, reports will be prepared that address data quality and usability and that provide tabulated laboratory and field data. Internal and external reporting procedures for this project are described in this section.

Upon receipt of the chemical data from the laboratories, the data will be subjected to a QA review (i.e., data validation). The QA reviews are anticipated to be completed within 30 days of receipt of the last data package from the laboratory. The results of the validated data will then be reported according to the schedule in the Groundwater Monitoring Plan. Details regarding the validation of data are presented in Section 12.0 of this QAPP. In the event of unscheduled delays in the project schedule, the Project Manager will inform the Ecology project manager.

11.2.1 Field Records

Field records will be maintained during all stages of sample collection and preparation for shipment to the laboratories. Field records will include the following items:

- Field notebook to record daily sampling activities, conditions, and field measurements;
- Combined station/sample log to document station locations and date and time of collection;
- Sample labels and tags;
- Combined chain-of-custody/sample analysis request (COC/SAR) forms;
- Custody seals to monitor cooler security during shipment; and
- Photographic documentation (if taken).

Descriptions of the information that will be reported on each field record form are provided in SOP-400, contained in the Groundwater Monitoring Plan.

In addition to the routine field records, the following reports will be completed if a deviation from the Groundwater Monitoring Plan or QAPP is encountered:

- Corrective action reports documenting any problems encountered during field activities and corrective actions taken,
- A summary of any changes made to documented procedures and the rationale for the changes.

11.2.2 Laboratory Data Reports

The laboratories will perform data reduction as described in each test method for this project and submit complete data packages, as appropriate, with full documentation for all analyses or other determinations. The laboratory QA managers or their designees are responsible for reviewing their respective laboratory data packages, verifying all method-specific QA/QC protocols were completed and are acceptable, and checking data reduction so that a QA review has been completed for all data reported prior to submittal to the Project Manager. Any transcription or computation errors identified during this review will be corrected by the laboratory.

The analytical laboratories will provide all information required to complete an abbreviated QA review (i.e., summary review) on 100 percent of the data.

To complete an abbreviated QA review, the information to be reported (as applicable to the analytical method) will include, at a minimum, the following:

- A cover letter discussing analytical procedures and any difficulties that were encountered;
- A summary of analyte concentrations and method reporting limits;
- Laboratory data qualifier codes appended to analyte concentrations, as appropriate, and a summary of code definitions;
- Results for method and calibration blanks;
- Results for all QA/QC checks, including SMCs, surrogate compounds, MS samples, LCSs, MSD samples, and laboratory duplicate or triplicate samples.

11.2.3 Data Review Report

A data review report will be prepared upon completion of the data review. The data review reports will summarize the results of the data validation and data quality review and will describe any significant QA problems that were encountered. The data review reports for the chemical analyses may include all or a portion (depending on the type of data validation that may be completed) of the following items:

- Executive summary of overall data quality and recommendations for data use and limitations;
- Description of sample collection and shipping, including chain-of-custody and holding time documentation;
- Description of analytical methods and detection limits;
- Description of data reporting;
- Description of completeness relative to QAPP objectives;
- Description of instrument tuning and initial and continuing calibration results;
- Description of any contamination in field and laboratory blanks and implications for bias of the data;
- Description of accuracy relative to QAPP objectives, including results of SMC, surrogate, MS, and LCS recoveries;
- Description of precision relative to QAPP objectives, including results for field and laboratory replicate analyses;
- Identification of cases where control limits or measurement performance criteria were not met and summary of the significance of these deviations; and
- Description of analyte identification and quantification.

All data and any qualifiers applied to the data as a result of the QA review will be reported in the final data report.

11.2.4 Location of Records and Reports

The records generated during sample collection and analysis document the validity and authenticity of the project data. These records will become part of the final project file. The project file will be retained by the Project Manager. Project reports will be kept with the project files for reference purposes. Records that are more than 3 years old may be archived at a data archiving subcontractor's site, but all data will be retrievable in a quick time frame (normally 1-2 days).

12.0 DATA REVIEW, VERIFICATION, AND VALIDATION

Data review, verification, and validation are conducted to establish the data quality and usability for the project. These procedures are described below. Data verification is the process of determining whether data have been collected or generated according to the Groundwater Monitoring Plan, QAPP, and the respective SOPs or method descriptions. Data validation is the process of evaluating the technical usability of the verified data with respect to the planned objectives of the project.

12.1 SAMPLE DESIGN AND SAMPLE COLLECTION PROCEDURES

The conformance of the field activities to requirements in the Groundwater Monitoring Plan will be evaluated by the Field Coordinator and/or QA Leader on an ongoing basis while field activities are in progress. The review process will include immediate evaluation of any change to the sampling plan so that an alternate field procedure may be established.

Additional verification procedures may be completed for information generated in the field. A final verification review of field activities will be made when the field effort is complete. The verification results will be included in the data quality and usability report. Specifically, field forms will be reviewed for:

- correct documentation of sample location;
- complete and accurate procedures for sample collection or measurement and proper documentation;
- proper chain-of-custody methodology, including sample shipment and preservation during transport; and
- evaluation of field QC results- field QC sample contamination could result in data qualification.

The analytical laboratories will complete a data review and verification prior to producing results. This verification will include checking that QC procedures were included at the required frequencies and that the QC results meet the control limits specified by the laboratory at the time of analysis. Any QA issues identified by the laboratory will be described in the case narrative and may result in qualification of some of the results by the laboratory.

12.2 VERIFICATION AND VALIDATION OF CHEMICAL DATA

Verification of chemical data will be completed at the laboratories and by the QA Manager. The laboratory will be responsible for the review and verification of all bench sheets; manual entry or transcriptions of data; review of any professional judgments made by a chemist during sample preparation, analysis, and calculation; and reporting of the final concentrations. The laboratory will also be responsible for the review of QC results to determine whether data are of usable quality or reanalyses are required. Any nonconformance issues identified during the laboratory's QA checks will be corrected and noted by the laboratory. Any data quality deviations will be discussed in the laboratory case narrative, including the direction and magnitude of any bias to the data, if possible.

Data validation and verification will be completed by the QA Manager prior to finalizing the data and release of the data set for interpretation. All data will be verified and validated in accordance with

U.S. EPA National Functional Guidelines (EPA, 2020a, 2020b), method-specific QC requirements, and laboratory-established control limits. Data will be qualified when QC procedures are not completed as

required, when measurement performance criteria established in the applicable method are not met, or when specific data quality objectives established for this project are not achieved.

