Port of Longview TPH Site

Remedial Investigation
Work Plan

Prepared for

Port of Longview
10 Port Way
Longview, Washington 98632

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LIMITATIONS

This work plan has been prepared for the exclusive use of the Port of Longview*,* their authorized agents, and regulatory agencies. It has been prepared following the described methods and information available at the time of the work. No other party should use this work plan for any purpose other than that originally intended, unless Floyd|Snider agrees in advance to such reliance in writing. The information contained herein should not be utilized for any purpose or project except the one originally intended. Under no circumstances shall this document be altered, updated, or revised without written authorization of Floyd|Snider.

The interpretations and conclusions contained in this work plan are based in part on site characterization data collected by others. Floyd|Snider cannot ensure the accuracy of this information.

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List of Acronyms and Abbreviations

Acronym/ Abbreviation	**Definition**
2016 VI Guidance	*Updated Process for Initially Assessing the Potential for Petroleum Vapor Intrusion*
Agreed Order	Agreed Order #DE 15907
AOPC	Area of potential concern
AST	Aboveground storage tank
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and total xylenes
Chevron	Chevron Environmental Management Company
COC	Contaminant of concern
cPAH	Carcinogenic polycyclic aromatic hydrocarbon
CSM	Conceptual site model
CUL	Cleanup level
CY	Cubic yards
Data Gaps Report	*Priority Data Gaps Investigation Work Plan*
DRO	Diesel-range organics
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management
FS	Feasibility Study
Golder	Golder Associates
GPR	Ground-penetrating radar
GRO	Gasoline-range organics
HPT	Hydraulic profiling tool
LNAPL	Light non-aqueous-phase liquid
µg/L	Micrograms per liter
MSL	Mean sea level
MTCA	Model Toxics Control Act
OIP	Optical Image Profiler
ORO	Oil-range organics

Acronym/ Abbreviation	**Definition**
ORP	Oxidation reduction potential
PAH	Polycyclic aromatic hydrocarbon
PLP	Potentially liable party
Port	Port of Longview
QAPP	Quality Assurance Project Plan
RI	Remedial Investigation
SAP	Sampling and Analysis Plan
SEF	Sediment Evaluation Framework
Site	Port of Longview Total Petroleum Hydrocarbons Site
SMS	Sediment Management Standards
Standard Oil	Standard Oil Company of California
TPH	Total petroleum hydrocarbons
USEPA	U.S. Environmental Protection Agency
UST	Underground storage tank
VI	Vapor intrusion
VOC	Volatile organic compound
Wilcox & Flegel	Wilcox & Flegel Oil Company
Work Plan	Remedial Investigation Work Plan

1.0 Introduction

This document presents a work plan for the Remedial Investigation (RI) of the Port of Longview (Port) Total Petroleum Hydrocarbons (TPH) Site (Site) in Longview, Washington (Figure 1.1). The RI Work Plan (Work Plan) is a specific requirement of Agreed Order # DE 15907 (Agreed Order) between the Port, Chevron Environmental Management Company (Chevron), Georgia-Pacific, and the Washington State Department of Ecology (Ecology). Other potentially liable parties (PLPs) related to the Site include Wilcox & Flegel Oil Company (Wilcox & Flegel; formerly Wilson Oil, Inc.), and Longview Fibre Paper and Packaging, Inc.[1] The PLPs are collectively referred to as the PLP Group.

1.1 BACKGROUND

The Site is located at 10 Port Way in Longview, Washington, on the north side of the Columbia River, directly east of the Lewis and Clark Bridge. The total area of the Port's property that encompasses the Site is approximately 28.2 acres and currently consists of an office for the Port, multiple buildings and warehouses, several berths, and a railyard (Figure 1.2).

Weyerhaeuser's property, a log export facility, is adjacent to (northwest of) the Site, and Wilcox & Flegel, an active bulk fuel facility formerly owned by Chevron, is located to the northeast. All other adjacent properties are owned by the Port. Land uses at the Site and in the surrounding area are industrial.

As a result of the discovery of releases of petroleum products to soil and groundwater associated with various historical uses, the Site was included on the Ecology list of confirmed and suspected impacted sites list in 1991. In the past, investigation and remediation work as well as routine groundwater monitoring at the Site have been accomplished cooperatively between the Port of Longview, Chevron, Longview Fibre, and the James River Corporation (a corporate successor to Crown Zellerbach and corporate predecessor of Georgia-Pacific).

Following the cessation of routine groundwater monitoring in 2013, the Port undertook a review of data gaps and conducted an additional investigation in 2015. The results of that work are described in the *Priority Data Gaps Investigation Work Plan* (Data Gaps Report; Floyd|Snider 2015) and provide the basis for much of the scope of the RI activities described in this Work Plan.

In 2016, Ecology issued PLP letters to the Port, Chevron, Georgia-Pacific, Wilcox & Flegel, and KapStone. The Port, Chevron, and Georgia-Pacific (PLP Group) worked with Ecology to prepare the Agreed Order, which underwent public comment and was entered with an effective date of February 13, 2019.

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[1] Longview Fibre Paper and Packaging, Inc., will be referenced as Longview Fibre in this document; Longview Fibre is also associated with KapStone Kraft Paper Corporation, which is referenced in the Agreed Order.

1.2 WORK PLAN ORGANIZATION

This Work Plan is organized as follows:

- **Section 2.0—Site Description.** Presents a description of the Site including a summary of the history of the Site and the physical setting.
- **Section 3.0—Previous Investigations and Remedial Actions.** Summarizes previous investigations and remedial actions that have been conducted at the Site.
- **Section 4.0—Preliminary Conceptual Site Model.** Presents the preliminary Conceptual Site Model (CSM) for the Site, including the preliminary contaminants of concern (COCs) and pathways, and preliminary screening levels proposed for the RI.
- **Section 5.0—Data Needs and Sampling Plan.** Presents the identified data needs based on previous data and details the data that will be collected. Refers to the additional site investigation plans, including the Sampling and Analysis Plan (SAP), Quality Assurance Project Plan (QAPP), and Health and Safety Plan.
- **Section 6.0—Remedial Investigation Tasks and Schedule.** Outlines major tasks for RI activities and schedule for implementing this Work Plan.
- **Section 7.0—Project Team and Responsibilities.** Describes technical consultants and Ecology's responsibilities for analysis and authorship of the RI.
- **Section 8.0—References.** Presents the sources cited in this Work Plan.

Documentation supporting this Work Plan are provided in the following appendices:

- Appendix A—Documents Reviewed
- Appendix B—Available Soil and Groundwater Data from Prior Investigations
- Appendix C—Historical Potentiometric Contour Maps
- Appendix D—Laboratory Reports
- Appendix E—Groundwater Field Sampling Forms
- Appendix F—Sampling and Analysis Plan/Quality Assurance Project Plan
- Appendix G—Health and Safety Plan
- Appendix H—Boring Logs

2.0 Site Description

2.1 GENERAL FACILITY INFORMATION

The Site is designated Ecology Facility Site ID No: 42978181 and is officially referred to as the Port of Longview TPH Site. The Site is located at 10 Port Way in Longview, Washington, on Cowlitz County parcels 10171, 10180, and 1018101, Section 8/Township 7N/Range 2W. The total area of the Site is approximately 28.2 acres.

The site is currently zoned as heavy industrial and is used for Port operations, including berths on the Columbia River and an active railyard, and storage of goods, vehicles, and heavy machinery. The site is expected to have similar land use in the future.

2.2 SITE HISTORY AND OPERATIONS

This section summarizes relevant historical Site operations based on information provided in previous reports about the Site (Golder 1994, 2000; Landau 2012) supplemented by the Agreed Order and by Floyd|Snider's review of additional Site records. The list of documents reviewed is provided in Appendix A. Prior analytical data from various investigations and monitoring events were reviewed and consolidated. A tabulation of prior data is provided in Appendix B.

Since the early twentieth century, the Port has been operating at its location on the Columbia River primarily as a bulk and break bulk import and export facility. The Site area encompasses a ship berth, a railyard, and associated warehouse buildings to accommodate the import and export activities. The following history is drawn from Section V of the Findings of Fact in the Agreed Order dated February 13, 2019.

The names given to the various facilities are naming conventions only. Many of the named facilities were owned or operated by multiple PLPs. For example, the Chevron Pipeline was owned or operated by predecessors of Chevron, by the Port, and by predecessors of Wilcox & Flegel. The Longview Pipeline was owned or operated by predecessors of WestRock and predecessors of Georgia-Pacific. References to these facilities by name (e.g., Chevron Pipeline or Longview Pipeline) are not intended to suggest that those entities, their predecessors, or their successors are liable or otherwise responsible for possible releases from them described in the Agreed Order or in this Work Plan.

> "A. The Port of Longview consists of multiple parcels along the Columbia River spanning approximately 835 acres. The parcel where the Site is primarily located is owned by the Port of Longview, and is designated as Heavy Industrial in the City of Longview's zoning code (Chapter 19.58 Longview Municipal Code) and lies approximately 31 feet above mean sea level, and is depicted on [Figure 1.2 of this Work Plan]. The investigation data to date indicate the Site is approximately 28.2 acres in size, as depicted [on Figure 1.2 of this Work Plan]. The Site is almost entirely paved, except for areas of rail track infrastructure.

"B. The Site is bordered in each direction by the following: The Columbia River to the southwest; Washington State Route 433 (Lewis & Clark Bridge) and an active lumber production facility owned by Weyerhaeuser NR Company to the northwest; an active bulk fuel facility (Bulk Plant) owned by Wilson and formerly owned by Chevron to the northeast; and property currently owned by the Port and formerly owned by International Paper Company to the southeast. BNSF Railway Company owns and operates rail lines that traverse the Site.

"C. The area of land within the Site has been owned primarily by the Port since the early 1900s. The Port formerly operated a 4,000-gallon underground storage tank (UST) and an 8,000-gallon UST on the Port Property (Port USTs). Calloway Ross, Inc. (Calloway) operated a 675-gallon UST (Calloway UST) on the Port Property. The United States Army Reserve operated a 2,800-gallon UST on the Port Property (Army UST). Correspondence between Wilson and the Port in 1993 suggests an additional UST used to stored gasoline may have been located near the Army Reserve building on the Port Property.

"D. Chevron, or its predecessor, Standard Oil Company of California (Standard Oil) installed pipelines on the Site in 1926 that ran parallel to Port Way beneath the BNSF rail lines, to transfer petroleum products between the Bulk Plant and shipping berths along the Columbia River (Standard Pipelines). Standard Oil or Chevron owned the Standard Pipelines until 1986, when they were conveyed to the Port under the terms of a Termination of License Agreement (Termination Agreement). In accordance with the Termination Agreement, Chevron removed hydrocarbon liquids from the Standard Pipelines, cleaned the Standard Pipelines between the Bulk Plant and their terminus at the shipping berths, and flushed the Standard Pipelines with water and air.

"E. KapStone (formerly Longview Fibre Company) constructed and began operating a pipeline (Longview Pipeline), fuel loading racks, and an 80,000 barrel aboveground storage tank (AST) on the Port Property in approximately 1935 to transfer and store petroleum products. The Longview Pipeline was positioned slightly east of the Standard Pipelines. In the 1950s, the AST was connected to the Standard Pipelines. After the connection was made, petroleum products were transferred to the AST from the Standard Pipelines. KapStone owned the Longview Pipeline, fuel loading racks, and AST until 1973, when it sold the AST to Crown Zellerbach Corporation ("Crown Zellerbach"), a corporate predecessor of Georgia-Pacific.

"F. Crown Zellerbach owned the AST from 1973 to 1983. Crown Zellerbach used the AST and Standard Pipelines to transfer and store petroleum products and ballast seawater from tanker ships.

"G. Wilson operated the Standard Pipelines on behalf of Chevron and Standard Oil between 1971 and 1985. Wilson operated the AST on behalf of Crown Zellerbach between 1974 and 1983.

"H. The Standard Pipelines, Longview Pipeline, loading racks, AST, Calloway UST, Port USTs, and Army UST have been abandoned and/or removed in various phases. No petroleum products have been stored or distributed at the Site since 1996.

"I. Petroleum contaminated soil and groundwater was first discovered in 1991 during the decommissioning and removal of the Calloway UST, located in the northwestern corner of the Site. The Port conducted several phases of subsurface investigations between 1992 and 1994 in response to this discovery. The results of the subsurface investigations are generally summarized in a *Phase IV Characterization Report – Bunker C and Diesel Fuel Investigation,* prepared by Golder Associates, dated December 7, 1994. A brief summary of each of these phases is provided below and a figure of the related areas is included [as Figure 1.2 of this Work Plan].

  "i. Phase 1: Gasoline, diesel fuel, and Bunker C were detected in soil and groundwater in the railyard east of Warehouse 9, as well as in the area formerly leased by Calloway.

  "ii. Phase 2: Petroleum contaminated soil and groundwater were detected and associated with the Calloway UST and the Standard Pipelines and Longview Pipeline.

  "iii. Phase 3: Two separate zones of soil and groundwater contamination were characterized, suggesting that at least two separate and distinct leaks from pipes have occurred.

  "iv. As a separate action from the investigations originating with the Calloway UST, the Port removed the Port USTs from the vicinity of the mechanics shop at the time of the Phase 3 investigation. Analysis of groundwater samples near the mechanic shop indicated the presence of gasoline, diesel, and Bunker C. Because the USTs reportedly only contained gasoline, a Phase 4 investigation was conducted to investigate the mechanic shop area and the pipeline locations between the mechanics shop and the Columbia River for the source of diesel and Bunker C contamination.

  "v. Phase 4: Soil and groundwater were found to contain significant concentrations of gasoline, diesel, and Bunker C throughout the investigation area. The identified impacts to soil and groundwater were generally located north of the mechanics shop area along the pipeline corridor.

"J. The investigations identified petroleum products in the gasoline, diesel, and oil carbon-ranges, and other petroleum-related constituents (e.g., benzene, toluene, ethylbenzene, and xylenes) in the subsurface at concentrations exceeding MTCA Method A soil and groundwater cleanup levels for unrestricted land use. The investigations suggest the Standard Pipelines, the Longview Pipeline, the fuel loading racks, the AST, the Calloway UST, the Port USTs, the Army UST, and the practices commonly associated with the storage and transfer of fuel are likely the principal sources of subsurface contamination at the Site.

"K. Remedial activities at the Site began in the 1990s as part of an independent cleanup action. In 1992, gasoline was detected in soil at depths below the groundwater table on the southwest side of the AST, and diesel and Bunker C fuel were detected at depths between 1.5 to 8 feet below ground surface (bgs) on the east and south sides of the AST. The highest concentrations of petroleum in surface soils were located beneath the AST. In 1996, soil in the vicinity of the AST was excavated to the soil and groundwater interface at a depth of approximately six feet bgs. Confirmation samples taken from the final limits of the excavation indicated residual petroleum products in the diesel carbon-range were present at concentrations above the MTCA Method A soil cleanup level for unrestricted land use and were left in place in a localized area at the southern extent of the excavation. Further excavation was limited by high groundwater, sandy soils, and the proximity to the BNSF rail lines.

"L. In spring 1996, approximately 800 cubic yards of surface soils impacted with petroleum were removed from the parcel formerly leased by Calloway. The impacts were likely related to historical activities occurring on the parcel. This remedial action did not fully address the subsurface impacts related to the Calloway UST.

"M. In December 2013, Ecology performed a Site Hazard Assessment (SHA) of the Site. The Site was given a hazard ranking of 2 out of 5 (1 being Ecology's highest priority for cleanup).

"N. In 2015, the Port retained Floyd|Snider to conduct a data gap analysis to further delineate the extent of soil and groundwater impacts at the Site (Floyd|Snider investigation). The Floyd|Snider investigation included 30 direct-push soil borings focused on the south and west portions of the Site, collection of 16 grab groundwater samples from those borings, and collection of a groundwater sample from an existing monitoring well. The Floyd|Snider investigation indicated that petroleum-impacted soils are primarily located beneath the BNSF rail lines and that petroleum-impacted groundwater does not extend beyond the Port Property boundary to the northwest and does not extend to the Columbia River to the southwest. The Floyd|Snider investigation identified several additional tasks to aid in the development of the remedial investigation and feasibility study.

> "O. In February 2016, approximately 5 gallons of petroleum product were released from abandoned pipelines beneath shipping berths 1 and 2 along the Columbia River through two separate corroded areas. The Port conducted spill response actions, plugged the leaks, and reported the releases to the United States Coast Guard and Ecology."

2.3 PHYSICAL SETTING, GEOLOGY, AND HYDROGEOLOGY

The Site is located on the northern bank of the Columbia River, adjacent to its confluence with the Cowlitz River to the east. The Site lies on a relatively flat alluvial floodplain at elevations ranging from approximately 15 to 30 feet above mean sea level (MSL). Longview, Washington, is situated in a topographic basin surrounded by bedrock uplands. The broad, northwest- to southeast-trending alluvial floodplain consists of unconsolidated and consolidated sediments, which filled in a trough that had been carved by the Columbia River into the underlying Quaternary and Tertiary sedimentary and volcanic rocks. The youngest deposits are unconsolidated Quaternary alluvium generally consisting of interbedded sand, silt, and gravel that extend beneath the Site and the Columbia River as deep as approximately 300 feet below ground surface (bgs; KJC 2012). In the vicinity of the Site, these native materials typically consist of silty, fine- to medium-grained sand that is interbedded with silty sand and sandy silt lenses and occasional thin layers of volcanic ash, clay, and organic-rich material. In addition, a noncontinuous, soft to stiff silt layer with low to high plasticity and occasional organic debris is sometimes present within the native fine- to medium-grained sand. Boring logs are included as Appendix H.

The shallow subsurface beneath the Site is characterized by fill material with an unknown origin overlying the alluvial sediments. The fill material consists of a heterogeneous mixture of predominantly silt and sand, with a maximum thickness of approximately 20 feet. The fill material was reportedly placed between the late 1800s and approximately 1950 (Golder 2000). Based on oblique aerial photographs, the thickest fill deposits appear to be located in the areas adjacent to the Columbia River, which were built up and developed as ship berths.

In 1923, seven independent operating diking districts within the region surrounding the Site were merged to form the Consolidated Diking Improvement District (CDID) No. 1 of Cowlitz County. The CDID's mission is to protect the valley north of the Columbia River and west of the Cowlitz River from flooding and to control stormwater runoff (CDID#1 2013). Fifteen miles of levees and thirty-five miles of stormwater collection ditches were constructed. Six high volume pumps were installed to discharge the collected stormwater out of the protected areas into the Coal Creek Slough. Over the years, improvements have been constructed and additional pump stations have been installed to keep up with increased runoff brought about by new development. The closest pump and ditch to the Site are the Oregon Way pump station, which pumps at a rate of 70,000 gallons per minute, and Ditch No. 3. Both are located approximately 0.5 miles to the north-northeast of the northern Site boundary (Figure 1.1).

As shown on the preliminary cross section that extends across the length of the Site (Figure 2.1) and is presented on Figure 2.2, groundwater at the Site occurs in both perched (i.e., discontinuous) lenses, present primarily in fill deposits, and in a shallow, unconfined aquifer, referred to hereafter as the alluvial aquifer, present primarily in deeper native deposits. Groundwater in both the perched zones and the alluvial aquifer is impacted (refer to Section 4.2.2). Perched groundwater has been found historically as shallow as 10 feet bgs (approximately 10 feet MSL in the center of the Site, below the ordinary high-water mark [OHWM] of 15.41 feet MSL [11.1 CRD]; Cowlitz County and Ecology 2017). The perched groundwater zone(s) occur atop low-permeability silt layer(s) that are typically 1 to 3 feet thick and lie above the regional groundwater in native deposits. The most significant of the silt layers is generally present within the center of the Site at approximately 2 to 4 feet above MSL (which corresponds to depths ranging from approximately 16 to 24 bgs, depending on the ground surface elevation), but the continuity of this unit has not been established. Perched groundwater was consistently observed in borings as far north as the north end of former Warehouse 9 and as far south as the Port offices. Declining water levels have been observed in several of the perched zone wells over time, resulting in an increasing tendency for these wells to be found dry in recent years.

Perched groundwater in the center of the Site, which has previously been described as mounded groundwater, is effectively isolated from the alluvial aquifer below (Golder 2000). Silt lenses are believed to trap thin occurrences of groundwater in separate water-bearing zones with limited hydraulic connection to the underlying aquifer. The isolation of perched zones is consistent with the limited observed tidal influence on groundwater located in the central portion of the Site (Golder 1999) of the approximately 2-foot (KJC 2012) tidal fluctuation in the Columbia River. In addition, the Oregon Way pump station and Ditch No. 3 (as part of the CDID) are less likely to have an influence on groundwater flow in the perched zone given the relatively long distance between the Site and these structures and the isolated hydrogeologic nature of the perched zone (the perched zone aquifer is at a higher elevation than the pump station and ditch). However, the potentially high flow rate from the Oregon Way pump station (up to 70,000 gallons per minute), could influence the alluvial aquifer (and perhaps, but less likely, the perched zone) at the Site. This potential influence will be assessed during the 3-day transducer study (refer to Section 5.2.2) to include coordination with the CDID on simultaneous pumping operations of the Oregon Way pump station.

In the vicinity of the Port, the overall groundwater flow direction of shallow groundwater in the alluvial aquifer is to the south-southwest, toward the Columbia River, which is the major discharge location for the regional groundwater system (KJC 2012). However, as described in Sections 3.0 and 4.0 of this Work Plan, investigations to date have found no movement of impacted groundwater from the Port Property to the Columbia River. Potentiometric contour maps from previous investigations are presented in Appendix C.

3.0 Previous Investigations and Remedial Actions

In this section, information about previous data collection and remedial actions provides historical context for further data collection to be conducted as part of the RI work scope.

3.1 1991 TO 2013 INVESTIGATIONS AND REMEDIAL ACTIONS

The scope of previous investigations and remedial actions are summarized below based on previous reports (Golder 2000; 2010). The findings of these investigations are included in the summary of Site impacts in Section 4.2:

- Petroleum Services Unlimited UST Investigation, June 1991. This investigation on the former Calloway Ross portion of the Site characterized the extent of impacts surrounding the removal of a 675-gallon UST. As part of the investigation, eight soil borings were advanced and five monitoring wells (MW-1 through MW-5) were installed.
- Golder Associates (Golder) Multi-Phase Site Investigations, 1992 to 1994:
  - Phase 1 (fall 1992): The investigation area expanded to include the former Calloway Ross UST area, the pipelines underlying the adjacent area, and the 80,000-barrel AST. The investigation included one soil boring, eight test pits, and installation of six additional monitoring wells (MW-6 through MW-12).
  - Phases 2 and 3 (spring 1993): These sequential investigations included ground-penetrating radar (GPR) location of the underground pipelines, advancement of eight soil gas probes, and installation of nine new monitoring wells (MW-13 through MW-21), and re-sampling of existing monitoring wells.
  - Phase 4 (March to June 1994): This investigation expanded the study area further to the south and included further GPR pipeline location, advancement of one soil boring, collection of one groundwater sample from a well point, and installation of eight monitoring wells (MW-22 through MW-29).
- Golder Calloway Ross Lease Area Investigation, March 1993. This focused assessment of surface soils in the Calloway Ross lease area of the site included collection of 10 surface soil samples.
- Golder Mechanic’s Shop UST Investigation (July 1993). Soils were investigated associated with the removal of two USTs (one 4,000-gallon and one 8,000-gallon UST) from near the former mechanic’s shop. The investigation included three soil borings and installation of one monitoring well (UST-4).
- AST Demolition (fall 1995 through June 1996). The 80,000-barrel AST was demolished and removed from the Site. Approximately 5,000 cubic yards (CY) of petroleum-impacted soils were removed from the Site. Twelve confirmation soil samples were collected, and two monitoring wells were installed.

- Calloway Ross Surface Soil Removal (spring 1996). Approximately 800 CY of petroleum-impacted near-surface soils were excavated in the spring of 1996 and transported off site for disposal. Six verification soil samples were collected following excavation.
- Groundwater Monitoring, 1998 to 1999. In 1998, groundwater monitoring resumed, with the intent to confirm that Site conditions had not significantly changed since 1994. As part of this work, groundwater was sampled site-wide (perimeter and interior) in 1998, a tidal influence study was conducted, and three perimeter monitoring wells were installed (MW-30, MW-31, and MW-32).
- Groundwater Monitoring, 2000 to 2013. A subset of monitoring wells were sampled during this period, which included a site-wide groundwater sampling event in 2009.

3.2 2011 AND 2016 SEDIMENT INVESTIGATIONS

In June 2011, the Port characterized sediments offshore of the Site in support of a dredging and berth deepening project (Anchor QEA 2011) and again in October 2016 in support of maintenance dredging (Anchor QEA 2017). The work in both 2011 and 2016 included collection and characterization of composited sediment samples from four dredge material management units spanning between Berths 1 and 9. Chemical analysis of the sediments included diesel-range organics (DRO), oil-range organics (ORO), and polycyclic aromatic hydrocarbons (PAHs), among other Sediment Evaluation Framework (SEF) and Sediment Management Standards (SMS) freshwater COCs, such as metals, semivolatile organic compounds, polychlorinated biphenyls, and pesticides. The analytical results were compared to both Model Toxics Control Act (MTCA) Method A unrestricted land use and industrial land use for potential upland disposal and SEF freshwater toxicity criteria for in-water disposal.

The analytical results from both 2011 (Table 3.1) and 2016 (Table 3.2) studies indicate that no chemicals exceed the SEF and SMS freshwater criteria nor the MTCA Method A industrial criteria. One sample collected in 2011 near Berths 6 and 7 exceeded the MTCA Method A unrestricted land use criterion for benzo(a)pyrene; the sample was collected from a deeper interval identified as native material, however, and the detected PAHs were determined to be likely naturally occurring. Another sample collected in 2011 near Berth 2 was noted to have a very slight hydrocarbon odor in the surface interval of the core; however, subsequent chemical analysis did not detect either DRO or ORO. In 2016, all analytical results were less than the MTCA Method A criteria for unrestricted land use. During this event, PAHs were only detected near Berth 1, less than the screening levels. These detections are likely due to a minor crude oil spill in February 2016; no petroleum was detected in this area.

As such, the sediment characterization reports in both 2011 and 2016 indicate that dredged sediments are suitable for in-water disposal or upland beneficial reuse. Additionally, prior to 2011, the sediments were ranked as “low-moderate.” The 2011 report concluded that based on the chemical concentrations, the ranking should be recharacterized to “low.” The 2016 report confirmed this site ranking of “low,” which is established after lines of evidence, such as chemical analysis, indicate that depositional materials do not originate from or near impacted areas and do not contain chemical contaminants at levels of concern. These findings suggest there is no upland source of impacts to the sediments in this area.

3.3 2015 PRIORITY DATA GAPS INVESTIGATION

Based on a review of available documents and data from this previous work, a review of data gaps related to the understanding of Site conditions was performed. Data needs identified from this review were summarized in the Data Gaps Report (Floyd|Snider 2015) and form the basis for much of the planned data collection described in this Work Plan.

A September 2015 investigation filled data gaps related to the extent of soil and groundwater impacts at the southern and western (downgradient) edges of known impacts, uninvestigated areas adjacent to the pipelines in the southern portion of the Site, and along the shoreline of the Columbia River. The work was conducted immediately after the demolition of Warehouse 9, the mechanic's shop, and the Gear Locker A buildings, which were removed in July and September 2015.

This work was performed in accordance with the Data Gaps Report (Floyd|Snider 2015) and included 30 soil borings (GP-1 through GP-30) advanced to up to 30 feet bgs using a direct-push rig, submittal of 38 soil samples for analysis, collection of groundwater screening samples from 16 direct-push borings, groundwater level measurements from selected monitoring wells, and groundwater sample collection from MW-23.

The results of priority data gaps are summarized in Section 4.2. Data gaps remaining to be filled in the Remedial Investigation (RI) are described in Section 5.0.

3.4 2019 EARLY SEASON GROUNDWATER SAMPLING AND MONITORING

Floyd|Snider performed groundwater monitoring and sampling activities between February 27 and March 1, 2019. Prior to this event, monitoring wells at the Site had most recently been sampled in 2013. The intent of the site-wide sampling event was to collect data during winter from wells that have typically been dry at other times of year, to establish current baseline conditions and to provide a winter quarterly groundwater sampling round as described in Section 5.2.1. Groundwater sampling was attempted from all Site monitoring wells, and samples were collected from all monitoring wells except for MW-8, MW-9, and MW-30 as described below.

Prior to collecting groundwater samples, depth to groundwater, total depth, and light non-aqueous-phase liquid (LNAPL) thickness measurements were collected from all existing monitoring wells on the property, except for MW-8, which could not be opened due to a damaged well box and bolts.

MW-9 contained LNAPL at a thickness of 0.01 feet and was not sampled. Absorbent socks were present in monitoring wells MW-3, MW-7, MW-9, and MW-20 and were removed, except from

MW-9, and disposed of in order to allow for future evaluation of the presence and, if present, recoverability of LNAPL during the RI.

MW-30 was dry due to excessive siltation and had a total depth approximately 10 feet shallower than its original installation depth; therefore, MW-30 was redeveloped on March 1, 2019, to remove accumulated sediment. In addition, after collecting groundwater samples from monitoring wells MW-20 and MW-26, both were redeveloped to address siltation. MW-20 and MW-26 had total depths approximately 4 and 3 feet, respectively, shallower than their original installation depths, but were not redeveloped to remove accumulated silt until after groundwater samples were collected.

Samples were collected using low-flow groundwater sampling techniques in accordance with standard environmental industry practice. Water quality indicator parameters monitored and recorded during purging included pH, specific conductivity, dissolved oxygen, temperature, turbidity, and oxidation reduction potential (ORP). Purging continued until parameters were approximately stable (when measurements are within 10 percent) for three consecutive readings. Once stable, groundwater samples were collected and analyzed for the following constituents:

- DRO and ORO by NWTPH-Dx, with and without silica-gel cleanup
- Gasoline-range organics (GRO) by NWTPH-Gx
- Benzene, toluene, ethylbenzene, and total xylenes (BTEX) by U.S. Environmental Protection Agency (USEPA) Method 8021

4.0 Preliminary Conceptual Site Model

This preliminary CSM is presented based on the physical conditions at the Site, findings from previous environmental reports, records, and correspondence. A figure summarizing the CSM and illustrating the Site in a conceptual cross section is included as Figure 4.1.

The preliminary CSM is intended at this stage of the project to summarize the known and potential hazardous substances at the Site in order to define contaminant transport, possible migration pathways, and routes of exposure. Additionally, this preliminary CSM aids in defining data needs to support the RI. The preliminary CSM is intended to be complete based on available information and subject to refinement as additional data are obtained during the RI process. There are no remaining data gaps in the Site history (refer to Section 2.2) that would significantly influence the CSM. Refer to Section 2.3 for additional information about physical Site setting, geology, and hydrogeology.

4.1 CONTAMINANTS, SOURCES, AND RELEASE MECHANISMS

Based on historical information for the Site, together with prior and current environmental data, the potential COCs whose concentrations exceed the MTCA Method A cleanup levels (CULs; used as screening levels in this Work Plan) are petroleum-derived and include GRO, DRO, and ORO. In addition, individual hazardous substances are found in petroleum, including BTEX and carcinogenic PAHs (cPAHs). MTCA Method A CULs are used only as screening levels, and draft CULs will be established in the RI for the COCs in soil, groundwater, and other applicable media based on the standard MTCA procedures. CULs, such as MTCA Method B or Method C CULs, will be considered and proposed in the Feasibility Study (FS). LNAPL has also been observed in some monitoring wells during historical sampling events. LNAPL has not been measured since approximately 2000, with the exception of the 0.01 feet measured in MW-09 in the 2019 site-wide event, although some wells where LNAPL had previously been observed were frequently found to be dry.

Golder reports dating between 1993 to 2013 indicate that the existing petroleum hydrocarbon impacts are from historical releases associated with the storage and transfer of petroleum fuels. There are currently no continuing sources of petroleum products or other known hazardous substances stored or used at the Site.

Impacts resulted from documented and undocumented discharges of petroleum products to the surface and subsurface soil by means of leaks or spills that are summarized in Section 2.2 of this document.

Following previous remedial actions including removal of soil from the Calloway Ross area and former AST area (refer to Section 3.1), and because of the age of the releases, predominantly subsurface location of the releases, and changing land use at the Port over several decades since the releases, there are no known areas of the Site with impacted surface soils that could allow for contaminant transport by stormwater. The one small area where near-surface soils are known to be impacted, near the terminus of the Standard and Longview Pipelines, is protected from stormwater beneath Berth 2. There is no transport pathway for contaminants from these bank soils, which are located above the Columbia River OHWM elevation of 15.3 feet MSL, to reach river sediments. Because the extent of impacted groundwater has been determined not to extend to within several hundred feet of the river, there is no complete pathway for discharge of Site contaminants to surface water or sediments, and surface water and sediment are not considered media of concern.

From each point of subsurface release, potential impacts could have migrated downward by gravity drainage through soil in the unsaturated zone. Lateral spreading may have occurred via preferential pathways such as through pipeline bedding, utility trenches, or heterogeneities in fill material, or on top of low-permeability silt layers. In some areas, enough product was released, especially in the northern perched zone area, that the petroleum products reached both perched groundwater and groundwater in the underlying alluvial aquifer. In some instances, petroleum accumulated as LNAPL on the surface of either perched zone groundwater or alluvial aquifer groundwater, and soluble constituents began dissolving into shallow groundwater. Soluble constituents that migrated with groundwater would have flowed away from the source areas until the plume stabilized as a result of biological degradation and/or adsorption to the organic matter in surrounding soils.

A portion of the TPH source mass is present in relatively isolated perched groundwater zones. Although some petroleum hydrocarbon impacts have reached the alluvial aquifer north of the perched area, the silt lenses beneath perched groundwater in this area result in a limited ability for contaminants in groundwater to be transported away from their sources in the hydrocarbon-affected perched area.

4.2 EXTENT OF IMPACTED MEDIA

The September 2015 priority data gaps investigation and previous investigations, together with the 2019 site-wide groundwater monitoring event, have defined the location and concentration of COCs in soil and groundwater at the Site. The soil and groundwater data from previous sampling events are compiled in Appendix B, and the soil and groundwater data from the September 2015 investigation and groundwater data from the 2019 site-wide groundwater monitoring are presented in Tables 4.1, 4.2, and 4.3 and Figures 4.2 through 4.6.

4.2.1 Soil

The extent of known residual petroleum hydrocarbons in soil at concentrations exceeding the MTCA Method A CULs is illustrated in Figure 4.2; and as stated previously, MTCA Method A CULs are used solely for screening purposes. The detectable concentrations of GRO and DRO/ORO impacts in soil form an elongated north-south trending pattern that extends beneath the rail lines from monitoring well MW-19 in the north to soil boring GP-27 in the south. Beneath the rail lines, the affected soil extends laterally to the east and west in two areas: (1) in the north in the vicinity of the former Calloway Ross UST, the rail lines, and the former 80,000-barrel AST and fuel loading racks, and (2) in the central portion of the property in the vicinity of the former mechanic's shop; soil boring GP-27; and monitoring wells MW-24, MW-26, and MW-28. Additionally, a limited area of soil impacts was encountered in soil boring GP-18, which is located adjacent to the northeast corner of Transit Shed 2. During the September 2015 sampling campaign, the only concentrations in excess of the MTCA Method A standards for soil were found in GP-27 and GP-18.

The soil impacts extend to variable depths, from approximately 2 to 19 feet bgs at various locations in the subsurface within the vicinity of the former pipelines adjacent to the former Warehouse 9, former AST, and loading racks. An area of elevated DRO/ORO and GRO concentrations in soil was also detected in monitoring wells MW-24 and MW-26 at 15 and 18 feet bgs, respectively, and above a low-permeability silt layer with a surface at approximately 20 feet bgs (3 to 5 feet MSL). The September 2015 results indicate soil in GP-27 are impacted by hydrocarbons in the diesel to heavy oil range. In addition to DRO and ORO impacts, cPAHs were detected in GP-27 at a toxic equivalent concentration exceeding the MTCA Method A CUL for soil, which is being used as a screening level. Hydrocarbon impacts were not encountered in soil borings GP-24 through GP-26; therefore, the extent of impact in this area is delineated to the south along the former adjacent pipeline but has not been delineated to the east of GP-27.

Petroleum impacts in soil have not been observed in the off-property borings to the west-northwest, such as MW-4 and MW-30. In addition, soil analytical data from borings GP-1 through GP-7 and GP-30 show GRO, DRO, and ORO concentrations less than their respective MTCA Method A CUL or the laboratory detection limits. These data indicate that residual hydrocarbon impacts in soil do not extend off the property to the northwest beneath the former Warehouse 9.

Soil analytical data from monitoring wells MW-22, MW-23, and MW-29 and soil borings GP-7 through GP-17 and GP-20 through GP-23 south of the existing soil impacts show concentrations less than the MTCA Method A CULs or the laboratory detection limits. These data indicate that the known hydrocarbon impacts to soil do not extend south toward the Columbia River from this area, and there is no complete pathway for potential impacts from this area to reach surface water or sediments.

A new area of soil impacts unassociated with the known impacts to the north was found based on detections of DRO, ORO, and cPAHs in soil boring GP-18 at concentrations exceeding their respective MTCA Method A CULs. The September 2015 results indicate impacts by hydrocarbons in the diesel to heavy oil range. Impacted soil was limited to a thin layer of silty sand/sandy silt between 27 and 28 feet bgs, which is close to the depth of the alluvial aquifer. Perched zones were not encountered within boring GP-18. Importantly, no DRO or ORO was detected in corresponding groundwater samples from this or any nearby locations (see Section 4.2.2). This area of soil impacts appears to be limited based on a lack of detections in borings to the north, northeast, and southwest. Transit Shed 2 will be investigated as a data gap in the RI (refer to Section 5.1.1)

Residual product in pipelines that emerge beneath Berth 2 south of Transit Shed 2 is being addressed through the Pipeline Interim Action under a separate Work Plan. This work will address potential future releases from the pipelines in this area that may affect the Columbia River.

There is also evidence of a release to surface soil beneath Berth 2 to the south of soil boring GP-18. Historical surface soil samples (P-1 and P-2) were collected below a set of abandoned pipelines (the pre-1970 Standard and Longview Pipelines) exposed beneath Berth 2. The analytical results from both surface soil samples indicate DRO at concentrations exceeding the MTCA Method A CUL (Golder 1994). Soil beneath Berth 2 will be investigated as a data gap in the RI (refer to Section 5.1.1)

4.2.2 Groundwater

The lateral extents of dissolved-phase GRO and DRO in perched zone and alluvial aquifer groundwater at concentrations exceeding their respective MTCA Method A CULs are shown in Tables 4.3 and 4.4 and on Figures 4.3, 4.4, 4.5, and 4.6. The extents are based on the analysis of groundwater samples collected from monitoring wells between 1998 and 2013, several of which are screened within perched zone(s) above the alluvial aquifer (Table 4.5 and Figure 4.3), as well as groundwater samples from the alluvial aquifer collected from the September 2015 direct-push borings (Figure 4.4). Based on 2019 data, dissolved-phase hydrocarbons in the regional alluvial aquifer have not migrated beyond the property boundary to the west-northwest or the south-southwest toward the Columbia River (Figures 4.5 and 4.6). The following sections summarize historical groundwater data results followed by results from the February 2019 sampling event, which are presented in Tables 4.3 and 4.4 and illustrated on Figures 4.3 through 4.6. Laboratory reports and chromatograms are included as Appendix D, and field sampling forms are included as Appendix E.

4.2.2.1 Diesel-Range and Oil-Range Organics

Elevated DRO concentrations have historically been measured in alluvial aquifer wells MW-10 and MW-12 in this area, as well as in several nearby perched zone monitoring wells (Figures 4.3 and 4.4). For example, DRO was measured at concentrations up to 160,000 micrograms per liter (µg/L) in perched zone monitoring well MW-14 during the September 2009 site-wide sampling event (Golder 2010). This value may reflect the presence of free product in the sample. In addition, PAHs, which are typically associated with ORO, have been detected at elevated concentrations in monitoring wells in this area, including alluvial aquifer monitoring wells MW-10 and MW-12. Further discussion of the 2019 sampling related to these wells is provided below.

In 1993, DRO was detected in groundwater at concentrations exceeding the MTCA Method A CUL in two alluvial aquifer monitoring wells north of this area and adjacent to the post-1970 Standard Pipeline, MW-19 and MW-6.

Farther south, DRO has also been historically detected in groundwater at concentrations exceeding the MTCA Method A CUL in perched zone monitoring wells MW-26 and MW-28. These wells were dry during the last site-wide sampling event in September 2009 and again during the September 2015 investigation, but both contained enough of a water column to be sampled during the February 2019 sampling event; results are discussed below. At nearby monitoring well MW-30, believed to be screened in across the perched zone and into the alluvial aquifer, the DRO concentrations exceeded the MTCA Method A CUL prior to 2001. However, since 2001, the DRO concentrations in that monitoring well have been less than the MTCA Method A CUL, which coincides with the use of silica gel cleanup for NWTPH-Dx analysis beginning in 2000. MW-30 was not sampled during the February 2019 sampling event due to siltation, but redevelopment activities removed approximately 10 feet of silt; therefore, MW-30 should have sufficient groundwater to sample during subsequent events. Groundwater analytical data from 2015 borings GP-3, GP-4, and GP-6 indicate that elevated DRO concentrations are unlikely to extend off the property toward MW-30.

Groundwater analytical results from the February 2019 round of groundwater sampling indicate that the current dissolved-phase extent of petroleum hydrocarbons may not be as extensive as believed during earlier investigations. Historical groundwater analytical data indicate that the extent of DRO and/or ORO, analyzed without silica gel cleanup, were detected at concentrations exceeding the MTCA Method A CULs in monitoring wells MW-3, MW-6, MW-7, MW-20, and MW-28. DRO analyzed with silica gel cleanup, was detected at a concentration exceeding the MTCA Method A CUL only in MW-28. Based on the 2019 groundwater data, DRO and ORO concentrations have declined to concentrations less than their respective CULs in monitoring wells that have historically had DRO and ORO exceedances, such as wells MW-10, MW-12, MW-14, and MW-26.

The analytical laboratory noted that 2019 groundwater results for several of the monitoring wells contained sample chromatographic patterns that did not resemble the diesel and oil fuel standards used for DRO and ORO quantitation (Table 4.4). A review of the chromatograms indicates that the results did not match the standards because most of the compounds detected are biogenic breakdown products associated with the fuels, not the actual fuel distillation products. This observation is common at old TPH sites where significant weathering/biodegradation of the petroleum compounds has occurred or is still occurring.

Of all wells with exceedances, only monitoring well MW-28 is screened in the perched zone (Figure 4.5); the rest are screened in the alluvial aquifer (Figure 4.6). Dissolved-phase hydrocarbons were not detected at concentrations exceeding the laboratory reporting limits or CULs in downgradient wells screened in the alluvial aquifer.

4.2.2.2 Gasoline-Range Organics and Benzene

Historical groundwater data indicate that the extent of GRO-impacted groundwater is less than the extent of DRO-impacted groundwater. Some commingling of the GRO and DRO plumes appears to have occurred as well. Historical data indicate that the greatest GRO concentrations measured in groundwater are in the vicinity of the former Calloway Ross UST in alluvial aquifer monitoring well MW-10, with a maximum concentration of 4,200 µg/L during the last site-wide sampling event in 2009 and similar concentrations in several perched zone monitoring wells in this area (Golder 2010). Elevated GRO concentrations are also observed in the vicinity of the former 80,000-barrel AST in alluvial aquifer monitoring wells MW-12 and MW-20. South of this area, GRO has been detected in monitoring wells MW-26 and UST-4, both believed to be screened in perched zones, at concentrations exceeding the MTCA Method A CUL in 1994 and less than the CUL in 1998. For the first time since 1998, monitoring wells MW-26 and UST-4 were sampled during the February 2019 groundwater sampling event. Groundwater analytical results for both MW-26 and UST-4 indicate that all constituents were at concentrations less than their respective

MTCA Method A CULs. Benzene has been detected in groundwater at concentrations greater than the MTCA Method A CUL, with a maximum concentration of 840 µg/L in alluvial aquifer monitoring well MW-12 during the site-wide sampling event in 2009.

Results from the February 2019 groundwater sampling event indicate that GRO and/or benzene were detected at concentrations exceeding their respective MTCA Method A CULs in monitoring wells MW-3, MW-7, MW-12, and MW-20. The greatest GRO concentration of 1,500 µg/L was detected in monitoring well MW-20, which is screened in the alluvial aquifer. The benzene concentration of 61 µg/L was detected in MW-12 within the vicinity of the former AST and is screened within the alluvial aquifer. Overall, the current analytical data indicate that GRO and benzene concentrations are declining; however, subsequent monitoring events will help determine whether these results are typical of current conditions or anomalous.

4.2.2.3 Light Non-Aqueous-Phase Liquid

Historically, LNAPL has been present in measurable concentrations with thicknesses between 0.01 and 1.34 feet in perched zone monitoring wells MW-9 and MW-16 and alluvial aquifer wells MW-3, MW-7, MW-19, and MW-20. LNAPL has not been detected in monitoring wells MW-16 and MW-19 since June 1993. Absorbent socks have been used to remove LNAPL in monitoring wells MW-3, MW-7, MW-9, and MW-20 between April 1999 and 2014. The socks were routinely monitored and replaced on a quarterly basis until at 2014. LNAPL thickness measurements were not reported in the most recent November 2013 monitoring report submitted by Golder (Golder 2013). However, 2013 monitoring observations indicated that absorbent socks in MW-9 and MW-20 contained a strong, very oily odor and were oily.

During the September 2015 field activities, LNAPL was not observed in wells MW-3, MW-7, MW-9, MW-16, and MW-19; and monitoring well MW-20 was dry. During the 2019 site-wide groundwater monitoring event, LNAPL was measured only in MW-09, at a thickness of 0.01 feet, which is the smallest unit of measurement for the interface probe. Absorbent socks were removed from monitoring wells MW-3, MW-7, and MW-20 in order to assess LNAPL recoverability in these wells. The absorbent sock was not removed from MW-9.

4.3 POTENTIAL RECEPTORS AND EXPOSURE PATHWAYS

Based on the current understanding of affected media and the extent of potential impacts, several potential receptors and exposure pathways are apparent. These pathways and potential receptors determine which regulatory cleanup standards are applicable.

For impacted soil found in previous investigations above 15 feet bgs, a potential exposure pathway consists of direct contact with shallow impacted soil in unpaved areas by potential future site workers based on industrial exposure scenarios, as well as direct contact with deeper impacted soil by utility workers entering the subsurface soil. Unpaved areas that are not covered with gravel are generally limited to the northern portion of the Site.

Where concentrations of volatile constituents such as benzene in soil and groundwater exceed the CULs, a potential exposure pathway consists of inhalation of impacted vapors within potential future buildings that may be constructed over these areas. Currently, it does not appear that any occupied buildings overlie areas of impacted soil or groundwater exceeding MTCA Method A standards for Industrial Properties. The RI will include an evaluation of the potential for a complete vapor intrusion (VI) pathway into potential future buildings based on Ecology guidance.

Terrestrial ecological receptors are not expected to be affected because of the limited habitat on the Site and adjacent lands. Based on the Site configuration of paved surfaces and Berths 1 and 2 adjacent to the shoreline, there is no potential for erosion and transport of contaminants from soil by stormwater.

There are no known drinking water wells in the immediate vicinity of the Site, and the use of Site groundwater is unlikely given the industrial location and the non-potable characteristics of Site groundwater. For example, concentrations of iron and manganese in excess of the federal secondary maximum contaminant levels have been measured in groundwater present in wells screened in native units well below the alluvial aquifer (KJC 2012), and perched zone groundwater occurs in fill material and is expected to have low yield. The potential but incomplete exposure pathway exists for drinking water at the Site.

4.4 SOIL AND GROUNDWATER SCREENING LEVELS

Based on the potential COCs and potential exposure pathways identified in the preliminary CSM, soil screening levels have been compiled for soil and groundwater (Table 4.6). MTCA Method A CULs, when available, are used as default screening levels throughout this Work Plan. Soil screening levels are based on worker protection in industrial setting and protection of potable groundwater. Groundwater screening levels are based on the MTCA Method A CULs for groundwater.

A list of Site COCs will be identified in the RI based on the frequency and concentrations of the detected constituents as compared to the screening levels. Draft CULs will then be established for the COCs in soil, groundwater, and other applicable media based on the standard MTCA procedures.

5.0 Data Needs and Sampling Plan

As described in Section 4.0, previous investigations including soil and groundwater data collected in 2015 and 2019 have largely defined the location and concentration of COCs in soil and groundwater at the Site. With the Site boundaries relatively well-defined, gaps in the understanding of nature and extent remain only in selected areas of potential concern (AOPCs). Additional data from these AOPCs will also support more accurate volume estimates for remedial evaluation, if necessary. Based on the review of existing Site data and with consideration of the preliminary CSM, the remaining data needs identified are as follows:

- Nature and extent of impacts, including focused questions of spatial extent, data density for quantifying contaminant volumes, and other data needed for evaluation of remedial alternatives, as might be required
- Other data needs including assessing seasonal change based on four quarters of groundwater monitoring and determination of COCs and CULs
- Site hydrogeology

The scope of additional data collection is described in this section. Refer to the SAP/QAPP (Appendix F) for additional details including sample collection, laboratory analysis, and quality assurance procedures. Refer to the Health and Safety Plan (Appendix G) for details regarding the health and safety procedures associated with these data collection activities.

5.1 DATA NEEDS RELATED TO NATURE AND EXTENT OF IMPACTS

Data needs related to the nature and extent of impacted media at the Site are described in this section. As noted above, these data needs and planned data collection activities that pertain to a specific AOPC are illustrated on Figure 5.1 and summarized in Table 5.1. Prior to any subsurface investigation work, a private utility survey and pipeline survey will be conducted.

Field work will occur in two phases/mobilizations. The first mobilization will consist of using an Optical Image Profiler [OIP] by Geoprobe® and a hydraulic profiling tool (HPT) attached to a direct-push drill rig that will be used to investigate the potential for remaining LNAPL and TPH impacts in the subsurface and to obtain hydrostratigraphic data in relevant AOPCs. The OIP can help provide rapid and cost-effective delineation of any remaining LNAPL or residual TPH impacts.

Technologies such as the OIP, Laser Induced Fluorescence, and the Ultra Violet Optical Screening Tool can detect hydrocarbons within the GRO, DRO, and lighter PAHs ranges, but are less effective identifying Bunker C. Technologies such as TarGOST can detect Bunker C, but are not effective in detecting GRO and the lighter PAHs. Hence, due to the broad mix of petroleum fuel products impact to the subsurface, the OIP-HPT combination will provide the most effective direct sensing tools for high resolution site characterization of GRO, DRO, PAH, and Bunker C. OIP will provide visual and photographic confirmation of LNAPL. Product samples collected from the pipeline removal interim action activities will be sent to Columbia Technologies prior to conducting fieldwork in order to evaluate the LNAPL and applicable direct sensing tools.