External data verification and validation will include an abbreviated QA review (summary data review) on 100 percent of the data. The laboratory information that will be reviewed, as applicable to the analyses completed, for each of these validation efforts is described below.

12.2.1 Abbreviated QA Review

Completion of an abbreviated QA review (i.e., a summary review data validation effort) assumes that all field results reported by the laboratory are correct. For this level of effort, summaries of applicable calibration and QC measurements are reviewed. Calculations and transcriptions are not verified or confirmed, and original instrument printouts are not reviewed. The following laboratory information will be reviewed, as applicable to each analysis:

- Chain-of-custody documentation to verify completeness of the data set;
- Case narratives discussing analytical problems (if any) and procedures;
- Sample preparation logs or laboratory summary result forms to verify analytical holding time constraints were met;
- Instrument tuning, initial calibration, and continuing calibration results to assess instrument performance;
- Method blank, trip blank, equipment rinsate blank, and other field blank results;
- Surrogate or system monitoring compound recoveries to assess preparation and analyses;
- MS and LCS recoveries; and
- Laboratory duplicate, field duplicate, and MSD results.

13.0 DATA QUALITY ASSESSMENT

The goal of data verification and validation is to determine the quality of each data point and to identify data points that do not meet measurement performance criteria and other project DQOs.

Nonconforming data may be qualified as estimated (J) or rejected (R) as unusable during data validation if criteria for data quality are not met. Rejected data (R) will be flagged as unreportable in the project database and will be excluded from all data retrievals. These data will not be used for any purpose. An explanation of the rejected data will be included in a data validation report. If the rejected data are needed to make a decision, then it may be necessary to resample. Any decision to resample would be based on discussions among the project management team.

Data qualified as estimated (J) will be appropriately qualified in the final project database. Although estimated data are less precise or less accurate than unqualified data, estimated results may still be used to evaluate and interpret site conditions provided that consideration of these data does not compromise the project objectives. The data review report will include all available pertinent information regarding the direction or magnitude of bias or the degree of imprecision for qualified data to facilitate the assessment of data usability.

The effect of estimated sample results in interpretation of site conditions depends on several factors.

- The nature and magnitude of the data quality problem: for example, a small positive bias in sample(s) concentration near a screening level may result in a conservative conclusion but a large negative bias may render the screening-level comparison meaningless.
- The nature and location of the affected sample(s): for example, a data deficiency in a result for a reference area may have a much greater impact on data interpretation than a similar deficiency in one of many results for a study site.
- The context of the sample results within the data set: for example, a questionable result for an analyte that is detected at high concentrations and important for site interpretation is likely to have a much greater impact on data interpretation than a questionable result for an analyte that is present at only low concentrations.
- The assessment of any data deficiencies on interpretive activities will be completed on a case-by-case basis. The data users are responsible for assessing the effect of the inaccuracy or imprecision of the qualified data on comparisons to screening criteria, statistical procedures, risk assessments, and other data uses. The effect of any data deficiencies on risk assessment and other interpretive activities and conclusions will be described in the final report.

14.0 REFERENCES

Dalton, Olmsted & Fuglevand, Inc., 2020, Groundwater Monitoring Plan, June.

EPA (U.S. Environmental Protection Agency), 2007, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd edition, February.

EPA, 2020a, USEPA Contract Laboratory Program, National Functional Guidelines for Superfund Organic Methods Review, EPA-540-R-20-005, November.

EPA, 2020b, USEPA Contract Laboratory Program, National Functional Guidelines for Inorganic Superfund Data Review, EPA-540-R-20-006, November.

Tables

TABLE 1
PROJECT PERSONNEL AND RESPONIBILITIES
Burlington Environmental, LLC Washougal Facility
Washougal Washinton

Personnel	Responsibilities	Contact Information
Kaia Petersen, Washington State Department of Ecology Project Manager	Oversee all program activities to ensure compliance; perform technical oversight and consultation on major quality assurance problems; provide final approval of all necessary actions and adjustments for activities to accomplish project objectives. Provide final approval of the Groundwater Monitoring Plan and QAPP.	Washington State Department of Ecology, SWRO PO Box 47775 Olympia, WA 98504-7775 (360) 407-6359
Laura Dell'Olio, Project Manager	Overall responsibility for sample collection activities. Oversee all program activities to ensure compliance; provide technical oversight and consultation on major quality assurance problems; implement final approval of all necessary actions and adjustments for activities to accomplish project objectives.	CleanEarth, Inc 20245 77th Avenue South Kent, WA 98032 (253) 246-9210
Michael Wright, Sampling Team Member	Coordinate with Project Manager, Consultant, and project laboratories for bottle and equipment shipments to the site and sample shipments to the laboratories; track submittal and receipt of samples to the laboratory, and initiate COC/SAR forms. Ensure field procedures are completed in accordance with Plans and QAPP; authorize and document minor adjustments to the sampling plan in response to field conditions, as necessary, notify Project Manager and QA/QC Coordinator.	CleanEarth, Inc. 1701 E Alexander Avenue Tacoma, WA 98421 (253) 281-5883
Duane Beery, Database Administrator	Organize and maintain project database. Ensure that the data are stored in accordance with the Groundwater Monitoring Plan and QAPP; supervise data management personnel.	CleanEarth, Inc. 1107 W 13th Ave Spokane, WA 99204 (206) 618-8649
Tasya Gray, Consultant Project Manager/Sampling Coordination & Support	Coordinate with and support Project Manager & Sampling Team in laboratory communications, sampling, and submittal and receipt of samples to the laboratory.	DOF Seattle, WA ngray@dofnw.com
Cari Sayler, QA/QC Coordinator	Provide technical quality assurance assistance; develop and review QAPP; oversee quality assurance activities to ensure compliance with QAPP; coordinate and supervise data validation and data quality report preparation; review and submit quality assurance reports.	Cari Sayler Sayler Data Solutions 14257 93rd Ct NE Kirkland, WA 98034 (425) 820-75048
Kelly Bottem, ARI Client Services Manager	Ensure that sample receipt and custody records are properly handled and data are reported within specified turnaround times: calibrate and maintain instruments as specified; perform internal quality control measures and analytical methods as required; take appropriate corrective action as necessary; notify the QA/QC Coordinator when problems occur; report data and supporting quality assurance information as specified in this QAPP.	Analytical Resources, LLC 4611 S 134th Pl #100. Tukwila, WA 98168 (206) 695-6200

Abbreviations

QAPP = quality assurance project plan
SWRO = Southwest Regional Office
COC = chain-of-custody
SAR = sampling analysis and request
QA/QC = quality assurance and quality control

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TABLE 2
MEASUREMENT QUALITY OBJECTIVES
Burlington Environmental, LLC Washougal Facility
Washougal, Washington

Analyte	Analytical Method	LCS %Recovery Limits[1]	MS %Recovery Limits[1]	Sample Surrogate %Recovery Limits[1]	MS/MSD, or Laboratory Duplicate RPD Limits (%)	Field Duplicate RPD Limits (%)
VOCs	EPA 8260D	48-190	48-190	80-129	≤30	≤30
VOCs-SIM	EPA 8260D SIM	59-141	59-141	75-129	≤30	≤30
1,4-Dioxane	EPA 8270E-SIM	35.1-120	39.9-120	33.6-120	≤30	≤30
Total Metals - Arsenic[2]	EPA 6020B	75-125	80-120	NA	≤20	≤20

Notes

1. Recovery limits are those previously provided by the project laboratory; data will be evaluated during data review using the most current control limits provided by the laboratory.

2. Dissolved metal sample will be taken only when turbidity will not stabilize.

TABLE 3
SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES
Burlington Environmental, LLC Washougal Facility
Washougal, Washington

Analyte	Analytical Method[1]	Sample Container	Preservation / Temperature	Holding Time[2]
VOCs	EPA 8260D	3 x 40-mL vial	HCl to pH<2.0; Between 0°C and 6°C	14 days
VOCs - SIM	EPA 8260D SIM	3 x 40-mL vial	HCl to pH<2.0; Between 0°C and 6°C	14 days
1,4-Dioxane	EPA 8270E-SIM	1 x 500 mL amber glass	≤6°C	7 days [3]
Total Metals - Arsenic[4]	EPA 6020B	500 mL HDPE	2.5 mL 1:1 HNO_3; ≤6°C	6 months

Notes

1. Method numbers refer to SW-846 EPA Analytical Methods (EPA,1986), or Washington State Department of Ecology analytical methods, or Standard Methods (SM) for the Examination of Water and Wastewater.
2. Holding times are based on elapsed time from date and time of collection.
3. 7 days is the extraction holding time. There is a secondary holding time of 40 days from extraction to analysis.
4. Dissolved metal sample will be taken only when turbidity will not stabilize.

Abbreviations

VOC = volatile organic compound
EPA = U.S. Environmental Protection Agency
mL = milliliter
HCl = hydrochloric acid
°C = degree Celsius
SIM = selective ion monitoring
TPH = total petroleum hydrocarbons
VOA = volatile organic analysis
HDPE = high density polypropylene
HNO_3 = nitric acid

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TABLE 4
QUALITY CONTROL SAMPLE TYPES AND FREQUENCY
Burlington Environmental, LLC Washougal Facility
Washougal, Washington

Parameter	Field QC			Laboratory QC			
	Field Duplicates[3]	Field Blank	Trip Blanks	Method Blanks	LCS	MS/MSD	Lab Duplicates
VOCs	1/20 samples per sampling event	1/20 samples per sampling event	1/cooler	1/batch	1/batch	1 set/batch	NR
1,4-Dioxane	1/20 samples per sampling event	1/20 samples per sampling event	NR	1/batch	1/batch	1 set/batch	NR
Total Metals - Arsenic[4]	1/20 samples per sampling event	1/20 samples per sampling event	NR	1/batch	1/batch	1 set/batch	NR

Notes

1. A sampling event is defined as consecutive days of sampling not separated by more than two days of inactivity.
2. A 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). No more than 20 field samples can be contained in one batch.
3. Field duplicates will be collected only for events with more than five samples.
4. Dissolved metal sample will be taken only when turbidity will not stabilize and is above 5 NTU.

Abbreviations

LCS = laboratory control sample
MS = matrix spike sample
NR = not required
QC = quality control
VOCs = volatile organic compounds
MSD = matrix spike duplicate sample

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TABLE 5
GROUNDWATER PRELIMINARY CLEANUP LEVELS
SHALLOW GROUNDWATER ZONE AND LOWER AQUIFER
Burlington Environmental, LLC Washougal Facility
Washougal, Washington

Concentrations in micrograms per liter (µg/L)

Constituent	CAS Number	Shallow Groundwater Zone Preliminary Cleanup Level	Lower Aquifer Preliminary Cleanup Level
Inorganics			
Arsenic	7440-38-2	22.84	1.42
VOCs			
Benzene	71-43-2	1	1
Bromodichloromethane	75-27-4	1	1
Bromoform	75-25-2	4.6	4.6
Bromomethane	74-83-9	11	11
Carbon disulfide	75-15-0	400	800
Carbon tetrachloride	56-23-5	1	1
Chlorobenzene	108-90-7	100	100
Chloroform	67-66-3	1.2	1.4
Chloromethane	74-87-3	150	--
1,2-Dibromo-3-chloropropane	96-12-8	2	2
Dibromochloromethane	124-48-1	1	1
1,4-Dichlorobenzene	106-46-7	4.9	8.1
1,1-Dichloroethane	75-34-3	7.7	7.7
1,2-Dichloroethane	107-06-2	1	1
1,1-Dichloroethene	75-35-4	7	7
1,2-Dichloroethene (total)	540-59-0	72	72
cis-1,2-Dichloroethene	156-59-2	16	16
trans-1,2-Dichloroethene	156-60-5	1	1
Dichlorodifluoromethane	75-71-8	5.6	--
1,2-Dichloropropane	78-87-5	1	1
Ethyl chloride (chloroethane)	75-00-3	--	--
Ethylene dibromide (EDB)	106-93-4	1	1
Methylene chloride	75-09-2	5	5
Styrene	100-42-5	100	100
1,1,1,2-Tetrachloroethane	630-20-6	1.68	1.68
1,1,2,2-Tetrachloroethane	79-34-5	1	1
Tetrachloroethene	127-18-4	2.4	2.4
Toluene	108-88-3	57	57
1,2,4-Trichlorobenzene	120-82-1	1	1
1,1,1-Trichloroethane	71-55-6	200	200
1,1,2-Trichloroethane	79-00-5	1	1
Trichloroethene	79-01-6	1	1
1,2,3-Trichloropropane	96-18-4	2	2
Vinyl chloride	75-01-4	0.02	0.02
m,p-Xylene	106-42-3	330	1600
SVOCs			
1,4-Dioxane	123-91-1	1	1