The number of OIP borings may be increased or decreased in each AOPC, pending real-time OIP results, to delineate the extent of impacts based on OIP results in the field. The HPT, which will be used on select locations, utilizes pressure measurements to quantify the permeability of the medium the probe is being advanced through and estimate a hydraulic conductivity (k) value. To accomplish this, water is pumped through a down-hole transducer at approximately 250 milliliters per minute into the formation. Pressure and flow are plotted against depth, resulting in a line graph that provides permeability as a function of depth.

In addition to the OIP/HPT boring locations, 4 to 6 direct-push boring locations will be advanced immediately adjacent to select OIP/HPT locations during the first phase of RI fieldwork in order to collect continuous soil samples and analytical data. The lithology and analytical results from these direct-push borings will be compared to the OIP/HPT results prior to proposing direct-push locations during the second phase of the RI activities. The select direct-push locations will be advanced in areas with significant impacts and varying geology to evaluate the OIP/HPT response data. The proposed OIP and HPT locations are shown on Figure 5.1.

The second phase of field work will consist of a subsequent mobilization with a direct-push probe and a hollow-stem auger rig. The OIP results, along with results from previous investigations, will be used to determine where direct-push locations will be advanced. Samples collected from direct-push boring will help obtain quantitative soil and groundwater results. Direct-push locations will be selected to collect vertical and lateral confirmation samples in order to delineate the extent and to calculate the volume of any remaining TPH. At least one direct-push boring will be advanced in all AOPCs in order to obtain quantitative results and to delineate the vertical and lateral extent of TPH impacts. The second mobilization will also include the installation of monitoring wells with the hollow-stem auger rig and the installation of subslab Vapor Pins. The proposed monitoring well locations will be based on the OIP results and on data needs (refer to Section 5.2).

For all soil boring locations, soil cores will be collected continuously, and field screened for indications of petroleum hydrocarbon impacts, which will be recorded on the soil boring logs. In general, soil borings will be advanced to the groundwater surface and deeper if visible impacts are observed. Soil samples will generally be collected from the depth representative of the greatest impacts based on field screening observations (e.g., photoionization detector measurements, sheen, odor, staining), and a minimum of one soil sample will be collected from the depth where water-bearing soils are first observed. Activities conducted during the first and second mobilizations, including all utility and pipeline surveying, monitoring well surveying, soil collection, sampling analyses, and other data needs activities described in the following sections, will be performed according to the SAP/QAPP in Appendix F.

5.1.1 AOPC 1: Soil and Groundwater near Southern Pipelines

Two surface soil samples (P-1 and P-2) that were collected in 1994 beneath the end of an abandoned pipeline under the docks indicate the presence of petroleum hydrocarbons in the soil (Golder 1994). Photographs included in the 1994 Golder report indicate “stained soil” beneath the former Standard and Longview Pipelines adjacent to Transit Shed 2; however, stained soil was not noted beneath the westernmost pipelines beneath Berth 1. Therefore, surface samples were never collected beneath the westernmost pipelines (Golder 1994). In addition, the soil analytical data and field observations from the Data Gaps Report (Floyd|Snider 2015) indicate that residual hydrocarbon impacts are present in the vicinity of soil boring GP-18, which is northeast of surface samples P-1 and P-2 northeast of Transit Shed 2. Residual hydrocarbon impacts present in GP-18 were encountered between 27 and 28 feet above groundwater and were located within a thin, silty sand/sandy silt layer. The extent of the impacts observed in soil boring GP-18 has not been delineated to the south-southeast along the abandoned pipelines.

Additional investigation is therefore needed to better delineate soil impacts between the surface samples (P-1 and P-2) and soil boring GP-18 and in soil at depths below the surface samples P-1 and P-2. Furthermore, two monitoring wells will be installed where the abandoned pipelines meet the bulkhead in the vicinity of GP-13 and GP-16 in order to confirm that impacted groundwater beneath the Port property has not migrated to the Columbia River. These investigation activities within AOPC 1 will be conducted during the second mobilization with the direct-push rig.

In order to address these data gaps, two OIP/HPT borings within Transit Shed 2 and downgradient of GP-18 will be advanced during the first mobilization. However, if field OIP results indicate the presence of petroleum impacts, additional step-out locations may be added in order to delineate the lateral extent of impacts in this area. During the second mobilization, additional strategic locations, based on the semiquantitative OIP results, will be investigated using a direct-push rig in order to obtain quantitative soil and groundwater results. Direct-push locations will be selected to collect vertical and lateral confirmation samples to delineate the extent and calculate a volume of any remaining TPH impacts. Multiple soil samples will be collected at various depths for analysis. In addition to collecting soil samples, high-resolution discrete groundwater samples, at depths based on the OIP and/or HPT surveys, will be collected from at least one location within Transit Shed 2.

Soil samples will be collected beneath surface samples P-1 and P-2 in order to delineate the vertical extent of surface soil impacts. Two borings will be advanced using a hand auger to collect deeper soil samples denoted as P3 and P4. Additionally, two borings, P5 and P6, will be advanced using a hand auger to collect soil samples beneath the westernmost pipelines beneath Berth 1. Locations are shown on Figure 5.1.

In addition, there is a need to confirm that impacted groundwater beneath the Port property does not reach the Columbia River. Therefore, two monitoring wells, MW-37 and MW-38, will be installed within the vicinity of GP-13 and GP-16 and screened across the alluvial aquifer (Figure 5.1). Soil samples will be collected during the installation of the monitoring wells and in accordance with the SAP/QAPP.

5.1.2 AOPC 2: Former AST Area

In 1996, an interim cleanup action was conducted below and around the footprint of the former 80,000-barrel AST, during which approximately 5,000 CY of petroleum-impacted soil was removed and transported off site for disposal. The excavation was completed to a depth of

6 feet bgs and expanded past the footprint of the AST toward the south, west, and east in order to remove the impacted soil detected in test pits TP-1, TP-3, TP-5, and TP-7. Compliance soil samples were collected from below the footprint of the former AST. Analytical data show that concentrations from all compliance samples, except one floor sample, were less than their respective MTCA Method A CULs. However, the post-excavation report indicates that no verification samples were collected beyond the extent of the former AST footprint and former test pit locations with known soil impacts (Golder 1996a). Soil in test pit TP-3 was found to exceed the MTCA CULs at a depth of 8 feet bgs, which is below the depth of the excavation (Golder 1996b). Therefore, it is possible that impacted soil remains below the excavated area and that soil impacts may extend to the east, southeast, and south of the former AST excavation. Monitoring well MW-21 was removed or destroyed as part of the excavation, and groundwater quality in the vicinity of the large area of soil impacts and at the edge of the groundwater plume is unknown.

Additional data are needed to confirm the soil and groundwater quality in this area. During the first mobilization, four OIP/HPT boring locations will be advanced to investigate the presence of remaining residual hydrocarbon impacts and/or the presence of residual LNAPL within the vicinity of the former AST and to obtain hydrostratigraphic data. Proposed locations are shown on Figure 5.1. If the OIP sensor detects LNAPL and/or residual hydrocarbon impacts, additional OIP boring locations will be added to delineate the extent of impacts.

Based on the semiquantitative OIP results, additional strategic locations will be investigated, during the second mobilization, with a direct-push rig in order to obtain quantitative soil and groundwater results. Direct-push locations will be selected to collect vertical and lateral confirmation samples to delineate the extent and calculate a volume of any remaining TPH impacts within AOPC 2. During the second mobilization, multiple soil samples will be collected at various depths for analysis. Soil samples will be collected in areas that contain the greatest TPH impacts, based on OIP results, and in locations to delineate the extent of impacts. Groundwater screening samples will be collected from each of the direct-push borings within AOPC 2. Analytical data from the groundwater screening samples, at depths based on the OIP and/or HPT surveys, will be used to determine whether an additional monitoring well needs to be installed to replace MW-21.

5.1.3 AOPC 3: Former Mechanic's Shop USTs

In 1993, approximately 15 CY of petroleum-impacted soil was removed during the decommissioning of the 4,000- and 8,000-gallon gasoline USTs associated with the Port's former maintenance building (referred to as the former mechanic's shop in previous reports). The maximum depth of the excavation was approximately 11 feet, and soil samples collected from the excavation indicate that residual hydrocarbon impacts remain (Golder 1993b). Impacted soil samples from these subsequent investigations were not collected in accordance with Ecology guidelines for UST decommissioning.

Additional data are needed to establish the vertical and horizontal extent of soil impacts. Soil samples from below the former USTs would help to delineate the vertical extent of GRO impacts and determine whether the former USTs are sources of the deeper GRO concentrations in the soil. In addition, the lateral extent of soil impacts is poorly defined to the south and west of the former UST locations.

During the first mobilization, four OIP/HPT borings will be advanced within the vicinity of the former mechanic's shop and former UST locations (Figure 5.1). Borings will be advanced to a depth of at least 30 feet bgs in order to investigate remaining residual impacts and/or presence of residual LNAPL and to obtain hydrostratigraphic data. If the OIP sensor detects LNAPL and/or residual hydrocarbon impacts, additional OIP borings will be added to delineate extent.

Based on the semiquantitative OIP results, additional strategic locations will be advanced with a direct-push rig in order to obtain quantitative soil and groundwater results. During the second mobilization, soils samples will be collected in accordance with Ecology's Table 830-1 and guidelines for UST decommissioning and in accordance with the SAP/QAPP. Historical groundwater analytical data indicated that GRO and benzene were detected at concentrations exceeding their respective MTCA Method A CULs in monitoring well UST-4 in 1994 but declined to concentrations less than laboratory reporting limits by 1998 and confirmed in February 2019. Therefore, monitoring well UST-4 will be included in quarterly groundwater sampling in order to determine current water quality to establish four consecutive quarters of concentrations less than the MTCA Method A CULs.

5.1.4 AOPC 4: Monitoring Well MW-19

The presence of LNAPL in the vicinity of monitoring well MW-19 is uncertain, and the potential extent in the vicinity has not been delineated. LNAPL was observed in this well in 1993 but has not been measured in more recent events. In addition, there is more than 100 feet between MW-19 and the closest investigation locations. Therefore, additional soil and groundwater data are needed to assess whether LNAPL is currently present within the vicinity of MW-19 and whether TPH impacts are present between MW-19 and MW-6 to the north and MW-15 to the south.

During the first mobilization, an OIP sensor and HPT, attached to a direct-push drill rig, will be used to investigate the potential for remaining residual LNAPL and TPH impacts in the subsurface and to obtain hydrostratigraphic data. Three OIP/HPT borings will be advanced within the vicinity of MW-19 at 25-foot spacings to provide a higher resolution (Figure 5.1). If the OIP sensor detects LNAPL and/or TPH impacts, additional OIP borings may be added to delineate the extent of impacts based on OIP results.

Based on the semiquantitative OIP results, additional strategic locations will be advanced with a direct-push rig during the second mobilization in order to obtain quantitative soil and groundwater results. Direct-push locations will be selected to collect vertical and lateral confirmation samples to delineate the extent and calculate a volume of TPH impacts remaining at the Site. In addition, at least one direct-push boring will be advanced in the area that contains the greatest TPH impacts, via OIP results, in order to collect soil samples and delineate the vertical extent of potential TPH impacts.

5.1.5 AOPC 5: Former Fuel Loading Racks

Residual hydrocarbon impacts in soil have not been adequately delineated to the east and southeast of the former railyard fuel loading racks associated with historical operations. There are limited soil data in this area, which has historically included measurements of LNAPL in MW-20, making accurate estimates of the volume of impacted soil difficult and leaving open the possibility that impacted soil extends further than previously delineated (refer to Figure 4.2). In addition, the CSM of surface spills near the loading racks leaves open the potential for an exposure pathway from shallow soil; therefore, additional shallow soil data are needed to confirm that no shallow soil pathway exists.

The nature and extent of impacted soil and LNAPL need to be defined better in this area, and additional soil and groundwater data are needed to address these uncertainties. The area potentially affected by the former loading rack activities and the former pipelines within this area is approximately 140 feet wide by 350 feet in length, north to south.

During the first mobilization, approximately 25 borings will be advanced, using an OIP sensor and HPT on a direct-push drill rig, at approximately 25-foot spacings along the entire length of the former loading racks between the loading racks and the former pipelines. Additionally, three perpendicular transects of OIP borings will be advanced from the area east of MW-20 to the west adjacent and within former Warehouse 9 footprint. The multiple lines of evidence from both OIP and HPT locations will provide a better understanding of the spatial and matrix distribution of any potential impacts and to obtain hydrostratigraphic data within AOPC 5. Proposed locations are shown on Figure 5.1 and are subject to change. The number of OIP locations is dependent on real-time results; additional borings may be added to delineate the extent of impacts, or fewer locations may be sufficient if impacts are not encountered. The three transect locations may also be adjusted in the field based on OIP results.

Based on the semiquantitative OIP results, additional strategic locations will need to be advanced and sampled using a direct-push rig, during the second mobilization, in order to obtain quantitative soil and groundwater results. Direct-push locations will be selected to collect vertical and lateral confirmation samples to delineate the potential extent and calculate a volume of TPH impacts remaining at the Site. Direct-push borings will be advanced along the length of the former loading racks and in the area that contains the greatest TPH impacts, based on OIP results. Soil samples will be collected to confirm that no shallow soil pathway exists and to delineate the vertical extent of potential TPH impacts. Shallow soil samples will be collected from the 0- to 2-foot interval at select soil boring locations based on OIP results.

Groundwater screening samples will be collected, at depths based on the OIP and/or HPT surveys, from select direct-push soil borings. In addition, there is a need for groundwater data from the alluvial aquifer in this area of the Site. A new monitoring well (tentatively shown as MW-33 on Figure 5.1) will be installed in an area that displays the greatest TPH impacts, based on OIP results, and within the deeper alluvial aquifer, which is also needed for water level data (refer to Section 5.2). Soil samples will be collected during the installation of the monitoring well and in accordance with the SAP/QAPP.

5.1.6 AOPC 6: Former Calloway Ross Parcel

Previous documents indicate that, in addition to the gasoline UST that was removed from this area (refer to Section 3.1), historical activities included spills and/or leaks that resulted in areas of petroleum-stained surface soil on the northern portion of the parcel, and there was storage of creosote-treated lumber (Golder 1996c). There are no remaining data gaps associated with the Site historical activities associated with spills and leaks to the surface, which were investigated and remediated through removal of approximately 175 tons of soil that contains TPH at concentrations greater than MTCA Method A CULs from three shallow excavations (shown on Figure 2.1) and transported off site for thermal treatment (Golder 1997).

As described in Section 4.2, subsurface GRO and DRO impacts remain in the vicinity of the former UST. The extent of impacted soil and groundwater at the southern edge of this area, close to former Warehouse 9, has not been adequately delineated. To address this data need, two borings will be advanced using an OIP sensor and HPT within AOPC 6 in the vicinity of the northeast corner of former Warehouse 9 and south of MW-9 and MW-10 (Figure 5.1). If necessary, additional step-out borings will be advanced as needed based on OIP results.

Based on the semiquantitative OIP results, additional strategic locations will be advanced during the second mobilization with a direct-push rig in order to obtain quantitative soil and groundwater results. Direct-push locations will be selected to collect vertical and lateral confirmation samples to delineate the potential extent and calculate a volume of TPH impacts remaining at the Site. Soil samples and groundwater grab samples will be collected in order to confirm OIP results, and sampling will be in accordance with the SAP/QAPP.

5.1.7 AOPC 7: Monitoring Wells MW-26 and MW-28

The results of 2019 groundwater monitoring indicated elevated concentrations of DRO and ORO detected at MW-28. Both monitoring wells, MW-26 and MW-28, are screened in the perched zone. In addition, historical soil data show DRO detections at a concentration of 42,000 milligrams per kilogram in monitoring well MW-26 at 18 feet bgs.

Therefore, there is a need to better understand of the spatial and matrix distribution of the impacts within this area. During the first mobilization, approximately nine borings will be advanced, using an OIP sensor and HPT on a direct-push drill rig, at approximately 25-foot spacings within AOPC 7. The number of OIP locations is dependent on real-time results; additional borings may be added to delineate the extent of impacts, or fewer locations may be sufficient if impacts are not encountered (Figure 5.1).

Based on the semiquantitative OIP results, additional strategic locations will be advanced and sampled using a direct-push rig during the second mobilization, in order to obtain quantitative soil and groundwater results. Direct-push locations will be selected to collect vertical and lateral confirmation samples to delineate the potential extent and calculate a volume of TPH impacts remaining at the Site. Groundwater screening samples will be collected, at depths based on the OIP and/or HPT surveys, from select direct-push soil borings.

In addition, there is a need for groundwater data from the alluvial aquifer in this area of the Site. A new monitoring well (tentatively shown as MW-34 on Figure 5.1) will be installed in an area that displays the greatest TPH impacts, based on OIP results, and within the deeper alluvial aquifer, which is also needed for water level data (refer to Section 5.2). Soil samples will be collected during the installation of the monitoring well and in accordance with the SAP/QAPP.

5.1.8 AOPC 8: Soil Vapor Quality

Previous reports indicated that vapor inhalation is not a viable exposure pathway at the Site because of the age and type of fuel products found in soil. The rationale was that diesel and Bunker C fuel have few volatile components, and the gasoline at the Site is old and weathered, reducing the potential for human exposure by means of vapor inhalation (Golder 1999).

Ecology requires an evaluation of VI into indoor air whenever LNAPL and/or volatile hazardous substances are present in the subsurface at a site (Ecology 2018). LNAPL has been observed and recent groundwater results indicate that benzene has been detected in groundwater at concentrations as great as 61 µg/L, which exceeds the MTCA Method C soil vapor screening level of 24 µg/L in groundwater for industrial sites.

In addition to Ecology's 2018 VI guidance, USEPA's 2015 technical guidance for addressing petroleum VI states that the lateral inclusion zone and horizontal separation distance must be defined to determine whether current buildings are threatened by potential VI (USEPA 2015). Ecology has updated its VI guidance to include lateral inclusion zones and vertical separation distances in the memorandum *Updated Process for Initially Assessing the Potential for Petroleum Vapor Intrusion* (2016 VI Guidance; Ecology 2016). The 2016 VI Guidance defines the lateral inclusion zone as the area surrounding a contaminant source through which vapor-phase impacts might travel and intrude into buildings. If the degree and extent of impacts are well-defined and the dissolved-phase plume is stable or receding, then a horizontal separation distance of 30 feet is appropriate for establishing a lateral inclusion zone. If the lateral inclusion zone of 30 feet is not met, the guidance recommends soil vapor sampling if the top of the smear zone, dissolved-phase plume, or LNAPL is present less than 15 feet in vertical distance beneath a building footprint or subslab or if TPH impacted soil or the dissolved-phase plume is present less than 6 feet beneath the building footprint during historical high groundwater table elevations.

Currently, there are no occupied buildings over or in the vicinity of shallow impacted soil, LNAPL, or the dissolved-phase plume. However, VI is a relevant potential future exposure pathway because there is a potential for buildings to be constructed within 30 feet of monitoring well MW-9, which contains an LNAPL thickness of 0.01 feet at a depth of 15.30 feet bgs. To take a conservative approach, one Vapor Pin will be installed in the slab of the former Warehouse 9 in the northeastern corner, near MW-9, and a second will be installed in the middle of the former Warehouse 9 slab (Figure 5.1). Two rounds of vapor sampling, 6 months apart, will be conducted in order to assess the VI risk to a potential future building and will be collected in accordance with the SAP/QAPP.

5.1.9 AOPC 9: U.S. Army Reserve Building

Two USTs were operated on site and maintained by the U.S. Army Reserve. One of the USTs was a heating oil UST located near the northwest corner of the former U.S. Army Reserve building (Wilcox 1993). A U.S. Navy drawing indicates that a 2,800-gallon-capacity heating oil UST was installed in approximately 1949 (U.S. Navy 1949). The drawing indicates that the tank was located immediately northeast of the building and supplied fuel for the building's steam boiler (U.S. Navy 1949). The heating oil UST was emptied and cleaned in the 1970s for possible storage of liquid fertilizer. In addition, a gasoline UST is believed to have been located near the former U.S. Army Reserve building (Wilcox 1993), although the existence of this UST has never been confirmed.

Because of the uncertainty regarding these tanks, an initial building and historical reconnaissance will be conducted to determine where the former heating oil UST was located, and whether there is any further indication of the gasoline UST. A GPR survey will be conducted to attempt to locate these tanks prior to advancing soil borings.

In conjunction with the GPR survey, two direct-push borings will be advanced within AOPC 9 during the second mobilization (refer to Figure 5.1 for AOPC 9 area). The boring locations are not shown on Figure 5.1 but will be advanced in the locations of the former heating oil and/or gasoline UST, as determined by the building survey and GPR results. Soil and groundwater samples will be collected to determine whether any releases related to the former heating oil UST affected soil and water quality. If further evidence of the gasoline UST is found, at least one boring will be advanced within the vicinity of the gasoline UST. Soil and groundwater samples will be collected in accordance with the SAP/QAPP.

5.2 OTHER DATA NEEDS

Data needs other than impact extent identified for the RI are described below.

5.2.1 Groundwater Monitoring, Seasonal Variability, and Other Parameters

Four quarters of groundwater data will be collected from all Site monitoring wells, including newly installed wells (described in the following section) for GRO, DRO, and BTEX. Four quarters of groundwater data will be collected from selected wells for cPAHs and volatile organic compound (VOCs). After two quarters of groundwater sampling results, the number of monitoring wells to be sampled may be reduced (after request to and approval by Ecology) pending consecutive results of non-detect or less than CULs.

Four quarters of groundwater data will be collected from a subset of monitoring wells for natural attenuation parameters (nitrate, sulfate, manganese, alkalinity, methane, and the additional field measurement of ferrous iron) to provide an updated understanding of groundwater parameters and constituents indicative of biological degradation, including key nutrients and energy sources used by relevant bacteria. Additional groundwater samples will be collected from selected monitoring wells for Table 830-1–required constituents (lead, 1,2-dibromoethane, 1,2-dichloroethane, methyl *tert*-butyl ether, and naphthalenes). Samples from another subset of spatially representative monitoring wells will be submitted for the full suite of VOC analysis. The analysis of this subset will inform the selection of wells in different areas of the Site that have previously contained elevated concentrations of GRO, DRO, ORO, and benzene. Four consecutive quarters of groundwater samples is likely unattainable for some wells screened in the perched zone due to seasonal fluctuations and insufficient volume of water to sample. Any proposed reduction in the number of monitoring wells to be sampled will be sent to Ecology for review and approval. The intent is to reduce the redundant and necessary perched zone wells that have been seasonally dry, historically clean, or within known impacted areas.

During the second mobilization, selected soil samples will be collected for site-specific CUL calculations based on volatile petroleum hydrocarbons/extractable petroleum hydrocarbons. Ecology suggested that the most practical approach is to use data from multiple soil or product locations to calculate a median soil CUL that is representative of the Site (or portion of the Site impacted by the same product). Three soil samples, GP-1, G-18, and GP-27, were previously collected in September 2015 and subjected to the additional analyses to calculate Site-specific MTCA Method C TPH CULs (Table 4.2). GP-1 had detections of both GRO and DRO; the other two samples, GP-18 and GP-27, contained elevated DRO and ORO concentrations. To calculate an average Site-specific CUL, additional soil samples will be needed from each source area, such as the area adjacent to wells MW-26 and MW-28 (AOPC 7), within the vicinity of the former loading racks (AOPC 5), and within an area that mainly consists of gasoline impacts. Samples collected adjacent to wells MW-26 and MW-28 and within the loading rack area will represent an area of overlapping DRO and GRO impacts in soil. These locations will be determined using OIP results collected during the first mobilization.

Refer to the SAP/QAPP (Appendix F) for additional details.

5.2.2 Hydrogeologic Characterization

Hydrogeologic data needs for the Site include a need for additional alluvial aquifer monitoring wells and associated data, and an improved understanding of the perched zone and its role in the CSM. HPT data collected during the first mobilization will be used to help understand the Site's stratigraphy and hydrogeology within the perched zone and lower alluvial aquifer, including discontinuous zones, but additional monitoring wells will be required as well.

The Site monitoring well network consists primarily of monitoring wells with screened intervals in the vadose or perched zone, with only a small number of monitoring wells with screened intervals in the alluvial aquifer within the central portion of the Site. Construction details of existing monitoring wells are provided in Table 4.5, and several of these wells are illustrated on the preliminary cross-section, Figure 2.2. MW-19, MW-7, MW-10, and MW-12 are screened in the alluvial aquifer in the north portion of the Site, and MW-23 is screened in the alluvial aquifer in the southern portion of the Site; several wells have well screens that span both units.

The conceptual understanding that groundwater in the alluvial aquifer flows toward the Columbia River is based on limited available information. Also, groundwater in the perched zone occurs in a thin, discontinuous zone that appears to be relatively isolated hydraulically.

Therefore, a key hydrogeologic data need is for additional alluvial aquifer monitoring wells to allow accurate potentiometric mapping of groundwater flow and gradients in the alluvial aquifer, as well as vertical gradients between the perched zone and alluvial aquifer.

Additional monitoring wells are needed in the alluvial aquifer in the central and southern portions of the Site to establish groundwater flow directions and gradients between the area of groundwater impacts and the Columbia River. Additional alluvial aquifer monitoring wells are needed to accurately map the potentiometric surface because of the small number of alluvial aquifer monitoring wells and the geographic distribution of the monitoring wells. Previous potentiometric contour maps are included in Appendix C. As noted previously, these maps combine elevations of groundwater from monitoring wells screened in the alluvial aquifer with those from monitoring wells screened in shallower perched zone(s). As illustrated by the previous potentiometric maps, the groundwater monitoring network is concentrated in the northern perched area and a narrow north-south section of the Site along the rail line and pipelines. Two separate potentiometric maps will be prepared for the RI Report that will present groundwater elevations for wells screened in the alluvial aquifer and wells screened in the vadose zone.

During the second mobilization, the following new monitoring wells are proposed to be installed and sampled as part of the monitoring well network during the RI:

- Two additional 2-inch monitoring wells will be installed and developed in the alluvial aquifer, in the central portion of the Site, with screened intervals between approximately 25 and 35 feet bgs: proposed monitoring well MW-33, located near the MW-17 and several other perched zone wells; and MW-34, located near MW-28 and several other perched zone monitoring wells. Refer to Figure 5.1. These monitoring wells will fill a gap for alluvial aquifer wells in the center of the Site between MW-10 and MW-23, and both will allow for calculation of vertical hydraulic gradients relative to adjacent perched zone wells. In addition, MW-33 and MW-34 will provide useful contaminant data (refer to Sections 5.1.5 and 5.1.7, respectively).
- One additional 2-inch monitoring well will be installed and developed in the alluvial aquifer near the western boundary of Site impacts. Proposed monitoring well MW-35 will provide an important data point for monitoring gradients and flow directions in the alluvial aquifer.
- One additional 2-inch monitoring well will be installed and developed in the alluvial aquifer near former Gear Locker A area. Proposed monitoring well MW-36 will provide an important data point for monitoring gradients and flow directions in the alluvial aquifer.
- Two additional 2-inch monitoring wells will be installed where the abandoned pipelines meet the bulkhead in the vicinity of GP-13 and GP-16 to confirm that impacted groundwater beneath the Port property has not migrated to the Columbia River.

In addition, further data would be useful to support the preliminary CSM for the perched area in the center of the Site, which holds that this unit is relatively insubstantial as a water-bearing unit and has limited hydraulic connection with the alluvial aquifer below, so that impacts in the perched zone are relatively immobile, with little potential for migration with groundwater flow. Refer to the cross-section on Figure 2.2.

To fill this data need, the following activities will be performed:

- A limited drawdown test will be conducted on the perched zone in accordance with standard methods for constant-rate discharge tests, as described in ASTM Method D4050 and summarized for Site use in the SAP/QAPP (Appendix F). The drawdown test will utilize a perched-zone monitoring well, located in the central portion of the Site, as the pumping well and nearby monitoring wells as observation wells. The goal of the test is to observe the extent to which pumping draws down the perched-zone water levels. The draw-down test may have to be conducted during the wet season in order to avoid dewatering issues during the drier months.
- A 3-day transducer study will be conducted to measure the relative change in water levels in the alluvial aquifer, which is affected by the tidally influenced stage of the Columbia River (KJC 2012), and the perched zone, which is not likely to be influenced by changes in river stage. The study will install approximately three monitoring wells in the perched zone and approximately three monitoring wells in the alluvial aquifer. The transducer data will also help determine if the Oregon Way pump station has an influence on the perched and alluvial aquifers at the Site.
- Soil samples will be collected from the perched zone, silt underlying the perched zone, and the alluvial aquifer and submitted for grain size, porosity, fraction organic carbon, and bulk density. Two locations that are expected to provide representative samples are planned for new monitoring wells MW-33 and MW-34. The proposed locations for these wells are shown on Figure 5.1, but their final locations may be adjusted, pending OIP/HPT results.

6.0 Remedial Investigation Tasks and Schedule

This section provides summary descriptions and a schedule for RI activities following Ecology approval of the Final Work Plan, including written reports that will be generated.

6.1 REMEDIAL INVESTIGATION FIELD INVESTIGATION

The RI field investigation will include execution of the field data collection activities described in this Work Plan, including but not limited to a utility survey, water level measurement, direct-push soil boring sampling, OIP drilling, installation of monitoring wells, a survey of existing and new monitoring wells, groundwater sampling via monitoring wells and temporary well points installed in Geoprobe borings, and aquifer testing.

6.2 INTERIM DATA REPORT

The Agreed Order requires that data reports and updates be provided to Ecology as new Site data and information become available, and raw laboratory data be provided on request. All validated data will be submitted to Ecology's Environmental Information Management (EIM) System (refer to the SAP/QAPP, Appendix F). In addition to these exchanges of information, an Interim Data Report will be submitted to Ecology for review and comment following the completion of the initial RI field data collection. The purpose of the Interim Data Report is to present the initial field data and identify whether any data gaps remain to be filled. Specifically, the Interim Data Report shall describe the work conducted to collect the data, including a summary of the sampling design, sampling methods, and sampling results. It is expected that the sampling results will be provided both in summary tables and on figures and that screening levels as previously described will be used to evaluate the concentrations of the chemicals detected.

6.3 GROUNDWATER MONITORING

The monitoring wells and sampling program described in this Work Plan are expected to be representative of Site conditions both in the source zones and in downgradient areas. If necessary, following the review of data, additional monitoring wells may be installed.

RI groundwater monitoring will proceed for four quarters. RI groundwater monitoring will include water level measurement, LNAPL measurement where applicable, and groundwater sample collection in accordance with the SAP/QAPP. Groundwater analytes will include DRO, ORO, GRO, and BTEX at all locations and cPAHs, VOCs, and natural attenuation parameters and constituents required under Table 830-1, Required Testing for Petroleum Releases, at selected locations.

6.4 REMEDIAL INVESTIGATION REPORT

Following approval of the Interim Data Report, and completion of four quarters of groundwater monitoring and other required data collection, the Agency Review Draft RI Report will be prepared.

Primary RI reporting tasks include presenting the data, both current and historical, in a comprehensive fashion in order to define the nature and extent of impacts at the Site; defining site-wide COCs and CULs, as well as points of compliance; and updating the CSM to reflect site-wide comprehensive information. Chemical and physical data collected will be presented on figures and in tables per contaminant class and environmental media. A discussion of how the data were collected and an evaluation of the results will be included.

The preliminary CSM developed based on previous site investigations will be refined throughout the RI process as additional data are collected and site conditions are better defined. The CSM will include a comprehensive understanding of contaminants and sources; nature and extent of impacts; fate and transport processes; and exposure pathways and receptors.

All chemical data collected during the field work will be submitted in Ecology's EIM format. The overall objective of the RI document is to sufficiently define site conditions necessary for the FS to define detailed remedial action objectives and remedial alternatives.

6.5 SCHEDULE

The schedule for the RI will proceed according to or, if feasible, ahead of the existing schedule set forth in the Agreed Order, based on the effective date of February 13, 2019. Below are the dates of performance or completion for significant RI tasks in general accordance with the Agreed Order schedule. Actual dates below are subject to change depending on Ecology review periods and subcontractor/field crew availability.

Task	Expected Duration	Date
Submit Final RI Work Plan to Ecology (1)	--	October 21, 2019
Implement RI Field Work (2):		
RI Investigation Phase I (1st Mobilization)	2 weeks	November 2019
Review OIP and HPT Data	4 weeks	December 2019
Phase II (2nd Mobilization)	2 weeks	January 2020
1st Round Groundwater Sampling	3 days	February 2020
2nd Round Groundwater Sampling	3 days	May 2020
3rd Round Groundwater Sampling	3 days	August 2020
4th Round Groundwater Sampling	3 days	November 2020
Receive Data Reports from Laboratories, Complete Data Validation, Load Data to EIM (3)	--	January to December 2020
Submit Interim Data Report to Ecology	--	June, 2020
Submit Agency Review Draft RI Report (1)	--	March 2021
Submit Public Review Draft RI Report (1)	--	June, 2021

Notes:

1 Ecology review periods are assumed to be 60 days for draft documents and 30 days for draft final documents.

2 If Phase I and Phase II mobilizations are not completed by February 1, 2020, a request for an extension of schedule will be submitted to Ecology in accordance with Agreed Order No. DE 15907 Section VIII. I. Extension of Schedule.

3 Final laboratory data must be submitted to EIM within 180 days of receipt; this completion date may change based on the field data collection completion and data validation completion dates.

7.0 Project Team and Responsibilities

7.1 WASHINGTON STATE DEPARTMENT OF ECOLOGY

Ecology is responsible for participation in the planning and scoping of the RI and reviewing and approving the draft RI documents. Matt Morris is the Site Project Manager for Ecology. He will review and approve all work plans and reports for the RI and FS and will determine if all requirements of the Agreed Order have been met.

Ecology will have lead responsibility for all public involvement activities during the RI process. Ecology will be responsible for public relations and outreach in coordination with the Port during the project, which may include participation at public meetings, project fact sheets, and direct community involvement.

7.2 PORT OF LONGVIEW

In addition to its role as part of the PLP Group, the Port's responsibilities include overall project direction and oversight, site access, tenant coordination, and all tasks to support the planning and performance of the work. The Port is the landowner. Lisa Hendriksen is the Port's Manager for the project.

7.3 PLP GROUP

The PLP Group's responsibilities include participation in the planning and scoping of the RI and technical review of draft RI documents. Lisa Hendriksen is the named Agreed Order Coordinator for the PLP Group.

7.4 FLOYD|SNIDER

Floyd|Snider is the PLP Group technical consultant responsible for project planning, technical analysis, authorship, and Ecology coordination to produce the RI in a manner consistent with the Agreed Order and Ecology requirements. Scott Adamek, P.E., L.G. is the Floyd|Snider Project Manager.

7.5 LABORATORY

An Ecology-accredited laboratory will conduct chemical testing of soil, groundwater, and sediment samples. The laboratory will be responsible for calculating method detection limits for each COC and meeting laboratory quality control requirements as specified in the SAP/QAPP.

7.6 OTHER SUBCONTRACTORS—GEOPHYSICAL, DRILLER, AND SURVEYOR

A professional utility locator will perform geophysical work including underground pipeline location. Geoprobe soil boring and monitoring well installation will be performed by licensed drillers with oversight by Floyd|Snider. Professional surveying of site features and monitoring well locations will be performed by licensed surveyors.

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Port of Longview TPH Site

Remedial Investigation Work Plan

Tables

Table 3.1
Sediment Physical and Chemical Analytical Results from 2011

	SEF	SMS Freshwater		Berths 1,2,4,5		Berths 6,7		Berth 8		Berth 9	
	Freshwater	Sediment Criteria		POL-01A	POL-01B	POL-02A	POL-02B	POL-03A	POL-03B	POL-04A	POL-DUP
	SL Criteria	SCO	CSL	6/15/2011	6/15/2011	6/16/2011	6/16/2011	6/30/2011	6/30/2011	6/18/2011	6/18/2011
Conventional Parameters (percent)											
Total organic carbon				**0.20**	**0.42**	**0.35**	**0.61**	**0.17**	**0.14**	**0.33**	**0.16**
Total solids				**80.2**	**80.7**	**74.9**	**77.9**	**80.9**	**76.4**	**78.4**	**79.4**
Conventional Parameters (mg/kg)											
Ammonia		230	300	**3.5**	**4.5**	**10.5**	**11.8**	**3.5**	**5.1**	0.13 U	--
Sulfide		39	61	1.24 U	**22.8**	1.31 U	1.23 U	**16.3**	**2.21**	1.26 U	--
Grain Size (percent)											
Gravel				**7.1**	**13.7**	**0.3**	**6.5**	**22.9**	**6.2**	**21.8**	**15.3**
Sand				**82.1**	**79.8**	**71.4**	**66.5**	**66.3**	**79.5**	**76.9**	**83.4**
Silt				**9.8**	**5.6**	**26.2**	**24.6**	**9.4**	**12.9**	**1.1**	**1.3**
Clay				**0.8**	**1.2**	**2.1**	**2.4**	**1.4**	**1.2**	0.0	0.0
Metals (mg/kg)											
Antimony				6 UJ	6 UJ	6 UJ	6 UJ	6 UJ	6 UJ	6 UJ	6 UJ
Arsenic	20	14	120	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U
Cadmium	1.1	2.1	5.4	0.2 U	0.2 U	0.3 U	0.2 U	0.3 U	0.3 U	0.3 U	0.2 U
Chromium	95	72	88	**7**	**10**	**7**	**20**	**6**	**6**	**6**	**6**
Copper	80	400	1,200	**15**	**16**	**18**	**18**	**17 J**	**15 J**	**12**	**11**
Lead	340	360	> 1,300	2 U	2	3 U	2 U	3 U	3 U	3 U	2 U
Mercury	0.28	0.66	0.8	0.02 U	0.02 U	0.03 U	**0.03**	0.03 U	0.03 U	0.02 U	0.03 U
Nickel	60	26	110	**7**	**9**	**7**	**13**	**6**	**6**	**8**	**7**
Silver	2	0.57	1.7	0.4 U	0.3 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Zinc	130	3,200	> 4,200	**32**	**34**	**41**	**35**	**34**	**25**	**42**	**40**
Organometallic Compounds (µg/kg)											
Tributyltin (ion)	75	47	320	**2.8**	3.3 U	**5.4 J**	3.3 U	3.4 U	3.5 U	3.4 U	3.5 U
Polycyclic Aromatic Hydrocarbons (PAHs) (µg/kg)											
1-Methylnaphthalene				19 U	19 U	18 U	18 U	18 U	18 U	20 U	20 U
2-Methylnaphthalene	470			19 U	19 U	18 U	18 U	18 U	18 U	20 U	20 U
Acenaphthene	1,100			19 U	**31**	18 U	**50**	18 U	18 U	20 U	20 U
Acenaphthylene	470			19 U	19 U	18 U	18 U	18 U	18 U	20 U	20 U
Anthracene	1,200			19 U	**11 J**	18 U	**23**	18 U	18 U	20 U	20 U
Benzo(a)anthracene	4,300			19 U	**10 J**	18 U	**150**	18 U	18 U	20 U	20 U
Benzo(a)pyrene	3,300			19 U	19 U	18 U	**200**	18 U	18 U	20 U	20 U
Benzo(g,h,i)perylene	4,000			19 U	19 U	18 U	**150**	18 U	18 U	20 U	20 U
Total Benzofluoranthenes				**9.3 J**	**15 J**	18 U	**340**	18 U	18 U	20 U	20 U
Chrysene	5,900			19 U	**12 J**	18 U	**180**	18 U	18 U	20 U	20 U
Dibenzo(a,h)anthracene	800			19 U	19 U	18 U	**54**	18 U	18 U	20 U	20 U
Fluoranthene	11,000			19 U	**24**	**12 J**	**320**	18 U	18 U	20 U	20 U
Fluorene	1,000			19 U	**16 J**	18 U	**19**	18 U	18 U	20 U	20 U
Indeno(1,2,3-c,d)pyrene	4,100			19 U	19 U	18 U	**130**	18 U	18 U	20 U	20 U
Naphthalene	500			19 U	**14 J**	18 U	18 U	18 U	18 U	20 U	20 U
Phenanthrene	6,100			19 U	**42**	**14 J**	**150**	**10 J**	18 U	20 U	20 U
Pyrene	8,800			19 U	**51**	**10 J**	**310**	18 U	18 U	20 U	20 U
Total PAHs		17,000	30,000	161	293	162	2,112	154	18 U	20 U	20 U
HPAHs (U=1/2)	31,000			**85.3**	**150**	**85**	**1,834**	18 U	18 U	20 U	20 U
LPAHs (U=1/2)	6,600			19 U	**133**	**68**	**269**	**64**	18 U	20 U	20 U
Semivolatile Organic Compounds (µg/kg)											
1,2-Dichlorobenzene				19 U	19 U	18 U	18 U	18 U	18 U	20 U	20 U
1,2,4-Trichlorobenzene				19 U	19 U	18 U	18 U	18 U	18 U	20 U	20 U
1,3-Dichlorobenzene				19 U	19 U	18 U	18 U	18 U	18 U	20 U	20 U
1,4-Dichlorobenzene				19 U	19 U	18 U	18 U	18 U	18 U	20 U	20 U
2-Methylphenol (o-Cresol)				19 U	19 U	18 U	18 U	18 U	18 U	20 U	20 U
2,4-Dimethylphenol				37 U	38 U	37 U	37 U	37 U	37 U	40 U	39 U
4-Methylphenol (p-Cresol)		260	2,000	37 U	**21 J**	**24 J**	**21 J**	37 U	37 U	40 U	39 U
Benzoic acid				370 U	380 U	370 U	370 U	370 U	370 U	400 U	390 U
Benzyl alcohol				19 U	19 U	18 U	18 U	18 U	18 U	20 U	20 U
Bis(2-ethylhexyl) phthalate	220	500	22,000	23 U	24 U	**48**	23 U	**15 J**	23 U	25 U	24 U
Butylbenzyl phthalate	260			19 U	19 U	18 U	18 U	18 U	18 U	20 U	20 U
Dibenzofuran	400	200	680	19 U	19 U	18 U	**9.2 J**	18 U	18 U	20 U	20 U
Diethyl phthalate				47 U	47 U	46 U	46 U	46 U	46 U	50 U	49 U
Dimethyl phthalate	46			19 U	19 U	18 U	18 U	18 U	18 U	20 U	20 U
Di-n-butyl phthalate		380	1,000	19 U	19 U	18 U	18 U	18 U	18 U	20 U	20 U
Di-n-octyl phthalate	26	39	> 1,100	19 U	19 U	18 U	18 U	18 U	18 U	20 U	20 U
Hexachlorobenzene				19 U	19 U	18 U	18 U	18 U	18 U	20 U	20 U
Hexachlorobutadiene				93 U	94 U	92 U	92 U	92 U	92 U	99 U	98 U
Hexachloroethane				19 U	19 U	18 U	18 U	18 U	18 U	20 U	20 U
N-Nitrosodiphenylamine				19 U	19 U	18 U	18 U	18 U	18 U	20 U	20 U
Pentachlorophenol		1,200	> 1,200	190 U	190 U	180 U	180 U	180 U	180 U	200 U	200 U
Phenol		120	210	19 U	19 U	18 U	18 U	18 U	18 U	20 U	20 U
Polychlorinated Biphenyl (PCB) Aroclors (µg/kg)											
Aroclor 1016				9.3 U	9.5 U	9.2 U	9.6 U	4 U	9.6 U	9.4 U	9.2 U
Aroclor 1221				9.3 U	9.5 U	9.2 U	9.6 U	4 U	9.6 U	9.4 U	9.2 U
Aroclor 1232				9.3 U	9.5 U	9.2 U	9.6 U	4 U	9.6 U	9.4 U	9.2 U
Aroclor 1242				9.3 U	9.5 U	9.2 U	9.6 U	4 U	9.6 U	9.4 U	9.2 U
Aroclor 1248				9.3 U	9.5 U	9.2 U	9.6 U	4 U	9.6 U	9.4 U	9.2 U
Aroclor 1254				9.3 U	9.5 U	9.2 U	9.6 U	4 U	9.6 U	9.4 U	9.2 U
Aroclor 1260				9.3 U	9.5 U	9.2 U	9.6 U	4 U	9.6 U	9.4 U	9.2 U
Total PCB Aroclors (U=0)	60	110	2,500	9.3 U	9.5 U	9.2 U	9.6 U	4 U	9.6 U	9.4 U	9.2 U
Pesticides (µg/kg)											
4,4'-DDD (p,p'-DDD)	16	310	860	1.9 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U
4,4'-DDE (p,p'-DDE)	9	21	33	1.9 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U
4,4'-DDT (p,p'-DDT)	12	100	8,100	1.9 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U
Total DDX (U=0)				1.9 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U
Aldrin	9.5			0.97 U	0.92 U	0.97 U	0.97 U	0.93 U	0.94 U	0.92 U	0.94 U
alpha-Chlordane (cis-Chlordane)				0.97 U	0.92 U	0.97 U	0.97 U	0.93 U	0.94 U	0.92 U	0.94 U
beta-Chlordane (trans-Chlordane)				0.97 U	0.92 U	0.97 U	0.97 U	0.93 U	0.94 U	0.92 U	0.94 U
cis-Nonachlor				1.9 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U
trans-Nonachlor				1.9 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U

Table 3.1
Sediment Physical and Chemical Analytical Results from 2011

	SEF Freshwater SL Criteria	SMS Freshwater Sediment Criteria		Berths 1,2,4,5		Berths 6,7		Berth 8		Berth 9	
				POL-01A	POL-01B	POL-02A	POL-02B	POL-03A	POL-03B	POL-04A	POL-DUP
		SCO	CSL	6/15/2011	6/15/2011	6/16/2011	6/16/2011	6/30/2011	6/30/2011	6/18/2011	6/18/2011
Pesticides (µg/kg) (cont.)											
Oxychlordane				1.9 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U
Total Chlordane (U=0)	2.8			1.9 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U
Dieldrin	1.9	4.9	9.3	1.9 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U
Endrin		8.5		1.9 U	1.8 U	1.9 U	1.9 U	1.9 U	1.9 U	1.8 U	1.9 U
gamma-BHC (Lindane)				0.97 U	0.92 U	0.97 U	0.97 U	0.93 U	0.94 U	0.92 U	0.94 U
Heptachlor	1.5			0.97 U	0.92 U	0.97 U	0.97 U	0.93 U	0.94 U	0.92 U	0.94 U
Total Petroleum Hydrocarbons (mg/kg)											
Diesel-Range Organics		340	510	6.3 U	**13**	**7.2**	**9.5**	6.2 U	6.5 U	6.2 U	6.2 U
Motor Oil-Range Organics				12 U	**20**	**15**	**24**	12 U	13 U	12 U	12 U

Notes:

	Blank cells are intentional.
--	Not available.
BOLD	Detected result.

Abbreviations:

CSL	Cleanup screening level
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DDX	Sum of DDE, DDD, and DDT
HPAH	High molecular weight polycyclic aromatic hydrocarbon
LPAH	Low molecular weight polycyclic aromatic hydrocarbon
µg/kg	Micrograms per kilogram
mg/kg	Milligrams per kilogram
SCO	Sediment Cleanup Objective
SEF	Sediment Evaluation Framework
SL	Screening level
SMS	Sediment Management Standards

Qualifiers:

J	Analyte was detected; concentration is considered an estimate.
U	Analyte was not detected at the given reporting limit.
UJ	Analyte was not detected at the given reporting limit; concentration is considered an estimate.