Notes
Preliminary cleanup levels as reported in the 2021 Final Feasibility Study
-- = no cleanup level calculated
CAS = Chemical Abstracts Service
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds

ATTACHMENT D
HEALTH AND SAFETY PLAN

Site Specific Health and Safety Plan
Groundwater Monitoring

Burlington Environmental, LLC
WASHOUGAL FACILITY
WASHOUGAL, WASHINGTON

May 2021

CleanEarth

Table of Contents

1.0 INTRODUCTION

This plan has been prepared in conformance with the Burlington Environmental, LLC and Clean Earth Environmental Solutions (ESOL) Health and Safety (H&S) Program. It addresses all activities associated with the Groundwater Monitoring Plan (GMP) at the Washougal site. All workers and third parties who enter the site to accomplish GMP activities will be required to comply with this site-specific Health and Safety Plan (HASP).

2.0 PROJECT ORGANIZATION

Site /Project Name	*BURLINGTON ENVIRONMENTAL, LLC - Washougal Facility Groundwater Monitoring*
Location	*632 South 32nd Street in Washougal, Washington*
Regional Operations Director	*Kris Iverson*
Telephone No.	*360-772-3761*
Facility Manager	*Patrick Hymas*
Telephone No.	*360-772-3769*
Operational EHS Manager	*Guadalupe Montes*
Telephone No.	*253-219-3681*
Project Manager	*Laura Dell'Olio*
Telephone No.	*253-246-9210*
Site Safety Officer	*Patrick Hymas*
Telephone No.	*360-772-3769*
Key Project Personnel/Phone	
Site Team/Crew Size	
Work Hours	Work will be performed during daylight hours.

Responsibilities for staff conducting work on this project.

The following section briefly describes the health and safety designations and general responsibilities that will be identified during each sampling event and other duties to maintain the groundwater monitoring network in good working order.

Training

Clean Earth ESOL personnel have both formal training and prior on-the job training for those tasks to which they are assigned. All personnel have completed at least 40-hours of basic H&S training as specified in the Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) HAZWOPER. Additionally, any personnel operating a forklift or electric pallet jack will have undergone classroom training and a formal evaluation. Copies of applicable certificates will be available upon request. In addition, the SSO shall have basic first aid training and CPR certification.

Medical Surveillance

All Clean Earth ESOL personnel engaged in work at the site shall participate in an annual medical surveillance program. Clean Earth ESOL personnel must be cleared by an examining physician to wear a respirator and personal protective equipment (PPE), should the need arise, while performing work at the site. All medical surveillance records are maintained with a third-party company All One Health. On site medical surveillance for specific hazards (i.e., hot, cold stress, illness) will be performed by the SSO.

The specific tasks of key personnel involved in the groundwater monitoring program are summarized below.

Project Manager

The general functions of the Project Manager will be to:

- Maintain correspondence between regulatory agencies and Burlington.
- Verify parameter requirements and modify the groundwater monitoring program if necessary.
- Maintain the groundwater monitoring network in good working condition.
- Act as the Project Site Safety Officer (PHSO) and oversee implementation of the HASP, assures that all personnel designated to work at the site will be qualified according to Medical Surveillance and H&S training requirements.
- Verify that on-site personnel and visitors are working in a manner consistent with applicable environmental and H&S regulations, site work plans and this project HASP, Advise the affected individual if a deviation is noted, and follow-up as appropriate.
- Implement this HASP and report any observed deviations from site conditions anticipated in the plan.
- Verify that required personal protective, monitoring, and emergency equipment is used as required.
- Report all accidents/incidents and findings regarding personnel exposure and work practices to corporate Health and Safety Personnel.

Sampling Team Members

The Lead member of the Sampling team will act as the site safety officer (SSO). The general functions of the sampling team members will be to:

- Learn and follow all of the procedures in the Groundwater Monitoring Plan.
- Notify the Project Manager of any unresolved problems or deviations from approved procedures.
- Conduct daily or pre-work safety briefings and implement safety requirements.
- Report observed accidents/incidents or inadequate work practices to the Corrective Action Project Manager
- Obtain, maintain, and inspect all equipment used to fulfill their responsibilities.
- Oversee field sampling activities and equipment repair.
- Maintain lines of communication between those personnel involved in the field sampling activities, the Project Manager, and the analytical laboratory.

3.0 FACILITY DESCRIPTION AND BACKGROUND

Type of Facility	This former dangerous waste management facility is located in the Camas-Washougal Industrial Park, near the Columbia River. Burlington Environmental Inc. (Burlington) has owned this 5.2-acre site since 1985 and currently operates a hazardous waste transfer facility at this location.
Buildings/Structures/Surface Conditions	The site is approximately 5.2 acres and consists of 5 buildings, one of which is a temporary office trailer. Currently the property operates as a hazardous waste transfer facility. A small portion of the south-end of the property is leased to a neighboring property owner, TrueGuard,LLC for vehicle parking. Approximately 40% of the property is unpaved open gravel and is not used for facility operations.
Access	Field Vehicles

General Geologic and Hydraulic Setting	Land Use in the vicinity of the site is industrial, except for the Steigerwald Marsh, which is part of the Steigerwald Lake National Wildlife refuge to the east and downgradient of the property. The site is located within the diked portion of the Columbia River floodplain at an elevation of approximately 20 feet above mean sea level. The site gently slopes downward to the east. The immediate area was constructed by building up drege sands on top of native marshy silts. The Columbia river flows generally east to west approximaetly 0.4 miles south southwest of the site. Depth to ground water is 1-6 feet depending on the seasonal flucuations.
Site History	In 1992, the Department of Ecology (Ecology) and the U.S. Environmental Protection Agency (EPA) issued a dangerous waste management permit to Burlington. The permit required Burlington to close dangerous waste management units and to perform corrective action, or cleanup, of releases of dangerous wastes. Prior to expiration of the permit in 2002, Burlington closed of all of the dangerous waste management units at their facility, including the removal of a tank farm and excavation of contaminated soils beneath the tank farm.
Special Conditions/Comments	This site has an approved RI/FS with the Department of Ecology. Cleanup Site ID: 2796

4.0 COMPREHENSIVE WORK PLAN

SCOPE OF WORK
The Groundwater Monitoring Plan is designed to monitor the groundwater at the Washougal Site. It utilizes existing groundwater monitoring wells installed on and adjacent to the Burlington property (Figure 1). The monitoring wells are located to provide adequate information on (1) groundwater flow at the site, (2) groundwater units underlying the site; and (3) groundwater leaving the site and flowing to off-site, downgradient and cross-gradient locations.