Table 3.2
Sediment Physical and Chemical Analytical Results from 2016

	SEF Freshwater SL Criteria	SMS Freshwater Sediment Criteria		Berths 1,2,4,5 COMP-POL-01A_2016 DMMU-1 10/12/2016	Berths 6,7 COMP-POL-02A_2016 DMMU-2 10/11/2016	Berth 8 COMP-POL-03A_2016 DMMU-3 10/11/2016	Berth 9 COMP-POL-04A_2016 DMMU-4 10/11/2016
		SCO	CSL				
Conventional Parameters (percent)							
Total organic carbon	--			**0.09 J**	**0.12 J**	**0.23 J**	**0.29** J
Total solids	--			**72.36**	**71.53**	**67.1**	**74.34**
Total volatile solids	--			**0.523**	**0.694**	**1.18**	**0.436**
Conventional Parameters (mg/kg)							
Ammonia	230	230	300	**1.03**	**8.06**	**13.6**	**4.44**
Sulfide	39	39	61	0.673 U	0.664 U	**6.87**	0.662 U
Grain Size (percent)							
Gravel	--			**1.2**	0	0	0
Sand	--			**90.2**	**80.7**	**61.2**	94
Silt	--			**6.8**	**15.8**	**35.3**	**4.3**
Clay	--			**1.8**	**3.5**	**3.4**	**1.7**
Metals (mg/kg)							
Arsenic	14	14	120	6.79 U	6.48 U	6.92 U	6.45 U
Cadmium	2.1	2.1	5.4	**0.151 J**	**0.129 J**	**0.175 J**	**0.15** J
Chromium	72	72	88	**6.42**	**5.76**	**6.23**	**5.65**
Copper	400	400	1,200	**14.8**	**15.7**	**18.5**	**14.1**
Lead	360	360	> 1,300	**1.95 J**	**0.977 J**	**1.33 J**	**0.759** J
Mercury	0.66	0.66	0.8	0.02867 U	0.03345 U	0.0272 U	0.02327 U
Nickel	26	26	110	**7.88**	**7.1**	**7.19**	**7.09**
Selenium	11			2.62 U	2.63 U	**0.71 J**	**0.54 J**
Silver	0.57	0.57	1.7	0.408 U	0.389 U	0.415 U	0.387 U
Zinc	3,200	3,200	> 4,200	**25.4**	**25.8**	**24.8**	**21.5**
Organometallic Compounds (µg/kg)							
Tributyltin (ion)	47	47	320	4.92 U	4.95 U	5.79 U	5.22 U
Monobutyltin	540			5.2 U	5.23 U	6.12 U	5.52 U
Dibutyltim	910			7.37 U	7.41 U	8.67 U	7.82 U
Tetrabutyltin	97			6.38 U	6.41 U	7.5 U	6.77 U
Polycyclic Aromatic Hydrocarbons (PAH) (µg/kg)							
2-Methylnaphthalene	--			4.87 U	4.92 U	4.99 U	4.82 U
Acenaphthene	--			4.87 U	4.92 U	4.99 U	4.82 U
Acenaphthylene	--			4.87 U	4.92 U	4.99 U	4.82 U
Anthracene	--			4.87 U	4.92 U	4.99 U	4.82 U
Benzo(a)anthracene	--			**4.13 J**	4.92 U	4.99 U	4.82 U
Benzo(a)pyrene	--			**4.38 J**	4.92 U	4.99 U	4.82 U
Benzo(b)fluoranthene	--			**4.51 J**	**2.91 J**	**2.39 J**	4.82 U
Benzo(g,h,i)perylene	--			**3.4 J**	4.92 U	4.99 U	4.82 U
Benzo(k)fluoranthene	--			**2.37 J**	4.92 U	4.99 U	4.82 U
Chrysene	--			**4.96**	**4.13 J**	**2.51 J**	4.82 U
Dibenzo(a,h)anthracene	--			4.87 U	4.92 U	4.99 U	4.82 U
Fluoranthene	--			**10.2**	**12.1**	**5.56**	4.82 U
Fluorene	--			4.87 U	4.92 U	4.99 U	4.82 U
Indeno(1,2,3-c,d)pyrene	--			**3.05 J**	4.92 U	4.99 U	4.82 U
Naphthalene	--			**2.54 J**	4.92 U	4.99 U	4.82 U
Phenanthrene	--			**5.12**	**6.99**	**4.8 J**	4.82 U
Pyrene	--			**10.8**	**9.13**	**4.46 J**	4.82 U
Total PAH (U=1/2)	17,000			**79.13 J**	**70.98 J**	**55.18 J**	4.82 U
Semivolatile Organic Compounds (µg/kg)							
2-Methylphenol (o-Cresol)	--			19.5 U	19.5 U	19.9 U	19.2 U
2,4-Dimethylphenol	--			24.4 U	24.3 U	24.9 U	24 U
4-Methylphenol (p-Cresol)	260	260	2,000	19.5 U	19.5 U	19.9 U	19.2 U
Benzoic acid	2,900			195 U	195 U	**61.8**	192 U
Bis(2-ethylhexyl) phthalate	500	500	22,000	48.7 U	48.7 U	49.8 U	48 U
Carbazole	900			19.5 U	19.5 U	19.9 U	19.2 U
Dibenzofuran	200	200	680	19.5 U	19.5 U	19.9 U	19.2 U
Di-n-butyl phthalate	380	380	1,000	19.5 U	19.5 U	19.9 U	19.2 U
Di-n-octyl phthalate	39	39	> 1,100	19.5 U	19.5 U	19.9 U	19.2 U
Pentachlorophenol	1,200	1,200	> 1,200	97.4 UJ	97.4 UJ	99.7 UJ	95.9 UJ
Phenol	120	120	210	19.5 U	19.5 U	**8.4**	19.2 U
Polychlorinated biphenyl (PCB) Aroclors (µg/kg)							
Aroclor 1016	--			4 U	3.8 U	3.9 U	4 U
Aroclor 1221	--			4 U	3.8 U	3.9 U	4 U
Aroclor 1232	--			4 U	3.8 U	3.9 U	4 U
Aroclor 1242	--			4 U	3.8 U	3.9 U	4 U
Aroclor 1248	--			4 U	3.8 U	3.9 U	4 U
Aroclor 1254	--			4 U	3.8 U	3.9 U	4 U
Aroclor 1260	--			4 U	3.8 U	3.9 U	4 U
Total PCB Aroclors	110	110	2,500	4 U	3.8 U	3.9 U	4 U
Pesticides (µg/kg)							
4,4'-DDD (p,p'-DDD)	310	310	860	0.99 U	0.94 U	0.98 U	0.99 U
4,4'-DDE (p,p'-DDE)	21	21	33	0.99 U	0.94 U	0.98 U	0.99 U
4,4'-DDT (p,p'-DDT)	100	100	8,100	0.99 U	0.94 U	0.98 U	0.99 U
Aldrin	--			0.49 U	0.47 U	0.49 U	0.5 U
alpha-Chlordane (cis-Chlordane)	--			0.49 U	0.47 U	0.49 U	0.5 U
beta-Chlordane (trans-Chlordane)	--			0.49 U	0.47 U	**0.72**	0.5 U
cis-Nonachlor	--			0.99 U	0.94 U	0.98 U	0.99 U
trans-Nonachlor	--			0.99 U	0.94 U	2.94 UJ	0.99 U
Oxychlordane	--			0.99 U	0.94 U	0.98 U	0.99 U
Dieldrin	4.9	4.9	9.3	0.99 U	0.94 U	0.98 U	0.99 U
Endrin	8.5	8.5		0.99 U	0.94 U	0.98 U	0.99 U
gamma-BHC (Lindane)	7.2			0.49 U	0.47 U	0.49 U	0.5 U
Heptachlor	--			0.49 U	0.47 U	0.49 U	0.5 U
Total Chlordane (1)	--			0.99 U	0.94 U	**1.46**	0.99 U
Total Petroleum Hydrocarbons (mg/kg)							
Diesel-Range Organics	340			6.3 U	6.36 U	7.44 U	6.69 U
Residual-Range Organics	3,600			12.6 U	12.7 U	14.9 U	13.4 U

Notes:

-- Not available.
BOLD Detected result.
1 Total chlordane is the summation of alpha-chlordane, beta-chlordane, and oxychlordane.

Abbreviations:

CSL Cleanup screening level
DDD Dichlorodiphenyldichloroethane
DDE Dichlorodiphenyldichloroethylene
DDT Dichlorodiphenyltrichloroethane
DMMU Dredged Material Management Unit
µg/kg Micrograms per kilogram
mg/kg Milligrams per kilogram
PAH Polycyclic aromatic hydrocarbon
PCB Polychlorinated biphenyl
SCO Sediment Cleanup Objective
SEF Sediment Evaluation Framework
SL Screening level
SMS Sediment Management Standards

Qualifiers:

J Analyte was detected; concentration is considered an estimate.
U Analyte was not detected at the given reporting limit.
UJ Analyte was not detected at the given reporting limit; concentration is considered an estimate.

Table 4.1
Soil Analytical Results for TPH, BTEX, and Lead

			Analysis Method	NWTPH-HCID			USEPA 8260C				NWTPH-Gx	NWTPH-Dx		USEPA 6020
			Analyte	Gasoline	Diesel	Heavy Oil	Benzene	Ethylbenzene	Toluene	Xylenes (total)	Gasoline-Range Organics	Diesel-Range Organics	Oil-Range Organics	Lead
			MTCA Method A Cleanup Level	30/100 (1)	2,000	2,000	0.030	7	6	9	30/100 (1)	2,000	2,000	250
			Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Location	Sample ID	Sample Date	Depth (feet bgs)											
GP-1	GP-1-19.5-20	09/15/2015	19.5–20	--	--	--	0.03 U	0.05 U	0.05 U	0.1 U	18	280	250 U	1.75
GP-1	GP-1-21-21.5	09/15/2015	21–21.5	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-2	GP-2-16-16.5	09/15/2015	16–16.5	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-3	GP-3-2-3	09/15/2015	2–3	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-3	GP-3-16-16.5	09/15/2015	16–16.5	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-4	GP-4-21-21.5	09/15/2015	21–21.5	20 U	50 U	D	--	--	--	--	--	50 U	470	--
GP-5	GP-5-19-19.5	09/17/2015	19–19.5	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-6	GP-6-16-17	09/15/2015	16–17	20 U	50 U	D	--	--	--	--	--	50 U	140 JQ	--
GP-7	GP-7-25.5-26	09/15/2015	25.5–26	20 U	50 U	D	--	--	--	--	--	50 U	470	--
GP-8	GP-8-25.5-26	09/15/2015	25.5–26	20 U	50 U	D	--	--	--	--	--	50 U	720	--
GP-9	GP-9-27.5-28	09/16/2015	27.5–28	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-10	GP-10-28-28.5	09/16/2015	28–28.5	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-11	GP-11-27-27.5	09/16/2015	27–27.5	20 U	50 U	D	--	--	--	--	--	120 JM	530	--
GP-12	GP-12-26-26.5	09/16/2015	26–26.5	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-13	GP-13-26.5-27	09/16/2015	26.5–27	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-14	GP-14-26-26.5	09/16/2015	26–26.5	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-15	GP-15-27-27.5	09/16/2015	27–27.5	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-16	GP-16-27.5-28	09/16/2015	27.5–28	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-17	GP-17-26-26.5	09/17/2015	26–26.5	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-18	GP-18-27-28	09/16/2015	27–28	--	--	--	0.03 U	0.05 U	0.05 U	0.1 U	71	**4,400**	**5,600**	8.86
GP-18	GP-18-29-30	09/16/2015	29–30	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-19	GP-19-23.5-24	09/17/2015	23.5–24	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-20	GP-20-24-25	09/17/2015	24–25	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-21	GP-21-21-21.5	09/17/2015	21–21.5	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-21	GP-21-25.5-26	09/17/2015	25.5–26	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-22	GP-22-29-29.5	09/17/2015	29–29.5	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-23	GP-23-10.5-11	09/17/2015	10.5–11	20 U	50 U	D	--	--	--	--	--	50 U	510	--
GP-23	GP-23-27-27.5	09/17/2015	27–27.5	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-24	GP-24-20-20.5	09/17/2015	20–20.5	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-25	GP-25-20-20.5	09/17/2015	20–20.5	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-26	GP-26-14-14.5	09/18/2015	14–14.5	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-26	GP-26-19-19.5	09/18/2015	19–19.5	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-27	GP-27-14-14.5	09/18/2015	14–14.5	--	--	--	0.03 U	0.05 U	0.05 U	0.1 U	30	**11,000**	**11,000**	5.14
GP-27	GP-27-17-18	09/18/2015	17–18	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-29	GP-29-25-25.5	09/18/2015	25–25.5	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-29	GP-29-27-27.5	09/18/2015	27–27.5	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-30	GP-30-16-16.5	09/18/2015	16–16.5	20 U	50 U	250 U	--	--	--	--	--	--	--	--
GP-30	GP-30-19.5-20	09/18/2015	19.5–20	20 U	50 U	250 U	--	--	--	--	--	--	--	--

Notes:

-- Not analyzed.
BOLD/RED Detected at a concentration that exceeds the MTCA Method A cleanup level.
D Analyte was detected during screening.
1 Criterion is 30 mg/kg if benzene is present and 100 mg/kg if no detectable benzene is present.

Abbreviations:

bgs Below ground surface
BTEX Benzene, toluene, ethylbenzene, and xylenes
mg/kg Milligrams per kilogram
MTCA Model Toxics Control Act
TPH Total petroleum hydrocarbons
USEPA U.S. Environmental Protection Agency

Qualifiers:

JM Analyte was detected; concentration is considered an estimate due to a poor match to the chromatographic standard.
JQ Analyte was detected below the reporting limit; concentration is considered an estimate.
U Analyte was not detected; concentration given is the reporting limit.

Table 4.2
Soil Analytical Results for VOCs and EPH/VPH

	Location	GP-1	GP-18	GP-27	MTCA Method A Cleanup Level
	Sample ID	GP-1-19.5-20	GP-18-27-28	GP-27-14-14.5	
	Sample Date	09/15/2015	09/16/2015	09/18/2015	
	Sample Depth (feet bgs)	19.5–20	27–28	14–14.5	
Analyte	**Unit**				
DCE by USEPA 8260C Direct Sparge					
1,2-Dibromoethane	mg/kg	0.005 UJ	0.005 UJ	0.005 UJ	0.005
Volatile Organic Compounds by USEPA 8260C (1)					
1,2-Dibromoethane	mg/kg	0.05 U	0.05 U	0.05 U	0.005
1,2-Dichloroethane	mg/kg	0.05 U	0.05 U	0.05 U	11 (2)
Benzene	mg/kg	0.03 U	0.03 U	0.03 U	0.03
Ethylbenzene	mg/kg	0.05 U	0.05 U	0.05 U	6
Toluene	mg/kg	0.05 U	0.05 U	0.05 U	7
Xylenes (total)	mg/kg	0.1 U	0.1 U	0.1 U	9
Methyl tert-butyl ether	mg/kg	0.05 U	0.05 U	0.05 U	0.1
n-Hexane	mg/kg	0.25 U	0.25 U	0.25 U	4,800 (1)
Semivolatile Organic Compounds by USEPA 8270C-SIM (2)					
1-Methylnaphthalene	mg/kg	0.01 U	10	15	5,600 (1)
2-Methylnaphthalene	mg/kg	0.01 U	0.5 U	7.2	320 (1)
Acenaphthene	mg/kg	0.01 U	1.1	1.6	4,800 (1)
Acenaphthylene	mg/kg	0.01 U	0.5 U	0.1 U	--
Anthracene	mg/kg	0.01 U	1.6	2.6	24,000 (1)
Benzo(a)anthracene	mg/kg	0.01 U	0.86	2	1.37 (1)
Benzo(a)pyrene	mg/kg	0.01 U	0.5 U	0.65	0.1
Benzo(b)fluoranthene	mg/kg	0.01 U	0.5 U	0.35	1.37 (1)
Benzo(g,h,i)perylene	mg/kg	0.01 U	0.5 U	0.19	--
Benzo(k)fluoranthene	mg/kg	0.01 U	0.5 U	0.1 U	13.7 (1)
Chrysene	mg/kg	0.01 U	1.5	3.8	137 (1)
Dibenzo(a,h)anthracene	mg/kg	0.01 U	0.5 U	0.16	0.137 (1)
Fluoranthene	mg/kg	0.01 U	0.5 U	0.94	3,200 (1)
Fluorene	mg/kg	0.036	2.5	2.9	3,200 (1)
Indeno(1,2,3-c,d)pyrene	mg/kg	0.01 U	0.5 U	0.1 U	1.37 (1)
Naphthalene	mg/kg	0.01 U	0.5 U	0.1 U	5
Phenanthrene	mg/kg	0.076	3.6	10	--
Pyrene	mg/kg	0.01 U	2.4	4.3	2,400 (1)
cPAHs (MTCA TEQ-HalfND)	mg/kg	0.005 U	**0.5**	**0.95**	0.1
cPAHs (MTCA TEQ-ZeroND)	mg/kg	0.01 U	**0.5**	**0.95**	0.1
NWTPH-Gx/Dx					
Gasoline-range organics	mg/kg	18	71	30	100
Diesel-range organics	mg/kg	280	**4,400**	**11,000**	2,000
Oil-range organics	mg/kg	250 U	**5,600**	**11,000**	2,000
NWEPH					
C8-C10 Aliphatics	mg/kg	6.03 UJ	7.71	9.41	--
C10-C12 Aliphatics	mg/kg	6.03 UJ	74.9 JQ	154 JQ	--
C12-C16 Aliphatics	mg/kg	17.7 J	365 JQ	949	--
C16-C21 Aliphatics	mg/kg	26 J	388 JQ	1080	--
C21-C34 Aliphatics	mg/kg	6.03 UJ	374 JQ	879	--
C8-C10 Aromatics	mg/kg	6.03 U	5.9 U	6.79 U	--
C10-C12 Aromatics	mg/kg	6.03 U	27.5	48.5	--
C12-C16 Aromatics	mg/kg	6.03 U	327 JQ	583 JQ	--
C16-C21 Aromatics	mg/kg	19.4	1020	1900	--
C21-C34 Aromatics	mg/kg	6.03 U	919	1260	--
NWVPH					
C5-C6 Aliphatics	mg/kg	2.17 U	2.61 U	2.27 U	--
C6-C8 Aliphatics	mg/kg	2.17 U	2.61 U	2.27 U	--
C8-C10 Aliphatics	mg/kg	2.17 U	2.61 U	2.27 U	--
C10-C12 Aliphatics	mg/kg	2.17 U	12.3	7.69	--
C10-C12 Aromatics	mg/kg	3.88 J	23.3 J	28.7 J	--
C12-C13 Aromatics	mg/kg	7.05	47.9	55.8	--
C8-C10 Aromatics	mg/kg	7.81	8.1	10.6	--
Benzene	mg/kg	0.542 U	0.653 U	0.568 U	0.03
Ethylbenzene	mg/kg	0.542 U	0.653 U	0.568 U	6
Toluene	mg/kg	0.542 U	0.653 U	0.568 U	7
Xylenes (total)	mg/kg	0.542 U	0.653 U	0.568 U	9
Methyl tert-butyl ether	mg/kg	0.542 U	0.653 U	0.568 U	0.1
Naphthalene	mg/kg	0.542 U	3.07	2.31	5

Notes:

--	Not applicable
BOLD/RED	Detected at a concentration that exceeds the MTCA Method A cleanup level.
1	Includes VOCs required by Table 830-1 under MTCA.
2	MTCA Method B unrestricted land use cleanup level.

Abbreviations:

bgs	Below ground surface	TEQ	Toxicity equivalent
cPAH	Carcinogenic polycyclic aromatic hydrocarbons	TPH	Total petroleum hydrocarbons
DCE	Dichloroethene	USEPA	U.S. Environmental Protection Agency
EPH	Extractable petroleum hydrocarbons	VOC	Volatile organic compound
HalfND	Half of reporting limit used for all non-detections	VPH	Volatile petroleum hydrocarbons
mg/kg	Milligrams per kilogram	ZeroND	Reporting limit used for all non-detections
MTCA	Model Toxics Control Act		

Qualifiers:

J	Analyte was detected; concentration is considered an estimate.
JQ	Analyte was detected below the reporting limit; concentration is considered an estimate.
U	Analyte was not detected; concentration given is the reporting limit.
UJ	Analyte was not detected; concentration given is the reporting limit, which is considered to be an estimate.

Table 4.3

Groundwater Analytical Results for TPH and BTEX—2015 Priority Data Gaps Results

			Analysis Method	**USEPA 8021B**				**NWTPH-Gx**	**NWTPH-Dx**	
			Analyte	**Benzene**	**Ethylbenzene**	**Toluene**	**Xylenes (total)**	**Gasoline-Range Organics**	**Diesel-Range Organics**	**Oil-Range Organics**
			MTCA Method A Cleanup Level	**5**	**700**	**1,000**	**1,000**	**800/1,000 (1)**	**500 (2)**	
			Unit	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Location	**Sample ID**	**Sample Date**	**Sample Depth (feet bgs)**							
GP-1	GP-1-GW	09/15/2015	21.75–25	1 U	1 U	1 U	3 U	290	**820 JM**	250 U
GP-2	GP-2-GW	09/15/2015	21–25	1 U	1 U	1 U	3 U	310	**1,100 JM**	250 U
GP-3	GP-3-GW	09/15/2015	16.5–25	1 U	1 U	1 U	3 U	100 U	50 U	250 U
GP-4	GP-4-GW	09/15/2015	21.5–25	1 U	1 U	1 U	3 U	100 U	110 JM	250 U
GP-6	GP-6-GW	09/15/2015	16.5–20	1 U	1 U	1 U	3 U	100 U	**600 JM**	290 JM
GP-7	GP-7-GW	09/15/2015	26–30	1 U	1 U	1 U	3 U	100 U	50 U	250 U
GP-8	GP-8-GW	09/15/2015	26–30	1 U	1 U	1 U	3 U	100 U	50 U	250 U
GP-13	GP-13-GW	09/16/2015	27–30	1 U	1 U	1.1	3 U	100 U	180 JM	250 U
GP-14	GP-14-GW	09/16/2015	26.5–30	1 U	1 U	1 U	3 U	100 U	100 JM	250 U
GP-15	GP-15-GW	09/16/2015	27.5–30	1 U	1 U	1 U	3 U	100 U	50 U	250 U
GP-16	GP-16-GW	09/16/2015	28–30	1 U	1 U	1.1	3 U	100 U	50 U	250 U
GP-17	GP-17-GW	09/17/2015	26.5–30	1 U	1 U	1 U	3 U	100 U	68 JM	250 U
GP-18	GP-18-GW	09/18/2015	28–30	1 U	1 U	1 U	3 U	100 U	50 U	250 U
GP-20	GP-20-GW	09/17/2015	25–30	1 U	1 U	1 U	3 U	100 U	50 U	250 U
GP-21	GP-21-GW	09/17/2015	26–30	1 U	1 U	1 U	3 U	100 U	50 U	250 U
GP-28	GP-28-GW	09/18/2015	28–30	1 U	1 U	1 U	3 U	100 U	50 U	250 U
MW-23	MW-23-091415	09/14/2015	22.5–32.5	1 U	1 U	1 U	3 U	100 U	50 U	250 U

Notes:

BOLD/RED	Detected at a concentration that exceeds the MTCA Method A cleanup level.
1	Criterion is 800 µg/L if benzene is present and 1,000 µg/L if no detectable benzene is present.
2	Results for diesel- and oil-range organics are added together and compared against the MTCA Method A cleanup level. Non-detections are not added to the total.

Abbreviations:

bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and xylenes
µg/L	Micrograms per liter
MTCA	Model Toxics Control Act
TPH	Total petroleum hydrocarbons
USEPA	U.S. Environmental Protection Agency

Qualifiers:

JM	Analyte was detected; concentration is considered an estimate due to a poor match to the chromatographic standard.
U	Analyte was not detected; concentration given is the reporting limit.

Table 4.4
Groundwater Analytical Results for TPH and BTEX—2019 Monitoring Well Results

			Analysis Method	USEPA 8021B				NWTPH-Gx	NWTPH-Dx		NWTPH-Dx (Silica Gel Cleanup)	
			Analyte	Benzene	Ethylbenzene	Toluene	Xylenes (total)	Gasoline-Range Organics	Diesel-Range Organics	Oil-Range Organics	Diesel-Range Organics	Oil-Range Organics
			MTCA Method A Cleanup Level	5	700	1,000	1,000	800/1,000 (1)	500 (2)		500 (2)	
			Unit	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Location	Field Sample	Sample Date	Sample Depth (feet bgs)									
MW-01	MW-01-022719	02/27/2019	6.3–16.3	1 U	1 U	1 U	3 U	100 U	60 U	300 U	60 U	300 U
MW-02	MW-02-022719	02/27/2019	6.2–12.4	1 U	1 U	1 U	3 U	100 U	60 U	300 U	60 U	300 U
MW-03	MW-03-022719	02/27/2019	8.4–18.4	**13**	5 U	5 U	15 U	**960**	**1,700** (3)	**450** (3)	73 (3)	300 U
MW-04	MW-04-022819	02/28/2019	7.4–17.4	1 U	1 U	1 U	3 U	100 U	60 U	300 U	60 U	300 U
MW-05	MW-05-022719	02/27/2019	12.5–22.5	1 U	1 U	1 U	3 U	100 U	82 (3)	300 U	60 U	300 U
MW-06	MW-06-022719	02/27/2019	16–21	1 U	1 U	1 U	3 U	100 U	**800** (3)	300 U	140	300 U
MW-07	MW-07-022719	02/27/2019	18–23	2	2.2	9.2	6	**1,100**	**780** (3)	300 U	340 (3)	300 U
MW-08 (4)	--	--	--	--	--	--	--	--	--	--	--	--
MW-09 (4)	--	--	--	--	--	--	--	--	--	--	--	--
MW-10	MW-10-022719	02/27/2019	18–23	1.1	1 U	1 U	3 U	100 U	60 U	300 U	60 U	300 U
MW-11	MW-11-022819	02/28/2019	6.7–16.7	1 U	1 U	1 U	3 U	100 U	60 U	300 U	60 U	300 U
MW-12	MW-12-022719	02/27/2019	22–27	**61**	3.5	6.4	6.2	600	490 (3)	300 U	100 (3)	300 U
MW-13	MW-13-022819	02/28/2019	13–18	1 U	1 U	1 U	3 U	100 U	60 U	300 U	60 U	300 U
MW-14	MW-14-022719	02/27/2019	7–12	1 U	1 U	1 U	3 U	100 U	150 (3)	300 U	81	300 U
MW-15	MW-15-022719	02/27/2019	8.5–18.5	1 U	1 U	1 U	3 U	100 U	78 (3)	300 U	60 U	300 U
MW-16	MW-16-022719	02/27/2019	4.5–14.5	1 U	1 U	1 U	3 U	100 U	60 U	300 U	60 U	300 U
MW-17	MW-17-022819	02/28/2019	7.5–17.5	1 U	1 U	1 U	3 U	100 U	60 U	300 U	65 U	320 U
MW-18	MW-18-022819	02/28/2019	8–18	1 U	1 U	1 U	3 U	100 U	60 U	300 U	60 U	300 U
MW-19	MW-19-022719	02/27/2019	13.5–18.5	1 U	1 U	1 U	3 U	100 U	67 (3)	300 U	60 U	300 U
MW-20	MW-20-022819	02/28/2019	11.5–21.5	1.7	7	1 U	9.1	**1,500**	**970** (3)	**360** (3)	370 (3)	300 U
MW-22	MW-22-022819	02/28/2019	20.2–30.2	1 U	1 U	1 U	3 U	100 U	60 U	300 U	60 U	300 U
MW-23	MW-23-022819	02/28/2019	22.4–32.4	1 U	1 U	1 U	3 U	100 U	60 U	300 U	60 U	300 U
MW-24	MW-24-022819	02/28/2019	9.6–19.6	1 U	1 U	1 U	3 U	100 U	60 U	300 U	60 U	300 U
MW-25	MW-25-022819	02/28/2019	7.8–17.8	1 U	1 U	1 U	3 U	100 U	60 U	300 U	60 U	300 U
MW-26	MW-26-022819	02/28/2019	9.4–19.4	1 U	1 U	1 U	3 U	100 U	140 (3)	300 U	60 U	300 U
MW-27	MW-27-022819	02/28/2019	18–28	1 U	1 U	1 U	3 U	100 U	60 U	300 U	60 U	300 U
MW-28	MW-28-022819	02/28/2019	9.8–19.8	1 U	1 U	1 U	3 U	100 U	**5,500** (3)	**1,600** (3)	**610**	300 U
MW-29	MW-29-022819	02/28/2019	15–27.7	1 U	1 U	1 U	3 U	100 U	60 U	300 U	60 U	300 U
MW-30 (4)	--	--	--	--	--	--	--	--	--	--	--	--
MW-31	MW-31-022719	02/27/2019	9–19	1 U	1 U	1 U	3 U	100 U	60 U	300 U	60 U	300 U
	MW-131-022719	02/27/2019	9–19	1 U	1 U	1 U	3 U	100 U	60 U	300 U	60 U	300 U
MW-32	MW-32-022819	02/28/2019	8–18	1 U	1 U	1 U	3 U	100 U	60 U	300 U	60 U	300 U
UST-4	UST-4-022819	02/28/2019	14.3–24.3	1 U	1 U	1 U	3 U	100 U	140 (3)	300 U	60 U	300 U
	UST-104-022819	02/28/2019	14.3–24.3	1 U	1 U	1 U	3 U	100 U	140 (3)	300 U	60 U	300 U

Notes:

-- Not applicable.
OLD/RED Detected at a concentration that exceeds the MTCA Method A cleanup level.
1 Criterion is 800 µg/L if benzene is present and 1,000 µg/L if no detectable benzene is present.
2 Results for diesel-range organics and oil-range organics are added together and compared against the Method A cleanup level. Non-detections are not added to the total.
3 The laboratory noted that the sample chromatographic pattern does not resemble the fuel standard used for quantitation.
4 Monitoring well was not sampled during the February 2019 monitoring event.

Abbreviations:

bgs Below ground surface
BTEX Benzene, toluene, ethylbenzene, and xylenes
µg/L Micrograms per liter
MTCA Model Toxics Control Act
TPH Total petroleum hydrocarbons
USEPA U.S. Environmental Protection Agency

Qualifier:

U Analyte was not detected; concentration given is the reporting limit.

Table 4.5
Well Screen Depths

Monitoring Well ID	Construction Date	Approximate Ground Surface Elevation (feet MSL) (1)	Approximate Screen Length (feet)	Approximate Top of Screen Elevation (feet MSL)	Approximate Bottom of Screen Elevation (feet MSL)	Screened Interval Unit (2)
MW-1	04/30/1991	15	10	8.7	-1.3	Alluvial Aquifer
MW-2	04/30/1991	21	6	14.8	8.6	Vadose
MW-3	05/01/1991	20	10	11.6	1.6	Alluvial Aquifer
MW-4	05/02/1991	23	10	15.6	5.6	Vadose
MW-5	05/03/1991	21	10	8.5	-1.5	Alluvial Aquifer
MW-6	12/09/1992	16.0	5	0.0	-5.0	Alluvial Aquifer
MW-7	12/07/1992	20	5	2.0	-3.0	Alluvial Aquifer
MW-8	12/08/1992	20	5	2.0	-3.0	Alluvial Aquifer
MW-9	12/02/1992	21	10	13.0	3.0	Vadose
MW-10	12/07/1992	21	5	3.0	-2.0	Alluvial Aquifer
MW-11	12/03/1992	23	10	16.3	6.3	Vadose
MW-12	12/04/1992	20	5	-2.0	-7.0	Alluvial Aquifer
MW-13	05/26/1993	22	5	9.0	4.0	Vadose
MW-14	05/17/1993	22	5	15.0	10.0	Vadose
MW-15	05/18/1993	19	10	10.5	0.5	Alluvial Aquifer
MW-16	05/18/1993	20	10	15.5	5.5	Vadose
MW-17	05/19/1993	23	10	15.5	5.5	Vadose
MW-18	05/19/1993	24	10	16.0	6.0	Vadose
MW-19	05/20/1993	17	5	3.5	-1.5	Alluvial Aquifer
MW-20	05/20/1993	21	10	9.5	-0.5	Alluvial Aquifer
MW-22	03/01/1994	NA	10	NA	NA	NA
MW-23	03/02/1994	29	10	6.6	-3.4	Alluvial Aquifer
MW-24	03/03/1994	25	10	15.4	5.4	Vadose
MW-25	03/02/1994	19.5	10	11.7	1.7	Alluvial Aquifer
MW-26	03/03/1994	25	10	15.6	5.6	Vadose
MW-27	03/21/1994	24	10	6.0	-4.0	Alluvial Aquifer
MW-28	03/22/1994	26	10	16.2	6.2	Vadose
MW-29	06/03/1994	28	13	13.0	0.3	Alluvial Aquifer
MW-30	06/24/1998	24	17	15.0	-2.0	Alluvial Aquifer
MW-31	06/24/1998	18	10	9.0	-1.0	Alluvial Aquifer
MW-32	06/24/1998	19	10	11.0	1.0	Alluvial Aquifer
UST-4	07/26/1993	NA	10	NA	NA	NA

Notes:

1 Approximate ground surface elevation where available based on cross sections by Golder (1994) or top of well casing.

2 Screened interval unit indicates deepest unit penetrated based on alluvial aquifer surface at approximately 0 to 2 feet above MSL. Wells screened exclusiviely in the vadose zone may intersect perched groundwater.

Abbreviations:

MSL Mean sea level
NA Not available

Table 4.6
Preliminary Screening Levels

Exposure Pathway for Soil

Analyte	Unrestricted Land Use (Method A)	Direct Contact by Industrial Workers (Method C Industrial)	Protection of Drinking Water	MTCA Residual Saturation $^{(1)}$	Protection of Groundwater to Surface Water: 3-Phase (Saturated Soil) $^{(2)}$
Gasoline-range organics	30 mg/kg	30,000 mg/kg (EPH/VPH results)	17 mg/kg (EPH/VPH soil results)	5,625 mg/kg	--
Diesel-range organics	2,000 mg/kg			13,333 mg/kg	--
Oil-range organics	2,000 mg/kg			30,000 mg/kg	--
cPAHs	0.1 mg/kg	18 mg/kg	2 mg/kg	--	0.00013
Benzene	0.03 mg/kg	239 mg/kg	0.03 mg/kg	--	--
Toluene	7 mg/kg	280,000 mg/kg	7 mg/kg	--	--
Ethylbenzene	6 mg/kg	350,000 mg/kg	6 mg/kg	--	--
Total xylenes	9 mg/kg	700,000 mg/kg	9 mg/kg	--	--

Exposure Pathway for Groundwater

Analyte	MTCA Method A Protection of Drinking Water $^{(3)}$	MTCA Method B Protection of Surface Water Human Health	USEPA AWQC Protection of Surface Water: Freshwater Aquatic Life Chronic	USEPA AWQC Protection of Surface Water: Human Health (Water + Organism)
Gasoline-range organics	800 µg/L	--	--	--
Diesel-range organics	500 µg/L	--	--	--
Oil-range organics	500 µg/L	--	--	--
cPAHs	0.1 µg/L	0.1 µg/L $^{(4)}$	--	0.1 µg/L $^{(4)}$
Benzene	5 µg/L	22.7 µg/L	--	--
Toluene	1,000 µg/L	18,900 µg/L	--	--
Ethylbenzene	700 µg/L	6,820 µg/L	--	--
Total xylenes	1,000 µg/L	--	--	--

Exposure Pathway for Indoor Air

Analyte $^{(5)}$	Sub-Slab MTCA Method B Soil Gas Screening Level $^{(6)}$	Sub-Slab MTCA Method C Soil Gas Screening Level $^{(6)}$
Total TPH $^{(7)(8)}$	4,700 µg/m^3	--
Benzene	11 µg/m^3	110 µg/m^3
Ethylbenzene	15,000 µg/m^3	33,000 µg/m^3
Methyl tert-butyl ether	320 µg/m^3	3,200 µg/m^3
Naphthalene	2.5 µg/m^3	25 µg/m^3
Toluene	7,600 µg/m^3	170,000 µg/m^3
Total Xylenes	1,500 µg/m^3	3,300 µg/m^3

Notes:

-- Not applicable.
1 Assumes a lithology of fine to medium sand (Ecology 2001).
2 This pathway is based on a conservative calculation and deference is given to groundwater and/or porewater data.
3 Site-specific cleanup levels may be developed from EPH/VPH data.
4 Criterion is less than the quantitation level for benzo(a)pyrene (used as a surrogate for cPAHs) specified by Ecology in its January 2015 Water Quality Program Permit Writer's Manual, Attachment 1-I: Effluent Characterization for Permit Application. Therefore, the proposed preliminary cleanup level is the quantitation level for benzo(a)pyrene.
5 Select analytes are shown on this table; however, any additional additives that are detected in soil or groundwater will be analyzed in soil gas samples.
6 Screening levels acquired from The May 2019 CLARC Spreadsheet Interim Update and Ecology's Memo #18.
7 Total TPH concentrations are compared to Indoor Air Cleanup Levels listed on Table 1 of Ecology's January 2018 Publication No. 17-09-043, Memo #18. An attenuation factor of 0.03 is applied to the indoor air cleanup levels to acquire a sub-slab TPH screening level of 4,700 µg/m^3, as per Section A.2 in Memo #18.
8 A MTCA Method C screening for Total TPH has not been established by Ecology. Refer to Attachment A-3 in Memo #18.

Abbreviations:

APH	Air-phase petroleum hydrocarbons
AWQC	Ambient Water Quality Criteria
cPAH	Carcinogenic polycyclic aromatic hydrocarbon
Ecology	Washington State Department of Ecology
EPH	Extractable petroleum hydrocarbons
µg/m^3	Micrograms per cubic meter
µg/L	Micrograms per liter
mg/L	Milligrams per liter
mg/kg	Milligrams per kilogram
MTCA	Model Toxics Control Act
USEPA	Environmental Protection Agency
VPH	Volatile petroleum hydrocarbons

Table 5.1
Summary of Proposed Data Collection by Areas of Potential Concern

Areas of Potential Concern (refer to Figure 5.1)	Data Gaps	Summary of Proposed Data Collection (1)
1. Soil and Groundwater beneath Transit Shed 2 and near Southern Pipelines	Isolated soil impacts along pipelines near Transit Shed 2 will require additional data to establish extent. In addition, there is a need to confirm that impacted groundwater beneath the Port property does not reach the Columbia River.	During the first mobilization, two OIP/HPT borings within the Transit Shed 2 and downgradient of GP-18 are proposed. If impacts are encountered, additional borings will be advanced to delineate the extent of impacted soil. During the second mobilization, soil samples will be collected using a direct-push drill and will be submitted for laboratory analyses. Direct-push locations will be determined using OIP/HPT results, and analytical results will be used to delineate the potential extent and calculate the volume of TPH impacts remaining at the Site. Groundwater screening samples will be collected, at depths based on the OIP and/or HPT survey, from at least one location within Transit Shed 2. Two hand auger borings (P3 and P4) will be advanced adjacent to surface samples P-1 and P-2 in order to delineate the vertical extent of surface soil impacts. Two borings, P5 and P6, will be advanced using a hand auger to collect soil samples beneath the westernmost pipelines beneath Berth 1. Additional surface samples may be collected to confirm that surface impacts are limited to beneath the former pipelines. Two monitoring wells, MW-37 and MW-38, will be installed within the vicinity of GP-13 and GP-16 and screened across the alluvial aquifer to confirm that impacted groundwater beneath the Port property does not extend to the Columbia River.
2. Former AST Area	Soil and groundwater quality to the east, southeast, and south of the former AST has not been fully delineated.	During the first mobilization, four OIP/HPT borings are proposed in locations within the vicinity of the former AST. If the OIP data indicate LNAPL and or residual TPH impacts, additional OIP borings will be added to delineate the extent. Based on the semiquantitative OIP results, additional strategic locations will be investigated during the first and second mobilizations with a direct-push drill rig to collect soil samples for laboratory analyses. Shallow soil samples will be collected below the base of the former excavation and at the depths with the representative impacts based on field screening observations. A minimum of one deeper soil sample will be collected from the depth where water-bearing soils were first observed. Groundwater screening samples will be collected, at depths based on the OIP and/or HPT survey, from all locations around the AST.
3. Former Mechanic's Shop USTs	Impacted soil was left behind during the UST removal. Vertical and lateral extent of soil in the vicinity has not been fully delineated beneath the former USTs.	During the first mobilization, four OIP/HPT borings are proposed within the vicinity of the former mechanic's shop and former UST locations to a depth of at least 30 feet bgs. If the OIP sensor detects LNAPL and/or residual TPH impacts, additional OIP borings will be added to delineate the extent. Based on the semiquantitative OIP results, additional strategic locations will be investigated, during the first and second mobilizations, with a direct-push drill rig to collect soil samples for laboratory analyses. Soil samples will be collected in accordance with Ecology's Table 830-1 and guidelines for UST decommissioning. Additionally, monitoring well UST-4 will be included in quarterly groundwater sampling in order to determine current water quality.
4. Monitoring Well MW-19	LNAPL was observed in monitoring well MW-19 during the 1993 sampling event; however, recent groundwater data show concentrations less than the respective MTCA Method A cleanup levels. The extent of soil and groundwater impacts in this vicinity has not been fully defined.	Two OIP borings will be advanced in the vicinity of MW-19. Additional OIP borings will be advanced outward to delineate the vertical and lateral extent of impacts based on real-time OIP results. Based on the semiquantitative OIP results, additional locations will need to be conducted with a direct-push rig in order to obtain quantitative soil and groundwater results. Direct-push locations will be spaced approximately every 25 feet to delineate the lateral extent of TPH-impacted soil. During the first and second mobilizations, direct-push borings will be advanced in the area that contains apparent TPH impacts, based on OIP results, in order to collect soil samples and delineate the vertical extent TPH impacts and to assist in determining soil impacts volume. Groundwater screening samples will be collected during the direct-push borings, at depths based on the OIP and/or HPT survey.
5. Former Fuel Loading Racks	Soil descriptions and soil and groundwater data indicate that impacts likely extend to the east and south of the loading racks. Surface soil remains a potentially complete exposure pathway based on the CSM of surface spills.	Approximately 15 OIP borings will be advanced in a grid arrangement within the vicinity of the former loading racks. The number of OIP borings is dependent on real-time results. Based on the semiquantitative OIP results, additional locations will need to be advanced and sampled using a direct-push rig in order to obtain quantitative soil and groundwater results. Direct-push locations will be spaced approximately every 25 feet to delineate the lateral extent of TPH impacted soil. Additionally, three perpendicular transects of OIP borings will be advanced from the area east of MW-20 to the west adjacent and within the former Warehouse 9 footprint. During the first and second mobilizations, at least eight direct-push borings will be advanced along the length of the former loading rack and in the area that contains apparent TPH impacts, via OIP results. Soil samples will be collected to confirm that no shallow soil pathway exists and to delineate the vertical extent of TPH impacts. Soil samples and groundwater grab samples will be collected in order to confirm OIP results. Shallow soil samples will be collected from the 0- to 2-foot interval at all soil boring locations. Groundwater screening samples will be collected at depths based on the OIP and/or HPT survey. One permanent groundwater monitoring well (tentatively shown as MW-33 on Figure 5.1) will be installed within the alluvial aquifer, beneath the perched zone and within the area containing the greatest TPH impacts, based on OIP results.

Table 5.1
Summary of Proposed Data Collection by Areas of Potential Concern

Areas of Potential Concern (refer to Figure 5.1)	Data Gaps	Summary of Proposed Data Collection [(1)]
6. Former Calloway Ross Parcel	The extent of soil impacts and LNAPL has not been fully delineated to the south of the former UST, beneath Warehouse 9.	Two OIP/HPT borings will be advanced in the area south of MW-10 and MW-9. Additional step-out borings will be advanced as needed based on OIP results. During the second mobilization, soil samples will be collected using a direct-push drill and will be submitted for laboratory analyses. Direct-push locations will be determined using OIP/HPT results, and analytical results will be used to delineate the potential extent and calculate a volume of TPH impacts remaining at the Site. Groundwater screening samples will be collected from all borings at depths based on the OIP and/or HPT survey.
7. Monitoring Wells MW-26 and MW-28	The results of 2019 groundwater monitoring indicated elevated concentrations of DRO and ORO detected at MW-28. Both monitoring wells in this area, MW-26 and MW-28, are screened in the perched zone.	A new monitoring well, MW-34 (tentative location shown on Figure 5.1), is proposed to be installed in this location in the alluvial aquifer. However, prior to the installation of a well in this area, OIP/HPT borings will be advanced to determine its location. During the first mobilization, approximately nine borings will be advanced, using a OIP sensor and HPT on a direct-push drill rig, at approximately 25-foot spacings within AOPC 7. The number of OIP locations is dependent on real-time results; additional borings may be added to delineate the extent of impacts, or fewer locations may be sufficient if impacts are not encountered. Based on the semiquantitative OIP results, additional strategic locations will be advanced and sampled using a direct-push rig during the second mobilization, in order to obtain quantitative soil and groundwater results. Direct-push locations will be selected to collect vertical and lateral confirmation samples to delineate the potential extent and calculate a volume of TPH impacts remaining at the Site. In addition, there is a need for groundwater data from the alluvial aquifer in this area of the Site. MW-34 will be installed in an area that displays the greatest TPH impacts, based on OIP results, and within the deeper alluvial aquifer.
8. Soil Vapor Quality	The soil vapor pathway to indoor air may be a risk for occupants in any future building within 100 feet of known LNAPL accumulations, such as measured at MW-9 in 2019.	The latest monitoring results indicate that LNAPL is present in MW-9 at a depth of 15.30 feet bgs, below the 15-foot threshold requiring sampling by guidance. To take a conservative approach, two Vapor Pins will be installed in the slab of the former Warehouse 9; one in the northeastern corner, near MW-9, and a second in the middle of the former Warehouse 9 slab. Vapor samples will be collected in order to assess the VI risk.
9. U.S. Army Reserve Building	A correspondence letter from Wilson Oil stated that a heating oil UST and a gasoline UST were associated with the U.S. Army Reserve building. Drawings indicate that the heating oil UST was located adjacent to the north side of the building. The location of the gasoline UST is unknown, and it is uncertain if it ever existed. Additional data are needed to investigate soil and groundwater quality in the vicinity that may have resulted from leaks from these USTs.	A building reconnaissance will be conducted to determine where the former heating oil UST was located and whether there is any further indication of the gasoline UST. A GPR survey will be conducted to locate these tanks. At least two direct-push borings will be advanced within the area of the former heating oil UST location. One direct-push boring will be advanced in the area of the former gasoline UST if further evidence of the gasoline UST is found. Additional step-out borings will be advanced as needed based on indications of soil impacts. Groundwater screening samples will be collected from at least one location within the former heating oil UST location.

Note:

1 Refer to the Sampling and Analysis Plan/Quality Assurance Project Plan (Appendix F) for sample collection methodology and analysis.

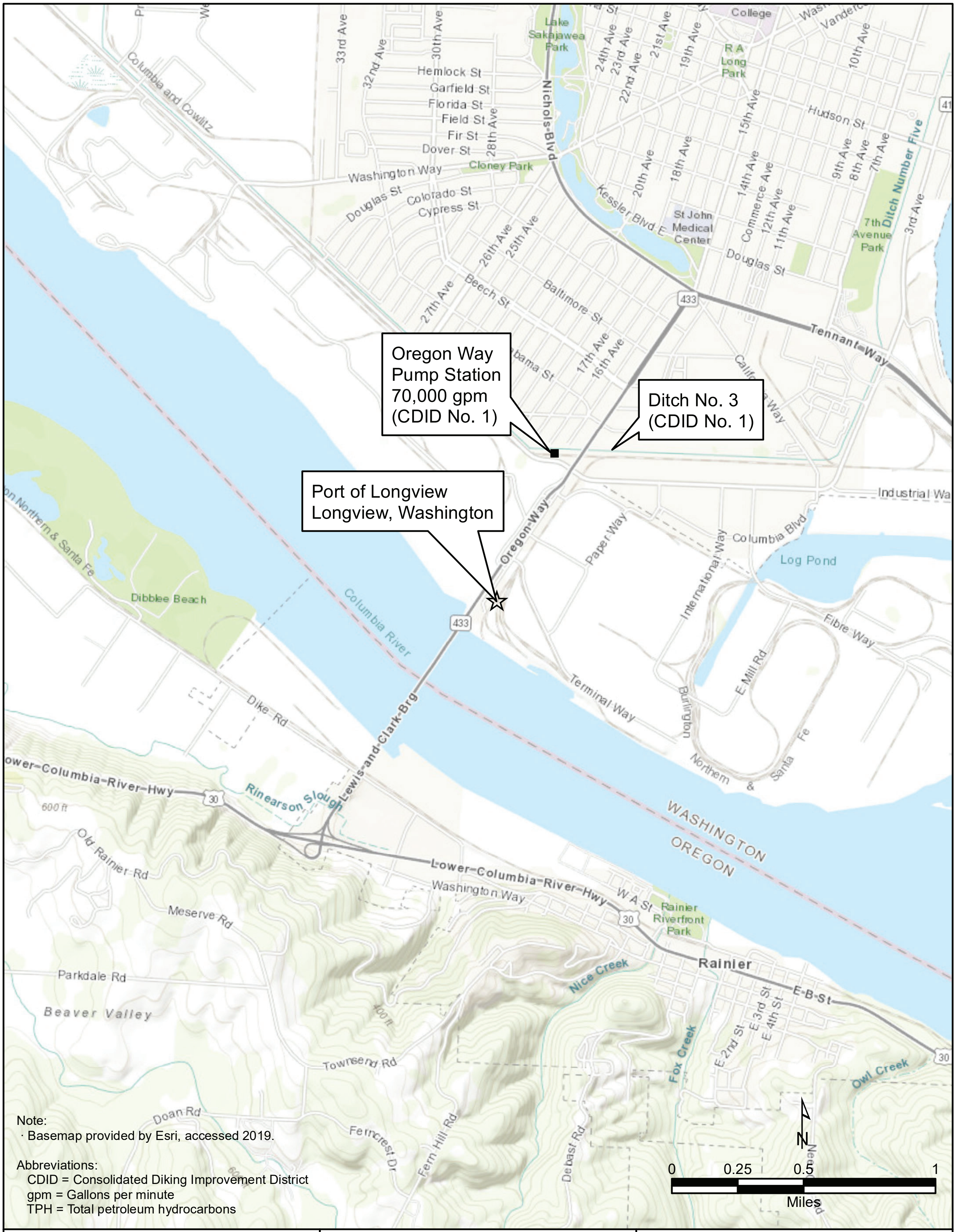
Abbreviations:

AST	Aboveground storage tank	LNAPL	Light non-aqueous-phase liquid
bgs	Below ground surface	MTCA	Model Toxics Control Act
CSM	Conceptual Site Model	OIP	Optical Image Profiler
DRO	Diesel-range organics	ORO	Oil-range organics
Ecology	Washington State Department of Ecology	TPH	Total petroleum hydrocarbons
GPR	Ground-penetrating radar	UST	Underground storage tank
HPT	Hydraulic profiling tool	VI	Vapor intrusion

Port of Longview TPH Site

Remedial Investigation Work Plan

Figures



Note:
· Basemap provided by Esri, accessed 2019.