Mobilization / Site Preparation

- Learn and follow all the procedures in the Groundwater Monitoring Plan.
- Obtain, maintain, and inspect all equipment used to fulfill their responsibilities.
- Oversee field sampling activities and equipment repair.
- Schedule sample analysis services with the analytical laboratory and the field sampling team.
- Verify or arrange for the shipment of sample bottles and sample transport containers, both from the analytical laboratory to the field and from the field to the laboratory.
- Calibrate equipment.
- Examine sample bottles, preservatives, and sample transport containers.
- Notify the Project Manager of any unresolved problems or deviations from approved procedures.
- Mobilize all personnel, equipment, and materials as required to the site.
- Inspect site prior to starting work to evaluate conditions.
- Establish work perimeter for each monitoring location utilizing Groundwater Monitoring Well Network Figure 1
- Establish work zones (exclusion, decontamination reduction, and support zones)
- Establish equipment, drum, and supplies management locations.

Implement Monitoring and Control Measures

- Assure relevant and appropriate equipment is on site and functioning prior to work activities.
- Test systems for operation and troubleshoot, as necessary.
- Work to prevent sample and/or well contamination.
- Notify the Project Manager of any unresolved problems or deviations from approved procedures.

Conduct Daily Safety Meeting and Periodic Safety Evaluations

- Assure all personnel are briefed on the day's tasks, known hazards, and hazard mitigation strategies.
- Encourage reporting unforeseen / unanticipated physical, equipment, and / or chemical hazards – issue STOP WORK AUTHORITY when necessary and review with all personnel – update Daily Toolbox Safety Meeting sheet

Site Orientation

- Prior to work assignment (layout, ingress; egress; emergency evacuation, phones)

Groundwater Monitoring Sampling

- Samples that will be collected throughout the site will be collected from each location and placed directly into laboratory supplied sampling containers.
- Assume responsibility for storage and provide security of sample transport containers and sample equipment.
- Conduct health and safety meetings and implement safety requirements.
- Provide field technical guidance for sampling and maintenance procedures.
- Perform or supervise the water-level survey and well inspection.
- Maintain lines of communication between those personnel involved in the field sampling activities, the Project Manager, and the analytical laboratory.
- Maintain or service all dedicated sampling equipment.
- Take all field measurements.
- Purge monitoring wells.
- Collect and preserve samples.
- Check that samples are correctly identified and packed securely with ice in the sample transport container(s).
- Take neat and complete field notes.

Decontamination – Personnel

- All personnel will proceed through decontamination (dry and wet methods may be used) and exit through an established Contamination Reduction Zone.
- An emergency eye wash & sanitation stations that will have soap and water will be available onsite.
- Containerize wash water and other materials generated during decontamination into DOT shippable containers.
- Characterize waste generated from personnel decontamination.
- Properly dispose of waste following State and Federal regulations.

Equipment Decontamination

- Decontaminate all equipment prior to leaving the site.
- Complete decontamination in controlled areas, ensure all waste generated is controlled and contained on site.
- Containerize wash water and other materials generated during decontamination into DOT shippable containers.
- Characterize waste generated from equipment decontamination.
- Properly dispose of waste following State and Federal regulations.

Demobilize Equipment

- De-Mobilize all personnel, equipment, materials and washing facilities from the site.
- Inspect site prior to conclusion of work to evaluate conditions and ensure client concurs with completion of the project.

5.0 POTENTIAL PHYSICAL HAZARDS

An assessment of the potential physical hazards that may be encountered during sampling activities in the field is designated by field task and discussed below.

ITEM	HAZARD	PREVENTION

Ambient weather / PPE load	Heat stress
	
	Dehydration
		• Must follow WAC 296-62-095 regulation for heat illness prevention.
		• Implement heat stress plan for personnel for any of the following ambient air temperature action levels.
		  ○ 52° - Nonbreathing clothes including vapor barrier clothing or PPE such as chemical resistant suits.
		  ○ 77° - Double-layer woven clothes including coveralls, jackets and sweatshirts.
		  ○ 89° - All other clothing
		• Provide shaded rest area for personnel.
		• Shall provide one quart of water per employee per hour for drinking for the entire shift.
		• Supervisor to track site temperature conditions to monitor for weather

Mobilization to site	Site Security	• Clear & Mark off drop off area with barrier tape (if required)

ITEM	HAZARD	PREVENTION
	Slips, Trips, Falls Traffic Overhead Hazards	• Visual barriers will be in place during work hours, and when site is unattended. • Limit all walking and access to designated paths / destinations
General work area	Slip / trip / fall	• Designated pathways • Maintain pathways cleared of debris. • Enforce good construction housekeeping
General work area – lifting	Lifting	• Plan and stage to minimize long distance carrying. • Split heavy loads into smaller loads. • Use mechanical lifting aids (i.e. forklift or excavator bucket) where possible and can be done safely. • Use assistant for heavy (>30 lbs.) or awkward load. • Use proper lifting techniques with good footing
General work area – traffic	Struck by	• Set up visible barricades on access roads. • Wear high visibility safety vests (except in exclusion zone)
Traffic	Struck by	• Set up visible barricades. • Wear high visibility safety vests. • Only authorized personnel in work zones • Set of Traffic Control and flagging if work is performed in the right of way.
Delivery of site equipment & supplies	Back Strains, Hand Injuries	• Verify before lifting that all hoses are bundled and secured in roll. • Do not throw equipment from truck, • Lift any object over 30lbs with assistance. If in doubt of the weight, ask for HELP first. • Lift properly with legs and maintain footing.
Loading, moving, and transportation activities (on-site)	Struck by Noise	• Level D PPE • Hearing protection if > 90 decibels • Back up alarms or rotating beacons • Keep unauthorized personnel out of operating areas. • Train personnel on working safely around equipment. • Wear Reflective Vests • Make eye to eye contact between operator/driver. • Signal or communicate movements. • Equipment operator controls movement of personnel in and out of swing zone or equipment travel area. • Stay clear of swing zone of equipment
Air monitoring	Inhalation	• Photoionization Detector (PID) will be available as part of groundwater sampling SOPs.

ITEM	HAZARD	PREVENTION
	Over exposure	• Ensure current calibration of equipment, including fresh air calibration. • Use PID to monitor work zone if odors noted at sampling work location. • The SSO will take action when air monitoring indicates that concentrations exceed an action level of 10 ppm and are sustained for more than 1 minute in the breathing zone of any worker. • If at any time workers suspect significant chemical exposures (e.g., detect unusual odors, develop symptoms of occupational exposure to the COCs) or have other unexplained adverse health effects (e.g., dizziness, nausea), workers will be encouraged to stop work and notify the PHSO. Monitor work zone area.
Break time	Ingestion	• Thoroughly wash hands before eating, drinking, smoking
Use of hand tools.	Pinch points Strain-sprain Difficult- positions Cut hazards	• Use proper holding and supporting techniques when turning wrenches, screwdrivers, and other torque-enhancing tools. • Ensure proper direction and grip on plumbing fixtures prior to use of full body weight for counterbalance – use proper footing stance. • Verify correct pipelines prior to disassembly
Confined space entry	Illness Death	• Not expected to be necessary, modify plan if required.
Falling	Bodily injury Death	• Fall hazards not expected in the vicinity of monitoring wells. Should site conditions change, modify plan as necessary.
Dust Mitigation (if required)	Dust levels visible	• Water will be sprayed periodically over exposed work area.
Debris Removal /Material Handling	Struck by Overhead Skin irritation	• Establish visual contact with operator prior to any movement of excavator bucket. • Ground personnel to wear high visibility vest. • Avoid skin contact with poison ivy /oak

ITEM	HAZARD	PREVENTION
Insects and Wildlife	Potential Exposure	• Notify Project Manager of known significant allergies to bees. Persons with allergies should avoid areas where bees have been identified and also be aware of areas that have the have a higher potential to have bees. (i.e. sunny dry dirt area
Railroad Hazards	Struck by	• If working near an active rail line, ensure proper controls are in place. Coordination with the owner of the rail will need to occur before work can start. • Wear appropriate high visibility clothing

6.0 POTENTIAL CHEMICAL HAZARDS

Listed below are hazardous substances that are known or suspected to be present at the site. Additional information on these chemicals, including their acute exposure effects, is noted below.

Chemical, Form	Media	Maximum Concentrations Detected at Site (mg/kg or µg/L)[1]	Routes of Exposure[2]	Acute Exposure Symptoms
Volatile Organic Compounds (VOCs)				
1,1-Dichloroethane	GW	420	RISE	Irritation skin; central nervous system depression; liver, kidney, lung damage
cis-1,2-Dichloroethene	GW	730	RISE	Irritation eyes, respiratory system; central nervous system depression
Trichloroethene	GW	1.5	RISE	Irritation eyes, skin; headache, visual disturbance, lassitude (weakness, exhaustion), dizziness, tremor, drowsiness, nausea, vomiting; dermatitis; cardiac arrhythmias, paresthesia; liver injury; [potential occupational carcinogen]

Chemical, Form	Media	Maximum Concentrations Detected at Site (mg/kg or µg/L)[1]	Routes of Exposure[2]	Acute Exposure Symptoms
Vinyl chloride	GW	130	RISE	Lassitude (weakness, exhaustion); abdominal pain, gastrointestinal bleeding; enlarged liver; pallor or cyanosis of extremities; liquid: frostbite; [potential occupational carcinogen]
Benzene	GW	2.0	RISE	Irritation eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; anorexia, lassitude (weakness, exhaustion); dermatitis; bone marrow depression; [potential occupational carcinogen]
Semivolatile Organic Compounds (SVOCs)				
1,4-Dioxane	GW	280	RISE	Irritation of eyes, nose, and throat; eczema; central nervous system depression; pulmonary edema; renal and hepatic injury; death.
Inorganics				
Arsenic	GW	27.1	RISE	In animals: irritation skin, possible dermatitis; respiratory distress; diarrhea; kidney damage; muscle tremor, convulsions; possible gastrointestinal tract, reproductive effects; possible liver damage

1. Maximum concentrations are in milligrams per kilogram for soil samples, and micrograms per liter for water samples

2. RISE = respiratory, ingestion, skin, eyes.

Abbreviations

GW = groundwater

µg/L = micrograms per liter

mg/kg = milligrams per kilogram

7.0 SAFETY EQUIPMENT AND PROCEDURES

Initial Level of Protection	*At a minimum, a modified Level D PPE ensemble will be used with the main objective to prevent unnecessary dermal exposure. The PHSO will be consulted to up- or downgrade the PPE requirements if conditions warrant.*
Training Requirements for Site Workers	*HAZWOPER 40, Current 8 Hour Refresher, First Aid /CPR, HAZWOPER Supervisor*
Decontamination Procedures	*Boots and hands will be decontaminated with soap and water as necessary.*

Health and Safety Equipment Checklist	
☐ *Respirator with Cartridges*	☒ *Fire Extinguisher — located in field vehicle (2 per truck)*
☒ *Protective Clothing (coveralls, FRCs)*	☒ *Drinking Water*
☒ *Disposable nitrile gloves*	☒ *Rain Gear*
☒ *Decontamination equipment*	☒ *High Visibility Vest*
☒ *Steel-toed Boots*	☒ *Cell Phone*
☐ *Disposable Boot Covers*	☐ *Radios*
☒ *Safety Glasses — use when appropriate*	☐ *Tychem Coveralls*
☒ *Hard Hat*	☒ *Emergency Eye Wash Bottles*
☒ *Caution Tape, Traffic Cones, or Barriers*	☒ *First Aid Kit: located in field Vehicle*
☐ *Fall Protection Harness*	☒ *Ear Plugs*