Abbreviations:
CDID = Consolidated Diking Improvement District
gpm = Gallons per minute
TPH = Total petroleum hydrocarbons

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Remedial Investigation Work Plan
Port of Longview TPH Site
Longview, Washington

Figure 1.1
Vicinity Map

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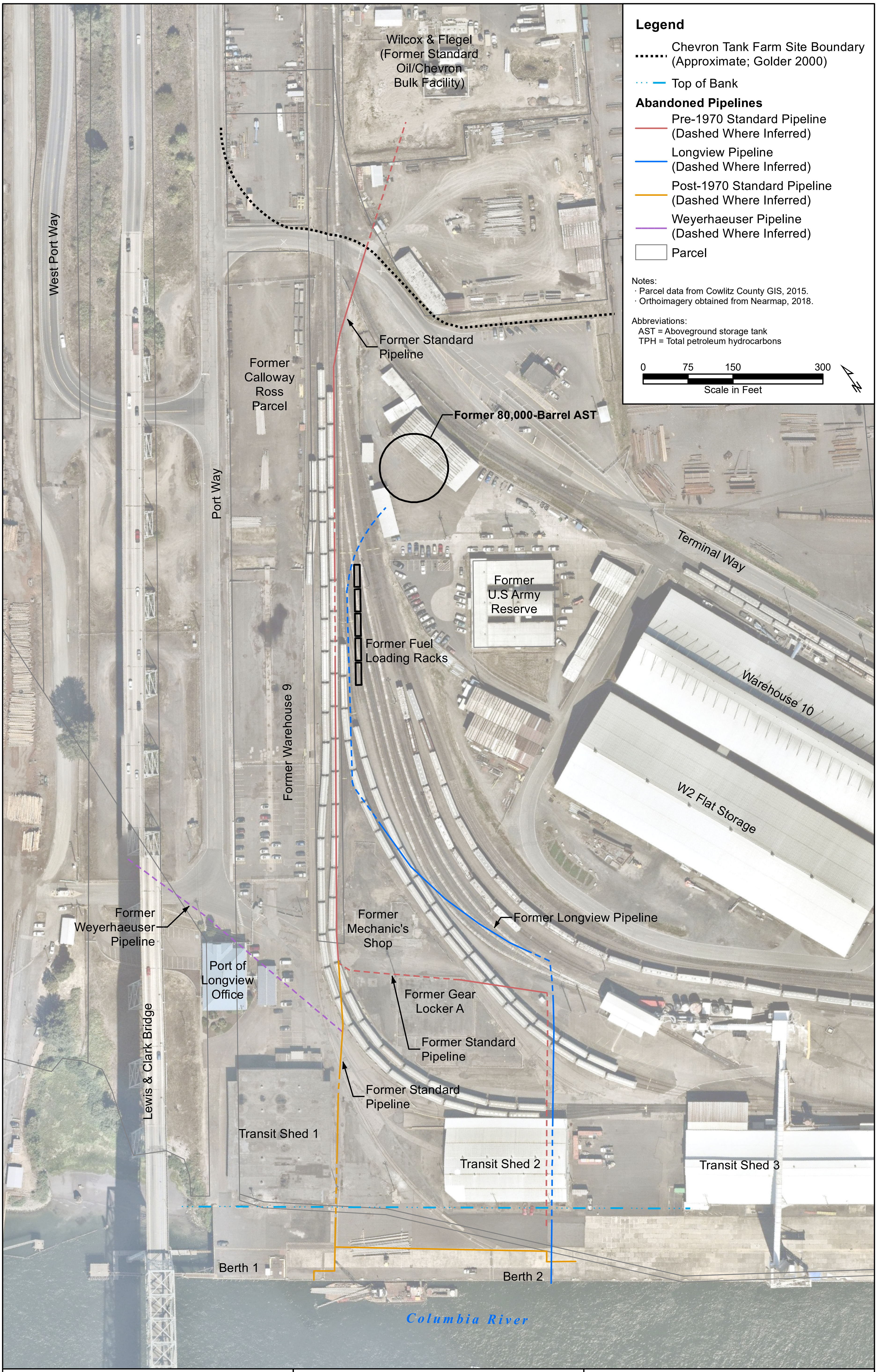

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Figure 1.2
Site Map

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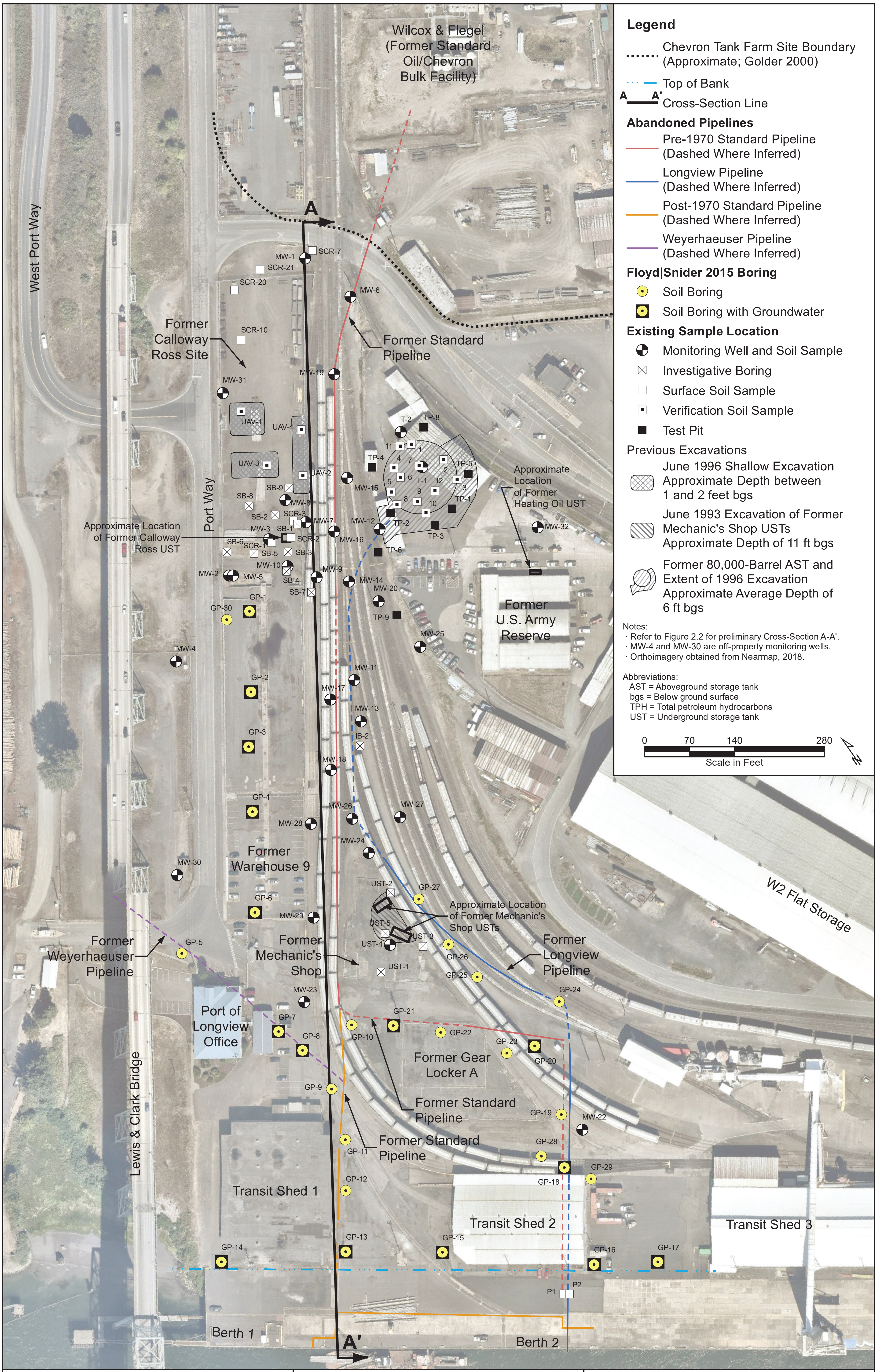
3/21/2019



Notes:
- Refer to Figure 2.2 for preliminary Cross-Section A-A'.
- MW-4 and MW-30 are off-property monitoring wells.
- Orthoimagery obtained from Nearmap, 2018.

Abbreviations:
AST = Aboveground storage tank
bgs = Below ground surface
TPH = Total petroleum hydrocarbons
UST = Underground storage tank

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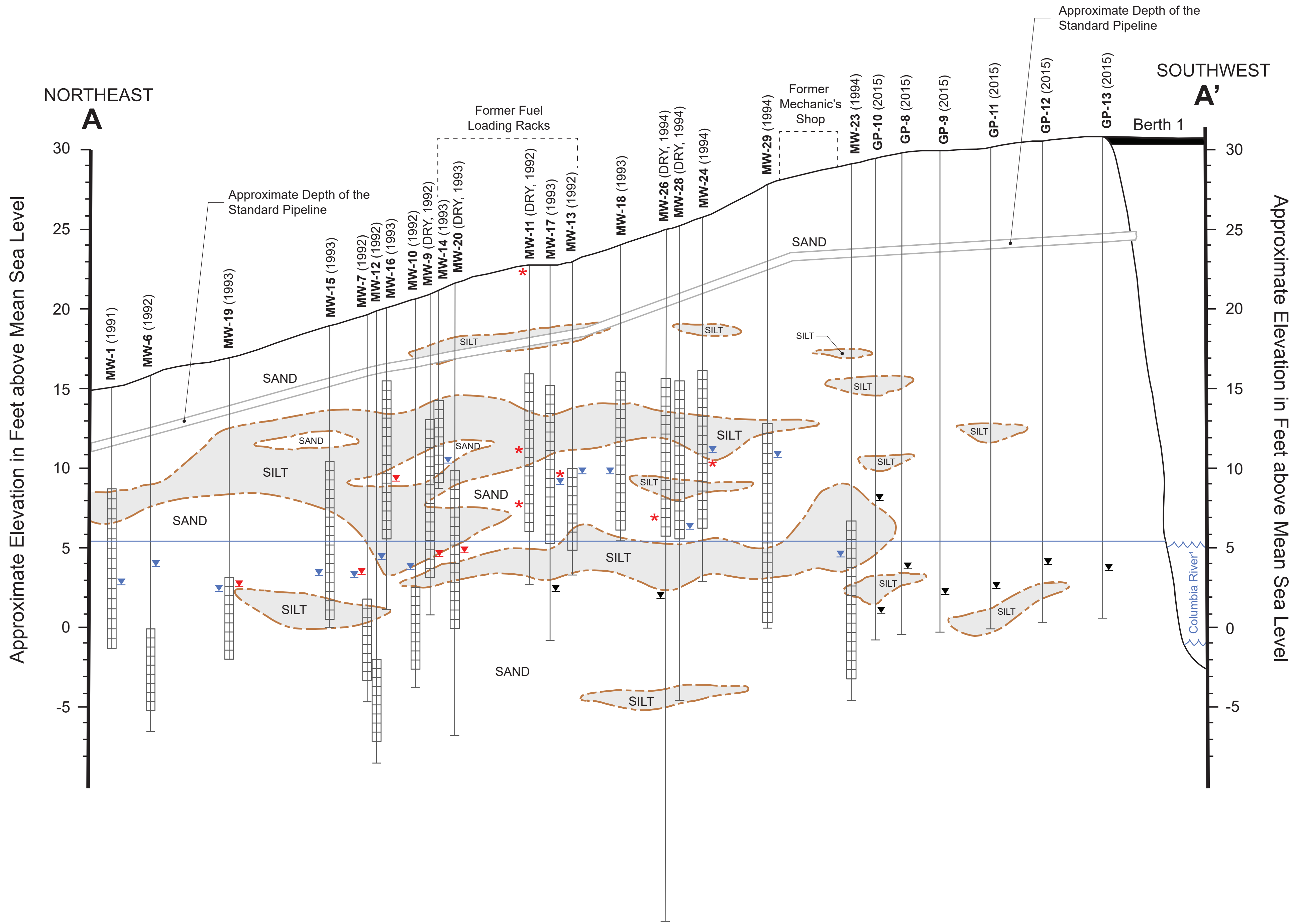
Port of Longview TPH Site
Longview, Washington

Figure 2.1
Site Map and Sample Locations

I:\GIS\Projects\POL-TPH\MXD\Remedial Investigation Work Plan\Figure 2.1 Site Map and Sample Locations.mxd
8/15/2019



Legend

(1992) Year Installed

Boring

* Soil sample with concentrations exceeding residual saturation levels for GRO or DRO

▼ Groundwater measured on 9/14/2015

Well Screen Interval

▼ Groundwater encountered at time of drilling

▼ LNAPL observed at least once during historical monitoring events

Approximate alluvial aquifer groundwater elevation measured on February 27, 2019

Contact boundary between lithologies

SAND Fine to medium SAND with little to some silt and occasional gravel

SILT SILT with low to high plasticity and little to some sand

Horizontal Scale in Feet
1" = 200'
0 100' 200'

Vertical Scale in Feet
1" = 8'

Notes:

1 The Columbia River has an approximate High Water Level of 5 feet MSL and an approximate low water level of -1 feet MSL.
- Top of Casing Elevations obtained from historical reports by Golder Associates and uses MSL datum.
- Cross-section location shown on Figure 2.1. Locations shown are offset.

Abbreviations

DRO = Diesel-range organics	LNAPL = Light non-aqueous-phase liquids
GRO = Gasoline-range organics	MSL = Mean seal level

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Figure 2.2
Preliminary Cross Section A-A'

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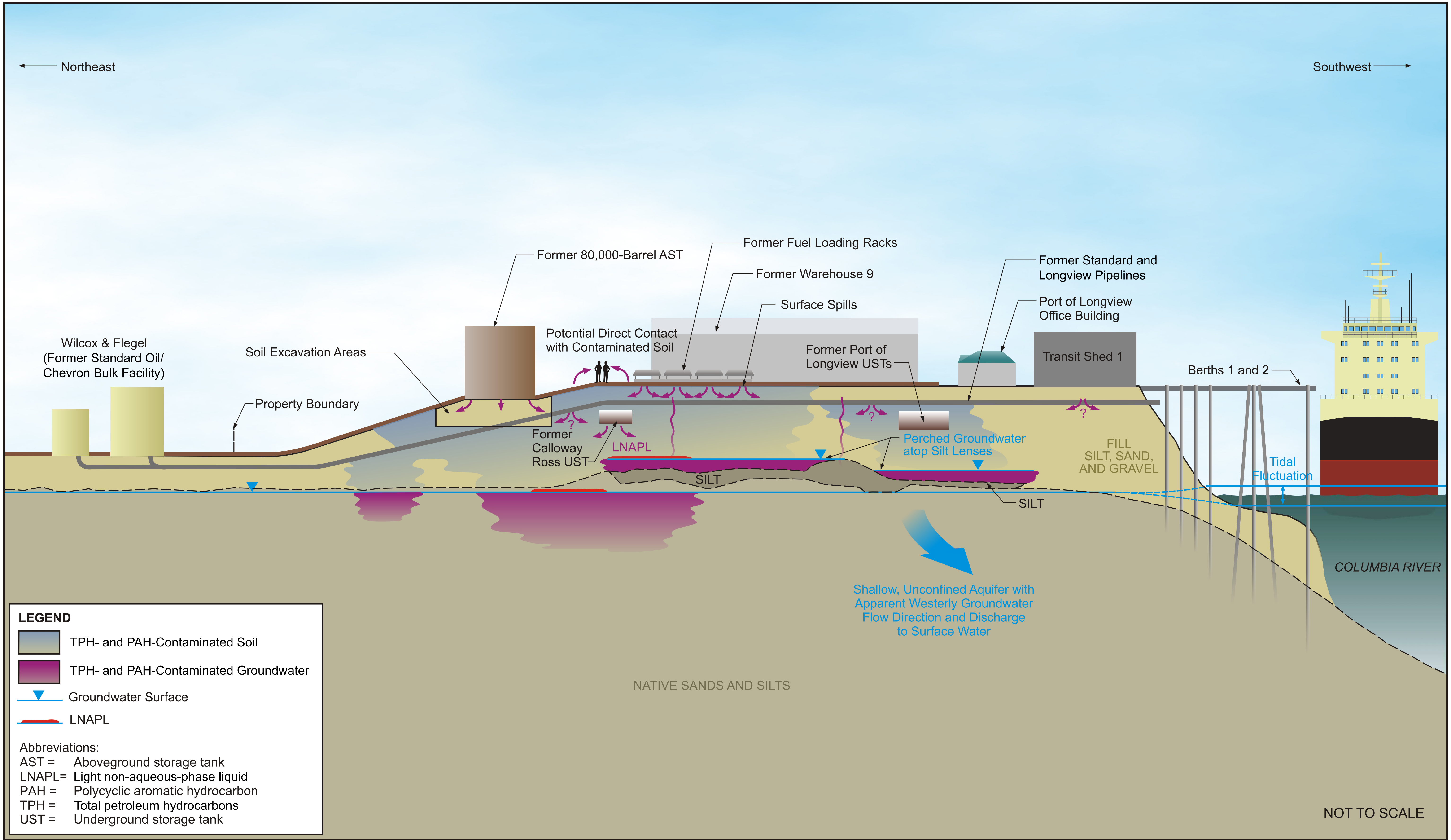
03/21/2019



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Port of Longview TPH Site
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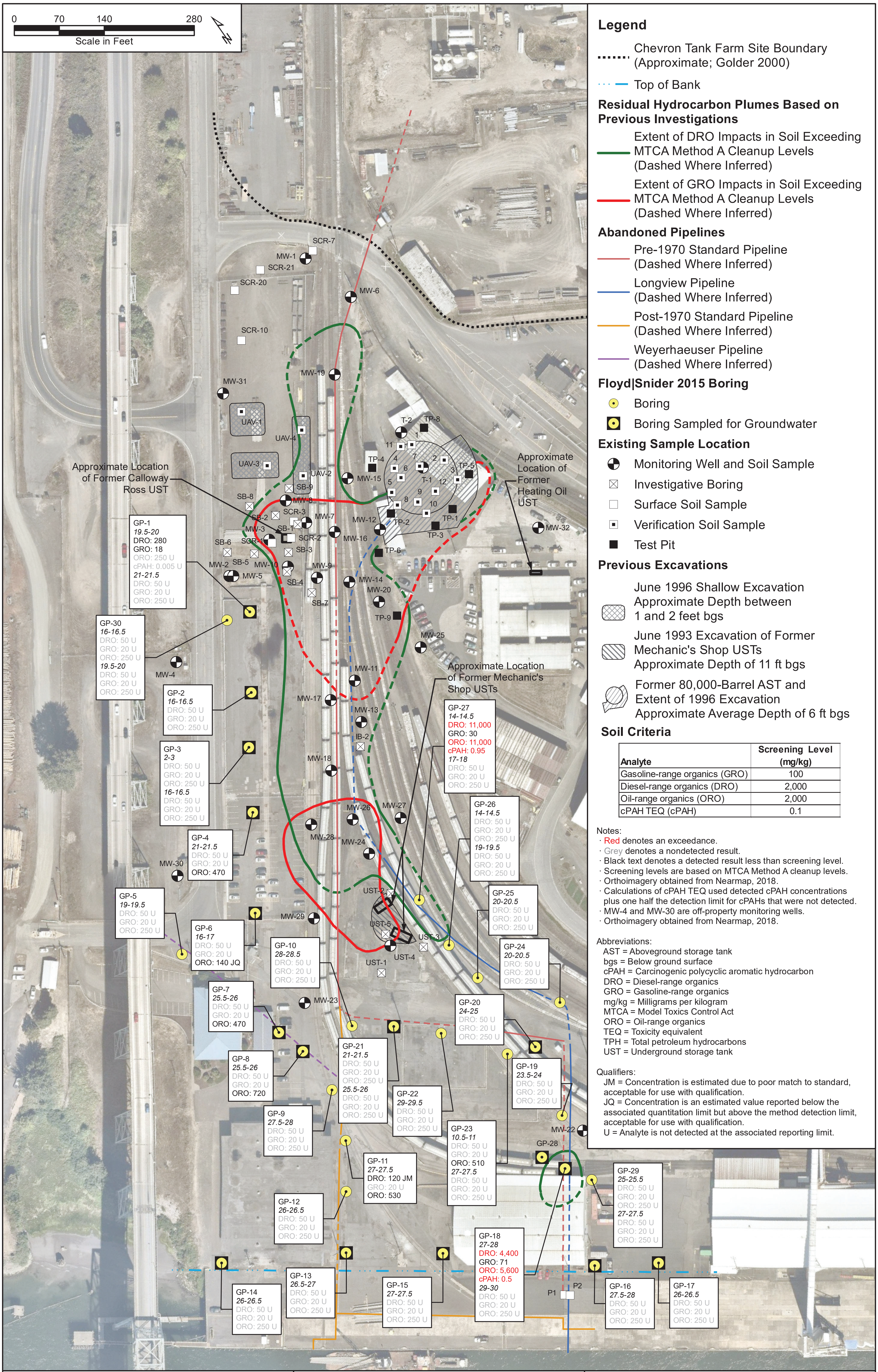
Figure 4.1
Preliminary Conceptual Site Model

I:\GIS\Projects\POL-TPH\AI\RI Work Plan\Figure 4.1 Preliminary Conceptual Site Model_2019-0507.ai
05/07/19



Legend

Chevron Tank Farm Site Boundary (Approximate; Golder 2000)

Top of Bank

Residual Hydrocarbon Plumes Based on Previous Investigations

Extent of DRO Impacts in Soil Exceeding MTCA Method A Cleanup Levels (Dashed Where Inferred)

Extent of GRO Impacts in Soil Exceeding MTCA Method A Cleanup Levels (Dashed Where Inferred)

Abandoned Pipelines

Pre-1970 Standard Pipeline (Dashed Where Inferred)

Longview Pipeline (Dashed Where Inferred)

Post-1970 Standard Pipeline (Dashed Where Inferred)

Weyerhaeuser Pipeline (Dashed Where Inferred)

Floyd|Snider 2015 Boring

Boring

Boring Sampled for Groundwater

Existing Sample Location

Monitoring Well and Soil Sample

☒ Investigative Boring

☐ Surface Soil Sample

Verification Soil Sample

■ Test Pit

Previous Excavations

June 1996 Shallow Excavation Approximate Depth between 1 and 2 feet bgs

June 1993 Excavation of Former Mechanic's Shop USTs Approximate Depth of 11 ft bgs

Former 80,000-Barrel AST and Extent of 1996 Excavation Approximate Average Depth of 6 ft bgs

Soil Criteria

Analyte	Screening Level (mg/kg)
Gasoline-range organics (GRO)	100
Diesel-range organics (DRO)	2,000
Oil-range organics (ORO)	2,000
cPAH TEQ (cPAH)	0.1

Notes:
- Red denotes an exceedance.
- Grey denotes a nondetected result.
- Black text denotes a detected result less than screening level.
- Screening levels are based on MTCA Method A cleanup levels.
- Orthoimagery obtained from Nearmap, 2018.
- Calculations of cPAH TEQ used detected cPAH concentrations plus one half the detection limit for cPAHs that were not detected.
- MW-4 and MW-30 are off-property monitoring wells.
- Orthoimagery obtained from Nearmap, 2018.

Abbreviations:
AST = Aboveground storage tank
bgs = Below ground surface
cPAH = Carcinogenic polycyclic aromatic hydrocarbon
DRO = Diesel-range organics
GRO = Gasoline-range organics
mg/kg = Milligrams per kilogram
MTCA = Model Toxics Control Act
ORO = Oil-range organics
TEQ = Toxicity equivalent
TPH = Total petroleum hydrocarbons
UST = Underground storage tank

Qualifiers:
JM = Concentration is estimated due to poor match to standard, acceptable for use with qualification.
JQ = Concentration is an estimated value reported below the associated quantitation limit but above the method detection limit, acceptable for use with qualification.
U = Analyte is not detected at the associated reporting limit.

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Port of Longview TPH Site
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Figure 4.2
Historical Soil Analytical Data and Locations— 2015 Priority Data Gaps Results

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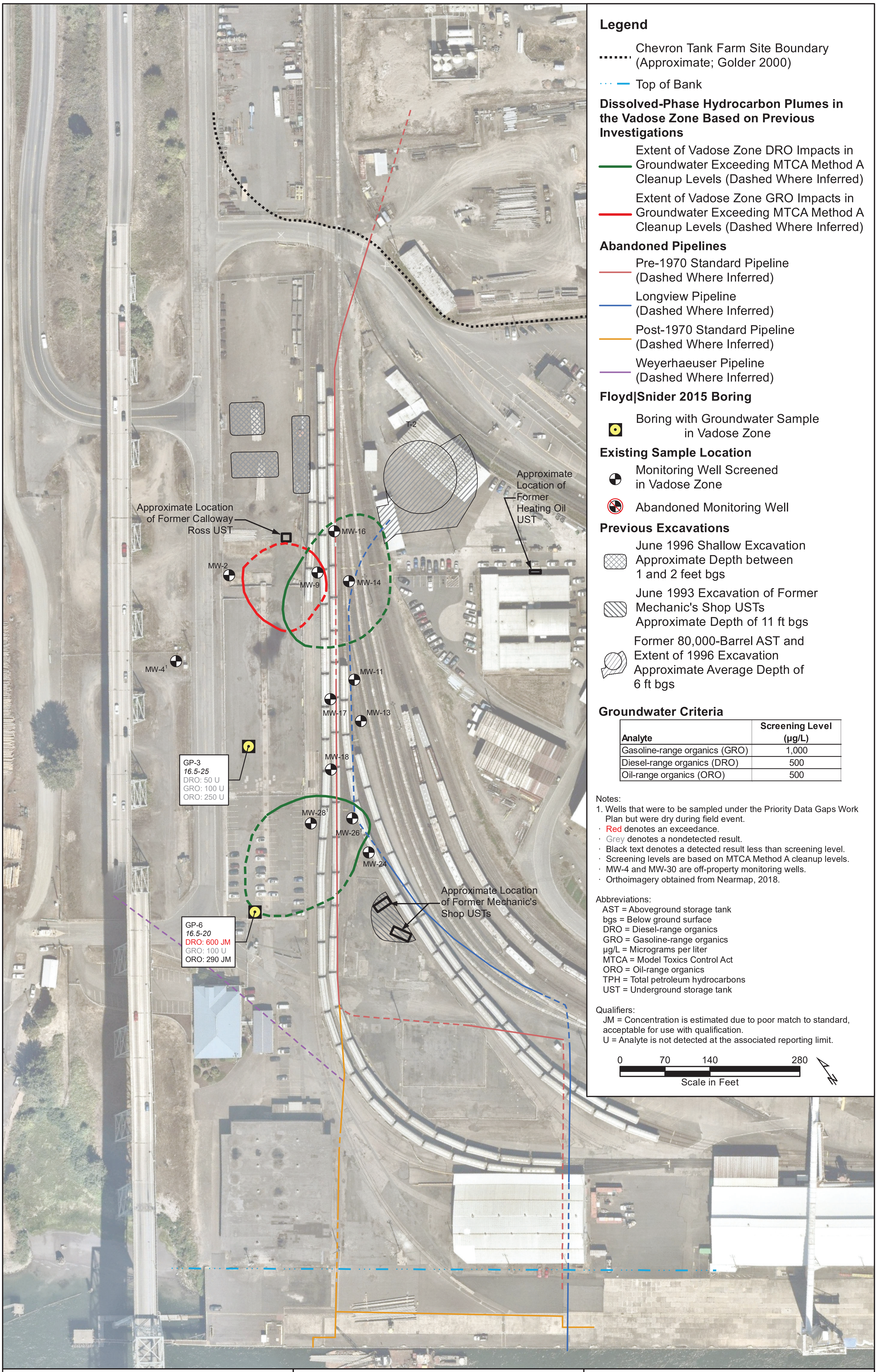
8/15/2019



Groundwater Criteria

Analyte	Screening Level (µg/L)
Gasoline-range organics (GRO)	1,000
Diesel-range organics (DRO)	500
Oil-range organics (ORO)	500

Notes:

1. Wells that were to be sampled under the Priority Data Gaps Work Plan but were dry during field event.

- Red denotes an exceedance.
- Grey denotes a nondetected result.
- Black text denotes a detected result less than screening level.
- Screening levels are based on MTCA Method A cleanup levels.
- MW-4 and MW-30 are off-property monitoring wells.
- Orthoimagery obtained from Nearmap, 2018.

Abbreviations:

AST = Aboveground storage tank
bgs = Below ground surface
DRO = Diesel-range organics
GRO = Gasoline-range organics
µg/L = Micrograms per liter
MTCA = Model Toxics Control Act
ORO = Oil-range organics
TPH = Total petroleum hydrocarbons
UST = Underground storage tank

Qualifiers:

JM = Concentration is estimated due to poor match to standard, acceptable for use with qualification.
U = Analyte is not detected at the associated reporting limit.

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Figure 4.3
Historical Groundwater Analytical Data and Locations in the Vadose Zone—2015 Priority Data Gaps Results

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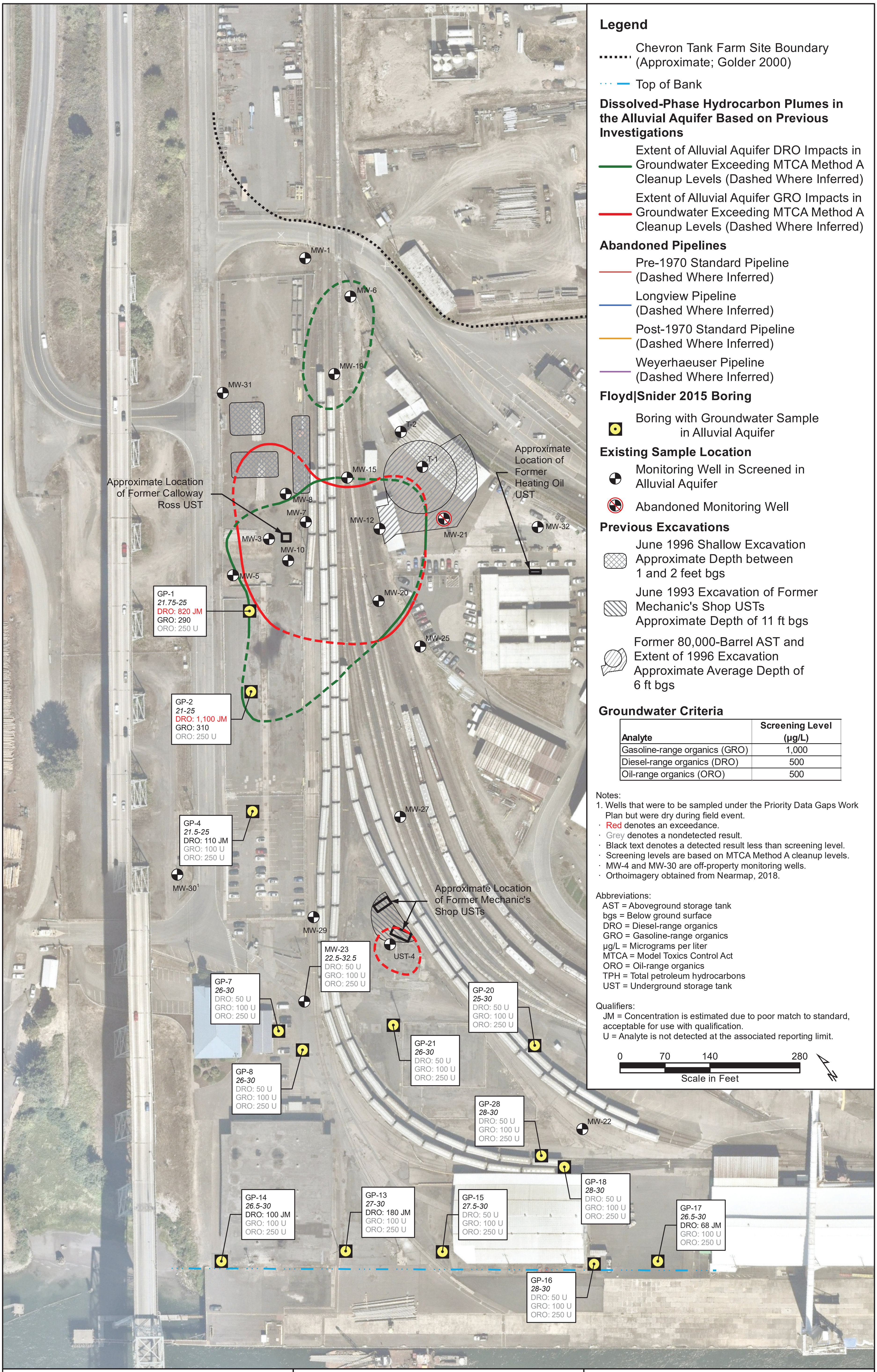

Legend

Chevron Tank Farm Site Boundary (Approximate; Golder 2000)

Top of Bank

Dissolved-Phase Hydrocarbon Plumes in the Alluvial Aquifer Based on Previous Investigations

Extent of Alluvial Aquifer DRO Impacts in Groundwater Exceeding MTCA Method A Cleanup Levels (Dashed Where Inferred)

Extent of Alluvial Aquifer GRO Impacts in Groundwater Exceeding MTCA Method A Cleanup Levels (Dashed Where Inferred)

Abandoned Pipelines

Pre-1970 Standard Pipeline (Dashed Where Inferred)

Longview Pipeline (Dashed Where Inferred)

Post-1970 Standard Pipeline (Dashed Where Inferred)

Weyerhaeuser Pipeline (Dashed Where Inferred)

Floyd|Snider 2015 Boring

Boring with Groundwater Sample in Alluvial Aquifer

Existing Sample Location

Monitoring Well in Screened in Alluvial Aquifer

Abandoned Monitoring Well

Previous Excavations

June 1996 Shallow Excavation Approximate Depth between 1 and 2 feet bgs

June 1993 Excavation of Former Mechanic's Shop USTs Approximate Depth of 11 ft bgs

Former 80,000-Barrel AST and Extent of 1996 Excavation Approximate Average Depth of 6 ft bgs

Groundwater Criteria

Analyte	Screening Level (µg/L)
Gasoline-range organics (GRO)	1,000
Diesel-range organics (DRO)	500
Oil-range organics (ORO)	500

Notes:

1. Wells that were to be sampled under the Priority Data Gaps Work Plan but were dry during field event.

- Red denotes an exceedance.
- Grey denotes a nondetected result.
- Black text denotes a detected result less than screening level.
- Screening levels are based on MTCA Method A cleanup levels.
- MW-4 and MW-30 are off-property monitoring wells.
- Orthoimagery obtained from Nearmap, 2018.

Abbreviations:

AST = Aboveground storage tank
bgs = Below ground surface
DRO = Diesel-range organics
GRO = Gasoline-range organics
µg/L = Micrograms per liter
MTCA = Model Toxics Control Act
ORO = Oil-range organics
TPH = Total petroleum hydrocarbons
UST = Underground storage tank

Qualifiers:

JM = Concentration is estimated due to poor match to standard, acceptable for use with qualification.
U = Analyte is not detected at the associated reporting limit.

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Remedial Investigation Work Plan
Port of Longview TPH Site
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Figure 4.4
Historical Groundwater Analytical Data and Locations in the Alluvial Aquifer—2015 Priority Data Gaps Results

I:\GIS\Projects\POL-TPH\MXD\Remedial Investigation Work Plan\Figure 4.4 Historical Groundwater Analytical Data and Locations in the Alluvial Aquifer - 2015 Priority Data Gaps Results.mxd
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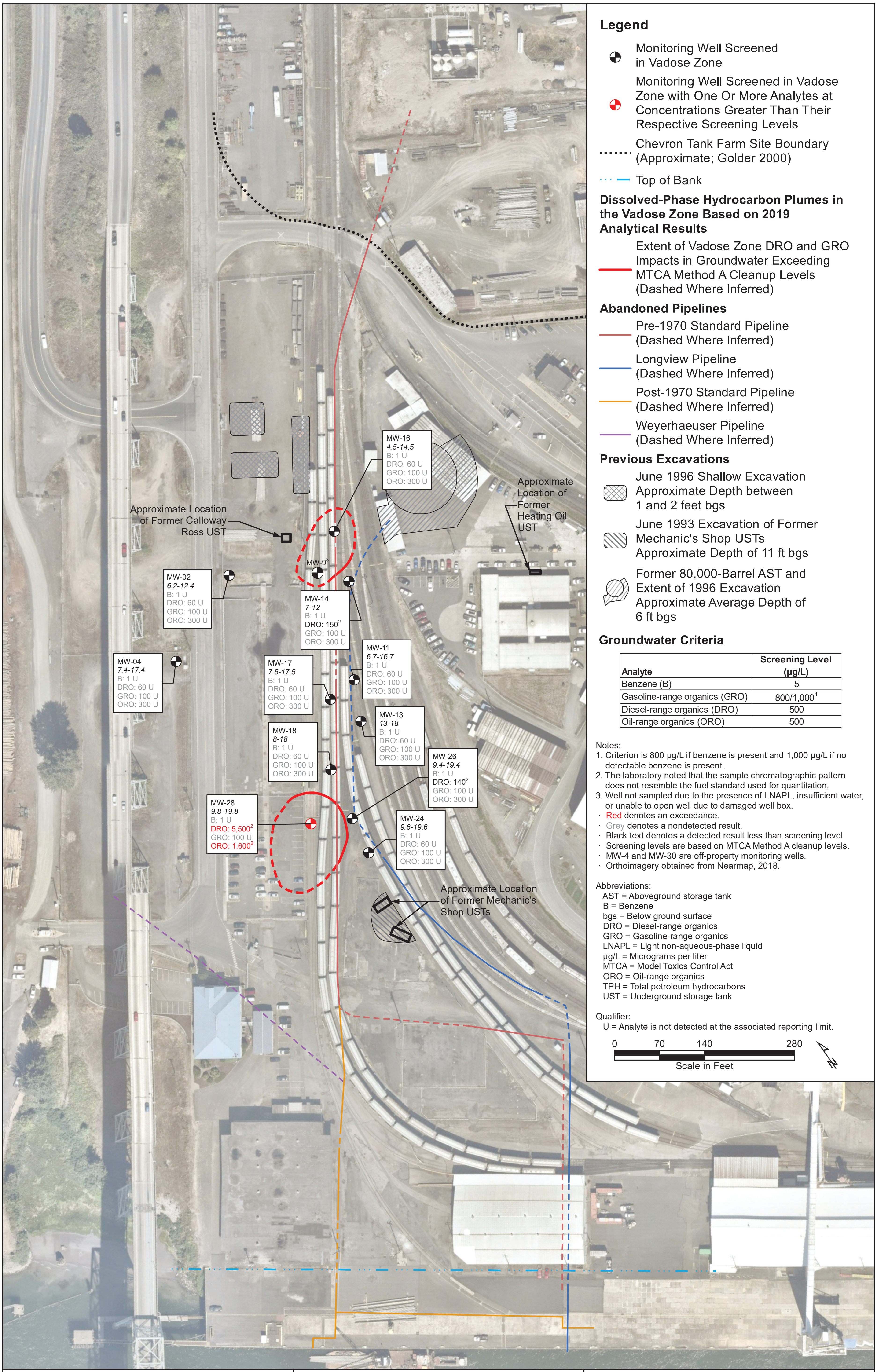

Legend

- Monitoring Well Screened in Vadose Zone
- Monitoring Well Screened in Vadose Zone with One Or More Analytes at Concentrations Greater Than Their Respective Screening Levels
- Chevron Tank Farm Site Boundary (Approximate; Golder 2000)
- Top of Bank

Dissolved-Phase Hydrocarbon Plumes in the Vadose Zone Based on 2019 Analytical Results

- Extent of Vadose Zone DRO and GRO Impacts in Groundwater Exceeding MTCA Method A Cleanup Levels (Dashed Where Inferred)

Abandoned Pipelines

- Pre-1970 Standard Pipeline (Dashed Where Inferred)
- Longview Pipeline (Dashed Where Inferred)
- Post-1970 Standard Pipeline (Dashed Where Inferred)
- Weyerhaeuser Pipeline (Dashed Where Inferred)

Previous Excavations

- June 1996 Shallow Excavation Approximate Depth between 1 and 2 feet bgs
- June 1993 Excavation of Former Mechanic's Shop USTs Approximate Depth of 11 ft bgs
- Former 80,000-Barrel AST and Extent of 1996 Excavation Approximate Average Depth of 6 ft bgs

Groundwater Criteria

Analyte	Screening Level (µg/L)
Benzene (B)	5
Gasoline-range organics (GRO)	800/1,000[1]
Diesel-range organics (DRO)	500
Oil-range organics (ORO)	500

Notes:

1. Criterion is 800 µg/L if benzene is present and 1,000 µg/L if no detectable benzene is present.
2. The laboratory noted that the sample chromatographic pattern does not resemble the fuel standard used for quantitation.
3. Well not sampled due to the presence of LNAPL, insufficient water, or unable to open well due to damaged well box.

- Red denotes an exceedance.
- Grey denotes a nondetected result.
- Black text denotes a detected result less than screening level.
- Screening levels are based on MTCA Method A cleanup levels.
- MW-4 and MW-30 are off-property monitoring wells.
- Orthoimagery obtained from Nearmap, 2018.

Abbreviations:

AST = Aboveground storage tank
B = Benzene
bgs = Below ground surface
DRO = Diesel-range organics
GRO = Gasoline-range organics
LNAPL = Light non-aqueous-phase liquid
µg/L = Micrograms per liter
MTCA = Model Toxics Control Act
ORO = Oil-range organics
TPH = Total petroleum hydrocarbons
UST = Underground storage tank

Qualifier:

U = Analyte is not detected at the associated reporting limit.

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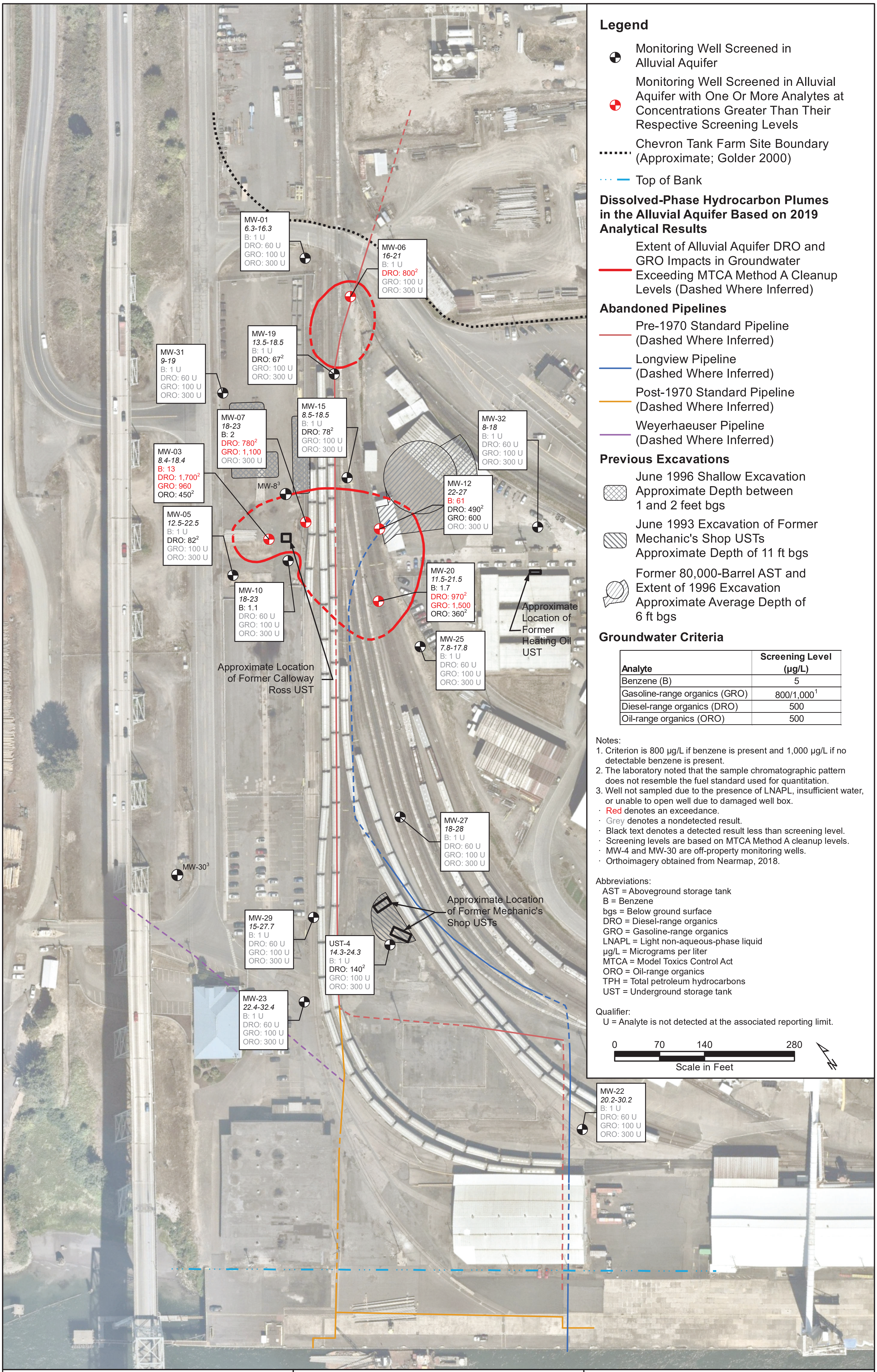
Port of Longview TPH Site
Longview, Washington

Figure 4.5
Current Groundwater Analytical Data and Locations in the Vadose Zone—2019 Monitoring Well Results



Legend

- ● Monitoring Well Screened in Alluvial Aquifer
- ● Monitoring Well Screened in Alluvial Aquifer with One Or More Analytes at Concentrations Greater Than Their Respective Screening Levels
- ┅ Chevron Tank Farm Site Boundary (Approximate; Golder 2000)
- ┄ Top of Bank

Dissolved-Phase Hydrocarbon Plumes in the Alluvial Aquifer Based on 2019 Analytical Results

- ━ Extent of Alluvial Aquifer DRO and GRO Impacts in Groundwater Exceeding MTCA Method A Cleanup Levels (Dashed Where Inferred)

Abandoned Pipelines

- ━ Pre-1970 Standard Pipeline (Dashed Where Inferred)
- ━ Longview Pipeline (Dashed Where Inferred)
- ━ Post-1970 Standard Pipeline (Dashed Where Inferred)
- ━ Weyerhaeuser Pipeline (Dashed Where Inferred)

Previous Excavations

- ▩ June 1996 Shallow Excavation Approximate Depth between 1 and 2 feet bgs
- ▨ June 1993 Excavation of Former Mechanic's Shop USTs Approximate Depth of 11 ft bgs
- ▨ Former 80,000-Barrel AST and Extent of 1996 Excavation Approximate Average Depth of 6 ft bgs

Groundwater Criteria

Analyte	Screening Level (µg/L)
Benzene (B)	5
Gasoline-range organics (GRO)	800/1,000[1]
Diesel-range organics (DRO)	500
Oil-range organics (ORO)	500

Notes:

1. Criterion is 800 µg/L if benzene is present and 1,000 µg/L if no detectable benzene is present.
2. The laboratory noted that the sample chromatographic pattern does not resemble the fuel standard used for quantitation.
3. Well not sampled due to the presence of LNAPL, insufficient water, or unable to open well due to damaged well box.

- Red denotes an exceedance.
- Grey denotes a nondetected result.
- Black text denotes a detected result less than screening level.
- Screening levels are based on MTCA Method A cleanup levels.
- MW-4 and MW-30 are off-property monitoring wells.
- Orthoimagery obtained from Nearmap, 2018.

Abbreviations:

AST = Aboveground storage tank
B = Benzene
bgs = Below ground surface
DRO = Diesel-range organics
GRO = Gasoline-range organics
LNAPL = Light non-aqueous-phase liquid
µg/L = Micrograms per liter
MTCA = Model Toxics Control Act
ORO = Oil-range organics
TPH = Total petroleum hydrocarbons
UST = Underground storage tank

Qualifier:

U = Analyte is not detected at the associated reporting limit.

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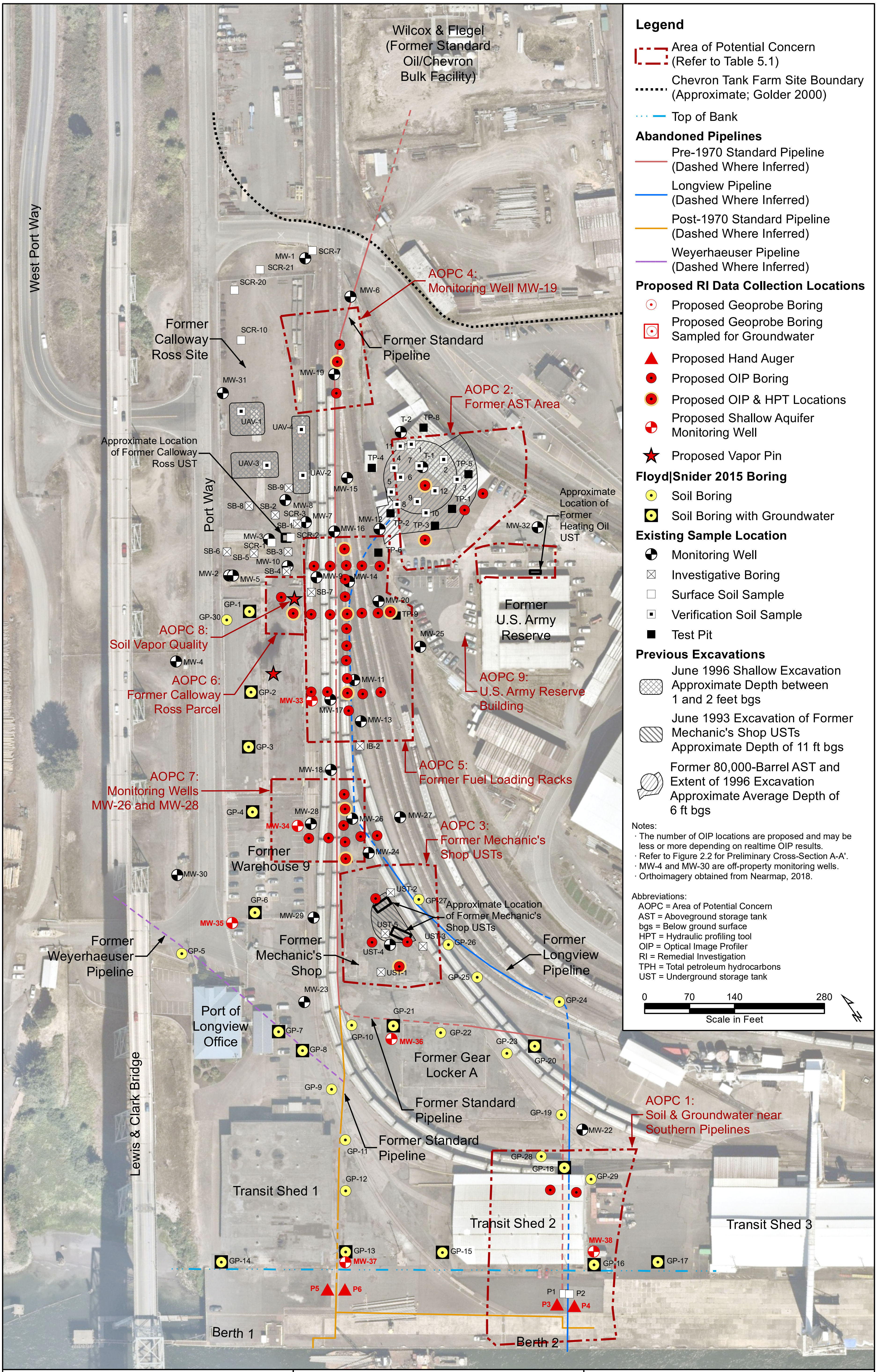
Port of Longview TPH Site
Longview, Washington

Figure 4.6
Current Groundwater Analytical Data and Locations in the Alluvial Aquifer—2019 Monitoring Well Results

I:\GIS\Projects\POL-TPH\MXD\Remedial Investigation Work Plan\Figure 4.6 Current Groundwater Analytical Data and Locations in the Alluvial Aquifer - 2019 Monitoring Well Results.mxd
8/15/2019



Notes:
- The number of OIP locations are proposed and may be less or more depending on realtime OIP results.
- Refer to Figure 2.2 for Preliminary Cross-Section A-A'.
- MW-4 and MW-30 are off-property monitoring wells.
- Orthoimagery obtained from Nearmap, 2018.