8.0 PERSONNEL PROTECTIVE EQUIPMENT BY TASK

TASK	Level	MASK /CARTRIDGE /AIR [1]	ADDITIONAL PPE
Establish support area / prepare	**D**	N/A	Hardhats, safety glasses, gloves, steel toe boots, high visible traffic vests.
Ground water sampling	**D**	N/A	Hardhats, safety glasses, nitrile gloves, steel toe boots, high visible traffic vests.
Decontaminate equipment	**D**	N/A	Hardhats, poly coated Tyvek suit, nitrile gloves, PVC or boot covered steel toe boots.
Conduct daily safety meeting (before shift & after shift)	**D**	N/A	Hardhats, safety glasses, cotton coveralls or Tyvek, hi-visibility safety vest, steel toe boots (each as appropriate)
Site Preparation / site security / site postings and notifications	**D**	N/A	Hardhats, safety glasses, hi-visibility safety vest, leather gloves (as needed), steel toe boots
Inspect appropriate equipment each day / monitor perimeter	**D**	N/A	Hardhats, safety glasses, hi-visibility safety vest, leather gloves (as needed), steel toe boots
De-mobilize	**D**	N/A	Hardhats, safety glasses, hi-visibility safety vest, leather gloves (as needed), steel toe boots

1.Respiratory protection is not anticipated to be necessary during groundwater sampling for the following reasons.

- Personnel are not expected to be exposed to sustained high levels of VOCs or dust while performing the tasks delineated in this plan.
- VOCs present in the groundwater/well bore are expected to be at low concentration levels and transitory in nature.

9.0 ACCIDENT/EXPOSURE PROCEDURES

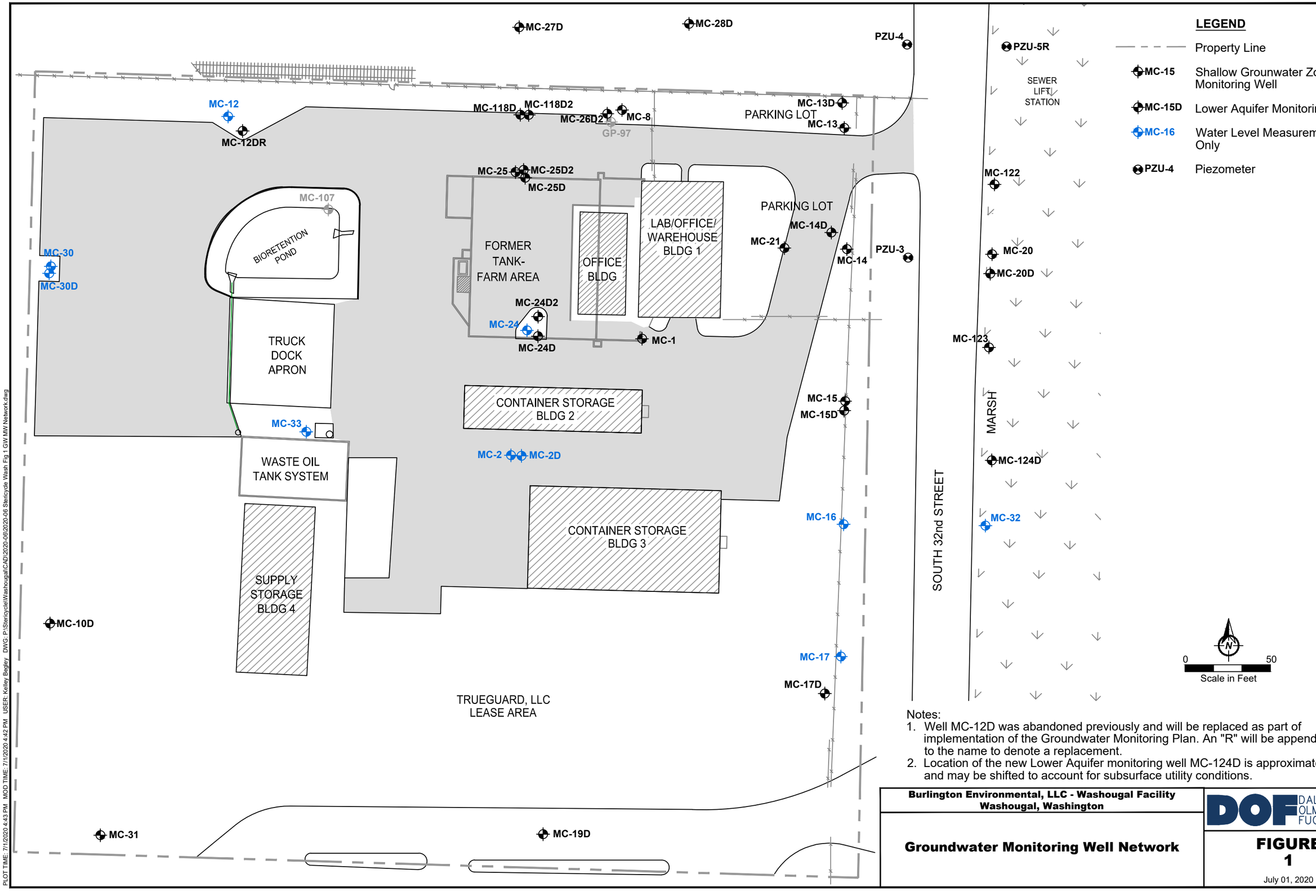
TYPE CONTACT	FIRST AID
Eyes	• Flush each eye continuously for 15 minutes. • Tilt head to side to ensure liquid runs onto floor not in the other eye. • Refer to EMT for evaluation
Skin	• Remove contaminated clothing immediately. • Wash skin continuously for 15 minutes • Refer to physician if redness, swelling, or pain persists after washing
Not Breathing	• Call 911 • Remove to fresh air immediately if respiratory distress develops. • Begin CPR until EMT arrives
Ingestion	• Aspiration hazard • Do not induce vomiting. • Do not give anything by mouth
Emergency Contact Information	Camas-Washougal Fire Department - • Fire/Ambulance: **(911)** • Police: **(911)** • **Hospital: PeaceHealth Southwest Medical Center (360) 514-2000**
Accident Reporting	• Employees immediately report all accidents or incidents to the Site Project Manager / Safety Officer • Project Manager / Safety Officer will relay information to Contract Manager. • Determination will be made regarding need for post-accident drug testing. • **Notify Project Manager immediately in the event of any incident**

10.0 EMERGENCY RESOURCES AND PROCEDURES

ELEMENT	LOCATION, SPECIFICATION OR REASON FOR USE
NEAREST HOSPITAL	**Hospital: PeaceHealth Southwest Medical Center (See Figure 2 for directions)** **400 NE Mother Joseph Pl** **Vancouver, WA 98664** **(360) 514-2000**
NEAREST PHONE	Supervisor cell phone
FIRST AID KIT	Locations to be determined during initial safety meetings
FIRE EXTINGUISHER	Locations to be determined during initial safety meetings
EYEWASH STATION AND EMERGENCY SHOWER	Locate facility emergency eyewash during H&S meeting
EVACUATION ROUTE / MEETING POINT	Determine after arrival at site. Draw on site map. Discuss with crew before start of project
SPILL CONTAINMENT	Work involving liquids shall be performed to the extent possible on sheet plastic and or secondary containment. In the event of a spill, absorbent shall be applied, and the absorbed waste shall be immediately transferred to container.