Abbreviations:
AOPC = Area of Potential Concern
AST = Aboveground storage tank
bgs = Below ground surface
HPT = Hydraulic profiling tool
OIP = Optical Image Profiler
RI = Remedial Investigation
TPH = Total petroleum hydrocarbons
UST = Underground storage tank

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Longview, Washington

Figure 5.1
Areas of Potential Concern and Proposed RI Data Collection Locations

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9/16/2019

Port of Longview TPH Site

Remedial Investigation Work Plan

Appendix A
Documents Reviewed

Appendix A
Documents Reviewed

Document	Author	Date	Type	Document Number
Annual Groundwater Monitoring Reports				
1st Quarter Groundwater Monitoring Event.pdf	Golder Associates	05/11/1999	Report	A001
Annual Groundwater Monitoring Event 1999	Golder Associates	11/1/1999	Report	A002
3rd Quarter Groundwater Monitoring Event.pdf	Golder Associates	12/07/1999	Report	A003
4th Quarter Groundwater Monitoring Event.pdf	Golder Associates	02/25/2000	Report	A004
5th Quarter Groundwater Monitoring Event.pdf	Golder Associates	07/13/2000	Report	A005
Post-Cap Annual Groundwater Monitoring Event 2000	Golder Associates	10/1/2000	Report	A006
Annual Groundwater Monitoring Event 2001	Golder Associates	9/27/2001	Report	A007
Post-Cap Annual Groundwater Monitoring Event 2002	Golder Associates	10/14/2002	Report	A008
Annual Groundwater Monitoring Event 2003	Golder Associates	11/20/2003	Report	A009
Annual Groundwater Monitoring Event 2004	Golder Associates	9/10/2004	Report	A010
Post-Cap Annual Groundwater Monitoring Event 2005	Golder Associates	11/29/2005	Report	A011
Annual Groundwater Monitoring Event 2006	Golder Associates	10/25/2006	Report	A012
Proposal for Additional Groundwater Sampling.pdf	Golder Associates	09/28/2007	Report	A013
Post-Cap Annual Groundwater Monitoring Event 2007	Golder Associates	11/19/2007	Report	A014
Groundwater Monitoring Event 2008	Golder Associates	12/12/2008	Report	A015
Standard Operating Procedure - Groundwater Sampling	Golder Associates	9/1/2009	Report	A016
Site-Wide Groundwater Monitoring Well Sampling 2010	Golder Associates	2/26/2010	Report	A017
Annual Sampling Photos - Aug 2010	Golder Associates	8/1/2010	Photos	A018
Groundwater Monitoring Data Package	Golder Associates	9/16/2010	Report	A019
Annual Groundwater Monitoring Event 2010	Golder Associates	11/29/2010	Report	A020
Annual Groundwater Monitoring Event 2011	Golder Associates	10/12/2011	Report	A021
Third Quarter Groundwater Monitoring Report	Golder Associates	12/28/2011	Report	A022
2012 Annual Groundwater Monitoring Event	Golder Associates	02/18/2013	Report	A023
Post-Cap Annual Groundwater Monitoring Event 2013	Golder Associates	11/12/2013	Report	A024
Second Semiannual 2013 Groundwater Monitoring Report	Leidos	1/23/2014	Report	A025
Hydrograph Figures		ND	Figures	A026
Correspondence				
Meeting Summary re Port of Kelso and Standard Oil	Port Secretary	05/18/1926	Correspondence	B001
Letter re Value of Oil Tank	R.G. Armstrong	10/02/1936	Correspondence	B002
Letter re Date for Initial Delivery of Fuel to Longview	Standard Oil Co.	07/26/1955	Correspondence	B003
Letter re Fuel Oil Facilities	Longview Fibre	11/22/1955	Correspondence	B004
Letter re Fuel Oil Heating Facilities	Harvey Hart - POL	11/23/1955	Correspondence	B005
Letter re 1955 Operative Fuel Contract	Standard Oil Co.	05/14/1956	Correspondence	B006
Inter-Office Correspondence re Increase in Quantity of Oil	H.L. Wollenberg	05/21/1956	Correspondence	B007
Letter re Operative Fuel Contract	Standard Oil Co.	04/09/1957	Correspondence	B008
Letter re Acknowledgement of Receipt	H.L. Wollenberg	04/11/1957	Correspondence	B009
Handwritten Note re Standard Oil Company	N.H. Anderson	02/15/1958	Correspondence	B010
Consent for Administrative Matters		07/16/1959	Correspondence	B011
Sampling of 1500 Viscosity Fuel Oil Shipments	V.M. Sutherling - LF	07/27/1959	Correspondence	B012
Inter-office Memo re Volume of Oil Discrepancies	H.L. Wollenberg	08/03/1959	Correspondence	B013
Letter re Samples of 1500 Viscosity Fuel	V.M. Sutherling - LF	08/04/1959	Correspondence	B014
Letter re 1500 Viscosity Fuel Oil Contract	V.M. Sutherling - LF	11/12/1959	Correspondence	B015
Letter re Difference in Thermal Value of 1500 Viscosity Fuel	R.V. Livingston - SO	11/20/1959	Correspondence	B016
Letter of Intent to Operate an Oil Transfer Facility	I.J. Blamire - SO	06/29/1973	Correspondence	B017
Port of Longview Meeting Minutes	Port of Longview	12/11/1973	Correspondence	B018
Crown Zellerbach Plan Check Sheet	Stephenson	12/18/1973	Correspondence	B019
Letter re Ballast Water Tariff Rate	Crown Zellerbach	09/06/1977	Correspondence	B020
Letter re Ballast Water Discharge	Crown Zellerbach Corp.	09/06/1977	Correspondence	B021
Large Oil Transfer Certified Handlers	Wilcox & Flegel	04/27/1981	Correspondence	B022
Correspondence re Selling Fuel Storage Tank and Lease Termination	Crown Zellerbach	12/21/1983	Correspondence	B023
Letter re Terminal of License Agreement	Port of Longview	12/16/1985	Correspondence	B024
Letter re Longview Site Sampling and Litigation	Crosby & Overton	11/12/1987	Correspondence	B025
Memo re Test Wells on Wilcox & Flegel Site	Port of Longview	11/20/1987	Correspondence	B026
Letter re Geotechnical Considerations Tower Loading Facility	David E. Hilts	06/05/1989	Correspondence	B027
Letter re Earth Pressures for Sheet Pile Shoring Rail Car Unloading	David E. Hilts	07/12/1989	Correspondence	B028
Letter re Geotechnical Explorations Tower Loading Facility	David E. Hilts	07/12/1989	Correspondence	B029
Letter re Pile Uplift Capacity Tower Loading Facility	David E. Hilts	09/13/1989	Correspondence	B030
Memo re International Paper Company	Port of Longview	11/16/1990	Correspondence	B031
Letter re Petroleum Services Work Summary	Port of Longview	03/18/1991	Correspondence	B032
Letter re Summary of Petroleum Services Unlimited Work		03/18/1991	Correspondence	B033
Letter re Tentative PSU Schedule	Port of Longview	04/16/1991	Correspondence	B034
Letter re Initial Site Characterization	Port of Longview	06/25/1991	Correspondence	B035
Longview's Letter to Ecology re Site Characterization		06/25/1991	Correspondence	B036
Letter re Petroleum Services Site Characterization Report	Petroleum Services Unlimited	06/26/1991	Correspondence	B037
Memo re Lust and Diesel Contamination	Port of Longview	07/17/1991	Correspondence	B038
Memo re Lust and Diesel Contamination at Calloway Ross Site	Port of Longview	07/17/1991	Correspondence	B039
Memo re Summary of Calloway Ross Site History	Davis Wright Tremaine Law Offices	07/24/1991	Correspondence	B040
Letter re Continued Use of Petroleum Services Unltd	Port of Longview	08/09/1991	Correspondence	B041
Ecology Letter re UST Closure	Department of Ecology	08/30/1991	Correspondence	B042
Letter re PLPs	Davis Wright Tremaine Law Offices	09/19/1991	Correspondence	B043
Letter re Investigation & Cleanup of Contamination	Port of Longview	02/26/1992	Correspondence	B044
Letter re Investigation and Cleanup of Contamination		02/26/1992	Correspondence	B045
Letter re Request for Cooperation in Investigation	Port of Longview	02/26/1992	Correspondence	B046
Memo re Hiring Golder	Port of Longview	10/06/1992	Correspondence	B047
Ecology letter re Requirements for Reporting Environmental Conditions	Department of Ecology	10/15/1992	Correspondence	B048
Letter re Golder Investigation Payment	Walker & Dowell	11/06/1992	Correspondence	B049
Letter re Golder Schedule	Golder Associates	11/11/1992	Correspondence	B050
Letter re Revised Schedule	Golder Associates	11/13/1992	Correspondence	B051
Letter re Contracting Golder	Port of Longview	11/19/1992	Correspondence	B052
Letter re Additional Testing	Port of Longview	12/15/1992	Correspondence	B053
Letter re Calloway Ross Site	Walker & Dowell	03/22/1993	Correspondence	B054
Letter re Status of On-going Site Investigation	Port of Longview	03/26/1993	Correspondence	B055

Appendix A
Documents Reviewed

Document	Author	Date	Type	Document Number
Correspondence (cont.)				
Letter to Ecology re On-going Site Investigation		03/26/1993	Correspondence	B056
Letter re Additional Agreement	Walker & Dowell	05/03/1993	Correspondence	B057
Letter re Cost Participation for Phases II and III	James River Corporation	05/06/1993	Correspondence	B058
Letter re Investigation and Cleanup of Petroleum Contamination	Walker & Dowell	05/06/1993	Correspondence	B059
Letter re Phase Expenses	Walker & Dowell	05/06/1993	Correspondence	B060
Letter re Investigation and Additional Agreement	Longview Fibre Company	06/03/1993	Correspondence	B061
Letter re Investigation and Cleanup of Contamination	Walker & Dowell	06/08/1993	Correspondence	B062
Letter re Percentage of Cleanup Cost to be Paid by Each Party	Longview Fibre Company	06/17/1993	Correspondence	B063
Letter re Investigation and Cleanup of Contamination	Walker & Dowell	07/07/1993	Correspondence	B064
Ecology Letter re Site Report	Department of Ecology	07/23/1993	Correspondence	B065
Cover Letter for Phase III Characterization Report	Golder Associates	07/27/1993	Correspondence	B066
Ecology Letter re Deficiencies in Report	Department of Ecology	08/03/1993	Correspondence	B067
Letter re Investigation and Cleanup of Petroleum Contamination	Walker & Dowell	08/03/1993	Correspondence	B068
Letter re PLPs	Walker & Dowell	08/06/1993	Correspondence	B069
Letter re Tank Removal, Mechanics Shop	O'Sullivan	08/24/1993	Correspondence	B070
Letter re Port of Longview -- Petroleum Contamination	Walker & Dowell	09/02/1993	Correspondence	B071
Letter re New Revelation	Walker & Dowell	09/03/1993	Correspondence	B072
Ecology Letter re Site Report	Department of Ecology	09/15/1993	Correspondence	B073
Letter re Investigation and Cleanup of Contamination	Walker & Dowell	09/17/1993	Correspondence	B074
Letter re Golder and Associates Report	Wilson Oil, Inc.	09/29/1993	Correspondence	B075
Meeting Minutes	Port of Longview	09/30/1993	Correspondence	B076
Letter re Petroleum Contamination Memos	James River Corp	10/14/1993	Correspondence	B077
Letter re Longview Petroleum Contamination	James River Corporation	10/14/1993	Correspondence	B078
Letter re Chevron U.S.A.	Helsell Fetterman	01/14/1994	Correspondence	B079
Port of Longview Invoice	Port of Longview	01/27/1994	Correspondence	B080
Letter re Chevron Participation in Site Investigation	Walker & Dowell	02/07/1994	Correspondence	B081
Letter re Schedule for Phase IV	Golder Associates	02/17/1994	Correspondence	B082
Letter re Chevron U.S.A.	Helsell Fetterman	03/07/1994	Correspondence	B083
Letter re Hydrocarbon Clean Up	Wilson Oil, Inc.	03/17/1994	Correspondence	B084
Letter re Chevron U.S.A.	Walker & Dowell	05/11/1994	Correspondence	B085
Ecology Letter re Site Meeting	Department of Ecology	05/25/1994	Correspondence	B086
Letter re Schedule for Future Events	Golder Associates	07/08/1994	Correspondence	B087
December 9, 1994 Meeting Minutes	Port of Longview	12/09/1994	Correspondence	B088
Meeting with Ecology Minutes	Port of Longview	01/26/1995	Correspondence	B089
Letter re Completion of Phase IV Report	Walker & Dowell	01/31/1995	Correspondence	B090
February 2, 1995 Meeting Minutes	Port of Longview	02/01/1995	Correspondence	B091
Letter re Chevron Documentary Material	Walker & Dowell	04/26/1995	Correspondence	B092
Ecology Letter re Continuation of Investigation	Department of Ecology	05/04/1995	Correspondence	B093
Ecology Letter re Division of Remediation Costs		05/04/1995	Correspondence	B094
Letter re Brief Action Plan	Port of Longview	06/13/1995	Correspondence	B095
Deposition of William Clarke	William Clarke	10/10/1995	Correspondence	B096
Letter re Summary of Chevron Work	Port of Longview	10/17/1995	Correspondence	B097
Letter re Port of Longview Petroleum Contamination	Walker & Dowell	11/02/1995	Correspondence	B098
Letter re Feb. 15, '96 Meeting Agenda	Port of Longview	01/29/1996	Correspondence	B099
Letter re Scope of Work and Cost Estimates	Port of Longview	02/12/1996	Correspondence	B100
Letter re Calloway-Ross	Pond, Roesch, Rahn & Nelson, P.S.	03/12/1996	Correspondence	B101
Letter re Remedial Cost Estimate for Contaminated Site	Port of Longview	03/22/1996	Correspondence	B102
Letter re Remedial Cost Estimate		03/22/1996	Correspondence	B103
Letter re Chevron's Modified Proposal	Helsell Fetterman	04/01/1996	Correspondence	B104
Letter re Chevron and Phase VII	Helsell Fetterman	04/04/1996	Correspondence	B105
Letter re Chevron's Proposal	Helsell Fetterman	04/04/1996	Correspondence	B106
Letter re Longview Contamination	Walker & Dowell	04/09/1996	Correspondence	B107
Letter re Port of Longview	Helsell Fetterman	07/30/1996	Correspondence	B108
Letter re Longview Contamination	William L. Dowell	08/15/1996	Correspondence	B109
Letter re Port of Longview	Helsell Fetterman	09/05/1996	Correspondence	B110
Letter re Longview Contamination	William L. Dowell	10/07/1996	Correspondence	B111
Letter re Outstanding Invoice	Port of Longview	01/21/1998	Correspondence	B112
Letter re PLPs and Chevron	William L. Dowell	02/25/1998	Correspondence	B113
Letter re Agreement for Conducting Contamination Investigation	William L. Dowell	03/17/1998	Correspondence	B114
Re: March 27, 1998, Meeting at Ecology Building	Department of Ecology	03/30/1998	Correspondence	B115
Ecology Letter re Meeting at Ecology	Department of Ecology	03/30/1998	Correspondence	B116
Letter re Environmental Insurance Claim	Nadler Law Group	02/26/2009	Correspondence	B117
Letter re Environmental Insurance	Arropoint Capital	03/09/2009	Correspondence	B118
Emails re Sampling Coordination	Golder Associates	07/15/2010	Correspondence	B119
Emails re Change of Scope	Golder Associates	07/26/2010	Correspondence	B120
Ecology Letter re Confirmed or Suspected Contaminates Sites List	Department of Ecology	09/30/2011	Correspondence	B121
Re: TPH Cleanup, Port of Longview, Washington	Frank Randolph	09/29/2014	Correspondence	B122
Re: TPH Cleanup, Port of Longview, Washington	Frank Randolph	10/08/2014	Correspondence	B123
Three Assorted Oil Operations Letters	Various	Various	Correspondence	B124
Letters relating to Chevron's Suspension Period	Standard Oil Company	Various	Correspondence	B125
Leases, Contracts, and Agreements				
POL Meeting Summaries		03/11/1931	Summaries	C001
Agreement between Port and Longview Fibre		06/10/1935	Agreement	C002
Port Construction Record		01/01/1944	Record	C003
License between Port and Standard Oil		01/31/1947	License	C004
Agreement between Port and Longview Fibre		10/15/1954	Agreement	C005
Contract between LFC and SOCC		05/23/1955	Contract	C006
Fuel Contract between Standard Oil and Longview Fibre.pdf		06/15/1955	Agreement	C007
Modification of '55 Contract		05/14/1956	Agreement	C008
Summary of Amendments to Contract		04/09/1957	Summaries	C009
Longview Fibre Letter re Amended Fuel Oil Contract		04/11/1957	Correspondence	C010
Standard Oil Letter re Contract Suspension		05/16/1957	Correspondence	C011

Appendix A
Documents Reviewed

Document	Author	Date	Type	Document Number
Leases, Contracts, and Agreements (cont.)				
LFC File Doc re Amendment of Fuel Oil Contract		05/22/1957	Record	C012
Inter-Office Correspondence re Contract Termination Agreement		06/12/1957	Correspondence	C013
Agreement between Port and Longview Fibre		08/02/1957	Agreement	C014
Contract between Standard Oil and Longview Fibre		07/09/1959	Contract	C015
Agreement between Port and Longview Fibre		01/01/1962	Agreement	C016
Longview Fibre Company Fuel Contract		04/24/1962	Contract	C017
Amended Fuel Oil Contract		07/24/1963	Contract	C018
Supplement to Agreement between Port and Longview Fibre		01/28/1965	Agreement	C019
Executed Agreement with Standard Oil Company		02/12/1965	Agreement	C020
Memo re Executed Agreement with Standard Oil.pdf		02/12/1965	Memo	C021
License Agreement between Port and Standard Oil		05/18/1971	Agreement	C022
Longview Fibre Admin Documents		10/31/1971	Correspondence	C023
Agreement between Port and Longview Fibre		12/11/1973	Agreement	C024
Lease between Port and Crown Zellerbach Corporation		12/11/1973	Lease	C025
Zellerbach Corp. Lease		12/11/1973	Lease	C026
Letter re Oil Tank Site Lease		12/11/1973	Lease	C027
Statutory Warranty Deed		06/14/1983	Deed	C028
Statutory Warranty Deed.pdf		06/30/1983	Agreement	C029
Lease between Port of Longview and Calloway Ross		07/05/1983	Lease	C030
Storage Tank Agreement.pdf		12/21/1983	Agreement	C031
Termination of License Agreement		08/08/1986	Agreement	C032
Amendment to Lease between Port of Longview and Calloway Ross		09/15/1987	Lease	C033
Agreement for Conducting Contamination Investigation.pdf		05/25/1995	Agreement	C034
Agreement for Conducting Contamination Investigation.pdf		05/19/1998	Agreement	C035
Index Port of Longview Deeds & Leases		11/18/2011	Record	C036
Record of Land Purchase		ND	Record	C037
Maps and Drawings				
Training Center building Heating and Ventilating Foundation Plan		05/05/1949	Drawing	D001
Drawing AD2 Mechanics Shop Storage Loft		05/14/1991	Drawing	D002
Drawing AD2 Exhaust System Mech. Shop		11/22/1991	Drawing	D003
Drawing AD1 Containment and Wash Area Mech. Shop		09/29/1987	Drawing	D004
Reports				
Petroleum Services Unlimited Proposal for Phase II	Petroleum Services Unlimited	03/04/1991	Proposal	E001
Site Investigation Plan	Petroleum Services Unlimited	4/29/1991	Report	E002
Extent of Contamination Investigation	Petroleum Services Unlimited	6/26/1991	Report	E003
Petroleum Services Proposal	Petroleum Services Unlimited	08/12/1991	Proposal	E004
Cleanup Action Plan	Petroleum Services Unlimited	8/13/1991	Report	E005
PLP Meeting Minutes	Port of Longview	04/22/1992	Minutes	E006
Port of Longview Costs to Date	Port of Longview	05/22/1992	Summary	E007
Tracer Tight Test of 2 Underground Storage Tanks	Tracer Research Corporation	10/09/1992	Report	E008
Summary of HCID Data	Golder Associates	12/11/1992	Summary	E009
Phases I - III Summary of Costs	Port of Longview	01/21/1993	Summary	E010
Preliminary Summary of Findings	Golder Associates	03/02/1993	Report	E011
Interim Data Report Bunker C and Diesel Fuel Investigation	Golder Associates	3/09/1993	Report	E012
Environmental Assessment Report	Golder Associates	4/20/1993	Report	E013
1993-04-28 Meeting Minutes	Port of Longview	04/28/1993	Minutes	E014
Basis for Contribution Calculations	Port of Longview	05/17/1993		E015
Characterization Report Bunker C and Diesel Fuel Investigation	Golder Associates	8/13/1993	Report	E016
Underground Storage Tank Site Characterization	Golder Associates	8/18/1993	Report	E017
Summary of Costs	Port of Longview	10/04/1993	Summary	E018
Golder Phase IV Scope of Services	Golder Associates	02/09/1994	Report	E019
Task Order for Phase IV	Port of Longview	02/09/1994	Report	E020
Draft Summary of Phase IV Soil Data	Golder Associates	04/26/1994	Report	E021
Draft Summary of Phase IV Soil and Groundwater Data	Golder Associates	04/29/1994	Report	E022
Phase IV Report Review	Golder Associates	08/11/1994	Report	E023
Characterization Report Bunker C and Diesel Fuel Investigation	Golder Associates	12/7/1994	Report	E024
Site Characterization Work Plan	AGRA Earth & Environmental	06/01/1995	Report	E025
Basis for Contribution Calculations	Golder Associates	06/12/1995	Work Plan	E026
Sample Analysis	National Environmental Testing, Inc.	06/13/1995	Report	E027
I.P. Tank Demolition Photos		08/01/1995	Photos	E028
POL Summary of Costs	Port of Longview	08/09/1995	Summary	E029
Golder Estimate for Disposal of Contaminated Soil	Golder Associates	08/30/1995	Report	E030
Subsurface Petroleum Hydrocarbon Assessment	AGRA Earth & Environmental	11/1/1995	Report	E031
Review of Subsurface Petroleum Hydrocarbon Assessment	Golder Associates	11/29/1995	Report	E032
Focused Feasibility Study Unit A	Golder Associates	1/25/1996	Report	E033
Pacific Environmental Proposal with Costs	Pacific Environmental	02/07/1996	Proposal	E034
Basis for Contribution Calculations	Golder Associates	02/12/1996	Report	E035
Projected Costs for Remediation Scenarios	Golder Associates	03/20/1996	Report	E036
Unit C and D Remedial Cost Estimate	Golder Associates	03/20/1996	Report	E037
Focused Feasibility Study Unit B	Golder Associates	3/27/1996	Report	E038
Site Layout and Well Locations	Golder Associates	06/29/1996	Figure	E039
Report on Verification Sampling Unit B	Golder Associates	9/26/1996	Report	E040
Report on Verification Sampling Unit A	Parametrix Inc.	6/2/1997	Report	E041
Petroleum Hydrocarbon Contamination at the Port of Longview		03/24/1998	Report	E042
Phase VI Scope of Work		03/24/1998	Report	E043
Summary of '98 GW Investigation	Golder Associates	3/27/1999	Report	E044
Historic Site Investigation and Remediation Summary Report	Golder Associates	10/1/2000	Report	E045
Remedial Investigation/Feasibility Study Report	SAIC	12/19/2003	Report	E046
Laboratory Report	Columbia Analytical Services	05/05/2005	Report	E047
POL Annual Sampling Analytical Report	Columbia Analytical Services	08/08/2008	Report	E048
Summary of POL Costs	Port of Longview	12/01/2009	Summary	E049
SAIC Annual Report		4/1/2010	Report	E050
Specialty Analytical Sample Analysis	Specialty Analytical	8/1/2010	Report	E051

Appendix A
Documents Reviewed

Document	Author	Date	Type	Document Number
Reports (cont.)				
Port of Longview Site Layout and Well Locations	Golder Associates	8/23/2010	Figure	E052
Sample Analysis	Specialty Analytical	08/31/2010	Report	E053
In-Situ Soil Stabilization Treatability Testing Work Plan	URS	7/19/2011	Report	E054
Sediment Characterization Report	Anchor QEA, LLC	8/1/2011	Report	E055
Mechanics Shop Investigation Report	URS	4/10/2012	Report	E056
TPH Expert Report	Landau Associates	6/22/2012	Report	E057
TWP & TPH Expert Report	Pacific Crest Environmental	6/22/2012	Report	E058
Rebuttal Expert Report	Pacific Crest Environmental	7/16/2012	Report	E059
CARA Level Two Hydrogeologic Assessment	Kennedy/Jenks Consultants	7/20/2012	Report	E060
Supplemental Site Assessment Report Former Chevron Bulk Fuel Facilit	SAIC	10/17/2012	Report	E061
Final Supplemental Remedial Investigation Work Plan	SAIC	08/21/2013	Report	E062
Site Hazard Assessment	Ecology	12/10/2013	Report	E063
Index of TPH Site Monitoring Reports Since 2000		ND	Record	E064
Summary of all POL Costs		ND	Record	E065
Summary of all POL Costs		ND	Record	E066
Amended Chevron Proposal	Chevron	ND	Proposal	E067
Phase II Cost Estimate	Port of Longview	ND	Report	E068
Phase III Summary of Costs		ND	Summary	E069
Project Cost Estimate	Golder Associates	ND	Report	E070

Abbreviations:

Ecology	Washington State Department of Ecology
ND	No date

Port of Longview TPH Site

Remedial Investigation Work Plan

Appendix B
Available Soil and Groundwater Data from Prior Investigations

Table B.1
Historical Soil Analytical Data

			NWTPH-Gx	NWTPH-Dx	NWTPH-Dx	USEPA 418.1
Location	Sample Date	Depth (ft)	Gasoline (ppm)	Diesel (ppm)	Other (ppm)	TPH (ppm)
Calloway Ross and Northern Pipeline Area						
SB-1	05/01/1991	5.5–7	ND	4,800	ND	NA
		7–8.5	ND	2,300	ND	NA
SB-2	05/01/1991	2.5–4	ND	ND	220	NA
		6–7.5	537	7,800	ND	NA
		7.5–9	1,500	13,000	ND	NA
SB-2 (Dup)	05/01/1991	6–7.5	591	7,200	ND	NA
SB-3	05/01/1991	10–11.5	ND	450	ND	NA
SB-4	05/02/1991	7–8.5	ND	11,000	ND	NA
SB-5 (1)	05/02/1991	6–7.5	591	7,200	ND	NA
SB-5	05/02/1991	10–11.5	ND	ND	ND	NA
SB-5 (Dup)	05/02/1991	10–11.5	ND	43	110	NA
SB-6	05/02/1991	11.5–13	ND	ND	ND	NA
SB-7	05/02/1991	7.5–9	25	54	ND	NA
SB-8	05/02/1991	9–10.5	ND	ND	ND	NA
SB-8 (2)	05/02/1991	10–11.5	ND	43	110	NA
SB-9	05/03/1991	9–10.5	ND	ND	ND	NA
MW-3	05/01/1991	9–10.5	ND	1,700	ND	NA
MW-5	05/03/1991	11–12.5	ND	ND	ND	NA
MW-6	12/09/1992	14	ND	ND	ND	NA
		19	ND	ND	ND	NA
MW-7	12/07/1992	9	ND	ND	ND	NA
		16	485	368	ND	NA
		24	ND	ND	ND	NA
MW-8	12/08/1992	10	ND	ND	ND	NA
		16	ND	ND	ND	NA
		24	ND	ND	ND	NA
MW-9	12/02/1992	2	16	1,500	4,600	NA
		7	649	13,000	1,200	NA
		10	ND	178	270	NA
		11	1,350	19,000	2,600	NA
		14	4,700	9,000	830	NA
		19.5	ND	549 (3)	ND	NA
MW-10	12/07/1992	2	10	113	140	NA
		8	1800 (3)	660	540	NA
		9	1,000	4,900	310	NA
		11	ND	152	ND	NA
		14	3,900	4,100	300	NA
		24	ND	ND	ND	NA
S-CR-1	03/25/1993	0–1	ND	60,000	3,500	NA
S-CR-2	03/25/1993	0–1	ND	14,000	150,000	NA
S-CR-3	03/25/1993	0–1	ND	5,300	21,000	NA
S-CR-4	03/25/1993	0–1	ND	3,800	33,000	NA
S-CR-5	03/25/1993	0–1	ND	5,100	38,000	NA
S-CR-6	03/25/1993	0–1	ND	2,400	19,000	NA
S-CR-7	03/25/1993	0–1	ND	296	2,380	NA
S-CR-8	03/25/1993	0–1	ND	3,000	62,000	NA
S-CR-9	03/25/1993	0–1	ND	3,500	22,000	NA
S-CR-10	03/25/1993	0–1	ND	224	1,430	NA
MW-15	05/18/1993	10	ND	ND	ND	NA
		13.5	ND	ND	ND	NA
		16.5	ND	ND	ND	NA
MW-16	05/18/1993	10	16,000	1,900	290	NA
		13.5	ND	9,400	ND	NA
		18	ND	ND	ND	NA
MW-19	05/20/1993	2–4	ND	3,700	12,000	NA
		4–8	ND	72,000	58,000	NA
UAV1-Floor	06/01/1996	3	NA	NA	NA	289
UAV2-Floor	06/01/1996	4	NA	NA	NA	ND
UAV3-Floor	06/01/1996	3	NA	NA	NA	ND
UAV4-Floor	06/01/1996	6	NA	NA	NA	15,000
MW-31	06/24/1998	10–11	ND	ND	ND	NA
		20–21.5	ND	ND	ND	NA

Table B.1
Historical Soil Analytical Data

			NWTPH-Gx	NWTPH-Dx	NWTPH-Dx	USEPA 418.1
Location	Sample Date	Depth (ft)	Gasoline (ppm)	Diesel (ppm)	Other (ppm)	TPH (ppm)
Former Loading Rack and Middle Pipeline Area						
MW-11	12/03/1992	1.5	449	26,000	34,000	NA
		9	ND	ND	ND	NA
		11	ND	17,000 (3)	830 (3)	NA
		15	ND	16,000 (3)	700 (3)	NA
		19	ND	ND	ND	NA
		20	ND	ND	ND	NA
IB-2	12/04/1992	20	ND	ND	ND	NA
MW-13	05/26/1993	1	ND	ND	ND	NA
MW-14	05/17/1993	8	6,920	13,000	410	NA
		11	5,980	12,000	ND	NA
MW-17	05/19/1993	11	ND	2,300	ND	NA
		13.5	ND	20,000	970	NA
		19.7	ND	ND	ND	NA
MW-18	05/19/1993	17	ND	ND	ND	NA
MW-18 (Dup)	05/19/1993	17	ND	ND	ND	NA
MW-20	05/20/1993	11.5	ND	ND	ND	NA
		18–19	ND	ND	ND	NA
		19	ND	ND	ND	NA
MW-25	03/02/1994	9.5	ND	ND	ND	NA
Former Longview Fibre 80,000-Barrel AST Area						
TP-1	11/23/1992	2	16	1,500	4,600	NA
TP-2	11/23/1992	7	649	13,000	1,200	NA
TP-3	11/23/1992	2	<10	113	140	NA
		8	1,800 (3)	660	540	NA
		11	ND	152	ND	NA
TP-5	11/23/1992	1.5	449	26,000	34,000	NA
		9	ND	ND	ND	NA
TP-6	11/23/1992	11	1,200 (3)	129	160	NA
TP-7	11/23/1992	1.5	ND	9,100	45,000	NA
MW-12	12/04/1992	6	510	121	ND	NA
		14	4,900	1,800 (3)	180 (3)	NA
		19	ND	ND	ND	NA
		22	ND	ND	ND	NA
MW-21	05/21/1993	14	ND	ND	ND	ND
		16.8	ND	ND	ND	ND
		17	ND	ND	ND	ND
T-1-3	08/30/1995	3	NA	3,000	1,800	NA
T-1-9	08/30/1995	9	NA	ND	ND	NA
T-1-20	08/30/1995	20	NA	78	ND	NA
T-2-19	08/30/1995	19	NA	ND	ND	NA
UBV1-Floor	06/05/1996	3	NA	NA	NA	ND
UBV2-Floor	06/05/1996	4	NA	NA	NA	ND
UBV3-East Side Wall	06/05/1996	3	NA	NA	NA	ND
UBV4-Floor	06/05/1996	6	NA	NA	NA	<50
UBV5-Floor	06/05/1996	7.5	NA	NA	NA	<50
UBV6-Floor	06/10/1996	6	NA	NA	NA	ND
UBV7-Floor	06/10/1996	6	NA	NA	NA	92
UBV8-Southwest Side Wall	06/10/1996	6	NA	NA	NA	<50
UBV9-Floor	06/11/1996	6	NA	NA	NA	8,300
UBV10-South Side Wall	06/11/1996	4	NA	NA	NA	ND
UBV11-North Side Wall	06/11/1996	3	NA	NA	NA	ND
UBV12-Floor	06/11/1996	6	NA	NA	NA	28

Table B.1
Historical Soil Analytical Data

			NWTPH-Gx	NWTPH-Dx	NWTPH-Dx	USEPA 418.1
Location	Sample Date	Depth (ft)	Gasoline (ppm)	Diesel (ppm)	Other (ppm)	TPH (ppm)
Former Mechanic's Shop and Southern Pipeline Area						
UST1-722-24	07/22/1993	24	<20	<50	<100	NA
UST2-723-15	07/23/1993	15	<20	<50	<100	NA
UST3-723-14.5	07/23/1993	14.5	<20	<50	<100	NA
UST4-726-10	07/26/1993	10	<20	<50	<100	NA
UST-5 (3,4)	06/03/1994	9	786	170	200	NA
UST-5	06/03/1994	13	ND	ND	ND	NA
		18	ND	ND	ND	NA
MW-23	03/02/1994	26.5	ND	ND	ND	NA
MW-24	03/03/1994	15.5	5,600 (3)	40,000 (3)	360	NA
		20	ND	ND	ND	NA
		22.2	ND	ND	ND	NA
MW-24 (5)	03/03/1994	15.5	2,200	43,000 (6)	NA	NA
MW-24D (5) (Dup)	03/03/1994	15.5	NA	47,000 (6)	NA	NA
MW-26	03/03/1994	12.8	2,300 (3)	17,000 (3)	94	NA
MW-26D (Dup)	03/03/1994	12.8	1,900 (3)	15,000 (3)	93	NA
MW-26 (5)	03/03/1994	18	2,100	42,000 (6)	NA	NA
		37.5	ND	5.4	NA	NA
MW-27	03/21/1994	18.2	ND	ND	ND	NA
MW-28	03/22/1994	14.6	830	8,700 (2)	ND	NA
		27.7	ND	ND	ND	NA
		29.5	ND	ND	ND	NA
MW-28D (Dup)	03/22/1994	14.6	1,100	11,000 (3)	57	NA
MW-28 (5)	03/22/1994	14.6	760	8,400x (6)	NA	NA
MW-28D (Dup) (5)	03/22/1994	14.6	690	8,100	NA	NA
MW-29	06/03/1994	10	ND	ND	ND	NA
		20	ND	ND	ND	NA
		24	ND	ND	ND	NA
Perimeter Borings and Wells						
MW-22	03/01/1994	27.5	ND	ND	ND	NA
MW-30	06/24/1998	16–16.5	ND	ND	ND	NA
		25–26.5	ND	ND	ND	NA
MW-32	06/24/1998	10–11.5	ND	ND	ND	NA
		20–21.5	ND	ND	ND	NA
Southern Pipeline Capped End (Transit Shed 2 and Berth 2)						
P-1 (5)	04/01/1994	Surface	NA	4,400 (3)	600 (3)	NA
P-2 (5)	04/01/1994	Surface	NA	8,300 (3)	5,400 (3)	NA

Notes:

1	Duplicate of SB-2 at 6 to 7.5 ft.
2	Duplicate of SB-5 at 10 to 11.5 ft.
3	Result due to diluted sample.
4	Sample was of soil directly adjacent to tank and represents limited quantity of soil.
5	Analyzed for TPH by Ecology TPH Methods.
6	More closely resembles Bunker C.
x	Value greater than linear range of instrument.

Abbreviations:

AST	Aboveground storage tank
Ecology	Washington State Department of Ecology
ft	Feet
MRL	Minimal risk level
NA	Not analyzed
ND	Not detected at unknown MRL
ppm	Parts per million
TPH	Total petroleum hydrocarbons
USEPA	U.S. Environmental Protection Agency

Table B.2
Groundwater Analytical Data

Well	Sample Date	Depth to Water	DRO	ORO	GRO	Benzene	Toluene	Ethylbenzene	Total Xylenes	cPAH TEQ
		ft btoc	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-2	08/04/2000	10.4	420	500 U	--	--	--	--	--	--
	08/07/2001	11.21	--	--	--	--	--	--	--	--
	08/19/2002	10.79	--	--	--	--	--	--	--	--
	08/21/2003	10.7	--	--	--	--	--	--	--	--
	08/05/2004	10.23	250 U	500 U	--	--	--	--	--	--
	08/10/2005	10.48	--	--	--	--	--	--	--	--
	08/21/2006	10.53	240 U	480 U	--	--	--	--	--	--
	08/10/2007	10.68	1,900 Y	530 U	--	--	--	--	--	--
	10/05/2007	11.34	--	--	--	0.5 U	1 U	1 U	1 U	0.02 U
	10/5/2007 (Dup)	11.34	--	--	--	0.5 U	1 U	1 U	1 U	0.02 U
	07/22/2008	10.26	--	--	--	--	--	--	--	--
	08/18/2010	10.31	--	--	--	--	--	--	--	--
	08/26/2011	10.31	--	--	--	--	--	--	--	--
	09/28/2012	10.91	--	--	--	--	--	--	--	--
	09/26/2013	10.86	--	--	--	--	--	--	--	--
MW-3	09/21/2009	--	710 Y	500 U	670 Y	6.6	4.90	14	4.83	0.02 U
MW-6	09/23/2009	--	370 Y	520 U	--	--	--	--	--	0.02 U
MW-7	09/22/2009	--	--	--	1,300 Y	2.2	1.30	0.50 U	1.78	--
MW-8	09/21/2008	--	250 U	500 U	2,900 Y	9	3.90	1.60	8.19	0.03
MW-10	07/16/1999	12.34	2,170	500 U	5,300	300	58	360	83	0.02 U
	08/03/2000	16.11	3,200	500 U	5,000	140	50	210	99	0.02 U
	08/3/2000 (Dup)	16.11	3,100	500 U	4,800	130	48	200	95	0.02 U
	08/07/2001	17.25	280 L	500 U	4,300 Y	190 C	40 C	190 C	62	0.02 U
	08/7/2001 (Dup)	17.25	290 L	500 U	4,200 Y	190 C	41 C	200 C	64	0.02 U
	08/19/2002	16.53	450 L	500 U	5,800 DY	250 D	46 D	260 D	75	0.01 U
	08/21/2003	16.83	320 Y	480 U	4,700 Y	130	44	180	75 P	0.02 U
	08/05/2004	16.44	340 Z	500 U	4,000 Y	110	21	140	42	0.02 U
	08/5/2004 (Dup)	16.44	320 Z	500 U	4,000 Y	130	32	140	43	0.01 U
	08/26/2005	16.7	1,700 Y	500 U	4,400 Y	310 D	51 D	290 D	77.40 D	0.02 U
	08/21/2006	16.68	500 L	480 U	4,400 Y	430 D	65 D	280 D	90 D	0.02 U
	08/21/2006 (Dup)	16.68	500 L	480 U	4,600 Y	470 D	70 D	3,310 D	96 D	0.02 U
	08/09/2007	16.55	660 L	500 U	5,100 Y	360 D	54	230 D	90.6	0.01 U
	07/23/2008	15.9	440 L	500 U	4,700 DY	340 D	51	260 D	65.6	0.01 U
	07/23/2008 (Dup)	15.9	330 L	500 U	4,800 DY	340 D	51	270 D	73.7	0.01 U
	09/24/2009	--	490 L	530 U	4,100 Y	160 D	37	130 D	54.3	0.01 U
	09/24/2009 (Dup)	--	500 L	520 U	4,200 Y	140 D	33	110 D	47.2	0.01 U
	08/19/2010	16.91	380 L	550 U	3,200 Y	70 D	16 D	99 D	22 D	0.02 U
	08/19/2010 (Dup)	16.91	340 L	540 U	3,200 Y	74 D	17 D	100 D	23 D	0.02 U
	08/26/2011	16.91	270 U	530 U	2,900 Y	110 D	24 D	130 D	28 D	0.05
	08/26/2011 (Dup)	16.91	270 U	530 U	3,000 Y	110 D	21 D	110 D	23 D	0.04
	09/28/2012	16.92	280 L	520 U	2,300 Y	--	--	--	--	0.02 U
	09/28/2012 (Dup)	16.92	270 U	530 U	2,300 Y	--	--	--	--	0.02 U
	09/26/2013	16.56	270 U	530 U	1,900 Y	64	13	55	25	0.02 U
	09/26/2013 (Dup)	16.56	270 U	530 U	1,800 Y	63	13	54	25	0.02 U
MW-12	07/16/1999	12.85	1,740	500 U	3,400	210	24	34	56	0.02 U
	07/16/1999 (Dup)	12.85	1,690	500 U	3,600	220	26	37	60	0.02 U
	08/03/2000	14.38	2,800	500 U	4,500	220	54	62	138	0.02 U
	08/08/2001	15.51	270 L	500 U	4,500 Y	710 DC	48 C	42 C	89.9	0.02 U
	08/19/2002	14.74	410 L	500 U	5,400 DY	420 D	41 D	53 D	77	0.02 U
	08/19/2002 (Dup)	14.74	400 L	500 U	5,300 DY	450 D	43 D	57 D	83	0.02 U
	08/21/2003	15.1	290 Y	480 U	3,900 Y	560 D	40	54	74.7 P	0.01 U
	08/21/2003 (Dup)	15.1	250 Y	480 U	4,000 Y	560 D	40	55	75.7 P	0.01 U
	08/05/2004	14.9	250 U	500 U	280 Z	17	1.6	1.9	2.3	0.02 U
	08/11/2005	14.85	760 L	500 U	3,400 DZ	880 D	52 D	63 D	84 D	0.02 U
	08/11/2005 (Dup)	14.85	410 L	500 U	3,300 DZ	890 D	48 D	63 D	77 D	0.02 U
	08/18/2006	14.95	240 U	480 U	970 Y	350 D	21	15	12	0.02 U
	08/09/2007	14.88	400 L	500 U	3,300 Y	730 D	42	48	72.2	0.02 U
	08/9/2007 (Dup)	14.95	470 L	500 U	3,200 Y	680 D	39	47	75.8	0.01 U
	07/23/2008	14.25	300 L	500 U	3,300 DY	660 D	45	34 D	94.6	0.01 U
	09/23/2009	--	550 L	500 U	3,100 Y	840 D	48 D	44 D	67 D	0.01 U
	08/19/2010	15.24	623 A1,L	199 U	2,410	133	29.6	46.1	52	0.04 U
	08/25/2011	15.24	290 L	520 U	2,500 Y	420 D	25 D	24 D	38 D	0.02 U
	09/27/2012	12.31	350 L	520 U	2,100 Y	--	--	--	--	0.02 U
	09/26/2013	14.79	350 L	530 U	640 Y	74	6	13	11	0.02 U
MW-14	09/22/2009	--	160,000 D	50,000 U	--	--	--	--	--	--
	08/19/2010	--	1,600	536 M	--	--	--	--	--	0.14
MW-15	09/23/2009	--	260 U	520 U	--	--	--	--	--	0.02 U
MW-16	09/23/2009	--	82,000 D	32,000 U	--	--	--	--	--	--

Table B.2
Groundwater Analytical Data

Well	Sample Date	Depth to Water ft btoc	DRO µg/L	ORO µg/L	GRO µg/L	Benzene µg/L	Toluene µg/L	Ethylbenzene µg/L	Total Xylenes µg/L	cPAH TEQ µg/L
MW-23	07/15/1999	22.8	--	--	--	--	--	--	--	--
	08/03/2000	24.22	--	--	--	--	--	--	--	--
	08/08/2001	25.48	--	--	--	--	--	--	--	--
	08/20/2002	25.34	--	--	--	--	--	--	--	--
	08/21/2003	25.21	--	--	--	--	--	--	--	--
	08/06/2004	24.54	--	--	--	--	--	--	--	--
	08/11/2005	25.43	--	--	--	--	--	--	--	--
	08/21/2006	25.55	--	--	--	--	--	--	--	--
	08/10/2007	25.26	--	--	--	--	--	--	--	--
	07/23/2008	23.89	--	--	--	--	--	--	--	--
	09/25/2009	--	250 U	500 U	--	--	--	--	--	--
	08/20/2010	25.64	--	--	--	--	--	--	--	--
	08/25/2011	25.64	--	--	--	--	--	--	--	--
	09/28/2012	26	--	--	--	--	--	--	--	--
	09/27/2013	25.31	--	--	--	--	--	--	--	--
MW-28	08/20/2010	--	878 A4	301 A2,M	--	--	--	--	--	2.76
MW-30	07/13/1998	14.59	1,320	--	--	--	--	--	--	--
	08/24/1998	14.9	1,680	--	--	--	--	--	--	--
	04/28/1999	13.19	943	500 U	--	--	--	--	--	--
	07/15/1999	13.76	1,230	500 U	--	--	--	--	--	--
	07/15/1999 (Dup)	13.76	1,200	500 U	--	--	--	--	--	--
	11/18/1999	14.54	1,660	500 U	--	--	--	--	--	--
	02/03/2000	13.16	2,200	500 U	--	--	--	--	--	--
	05/31/2000	13.68	1,400	500 U	--	--	--	--	--	--
	08/03/2000	14.09	2,000	500 U	--	--	--	--	--	--
	08/3/2000 (Dup)	14.09	320	500 U	--	--	--	--	--	--
	08/07/2001	15.25	250 U	500 U	--	--	--	--	--	--
	08/19/2002	14.31	250 U	500 U	--	--	--	--	--	--
	08/21/2003	14.28	240 U	480 U	--	--	--	--	--	--
	08/05/2004	13.99	250 U	500 U	--	--	--	--	--	--
	08/26/2005	14.11	3,800 Y	1,100 L	--	--	--	--	--	--
	10/28/2005	14.63	250 U	500 U	--	--	--	--	--	--
	08/21/2006	14.89	240 U	480 U	--	--	--	--	--	--
	08/09/2007	14.05	3,000 Y	680 L	--	--	--	--	--	--
	10/05/2007	16.1	--	--	--	0.5 U	1 U	1 U	1 U	0.02 U
	07/23/2008	14.15	250 U	500 U	--	--	--	--	--	--
	09/25/2009	--	260 U	520 U	--	--	--	--	--	--
	08/20/2010	15.14	--	--	--	--	--	--	--	--
	08/26/2011	15.14	--	--	--	--	--	--	--	--
	09/28/2012	17.82	830 Y	1,600 O	250 U	--	--	--	--	--
	09/26/2013	20.15	270 U	530 U	--	--	--	--	--	--

Note:

-- Not analyzed.

Abbreviations:

CLP	Contract Laboratory Program
cPAH	Carcinogenic polycyclic aromatic hydrocarbon
DRO	Diesel-range organics
ft btoc	Feet below top of casing
GC	Gas chromatogram
GRO	Gasoline-range organics
HPLC	High Performance Liquid Chromatography
MS	Matrix Spike
ORO	Oil-range organics
TEQ	Toxicity equivalent
µg/L	Micrograms per liter

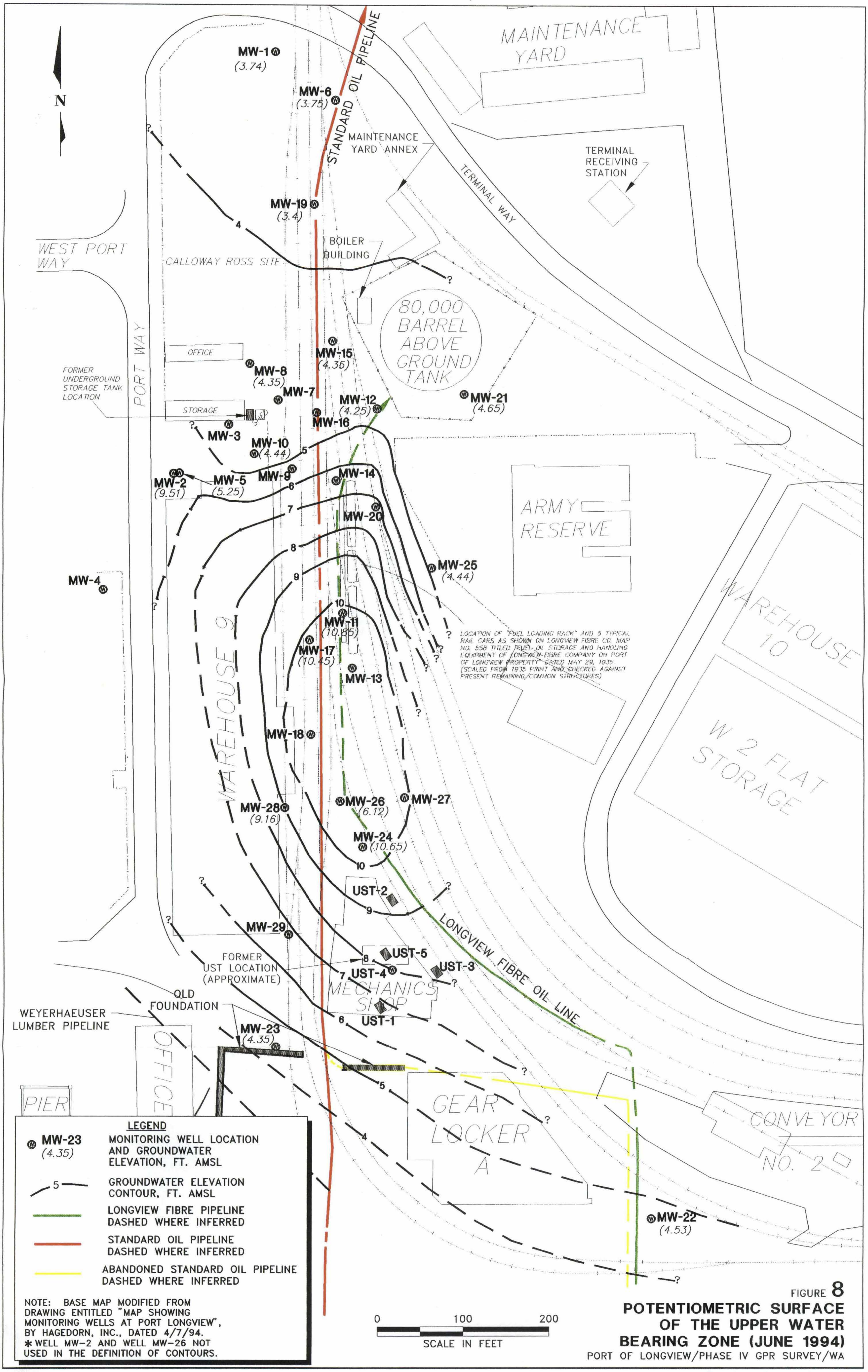
Qualifiers:

A1,L	This sample contains a DRO not identified as a specific hydrocarbon product. The result was quantified against diesel calibration standards. Diesel result is biased high due to amount of gasoline contained in the sample.
A2,M	This sample contains a ORO not identified as a specific hydrocarbon product. The result was quantified against a lube oil calibration standard. Oil result is biased high due to amount of diesel contained in the sample.
A4	The product appears to be aged or degraded diesel.
C	The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
D	The reported result is from a dilution.
DC	The reported result is from a dilution. The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
DY	The reported result is from a dilution. The chromatogram resembles a petroleum product but does not match the calibration standard.
DZ	The reported result is from a dilution. The chromatogram does not resemble a petroleum product.
L	The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
M	Oil result is biased high due to amount of diesel contained in the sample.
O	The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
P	The GC or HPLC confirmation criteria were exceeded. The relative percent difference is greater than 40% between the two analytical results (25% for CLP Pesticides).
U	Indicates the compound was undetected at the reported concentration.
Y	The chromatogram resembles a petroleum product but does not match the calibration standard.
Z	The chromatogram does not resemble a petroleum product.