11.0 SIGNATURE PAGE

I have read and understand the attached Site Health and Safety Plan agree to comply with the requirements described within.		
Date	**Print Name**	**Signature**



Notes:
1. Well MC-12D was abandoned previously and will be replaced as part of implementation of the Groundwater Monitoring Plan. An "R" will be appended to the name to denote a replacement.
2. Location of the new Lower Aquifer monitoring well MC-124D is approximate and may be shifted to account for subsurface utility conditions.

Burlington Environmental, LLC - Washougal Facility
Washougal, Washington

Groundwater Monitoring Well Network

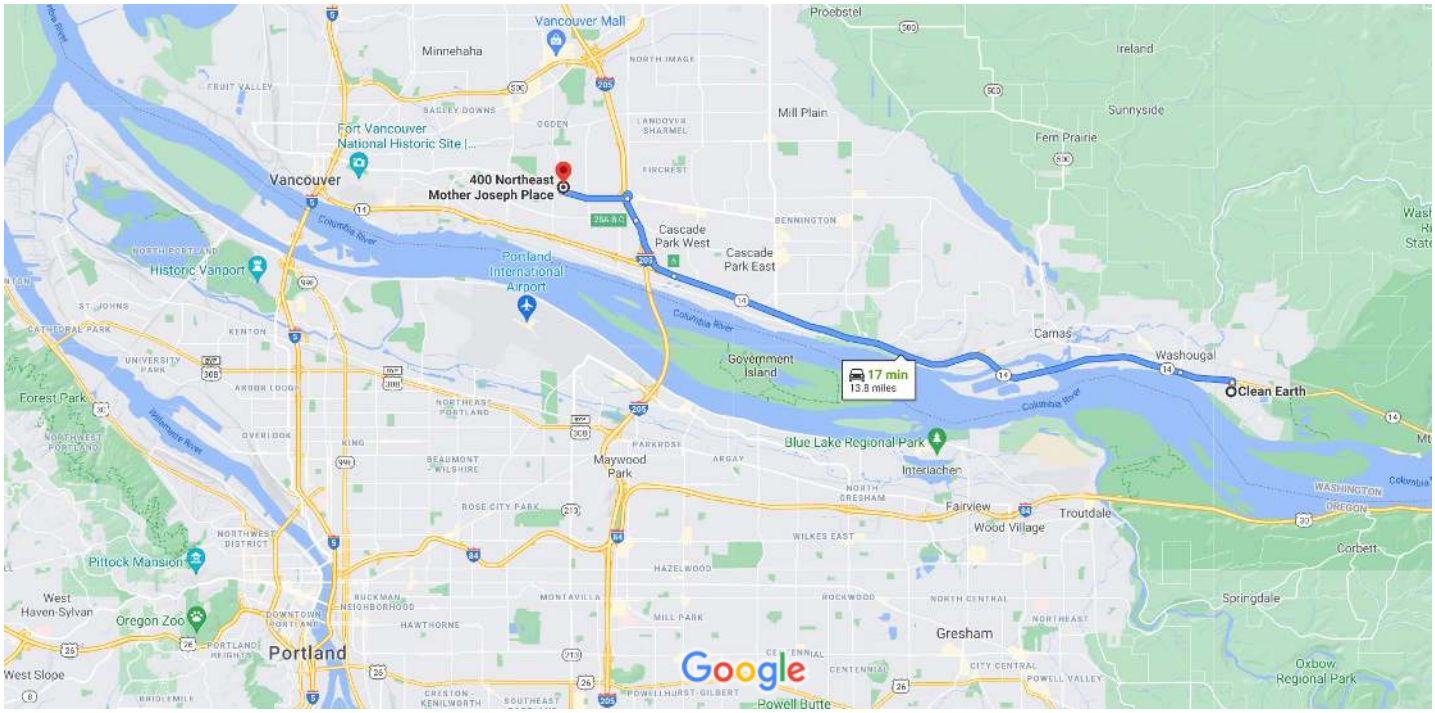
DALTON OLMSTED FUGLEVAND

FIGURE 1

July 01, 2020

PLOT TIME: 7/1/2020 4:43 PM MOD TIME: 7/1/2020 4:42 PM USER: Kelley Begley DWG: P:\Sterlcycle\Washougal\CAD\2020-06\2020-06 Sterlcycle Wash Fig 1 GW MW Network.dwg

Google Maps Clean Earth to 400 NE Mother Joseph Pl Drive 13.8 miles, 17 min



Map data ©2021 Google 1 mi

Clean Earth

625 S 32nd St, Washougal, WA 98671

Continue to WA-14 W

2 min (1.1 mi)

1. Head north on S 32nd St

0.2 mi

2. At the traffic circle, take the 3rd exit onto WA-14

1.0 mi

Continue on WA-14 W to Vancouver. Take exit 28A-B-C from I-205 N

12 min (11.4 mi)

3. At the traffic circle, continue straight onto WA-14 W

9.5 mi

4. Take exit 6 to merge onto I-205 N toward Seattle

1.3 mi

5. Use the right 2 lanes to take exit 28A-B-C to merge onto SE Mill Plain Blvd

0.7 mi

Follow SE Mill Plain Blvd to NE Mother Joseph Pl

4 min (1.3 mi)

6. Merge onto SE Mill Plain Blvd

1.2 mi

7. Turn right toward NE Mother Joseph Pl

102 ft

8. Turn right toward NE Mother Joseph Pl

335 ft

9. Turn left toward NE Mother Joseph Pl

56 ft

10. Turn left at the 1st cross street onto NE Mother Joseph Pl

Destination will be on the right

56 ft

400 NE Mother Joseph Pl

Vancouver, WA 98664