Port of Longview TPH Site

Remedial Investigation Work Plan

Appendix C
Historical Potentiometric Contour Maps

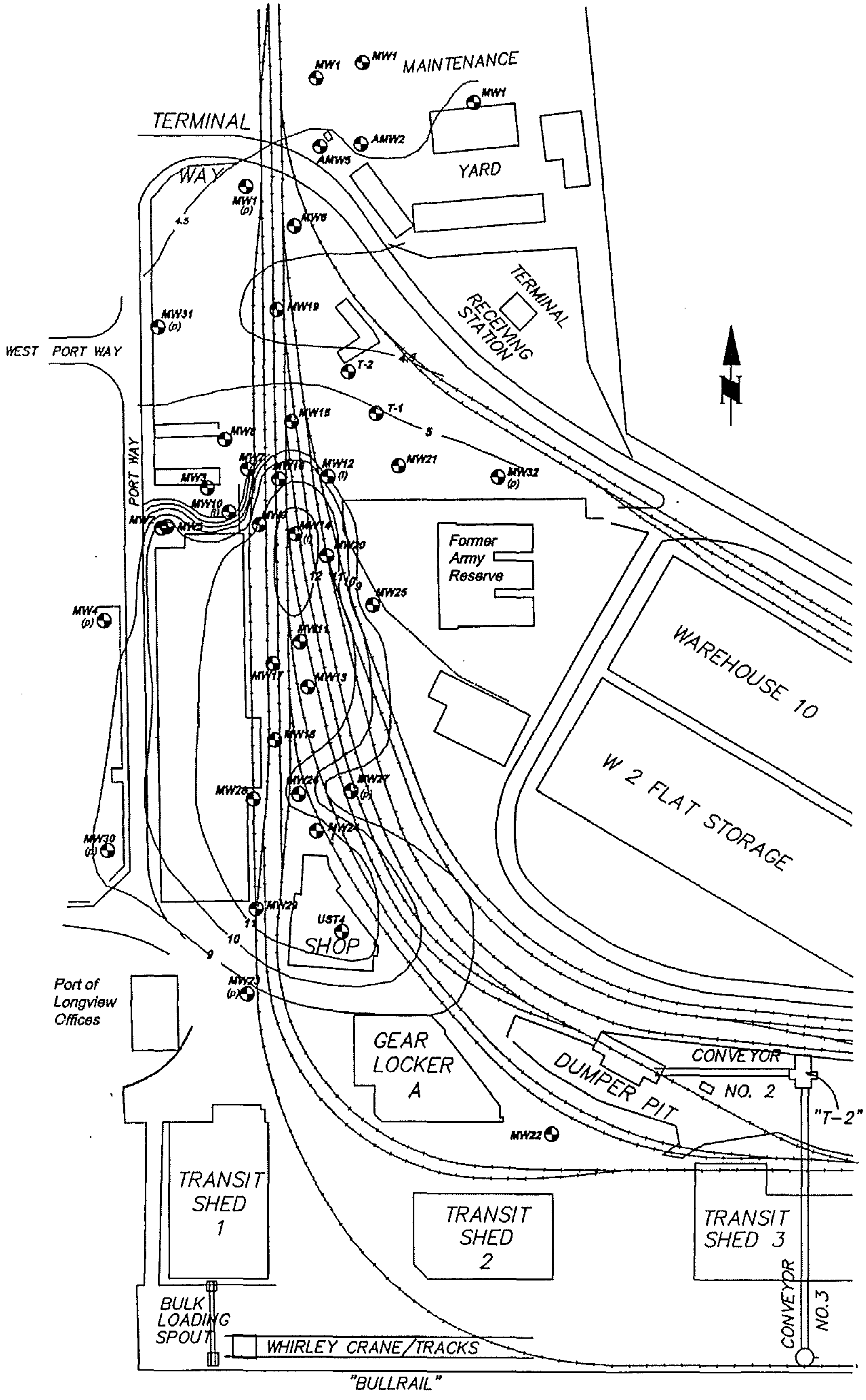


NOTE: BASE MAP MODIFIED FROM DRAWING ENTITLED "MAP SHOWING MONITORING WELLS AT PORT LONGVIEW", BY HAGEDORN, INC., DATED 4/7/94.
* WELL MW-2 AND WELL MW-26 NOT USED IN THE DEFINITION OF CONTOURS.

FIGURE 8
POTENTIOMETRIC SURFACE OF THE UPPER WATER BEARING ZONE (JUNE 1994)
PORT OF LONGVIEW/PHASE IV GPR SURVEY/WA

DWG ID: \JPM\9439735\500\40580 DATE 12-6-94 8:35

Golder Associates



MW22 ⊕ **Groundwater Monitoring Well**
(p) - Perimeter Sampling Well
(i) - Interior Sampling Well

Note: Groundwater contours are approximate only. Elevations shown are in feet above mean sea level.

FIGURE 3
TYPICAL GROUNDWATER ELEVATION MAP
(BASED ON JULY 1998 SAMPLING DATA)

PORT OF LONGVIEW/POST-CAP MONITORING/WA

Golder Associates

Port of Longview TPH Site

Remedial Investigation Work Plan

Appendix D
Laboratory Reports

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Yelena Aravkina, M.S.
Michael Erdahl, B.S.
Arina Podnozova, B.S.
Eric Young, B.S.

3012 16th Avenue West
Seattle, WA 98119-2029
(206) 285-8282
fbi@isomedia.com
www.friedmanandbruya.com

March 8, 2019

Gabriel Cisneros, Project Manager
Floyd-Snider
Two Union Square, Suite 600
601 Union St
Seattle, WA 98101

Dear Mr Cisneros:

Included are the results from the testing of material submitted on March 1, 2019 from the POL-TPH, F&BI 903013 project. There are 18 pages included in this report. Any samples that may remain are currently scheduled for disposal in 30 days, or as directed by the Chain of Custody document. If you would like us to return your samples or arrange for long term storage at our offices, please contact us as soon as possible.

We appreciate this opportunity to be of service to you and hope you will call if you should have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Michael Erdahl
Project Manager

Enclosures
c: Brett Beaulieu
FDS0308R.DOC

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

CASE NARRATIVE

This case narrative encompasses samples received on March 1, 2019 by Friedman & Bruya, Inc. from the Floyd-Snider POL-TPH, F&BI 903013 project. Samples were logged in under the laboratory ID's listed below.

Laboratory ID	Floyd-Snider
903013 -01	MW-06-022719
903013 -02	MW-19-022719
903013 -03	MW-15-022719
903013 -04	MW-12-022719
903013 -05	MW-07-022719
903013 -06	MW-16-022719
903013 -07	MW-14-022719
903013 -08	MW-31-022719
903013 -09	MW-131-022719
903013 -10	MW-1-022719
903013 -11	MW-02-022719
903013 -12	MW-05-022719
903013 -13	MW-03-022719
903013 -14	MW-10-022719
903013 -15	UST-4-022819
903013 -16	UST-104-022819
903013 -17	MW-22-022819
903013 -18	MW-29-022819
903013 -19	MW-23-022819
903013 -20	MW-24-022819
903013 -21	MW-27-022819
903013 -22	MW-13-022819
903013 -23	MW-26-022819
903013 -24	MW-28-022819
903013 -25	MW-11-022819
903013 -26	MW-25-022819
903013 -27	MW-20-022819
903013 -28	MW-17-022819
903013 -29	MW-18-022819
903013 -30	MW-32-022819
903013 -31	MW-04-022819
903013 -32	Trip Blank

All quality control requirements were acceptable.

Date of Report: 03/08/19
Date Received: 03/01/19
Project: POL-TPH, F&BI 903013
Date Extracted: 03/05/19
Date Analyzed: 03/05/19

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND TPH AS GASOLINE USING METHODS 8021B AND NWTPH-Gx

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Gasoline Range	Surrogate (% Recovery) (Limit 52-124)
MW-06-022719 903013-01	<1	<1	<1	<3	<100	80
MW-19-022719 903013-02	<1	<1	<1	<3	<100	83
MW-15-022719 903013-03	<1	<1	<1	<3	<100	85
MW-12-022719 903013-04	61	6.4	3.5	6.2	600	87
MW-07-022719 903013-05	2.0	9.2	2.2	6.0	1,100	88
MW-16-022719 903013-06	<1	<1	<1	<3	<100	84
MW-14-022719 903013-07	<1	<1	<1	<3	<100	84
MW-31-022719 903013-08	<1	<1	<1	<3	<100	83
MW-131-022719 903013-09	<1	<1	<1	<3	<100	84
MW-1-022719 903013-10	<1	<1	<1	<3	<100	84
MW-02-022719 903013-11	<1	<1	<1	<3	<100	85

Date of Report: 03/08/19
Date Received: 03/01/19
Project: POL-TPH, F&BI 903013
Date Extracted: 03/05/19
Date Analyzed: 03/05/19

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND TPH AS GASOLINE USING METHODS 8021B AND NWTPH-Gx

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Gasoline Range	Surrogate (% Recovery) (Limit 52-124)
MW-05-022719 903013-12	<1	<1	<1	<3	<100	84
MW-03-022719 903013-13 1/5	13	<5	<5	<15	960	83
MW-10-022719 903013-14	1.1	<1	<1	<3	<100	82
UST-4-022819 903013-15	<1	<1	<1	<3	<100	84
UST-104-022819 903013-16	<1	<1	<1	<3	<100	83
MW-22-022819 903013-17	<1	<1	<1	<3	<100	83
MW-29-022819 903013-18	<1	<1	<1	<3	<100	84
MW-23-022819 903013-19	<1	<1	<1	<3	<100	83
MW-24-022819 903013-20	<1	<1	<1	<3	<100	84
MW-27-022819 903013-21	<1	<1	<1	<3	<100	84
MW-13-022819 903013-22	<1	<1	<1	<3	<100	85

Date of Report: 03/08/19
Date Received: 03/01/19
Project: POL-TPH, F&BI 903013
Date Extracted: 03/05/19
Date Analyzed: 03/05/19

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND TPH AS GASOLINE USING METHODS 8021B AND NWTPH-Gx

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Gasoline Range	Surrogate (% Recovery) (Limit 52-124)
MW-26-022819 903013-23	<1	<1	<1	<3	<100	82
MW-28-022819 903013-24	<1	<1	<1	<3	<100	84
MW-11-022819 903013-25	<1	<1	<1	<3	<100	83
MW-25-022819 903013-26	<1	<1	<1	<3	<100	85
MW-20-022819 903013-27	1.7	<1	7.0	9.1	1,500	88
MW-17-022819 903013-28	<1	<1	<1	<3	<100	82
MW-18-022819 903013-29	<1	<1	<1	<3	<100	84
MW-32-022819 903013-30	<1	<1	<1	<3	<100	84
MW-04-022819 903013-31	<1	<1	<1	<3	<100	85
Method Blank 09-352 mb	<1	<1	<1	<3	<100	82
Method Blank 09-351 mb	<1	<1	<1	<3	<100	81

Date of Report: 03/08/19
Date Received: 03/01/19
Project: POL-TPH, F&BI 903013
Date Extracted: 03/04/19
Date Analyzed: 03/06/19

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL AND MOTOR OIL USING METHOD NWTPH-Dx

Sample Extracts Passed Through a Silica Gel Column Prior to Analysis

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Diesel Range (C_{10}-C_{25})	Motor Oil Range (C_{25}-C_{36})	Surrogate (% Recovery) (Limit 47-140)
MW-06-022719 903013-01 1/1.2	140	<300	117
MW-19-022719 903013-02 1/1.2	<60	<300	121
MW-15-022719 903013-03 1/1.2	<60	<300	123
MW-12-022719 903013-04 1/1.2	100 x	<300	117
MW-07-022719 903013-05 1/1.2	340 x	<300	116
MW-16-022719 903013-06 1/1.2	<60	<300	70
MW-14-022719 903013-07 1/1.2	81	<300	109
MW-31-022719 903013-08 1/1.2	<60	<300	105
MW-131-022719 903013-09 1/1.2	<60	<300	121
MW-1-022719 903013-10 1/1.2	<60	<300	118

Date of Report: 03/08/19
Date Received: 03/01/19
Project: POL-TPH, F&BI 903013
Date Extracted: 03/04/19
Date Analyzed: 03/06/19

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL AND MOTOR OIL USING METHOD NWTPH-Dx

Sample Extracts Passed Through a Silica Gel Column Prior to Analysis

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Diesel Range (C_{10}-C_{25})	Motor Oil Range (C_{25}-C_{36})	Surrogate (% Recovery) (Limit 47-140)
MW-02-022719 903013-11 1/1.2	<60	<300	102
MW-05-022719 903013-12 1/1.2	<60	<300	114
MW-03-022719 903013-13 1/1.2	73 x	<300	105
MW-10-022719 903013-14 1/1.2	<60	<300	108
UST-4-022819 903013-15 1/1.2	<60	<300	103
UST-104-022819 903013-16 1/1.2	<60	<300	110
MW-22-022819 903013-17 1/1.2	<60	<300	113
MW-29-022819 903013-18 1/1.2	<60	<300	111
MW-23-022819 903013-19 1/1.2	<60	<300	110
MW-24-022819 903013-20 1/1.2	<60	<300	111

Date of Report: 03/08/19
Date Received: 03/01/19
Project: POL-TPH, F&BI 903013
Date Extracted: 03/04/19
Date Analyzed: 03/06/19

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL AND MOTOR OIL USING METHOD NWTPH-Dx

Sample Extracts Passed Through a Silica Gel Column Prior to Analysis

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Diesel Range (C_{10}-C_{25})	Motor Oil Range (C_{25}-C_{36})	Surrogate (% Recovery) (Limit 47-140)
MW-27-022819 903013-21 1/1.2	<60	<300	117
MW-13-022819 903013-22 1/1.2	<60	<300	98
MW-26-022819 903013-23 1/1.2	<60	<300	120
MW-28-022819 903013-24 1/1.2	610	<300	122
MW-11-022819 903013-25 1/1.2	<60	<300	121
MW-25-022819 903013-26 1/1.2	<60	<300	122
MW-20-022819 903013-27 1/1.2	370 x	<300	118
MW-17-022819 903013-28 1/1.3	<65	<320	113
MW-18-022819 903013-29 1/1.2	<60	<300	103
MW-32-022819 903013-30 1/1.2	<60	<300	97

Date of Report: 03/08/19
Date Received: 03/01/19
Project: POL-TPH, F&BI 903013
Date Extracted: 03/04/19
Date Analyzed: 03/06/19

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL AND MOTOR OIL USING METHOD NWTPH-Dx

Sample Extracts Passed Through a Silica Gel Column Prior to Analysis

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Diesel Range (C_{10}-C_{25})	Motor Oil Range (C_{25}-C_{36})	Surrogate (% Recovery) (Limit 47-140)
MW-04-022819 903013-31 1/1.2	<60	<300	104
Method Blank 09-459 MB 1/1.2	<60	<300	123
Method Blank 09-461 MB 1/1.2	<60	<300	127

Date of Report: 03/08/19
Date Received: 03/01/19
Project: POL-TPH, F&BI 903013
Date Extracted: 03/04/19
Date Analyzed: 03/04/19 and 03/05/19

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL AND MOTOR OIL USING METHOD NWTPH-Dx

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Diesel Range (C_{10}-C_{25})	Motor Oil Range (C_{25}-C_{36})	Surrogate (% Recovery) (Limit 51-134)
MW-06-022719 903013-01 1/1.2	800 x	<300	101
MW-19-022719 903013-02 1/1.2	67 x	<300	103
MW-15-022719 903013-03 1/1.2	78 x	<300	99
MW-12-022719 903013-04 1/1.2	490 x	<300	87
MW-07-022719 903013-05 1/1.2	780 x	<300	93
MW-16-022719 903013-06 1/1.2	<60	<300	61
MW-14-022719 903013-07	150 x	<300	102
MW-31-022719 903013-08	<60	<300	94
MW-131-022719 903013-09 1/1.2	<60	<300	107
MW-1-022719 903013-10 1/1.2	<60	<300	109
MW-02-022719 903013-11 1/1.2	<60	<300	94

Date of Report: 03/08/19
Date Received: 03/01/19
Project: POL-TPH, F&BI 903013
Date Extracted: 03/04/19
Date Analyzed: 03/04/19 and 03/05/19

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL AND MOTOR OIL USING METHOD NWTPH-Dx

Results Reported as ug/L (ppb)

Sample ID	Diesel Range	Motor Oil Range	Surrogate (% Recovery)
Laboratory ID	(C_{10}-C_{25})	(C_{25}-C_{36})	(Limit 51-134)
MW-05-022719 903013-12 1/1.2	82 x	<300	112
MW-03-022719 903013-13 1/1.2	1,700 x	450 x	69
MW-10-022719 903013-14 1/1.2	<60	<300	100
UST-4-022819 903013-15 1/1.2	140 x	<300	102
UST-104-022819 903013-16 1/1.2	140 x	<300	103
MW-22-022819 903013-17 1/1.2	<60	<300	103
MW-29-022819 903013-18 1/1.2	<60	<300	ip
MW-23-022819 903013-19 1/1.2	<60	<300	101
MW-24-022819 903013-20 1/1.2	<60	<300	92
MW-27-022819 903013-21 1/1.2	<60	<300	97
MW-13-022819 903013-22 1/1.2	<60	<300	88

Date of Report: 03/08/19
Date Received: 03/01/19
Project: POL-TPH, F&BI 903013
Date Extracted: 03/04/19
Date Analyzed: 03/04/19 and 03/05/19

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL AND MOTOR OIL USING METHOD NWTPH-Dx

Results Reported as ug/L (ppb)

Sample ID	Diesel Range	Motor Oil Range	Surrogate (% Recovery)
Laboratory ID	(C_{10}-C_{25})	(C_{25}-C_{36})	(Limit 51-134)
MW-26-022819 903013-23 1/1.2	140 x	<300	100
MW-28-022819 903013-24 1/1.2	5,500 x	1,600 x	71
MW-11-022819 903013-25 1/1.2	<60	<300	97
MW-25-022819 903013-26 1/1.2	<60	<300	105
MW-20-022819 903013-27 1/1.2	970 x	360 x	72
MW-17-022819 903013-28 1/1.2	<60	<300	92
MW-18-022819 903013-29 1/1.2	<60	<300	100
MW-32-022819 903013-30 1/1.2	<60	<300	89
MW-04-022819 903013-31 1/1.2	<60	<300	95
Method Blank 09-459 MB	<60	<300	94
Method Blank 09-461 MB	<60	<300	96

Date of Report: 03/08/19
Date Received: 03/01/19
Project: POL-TPH, F&BI 903013

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES, AND TPH AS GASOLINE USING EPA METHOD 8021B AND NWTPH-Gx

Laboratory Code: 903013-01 (Duplicate)

Analyte	Reporting Units	Sample Result	Duplicate Result	RPD (Limit 20)
Benzene	ug/L (ppb)	<1	<1	nm
Toluene	ug/L (ppb)	<1	<1	nm
Ethylbenzene	ug/L (ppb)	<1	<1	nm
Xylenes	ug/L (ppb)	<3	<3	nm
Gasoline	ug/L (ppb)	<100	<100	nm

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Benzene	ug/L (ppb)	50	95	65-118
Toluene	ug/L (ppb)	50	100	72-122
Ethylbenzene	ug/L (ppb)	50	94	73-126
Xylenes	ug/L (ppb)	150	98	74-118
Gasoline	ug/L (ppb)	1,000	100	69-134

Date of Report: 03/08/19
Date Received: 03/01/19
Project: POL-TPH, F&BI 903013

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES, AND TPH AS GASOLINE USING EPA METHOD 8021B AND NWTPH-Gx

Laboratory Code: 903013-19 (Matrix Spike)

Analyte	Reporting Units	Spike Level	Sample Result	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
Benzene	ug/L (ppb)	50	<1	78	78	50-150	0
Toluene	ug/L (ppb)	50	<1	79	78	50-150	1
Ethylbenzene	ug/L (ppb)	50	<1	76	75	50-150	1
Xylenes	ug/L (ppb)	150	<3	79	79	50-150	0
Gasoline	ug/L (ppb)	1,000	<100	85	82	53-117	4

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Benzene	ug/L (ppb)	50	88	65-118
Toluene	ug/L (ppb)	50	93	72-122
Ethylbenzene	ug/L (ppb)	50	89	73-126
Xylenes	ug/L (ppb)	150	93	74-118
Gasoline	ug/L (ppb)	1,000	99	69-134

Date of Report: 03/08/19
Date Received: 03/01/19
Project: POL-TPH, F&BI 903013

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL EXTENDED USING METHOD NWTPH-Dx

Laboratory Code: 903013-19 (Matrix Spike) Silica Gel

Analyte	Reporting Units	Spike Level	Sample Result	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
Diesel Extended	ug/L (ppb)	3,000	<50	97	102	64-141	5

Laboratory Code: Laboratory Control Sample Silica Gel

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Diesel Extended	ug/L (ppb)	3,000	97	61-133

Date of Report: 03/08/19
Date Received: 03/01/19
Project: POL-TPH, F&BI 903013

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL EXTENDED USING METHOD NWTPH-Dx

Laboratory Code: Laboratory Control Sample Silica Gel

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Diesel Extended	ug/L (ppb)	3,000	102	108	63-142	6

Date of Report: 03/08/19
Date Received: 03/01/19
Project: POL-TPH, F&BI 903013

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL EXTENDED USING METHOD NWTPH-Dx

Laboratory Code: 903013-19 (Matrix Spike)

Analyte	Reporting Units	Spike Level	Sample Result	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
Diesel Extended	ug/L (ppb)	3,000	<50	92	94	52-149	2

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Diesel Extended	ug/L (ppb)	3,000	77	58-134

Date of Report: 03/08/19
Date Received: 03/01/19
Project: POL-TPH, F&BI 903013

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL EXTENDED USING METHOD NWTPH-Dx

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Diesel Extended	ug/L (ppb)	3,000	100	95	58-134	5

Data Qualifiers & Definitions

a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.

b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.

ca - The calibration results for the analyte were outside of acceptance criteria. The value reported is an estimate.

c - The presence of the analyte may be due to carryover from previous sample injections.

cf - The sample was centrifuged prior to analysis.

d - The sample was diluted. Detection limits were raised and surrogate recoveries may not be meaningful.

dv - Insufficient sample volume was available to achieve normal reporting limits.

f - The sample was laboratory filtered prior to analysis.

fb - The analyte was detected in the method blank.

fc - The analyte is a common laboratory and field contaminant.

hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. Variability is attributed to sample inhomogeneity.

hs - Headspace was present in the container used for analysis.

ht – The analysis was performed outside the method or client-specified holding time requirement.

ip - Recovery fell outside of control limits due to sample matrix effects.

j - The analyte concentration is reported below the lowest calibration standard. The value reported is an estimate.

J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.

jl - The laboratory control sample(s) percent recovery and/or RPD were out of control limits. The reported concentration should be considered an estimate.

js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.

lc - The presence of the analyte is likely due to laboratory contamination.

L - The reported concentration was generated from a library search.

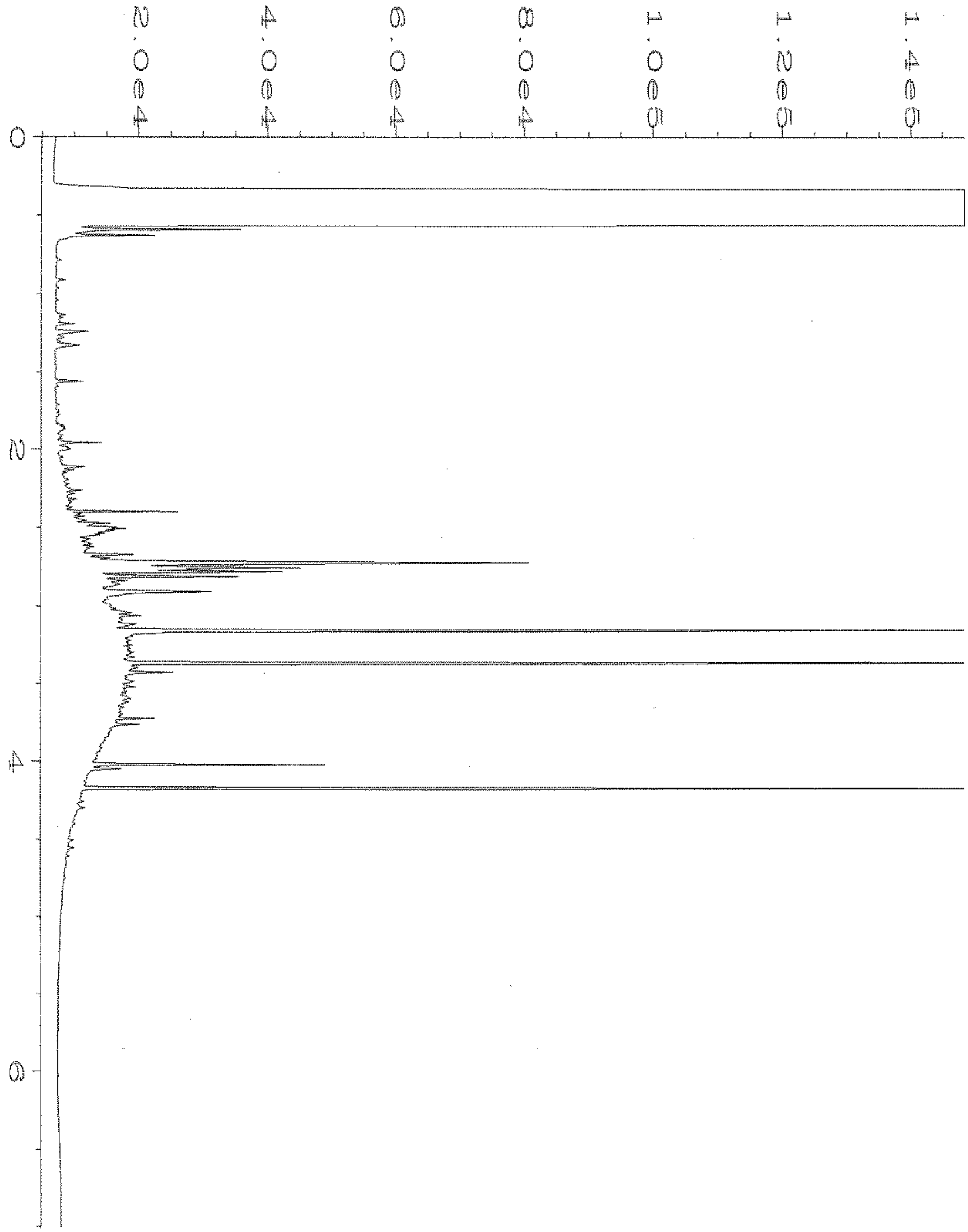
nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.

pc - The sample was received with incorrect preservation or in a container not approved by the method. The value reported should be considered an estimate.

ve - The analyte response exceeded the valid instrument calibration range. The value reported is an estimate.

vo - The value reported fell outside the control limits established for this analyte.

x - The sample chromatographic pattern does not resemble the fuel standard used for quantitation.



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Instrument        : GC6                                 Vial Number       : 20
Sample Name       : 903013-01                           Injection Number  : 1
Run Time Bar Code:                                      Sequence Line     : 7
Acquired on       : 04 Mar 19   03:18 PM                Instrument Method: DX.MTH
Report Created on: 05 Mar 19   08:46 AM                 Analysis Method   : DX.MTH
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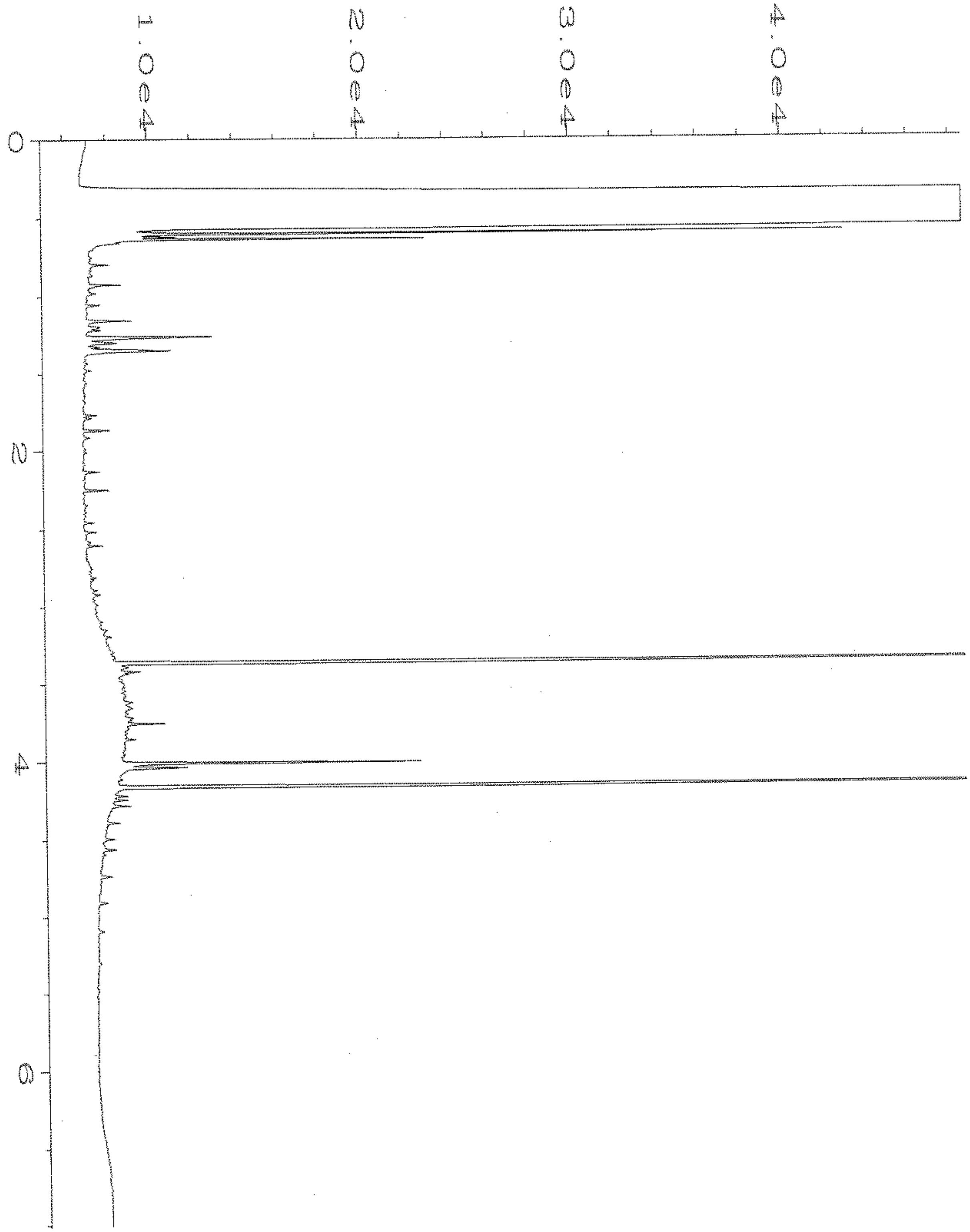

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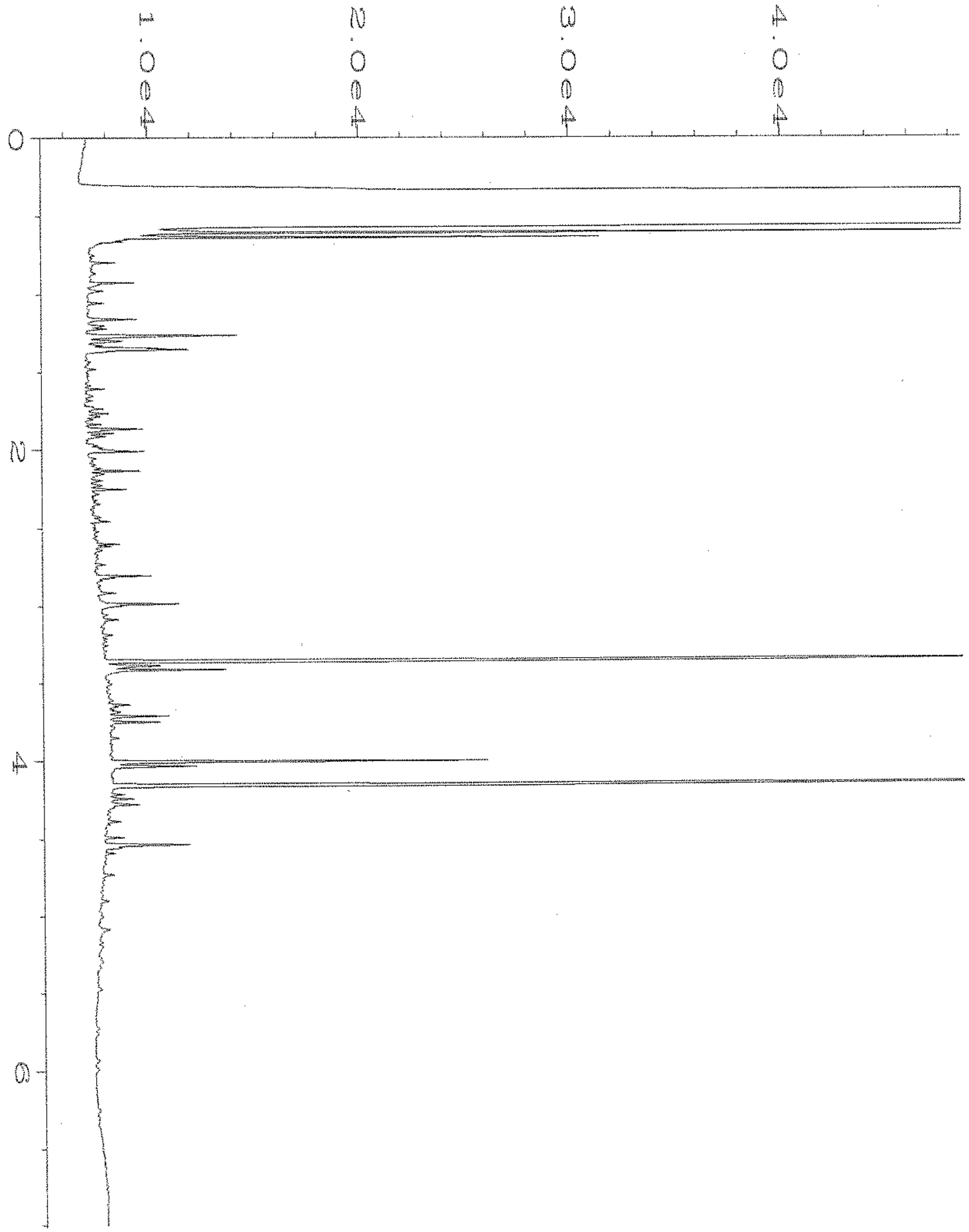
Operator : TL
Instrument : GC6
Sample Name : 903013-02
Run Time Bar Code:
Acquired on : 04 Mar 19 03:26 PM
Report Created on: 05 Mar 19 08:47 AM

Page Number : 1
Vial Number : 21
Injection Number : 1
Sequence Line : 7
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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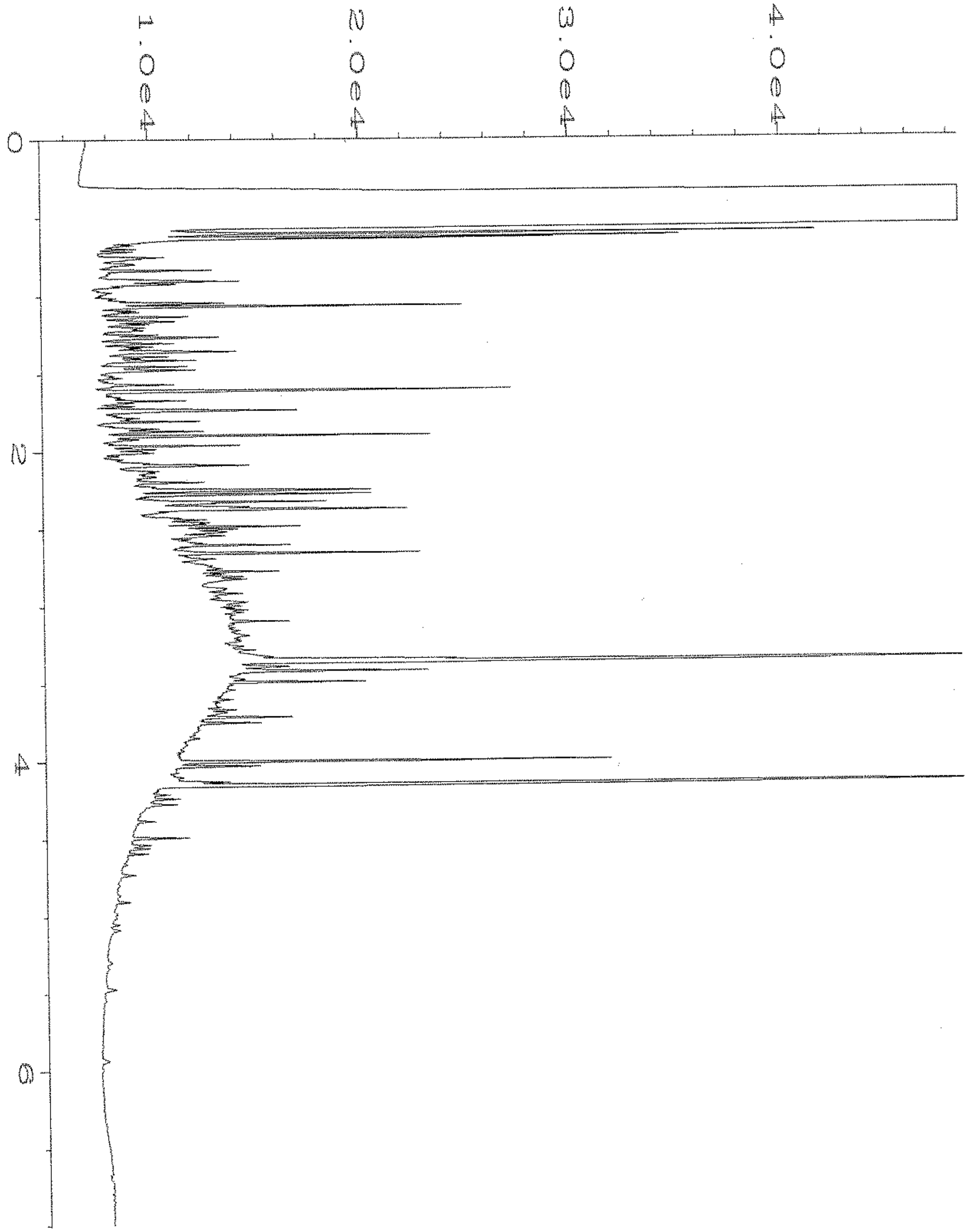
Operator : TL
Instrument : GC6
Sample Name : 903013-03
Run Time Bar Code:
Acquired on : 04 Mar 19 03:37 PM
Report Created on: 05 Mar 19 08:47 AM

Page Number : 1
Vial Number : 22
Injection Number : 1
Sequence Line : 7
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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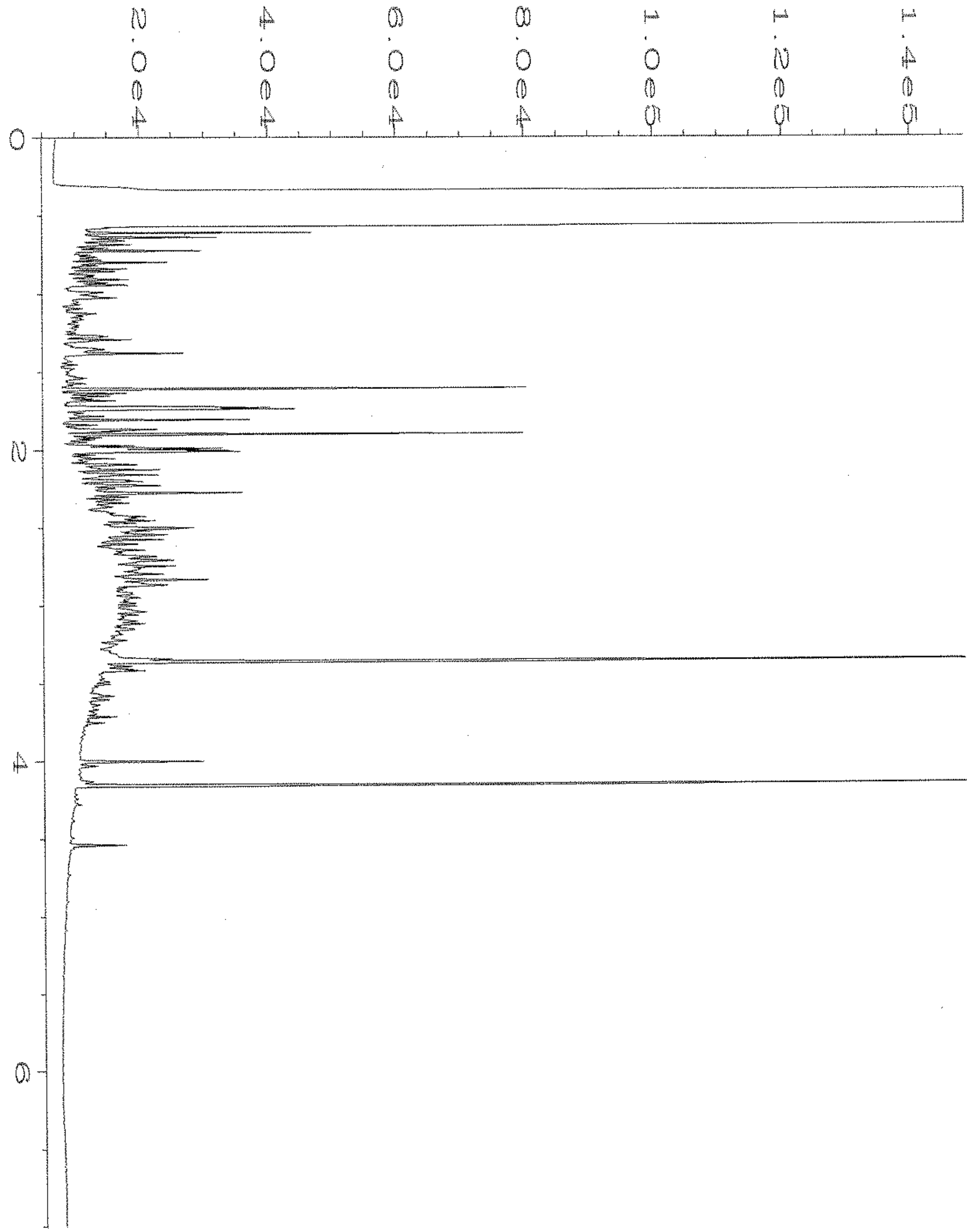
Operator : TL
Instrument : GC6
Sample Name : 903013-04
Run Time Bar Code:
Acquired on : 04 Mar 19 03:48 PM
Report Created on: 05 Mar 19 08:47 AM

Page Number : 1
Vial Number : 23
Injection Number : 1
Sequence Line : 7
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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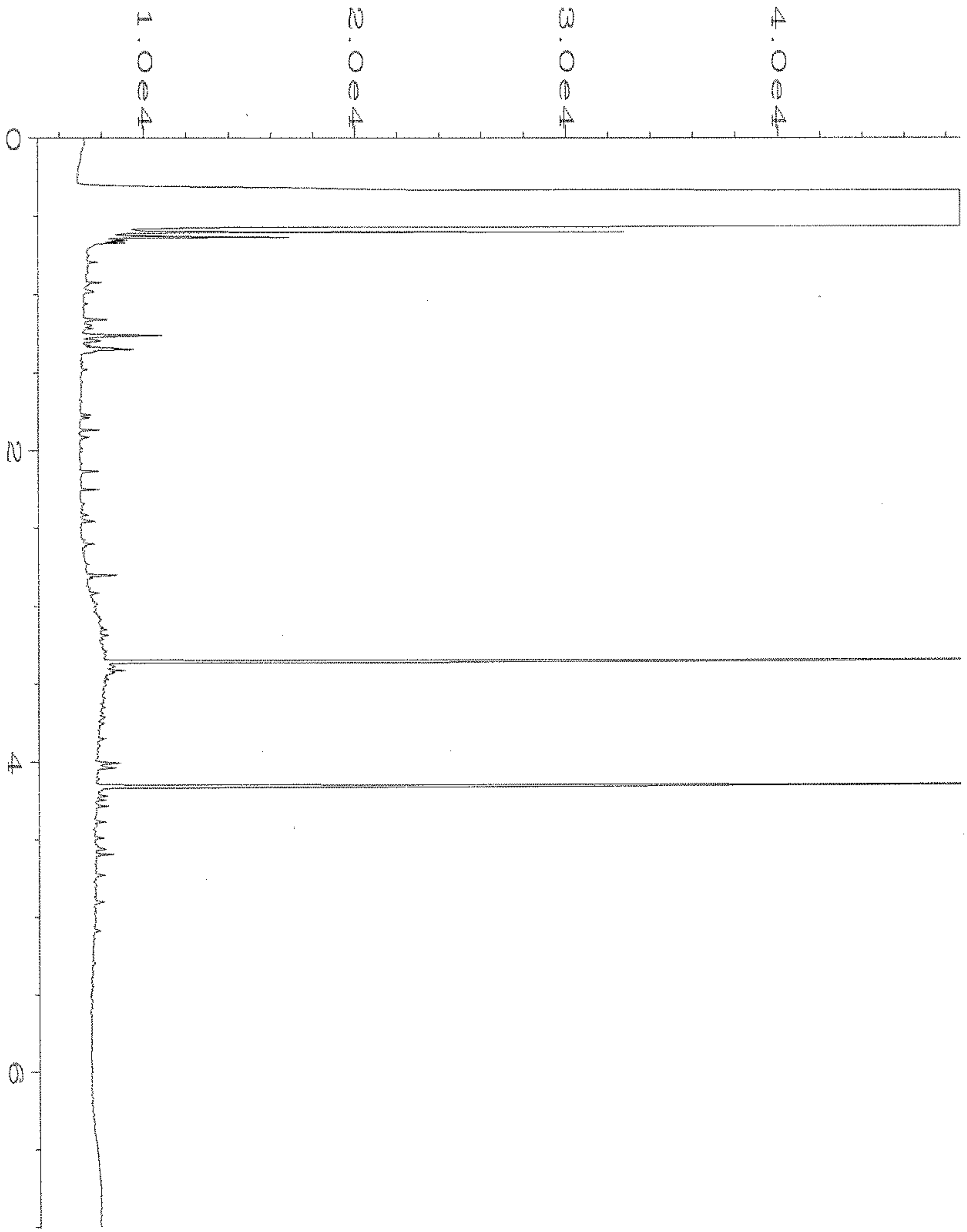
Operator : TL
Instrument : GC6
Sample Name : 903013-05
Run Time Bar Code:
Acquired on : 04 Mar 19 03:59 PM
Report Created on: 05 Mar 19 08:47 AM

Page Number : 1
Vial Number : 24
Injection Number : 1
Sequence Line : 7
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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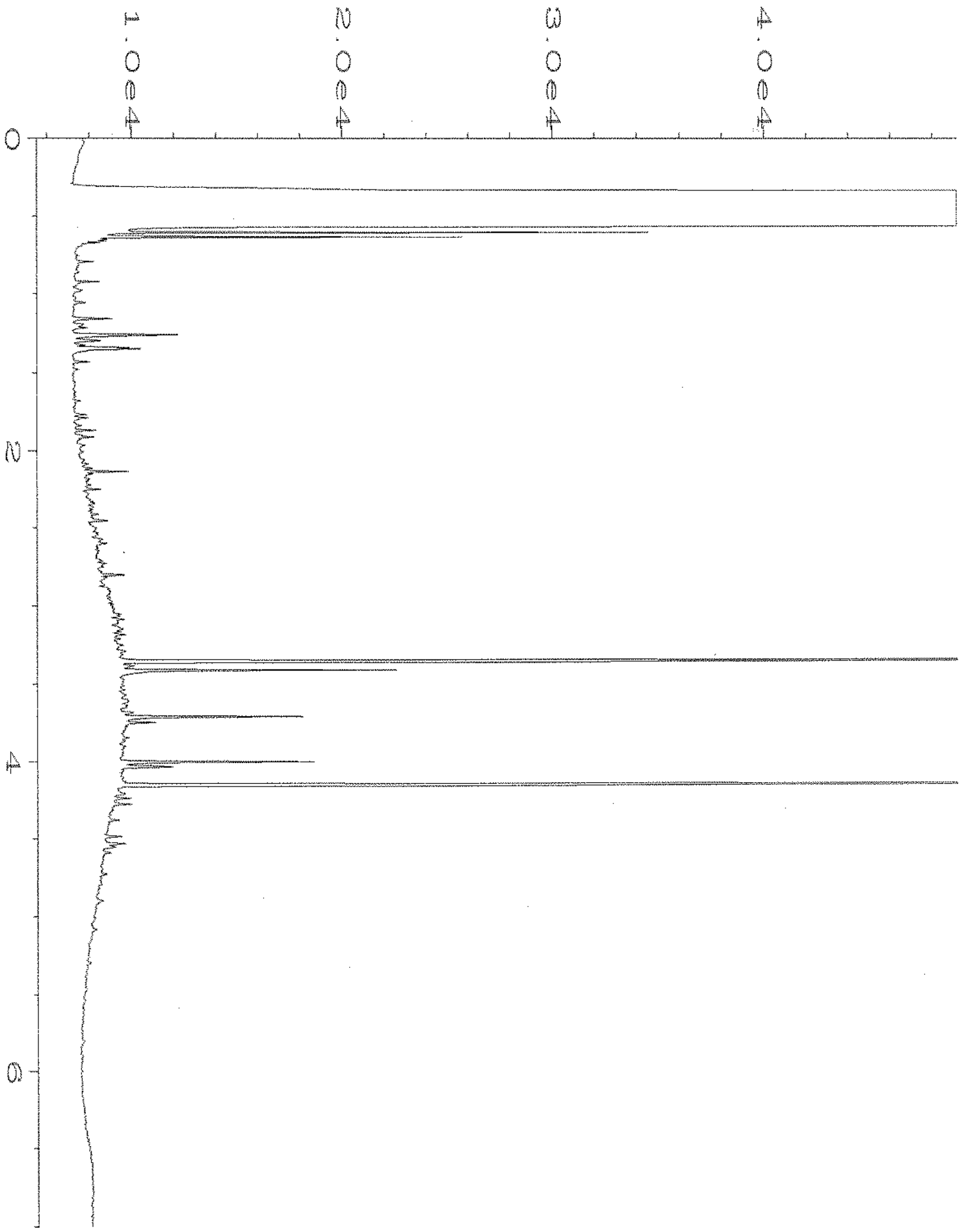
Operator : TL
Instrument : GC6
Sample Name : 903013-06
Run Time Bar Code:
Acquired on : 04 Mar 19 04:10 PM
Report Created on: 05 Mar 19 08:48 AM

Page Number : 1
Vial Number : 25
Injection Number : 1
Sequence Line : 7
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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Operator          : TL                              Page Number       : 1
Instrument        : GC6                             Vial Number       : 26
Sample Name       : 903013-07                       Injection Number  : 1
Run Time Bar Code:                                  Sequence Line     : 9
Acquired on       : 04 Mar 19   04:27 PM            Instrument Method: DX.MTH
Report Created on: 05 Mar 19   08:48 AM             Analysis Method   : DX.MTH
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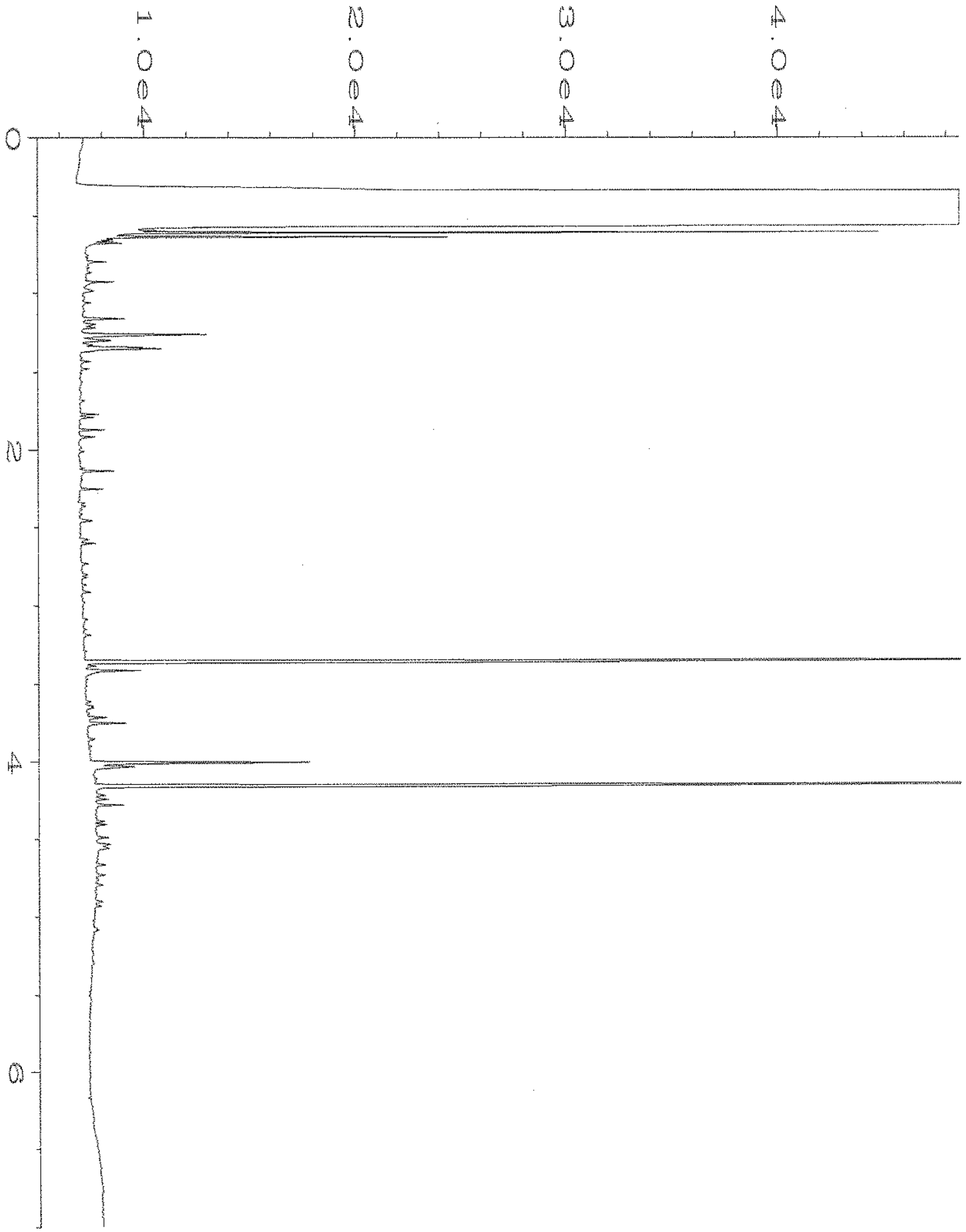

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Operator : TL
Instrument : GC6
Sample Name : 903013-08
Run Time Bar Code:
Acquired on : 04 Mar 19 04:38 PM
Report Created on: 05 Mar 19 08:48 AM

Page Number : 1
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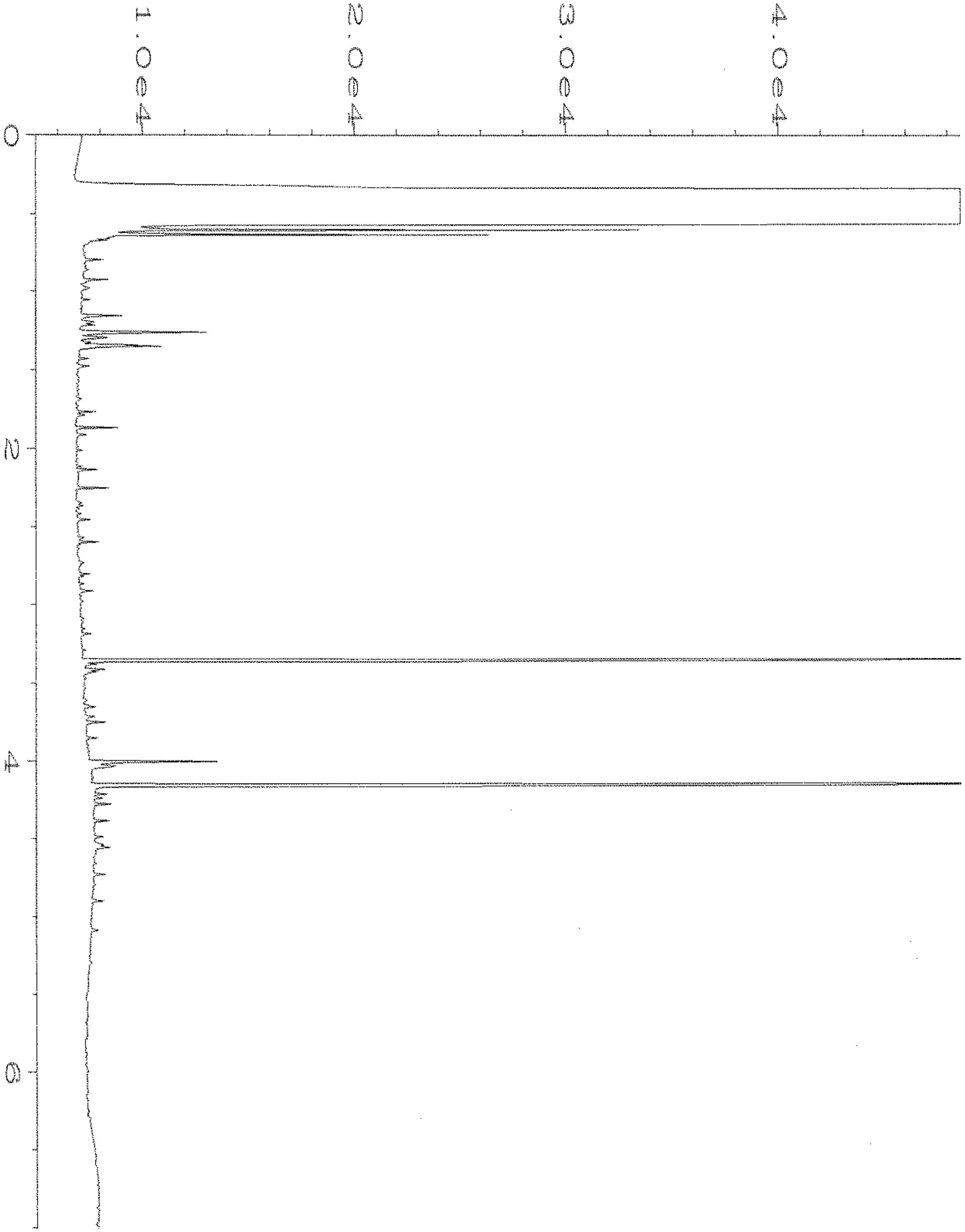
Injection Number : 1
Sequence Line : 9
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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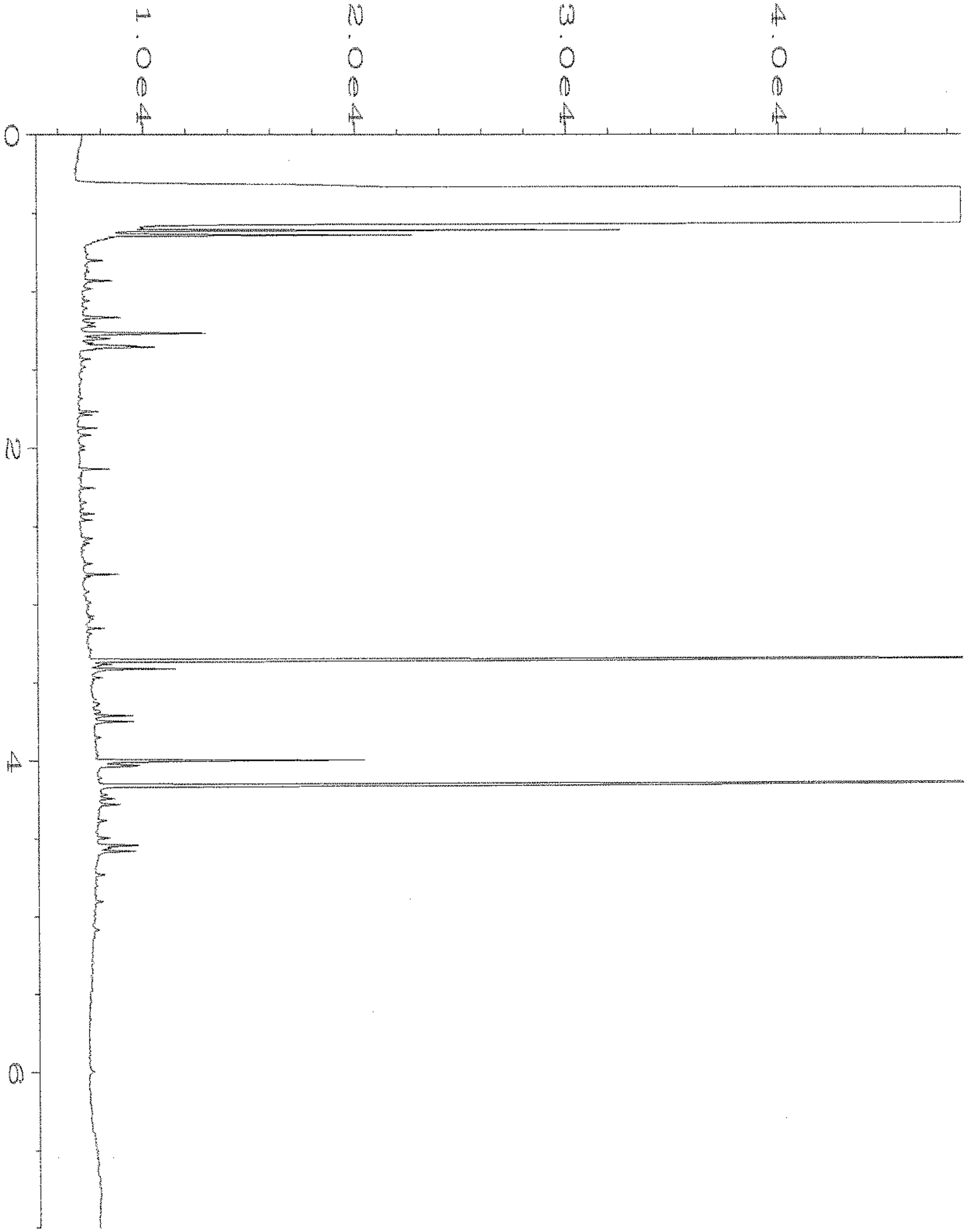
Operator : TL
Instrument : GC6
Sample Name : 903013-09
Run Time Bar Code:
Acquired on : 04 Mar 19 04:49 PM
Report Created on: 05 Mar 19 08:48 AM

Page Number : 1
Vial Number : 28
Injection Number : 1
Sequence Line : 9
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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Operator   : TL
Instrument   : GC6
Sample Name   : 903013-10
Run Time Bar Code:
Acquired on   : 04 Mar 19   05:00 PM
Report Created on: 05 Mar 19   08:48 AM

Page Number   : 1
Vial Number   : 29
Injection Number : 1
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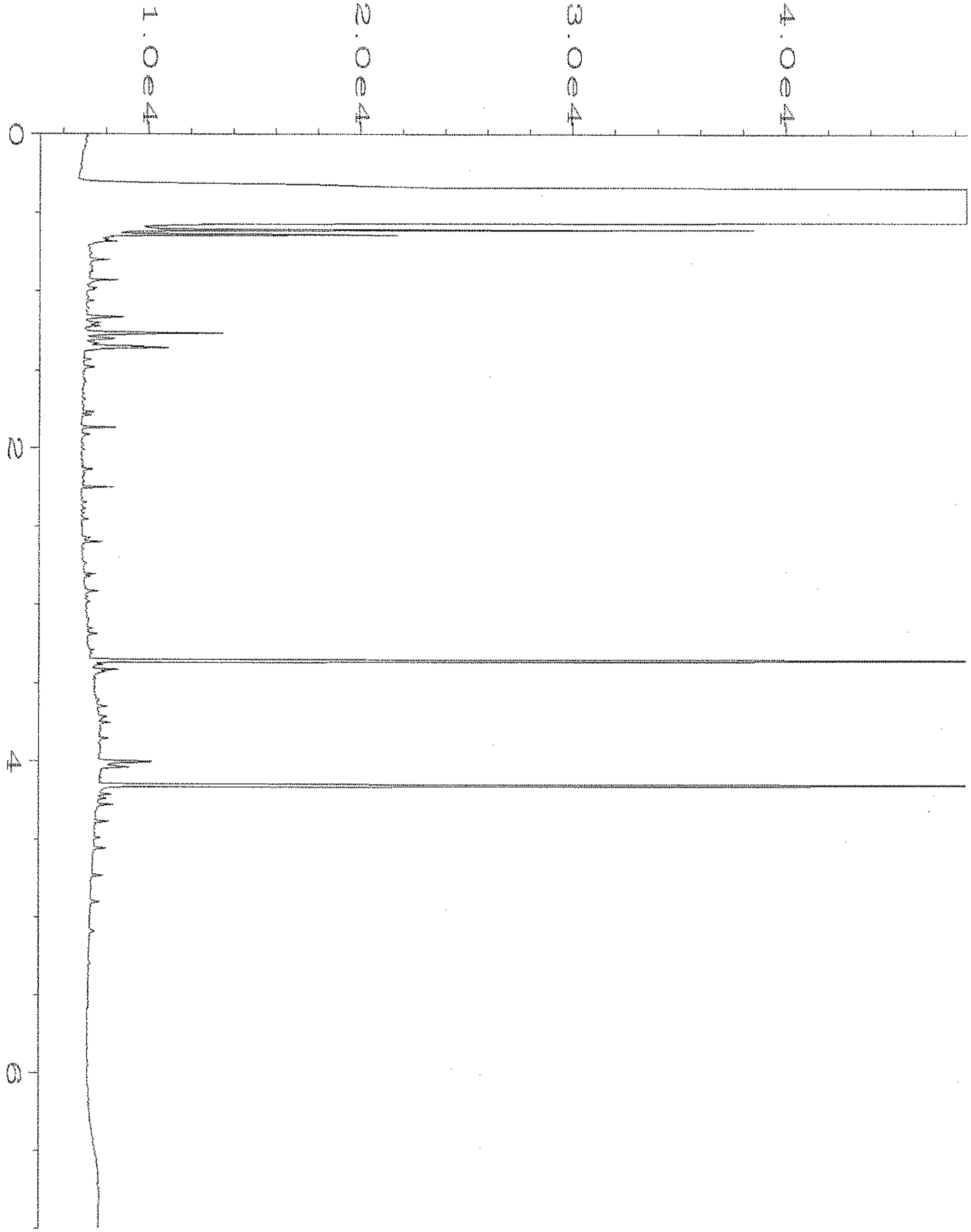
Instrument Method: DX.MTH
Analysis Method   : DX.MTH



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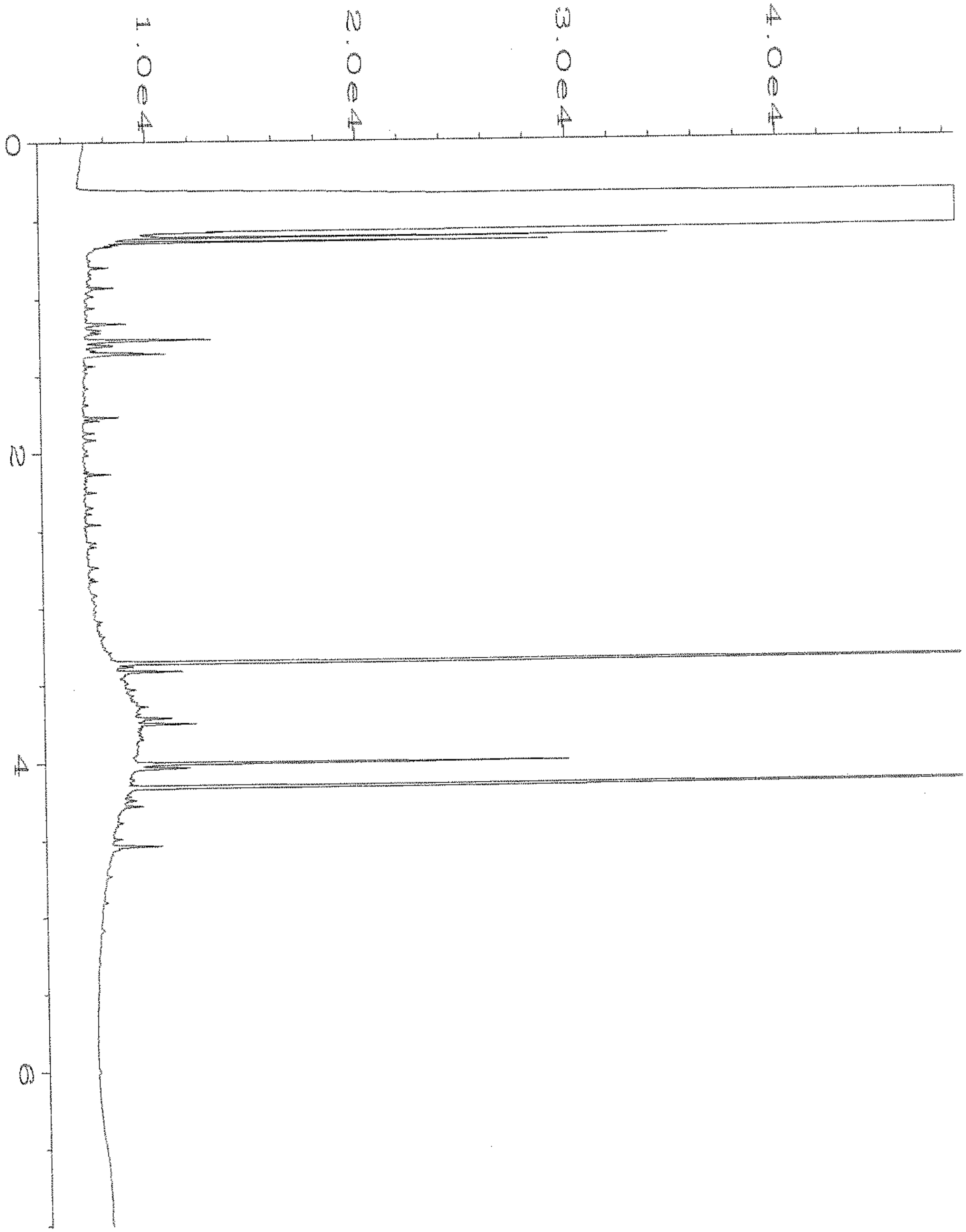
Operator	: TL	Page Number	: 1
Instrument	: GC6	Vial Number	: 30
Sample Name	: 903013-11	Injection Number	: 1
Run Time Bar Code:		Sequence Line	: 9
Acquired on	: 04 Mar 19 05:10 PM	Instrument Method:	DX.MTH
Report Created on:	05 Mar 19 08:48 AM	Analysis Method	: DX.MTH



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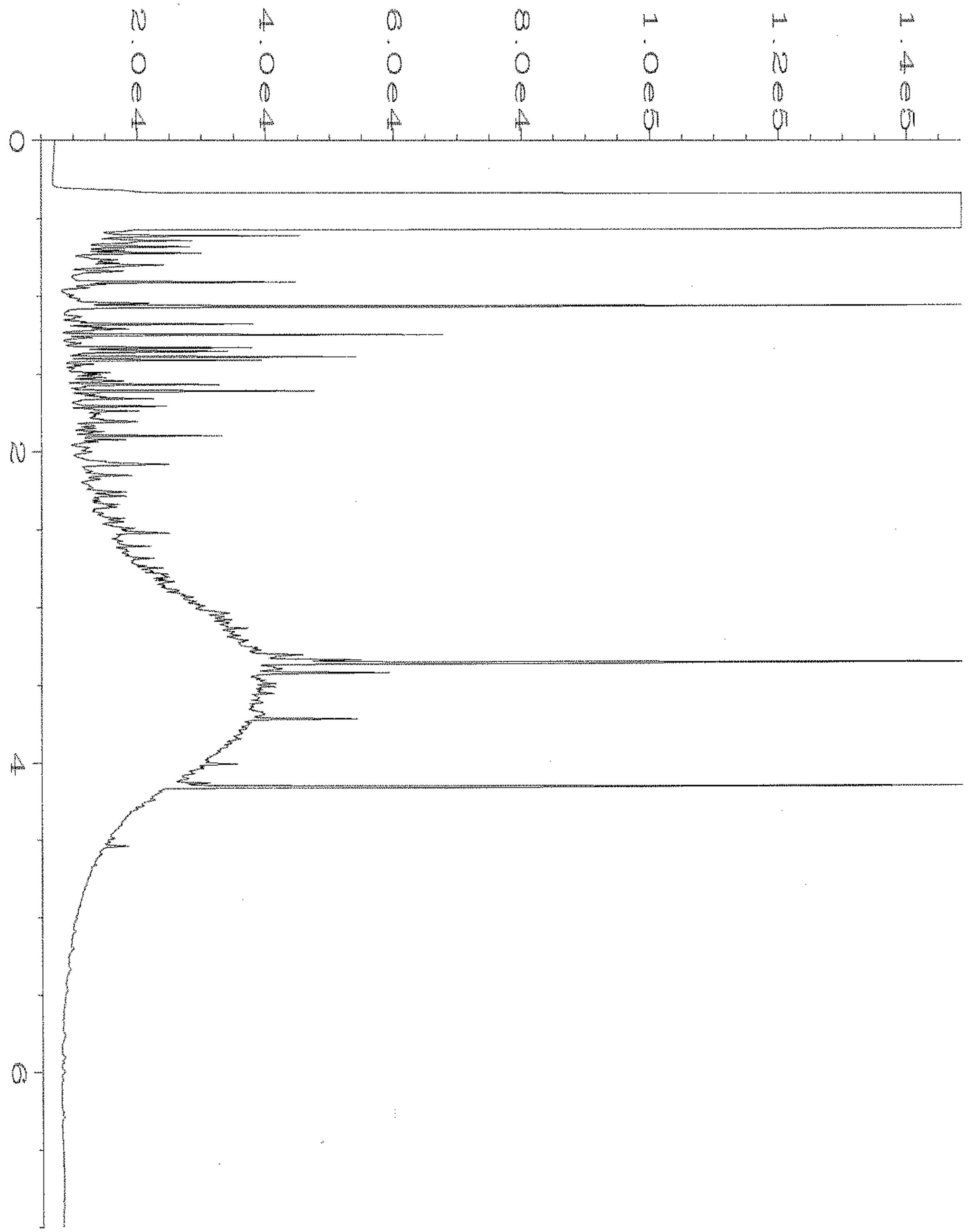
Operator : TL
Instrument : GC6
Sample Name : 903013-12
Run Time Bar Code:
Acquired on : 04 Mar 19 05:21 PM
Report Created on: 05 Mar 19 08:48 AM

Page Number : 1
Vial Number : 31
Injection Number : 1
Sequence Line : 9
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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Instrument        : GC6                           Vial Number       : 32
Sample Name       : 903013-13                     Injection Number : 1
Run Time Bar Code:                                Sequence Line     : 9
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Report Created on: 05 Mar 19   08:53 AM           Analysis Method   : DX.MTH
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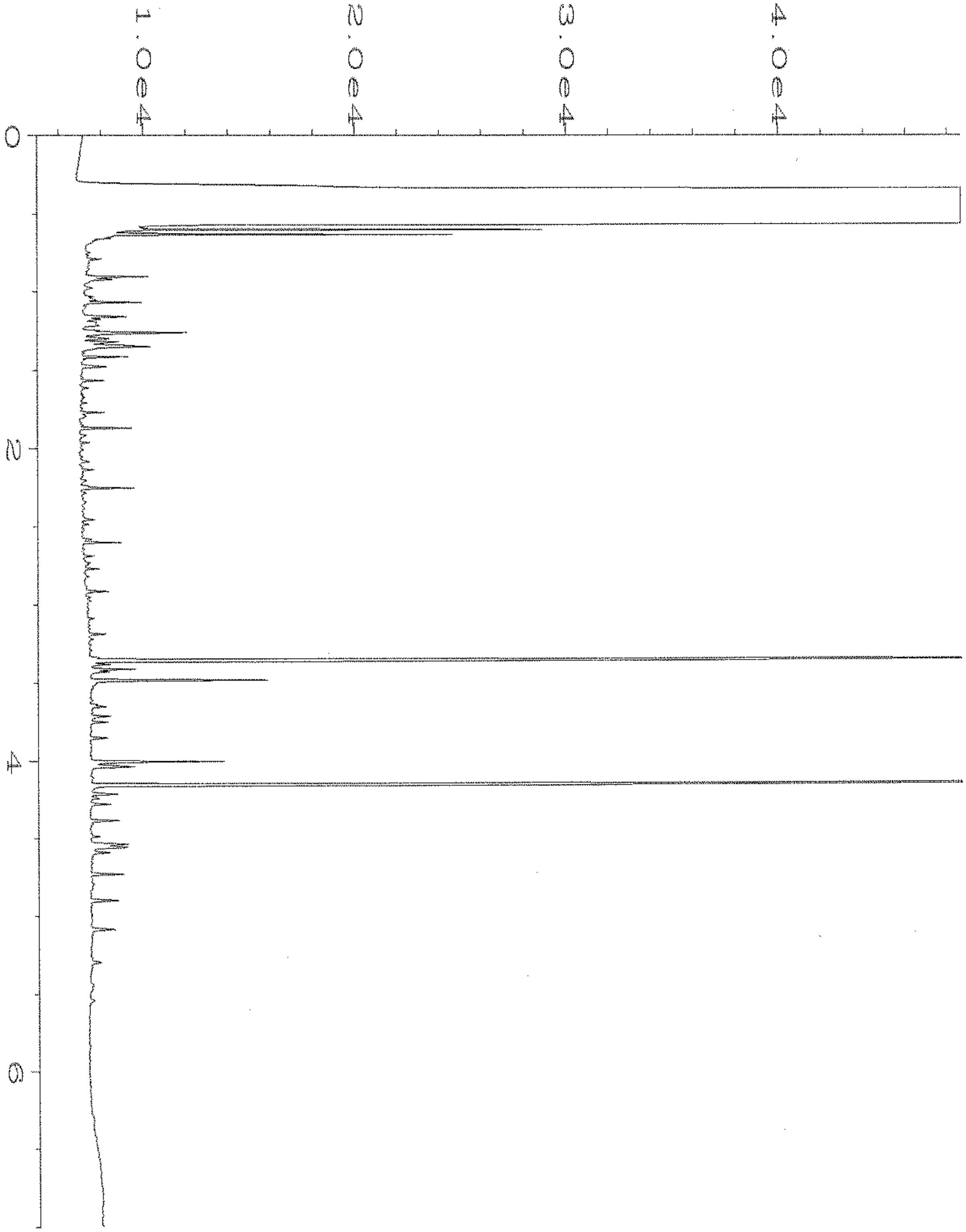

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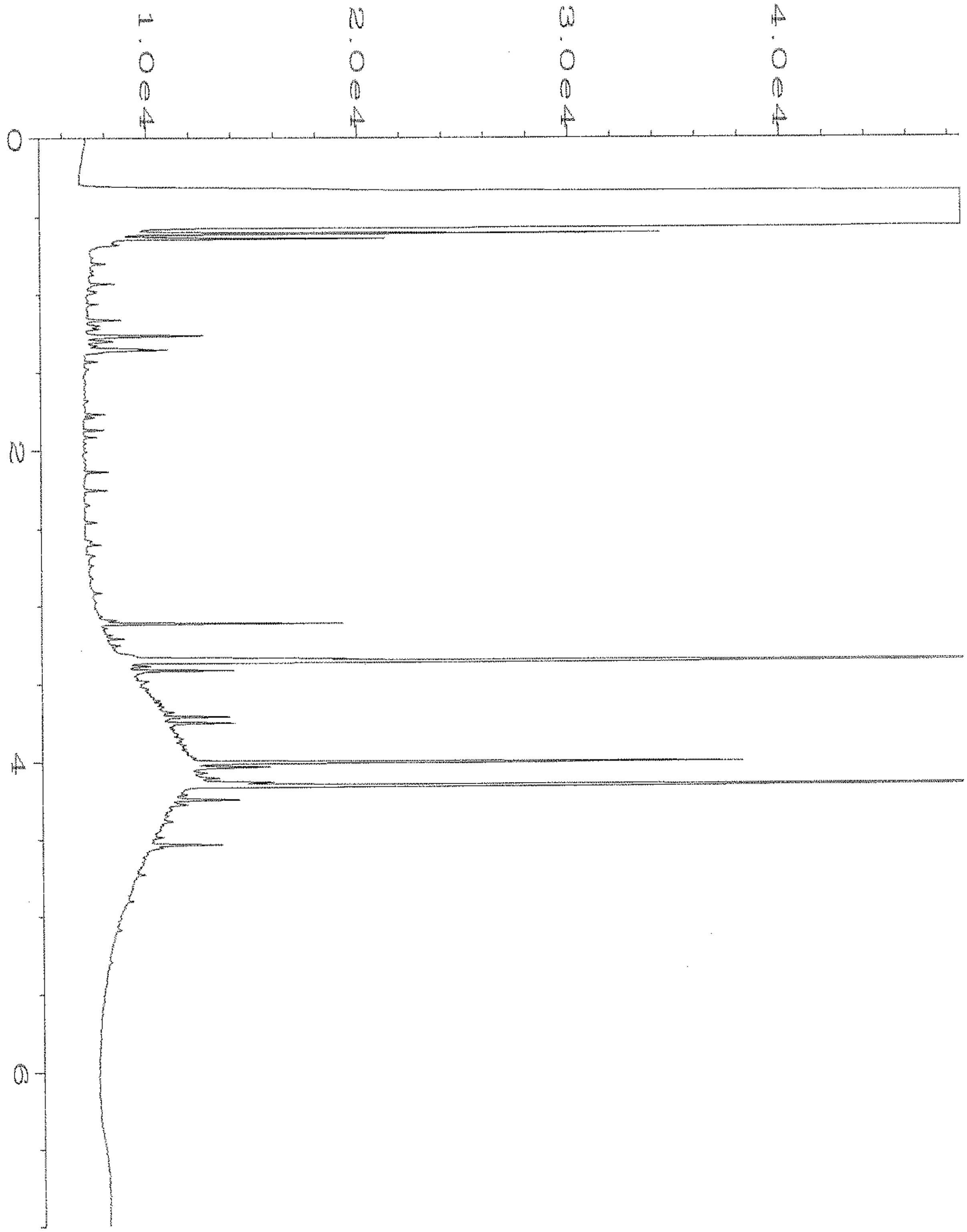
Operator   : TL
Instrument   : GC6
Sample Name   : 903013-14
Run Time Bar Code:
Acquired on   : 04 Mar 19   05:43 PM
Report Created on: 05 Mar 19   08:54 AM

Page Number   : 1
Vial Number   : 33
Injection Number : 1
Sequence Line   : 9
Instrument Method: DX.MTH
Analysis Method   : DX.MTH



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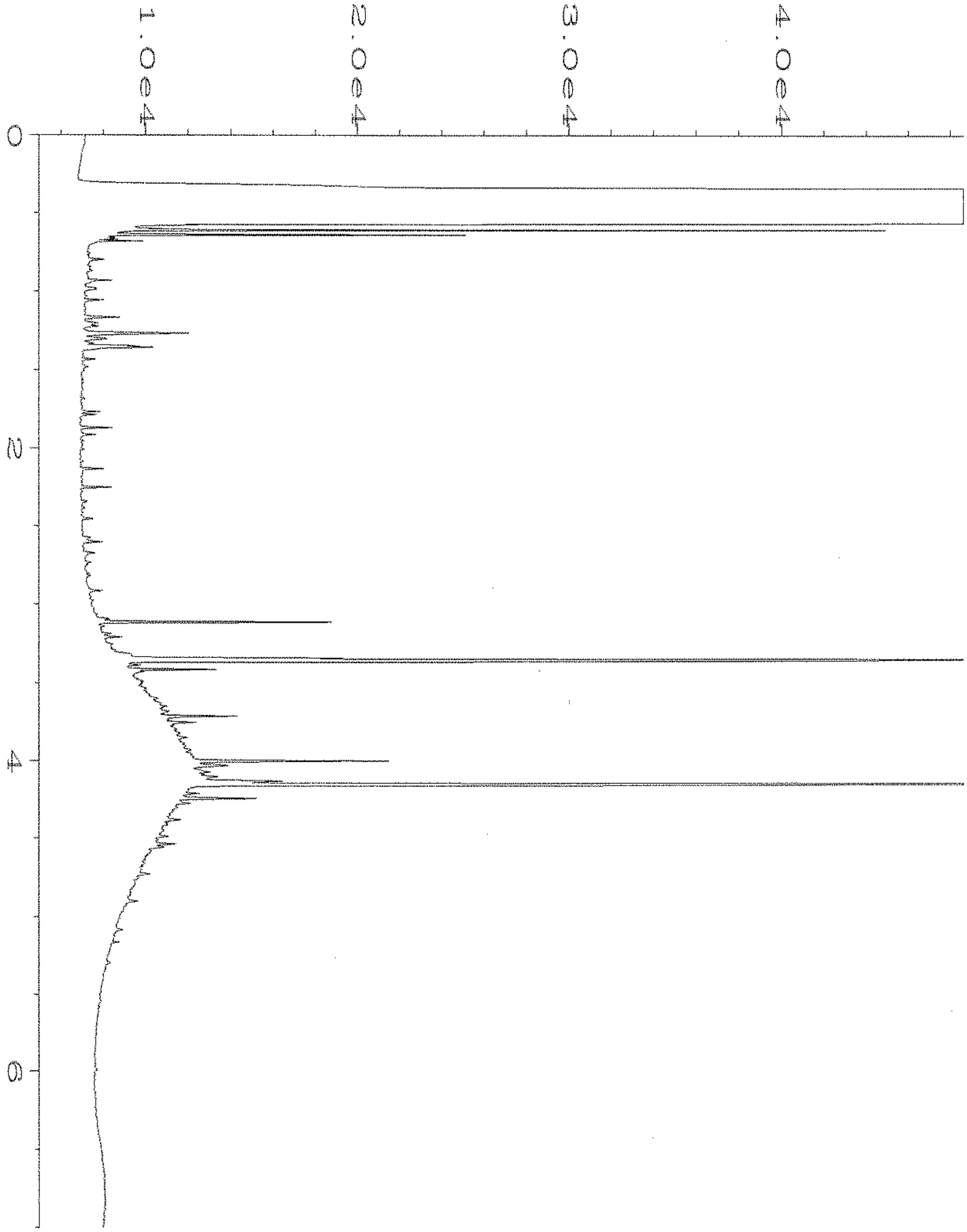
Operator   : TL
Instrument   : GC6
Sample Name   : 903013-15
Run Time Bar Code:
Acquired on   : 04 Mar 19   05:53 PM
Report Created on: 05 Mar 19   08:54 AM

Page Number   : 1
Vial Number   : 34
Injection Number : 1
Sequence Line   : 9
Instrument Method: DX.MTH
Analysis Method   : DX.MTH



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Operator          : TL                              Page Number       : 1
Instrument        : GC6                             Vial Number       : 35
Sample Name       : 903013-16                       Injection Number : 1
Run Time Bar Code:                                  Sequence Line     : 9
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Report Created on: 05 Mar 19   08:54 AM             Analysis Method   : DX.MTH
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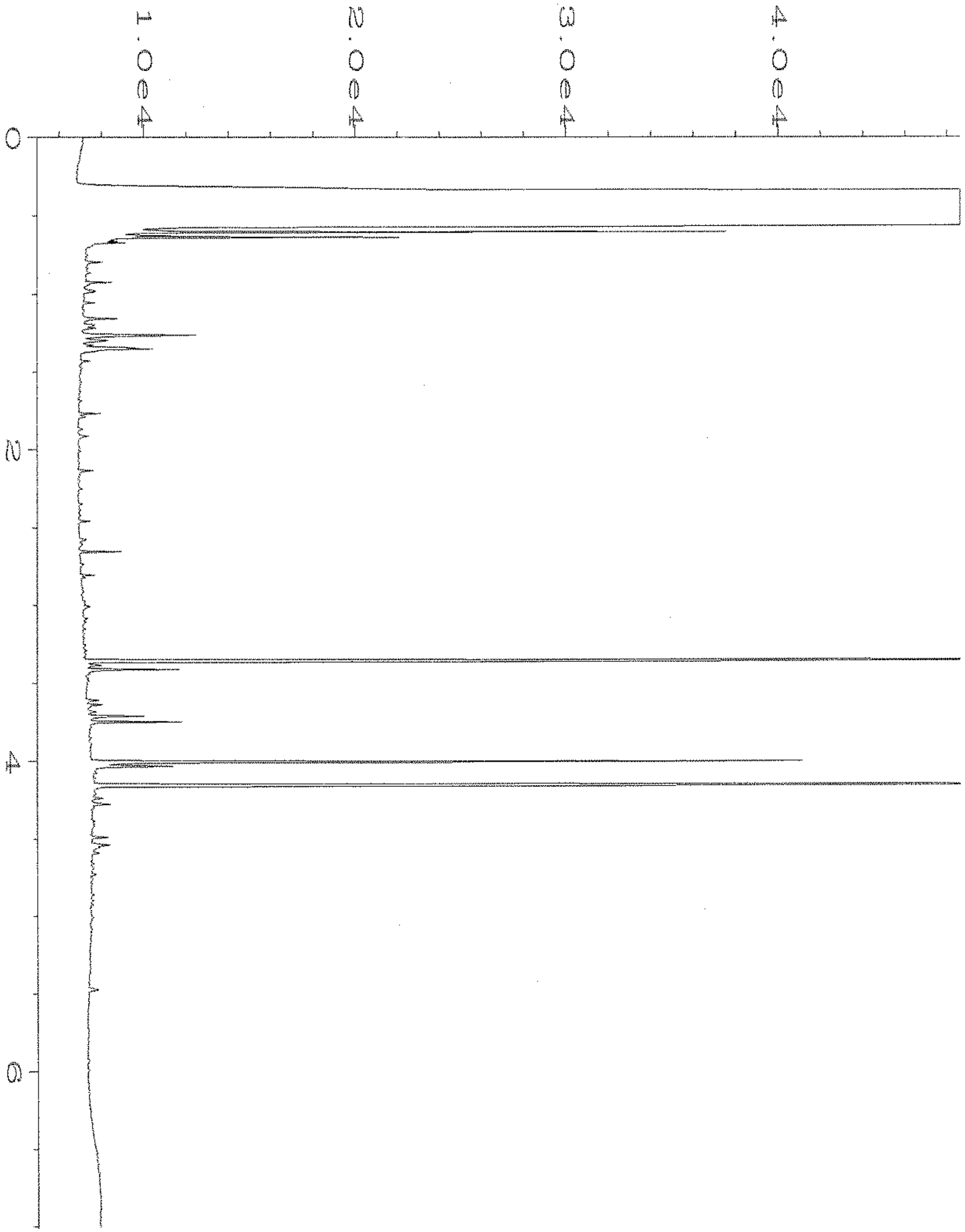
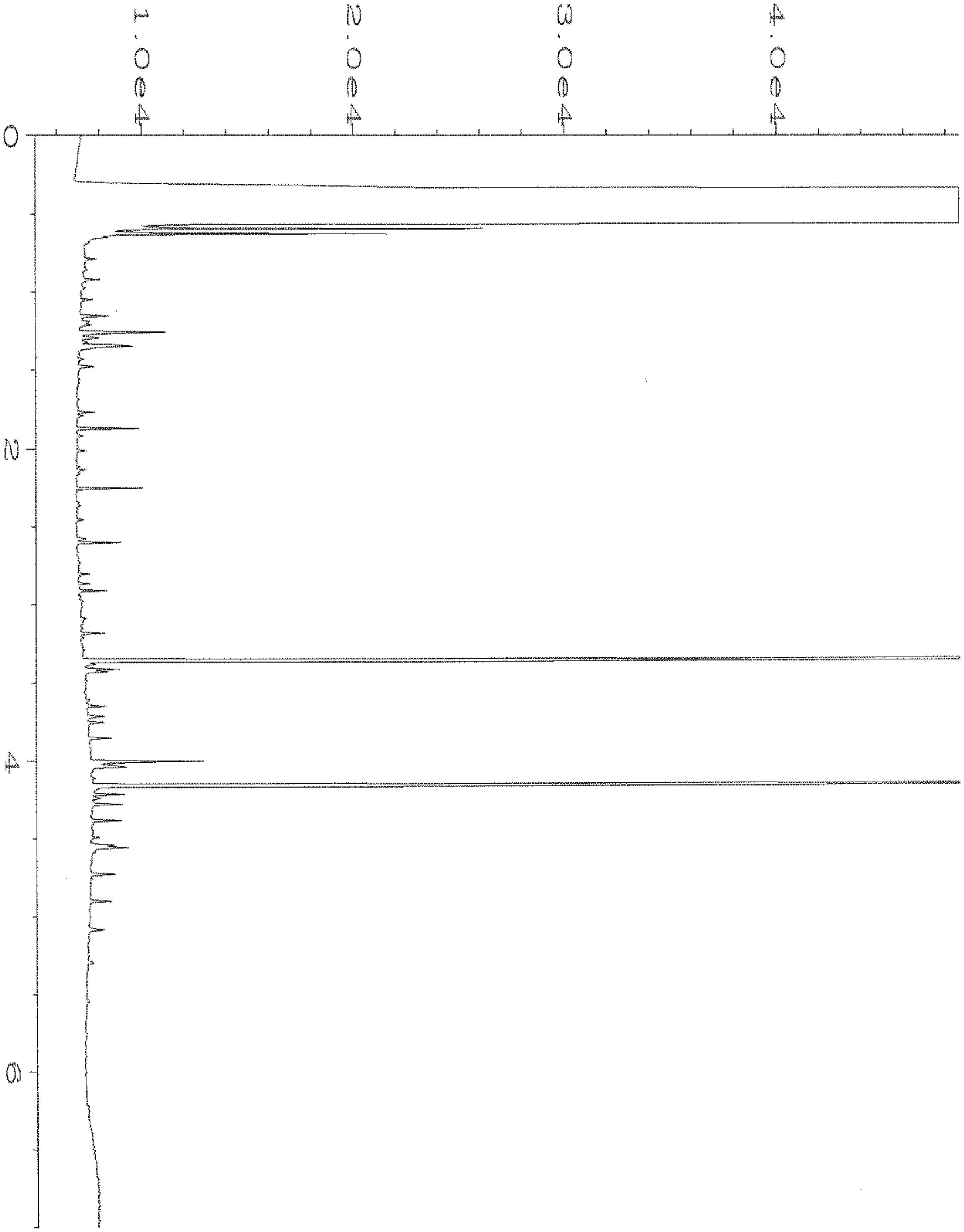


Data File Name   : C:\HPCHEM\6\DATA\03-04-19\036F0901.D
Operator   : TL
Instrument   : GC6
Sample Name   : 903013-17
Run Time Bar Code:
Acquired on   : 04 Mar 19 06:15 PM
Report Created on: 05 Mar 19 08:54 AM

Page Number   : 1
Vial Number   : 36
Injection Number : 1
Sequence Line   : 9
Instrument Method: DX.MTH
Analysis Method   : DX.MTH



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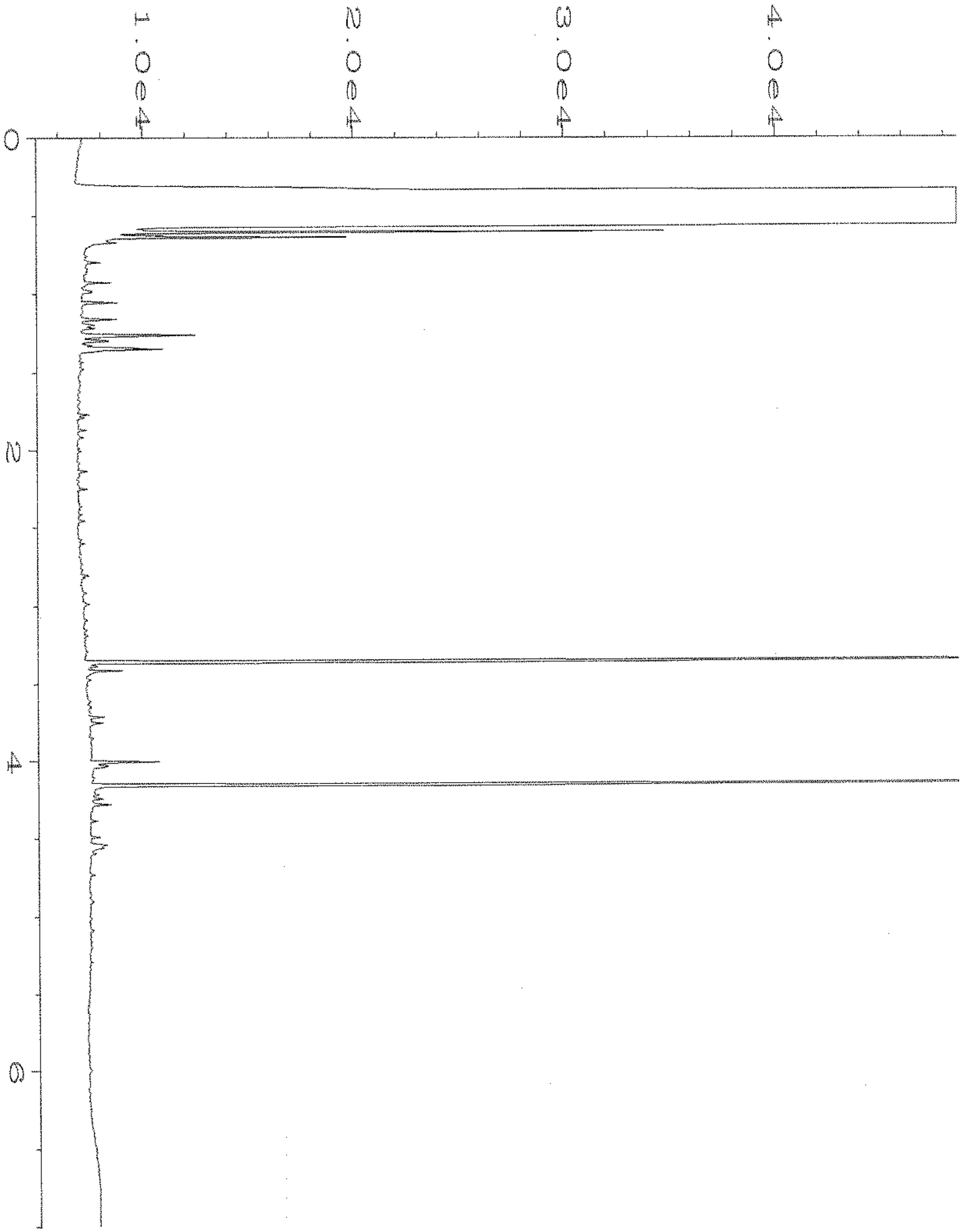
Operator : TL
Instrument : GC6
Sample Name : 903013-18
Run Time Bar Code:
Acquired on : 04 Mar 19 06:26 PM
Report Created on: 05 Mar 19 08:55 AM

Page Number : 1
Vial Number : 37
Injection Number : 1
Sequence Line : 9
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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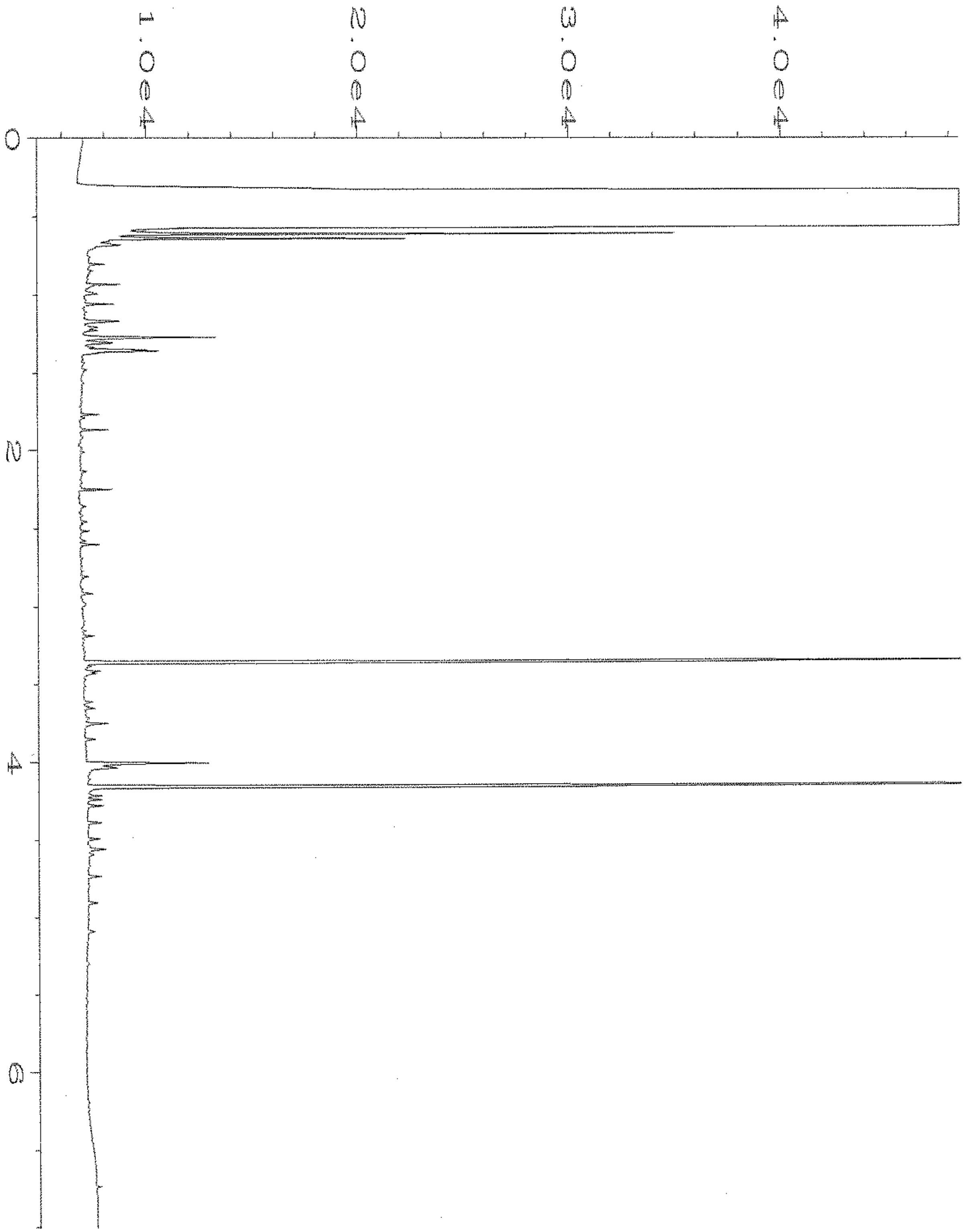
Operator : TL
Instrument : GC6
Sample Name : 903013-19
Run Time Bar Code:
Acquired on : 04 Mar 19 06:37 PM
Report Created on: 05 Mar 19 08:56 AM

Page Number : 1
Vial Number : 38
Injection Number : 1
Sequence Line : 9
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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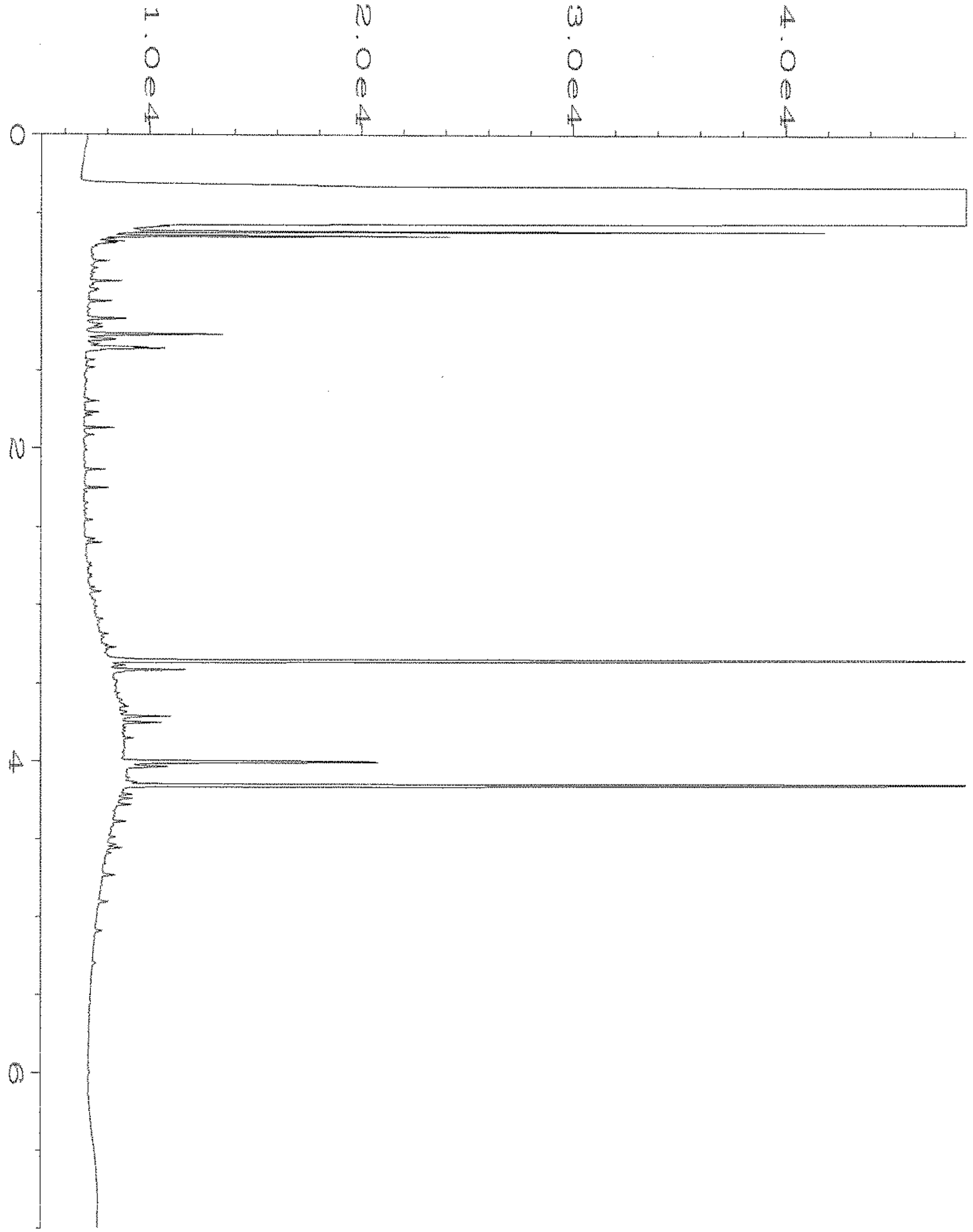
Operator : TL
Instrument : GC6
Sample Name : 903013-20
Run Time Bar Code:
Acquired on : 04 Mar 19 10:35 PM
Report Created on: 05 Mar 19 10:08 AM

Page Number : 1
Vial Number : 56
Injection Number : 1
Sequence Line : 13
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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Operator          : TL                          Page Number       : 1
Instrument        : GC6                         Vial Number       : 57
Sample Name       : 903013-21                   Injection Number  : 1
Run Time Bar Code:                              Sequence Line     : 13
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Report Created on: 05 Mar 19   10:08 AM         Analysis Method   : DX.MTH
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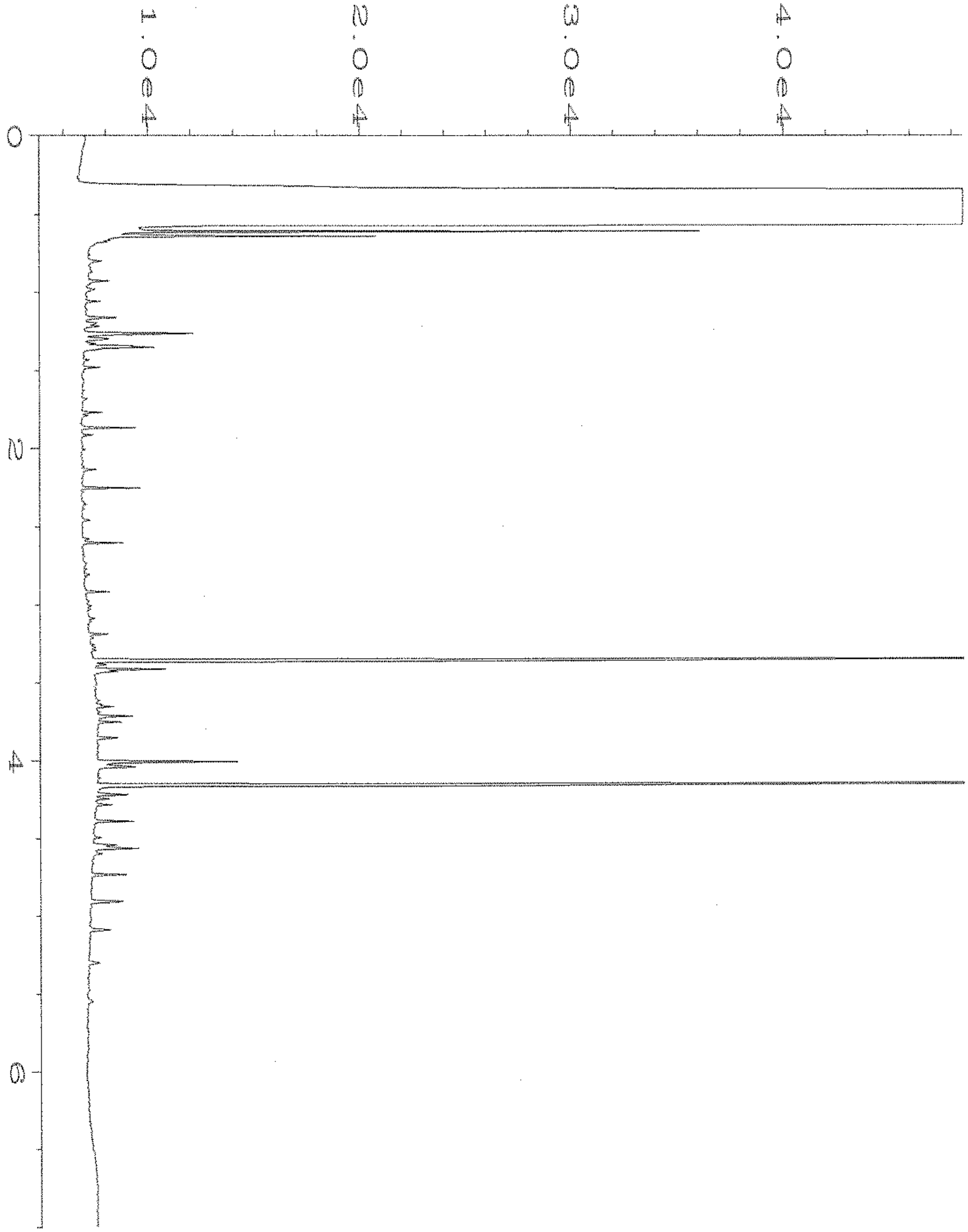
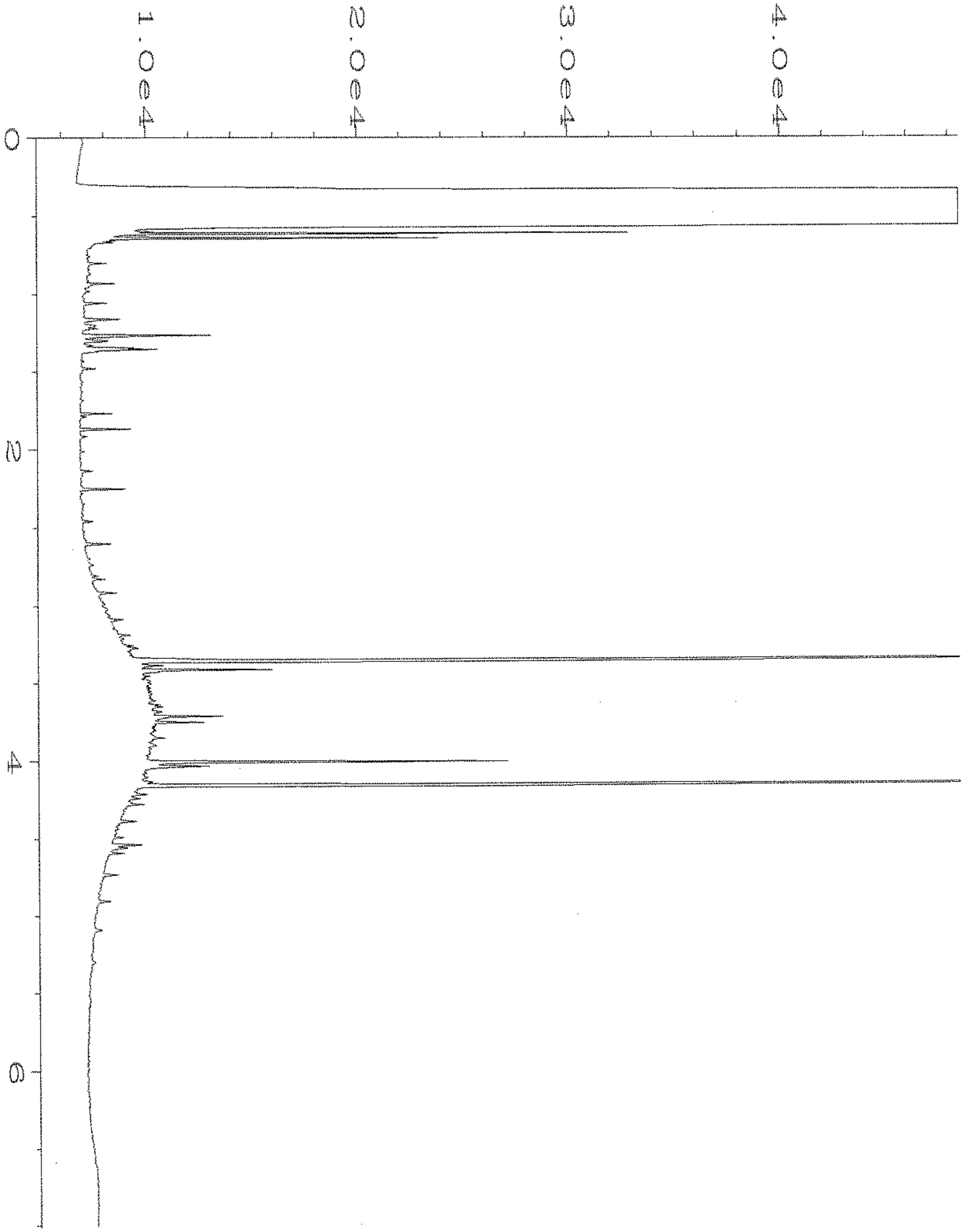


Data File Name : C:\HPCHEM\6\DATA\03-04-19\058F1301.D
Operator : TL
Instrument : GC6
Sample Name : 903013-22
Run Time Bar Code:
Acquired on : 04 Mar 19 10:57 PM
Report Created on: 05 Mar 19 10:09 AM

Page Number : 1
Vial Number : 58
Injection Number : 1
Sequence Line : 13
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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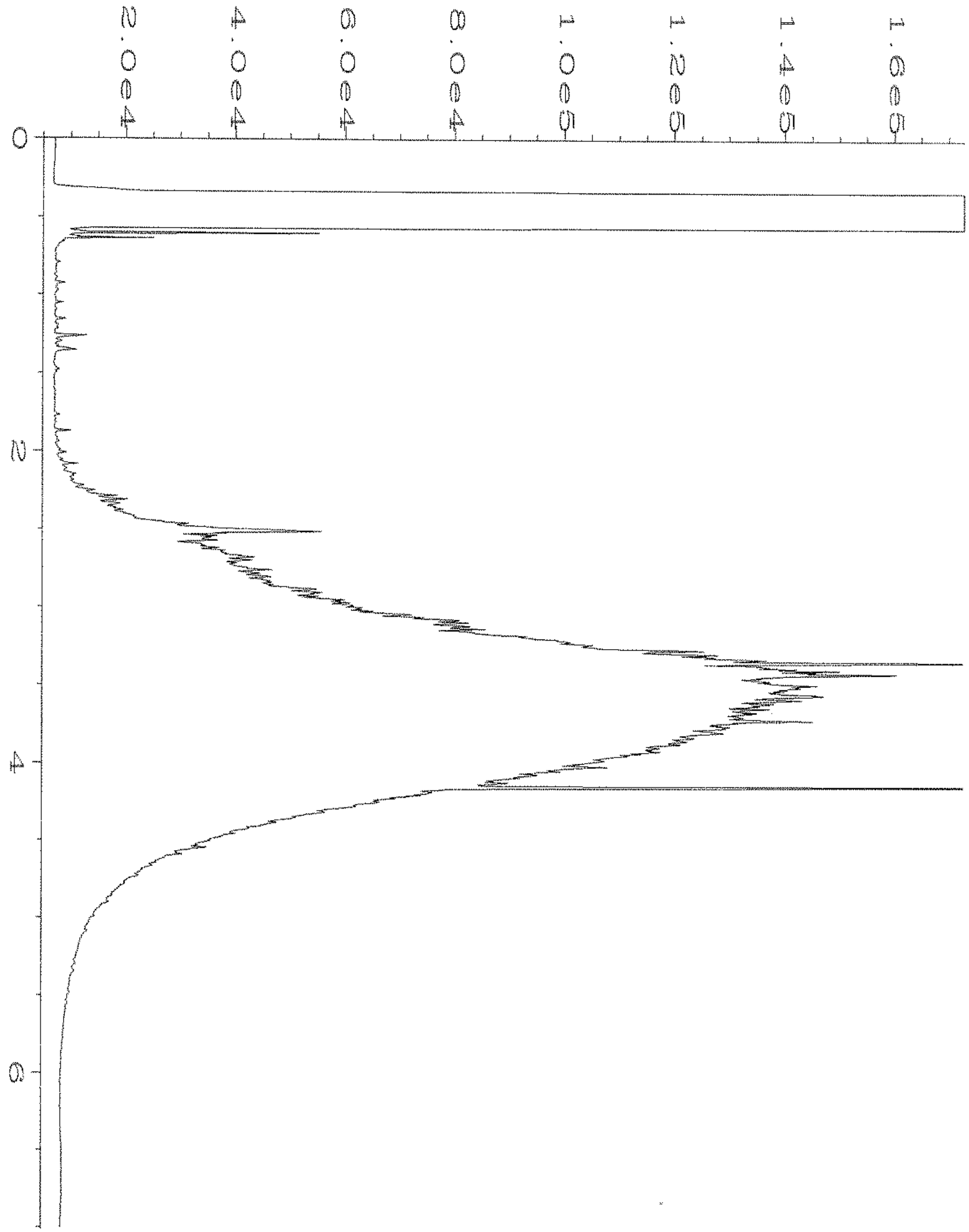
Operator : TL
Instrument : GC6
Sample Name : 903013-23
Run Time Bar Code:
Acquired on : 04 Mar 19 11:07 PM
Report Created on: 05 Mar 19 09:03 AM

Page Number : 1
Vial Number : 59
Injection Number : 1
Sequence Line : 13
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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Instrument        : GC6                             Vial Number       : 60
Sample Name       : 903013-24                       Injection Number  : 1
Run Time Bar Code:                                  Sequence Line     : 13
Acquired on       : 04 Mar 19   11:18 PM            Instrument Method: DX.MTH
Report Created on: 05 Mar 19   09:04 AM             Analysis Method   : DX.MTH
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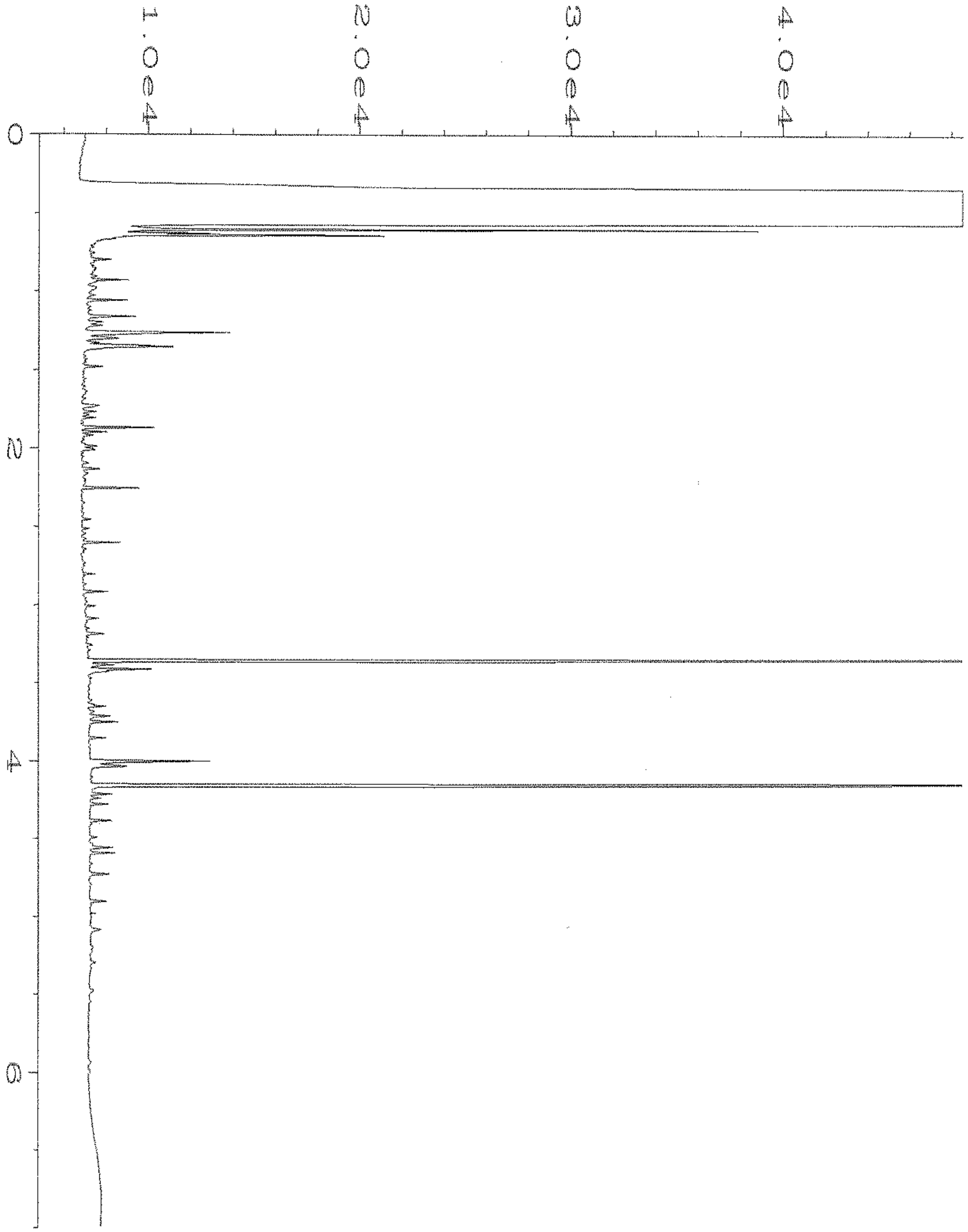
Data File Name : C:\HPCHEM\6\DATA\03-04-19\061F1301.D
Operator : TL
Instrument : GC6
Sample Name : 903013-25
Run Time Bar Code:
Acquired on : 04 Mar 19 11:29 PM
Report Created on: 05 Mar 19 10:09 AM

Page Number : 1
Vial Number : 61
Injection Number : 1
Sequence Line : 13
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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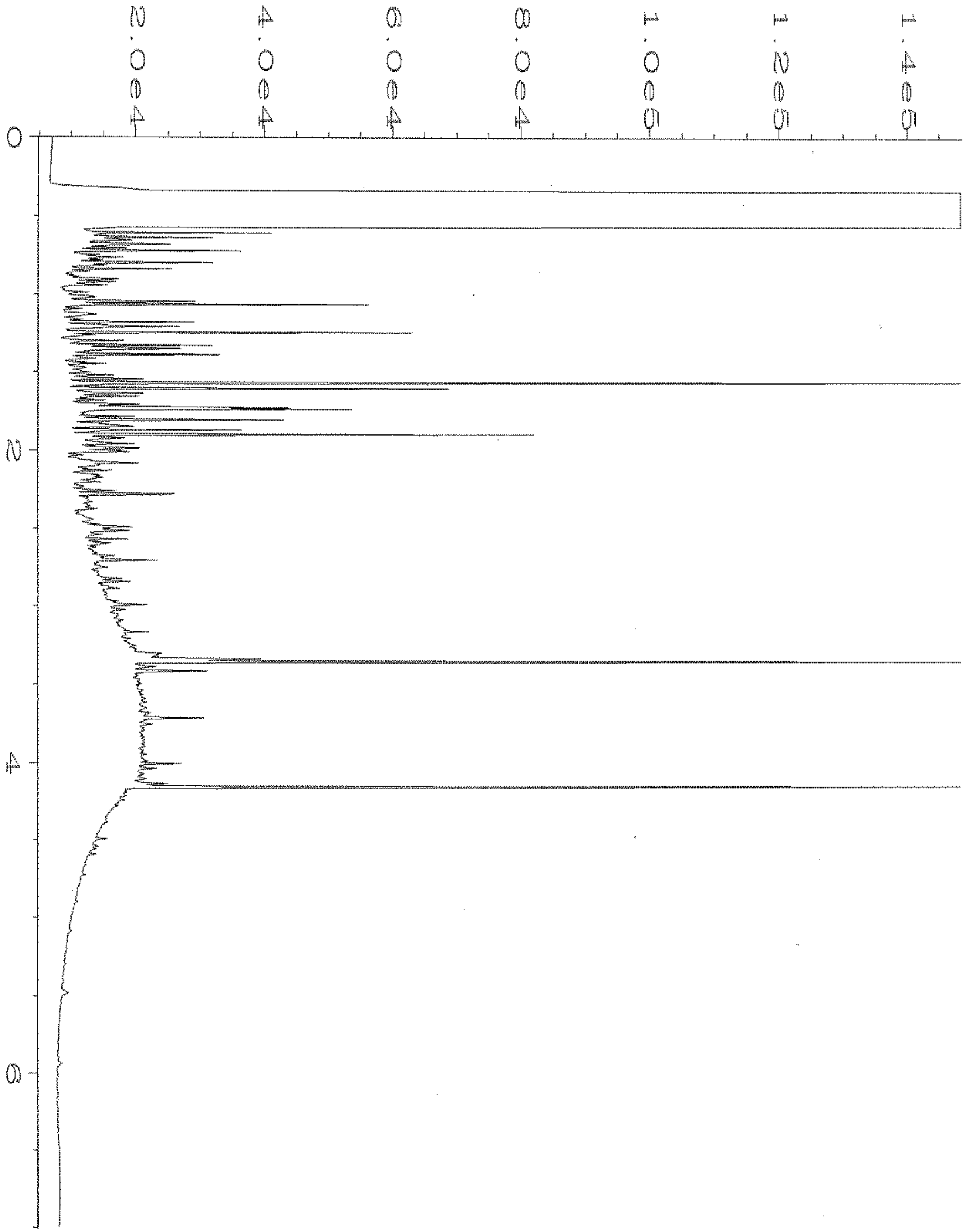
Operator   : TL   Page Number   : 1
Instrument   : GC6   Vial Number   : 62
Sample Name   : 903013-26   Injection Number : 1
Run Time Bar Code: Sequence Line   : 13
Acquired on   : 04 Mar 19   11:40 PM   Instrument Method: DX.MTH
Report Created on: 05 Mar 19   10:09 AM   Analysis Method : DX.MTH



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Data File Name    : C:\HPCHEM\6\DATA\03-04-19\063F1301.D
Operator          : TL                              Page Number      : 1
Instrument        : GC6                             Vial Number      : 63
Sample Name       : 903013-27                       Injection Number : 1
Run Time Bar Code:                                  Sequence Line    : 13
Acquired on       : 04 Mar 19   11:51 PM            Instrument Method: DX.MTH
Report Created on: 05 Mar 19   09:05 AM             Analysis Method  : DX.MTH
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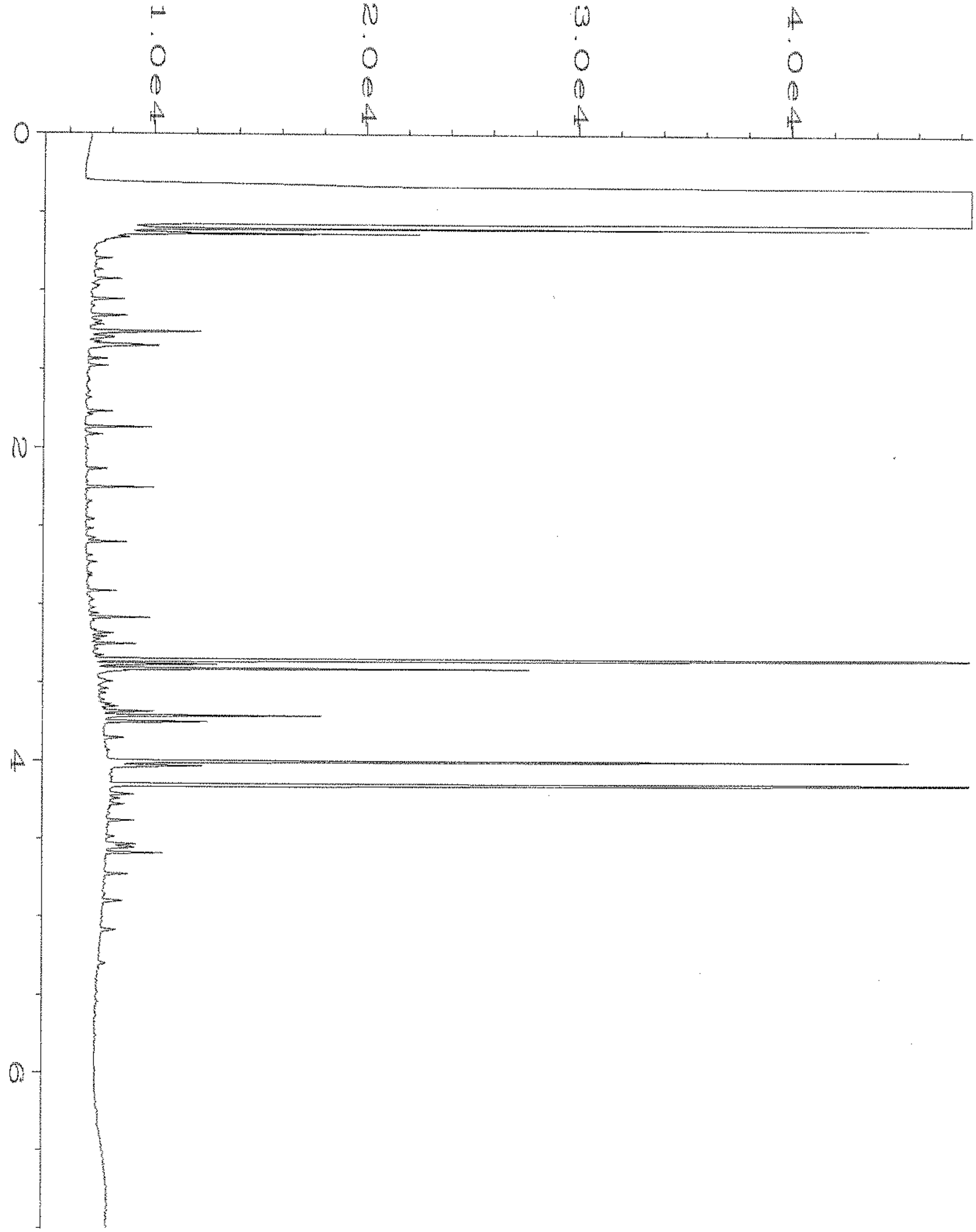

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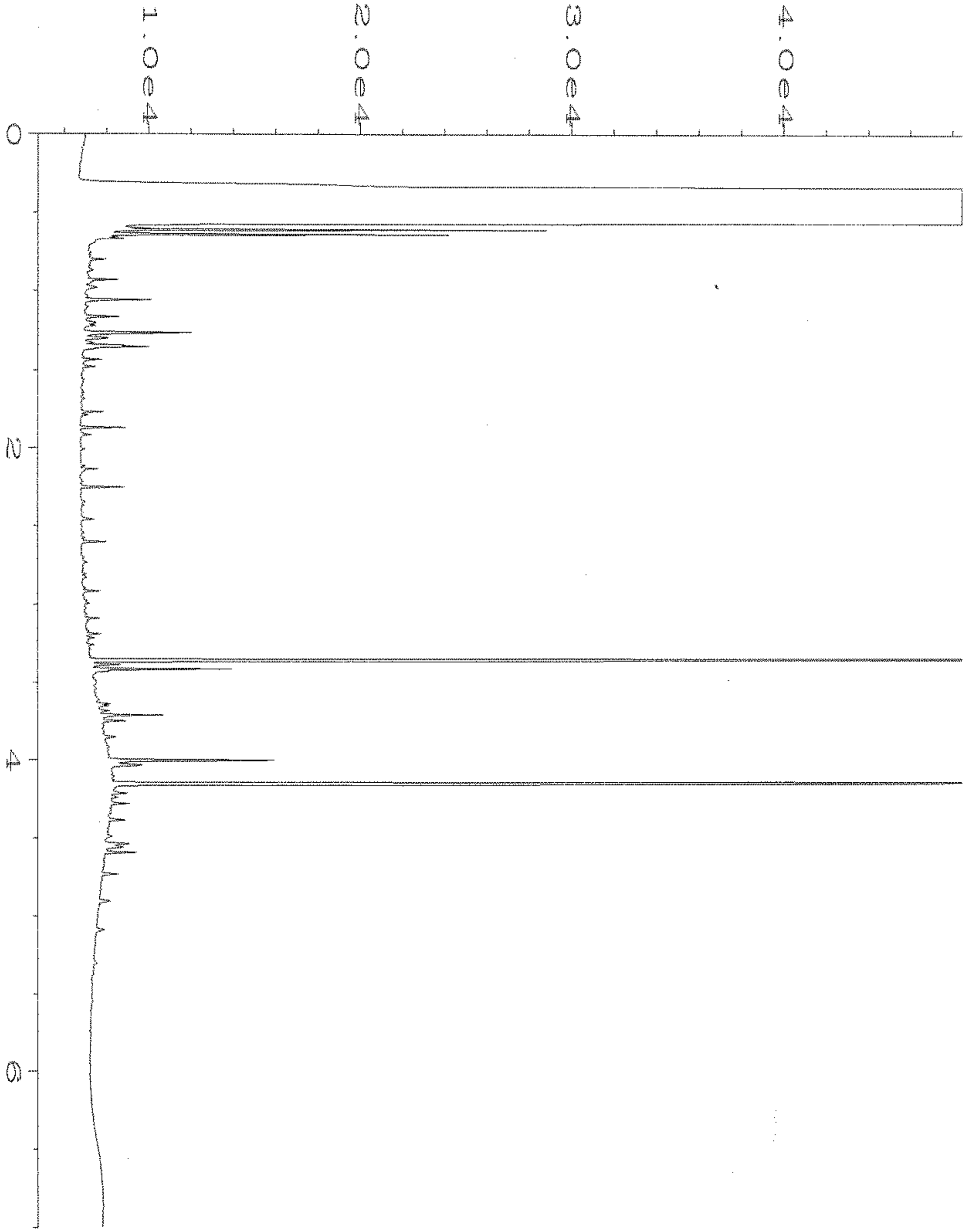
Operator : TL
Instrument : GC6
Sample Name : 903013-28
Run Time Bar Code:
Acquired on : 05 Mar 19 00:01 AM
Report Created on: 05 Mar 19 10:09 AM

Page Number : 1
Vial Number : 64
Injection Number : 1
Sequence Line : 13
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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Operator   : TL
Instrument   : GC6
Sample Name   : 903013-29
Run Time Bar Code:
Acquired on   : 05 Mar 19   00:12 AM
Report Created on: 05 Mar 19   10:09 AM

Page Number   : 1
Vial Number   : 65
Injection Number : 1
Sequence Line   : 13
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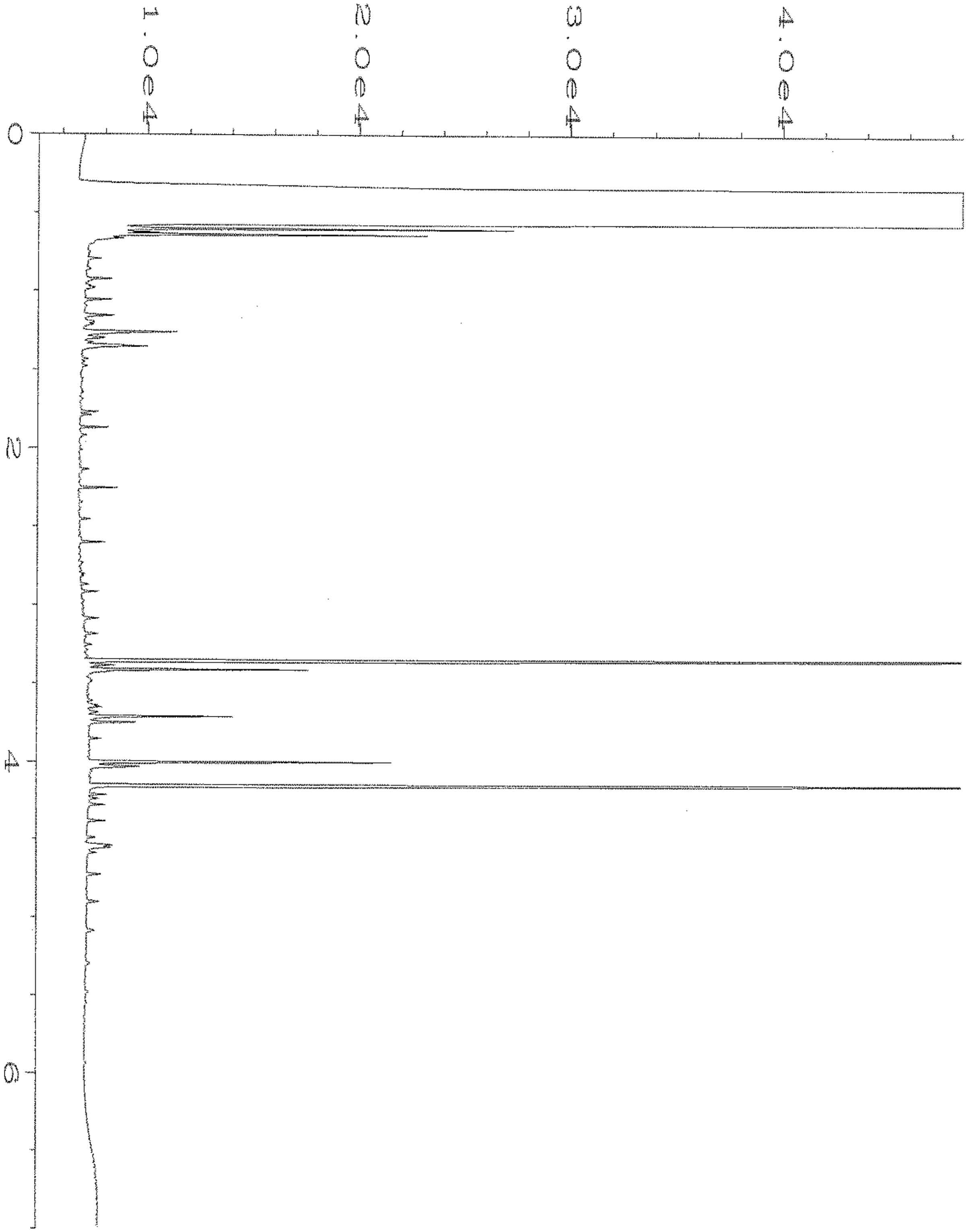
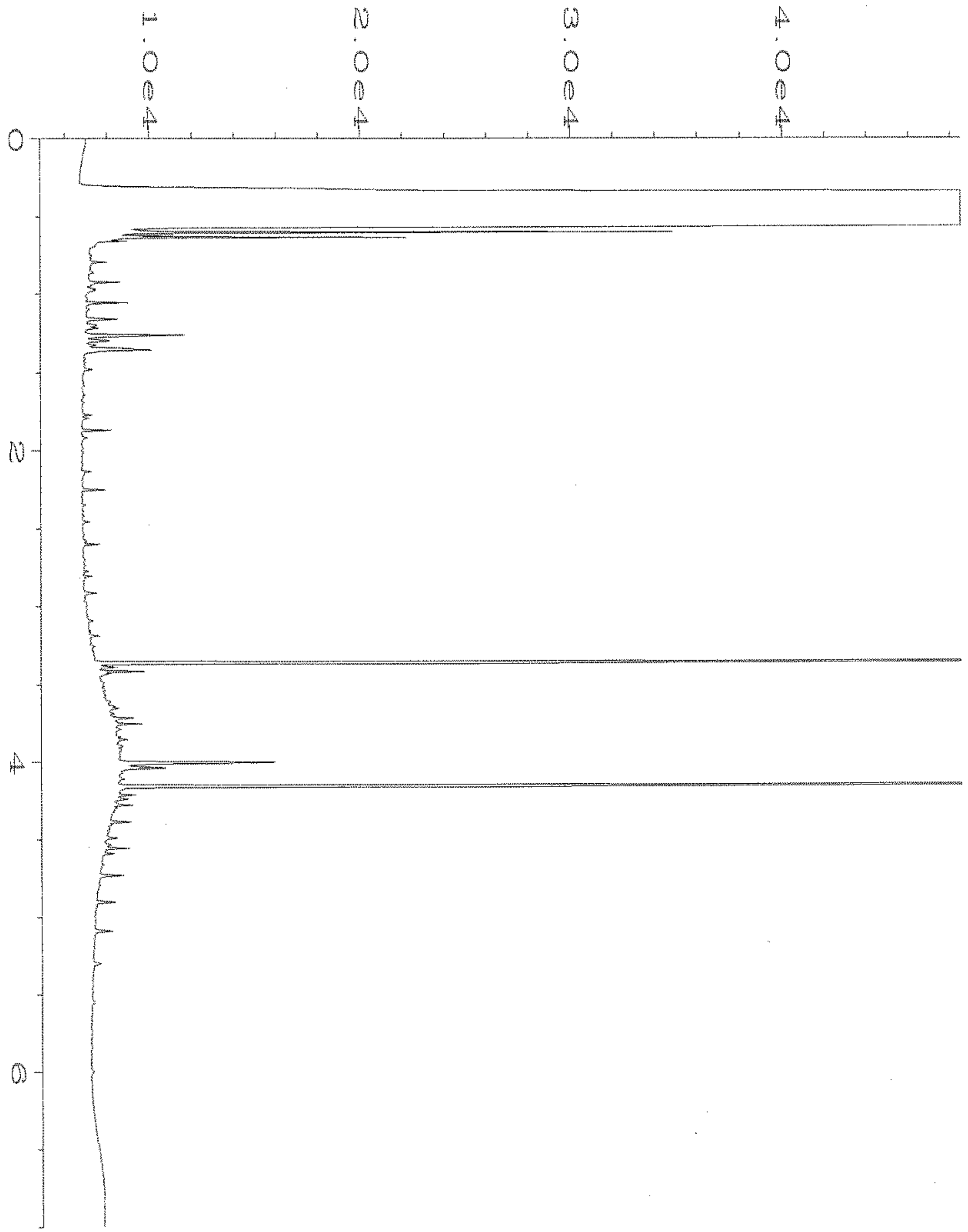
Analysis Method   : DX.MTH



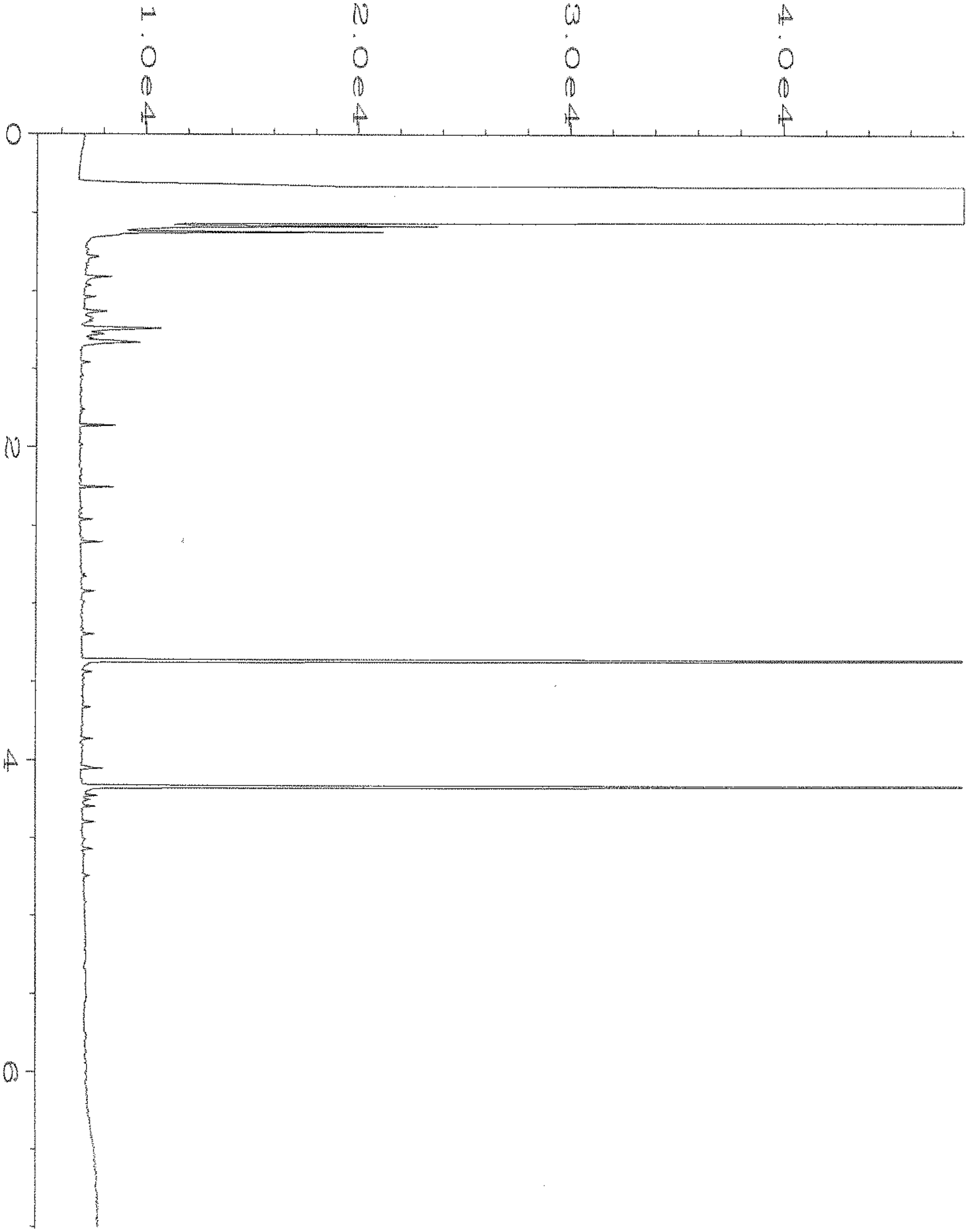
Data File Name   : C:\HPCHEM\6\DATA\03-04-19\066F1301.D
Operator   : TL
Instrument   : GC6
Sample Name   : 903013-30
Run Time Bar Code:
Acquired on   : 05 Mar 19   00:23 AM
Report Created on: 05 Mar 19   10:09 AM

Page Number   : 1
Vial Number   : 66
Injection Number : 1
Sequence Line   : 13
Instrument Method: DX.MTH
Analysis Method   : DX.MTH



Data File Name : C:\HPCHEM\6\DATA\03-04-19\067F1301.D
Operator : TL
Instrument : GC6
Sample Name : 903013-31
Run Time Bar Code:
Acquired on : 05 Mar 19 00:34 AM
Report Created on: 05 Mar 19 10:10 AM

Page Number : 1
Vial Number : 67
Injection Number : 1
Sequence Line : 13
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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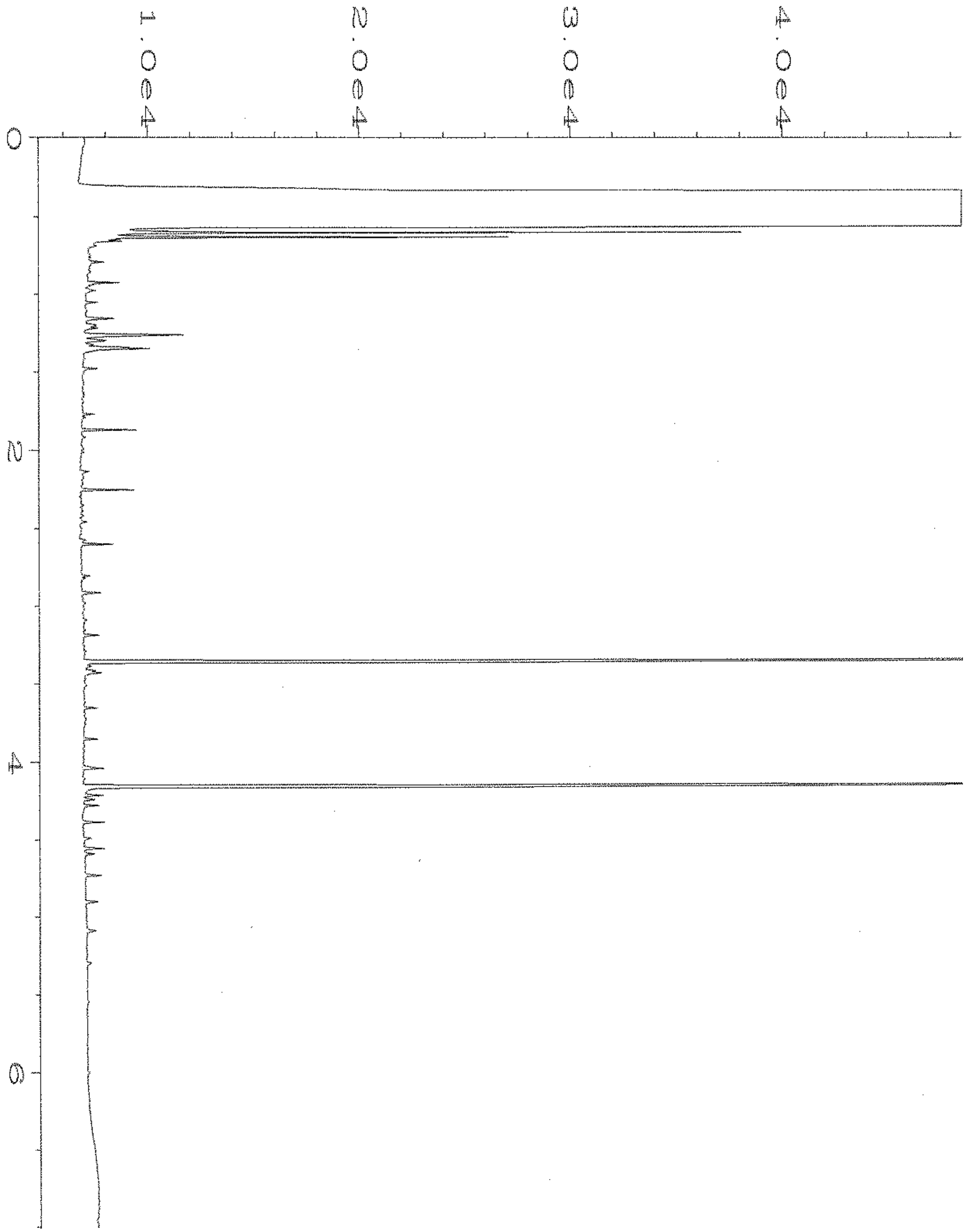
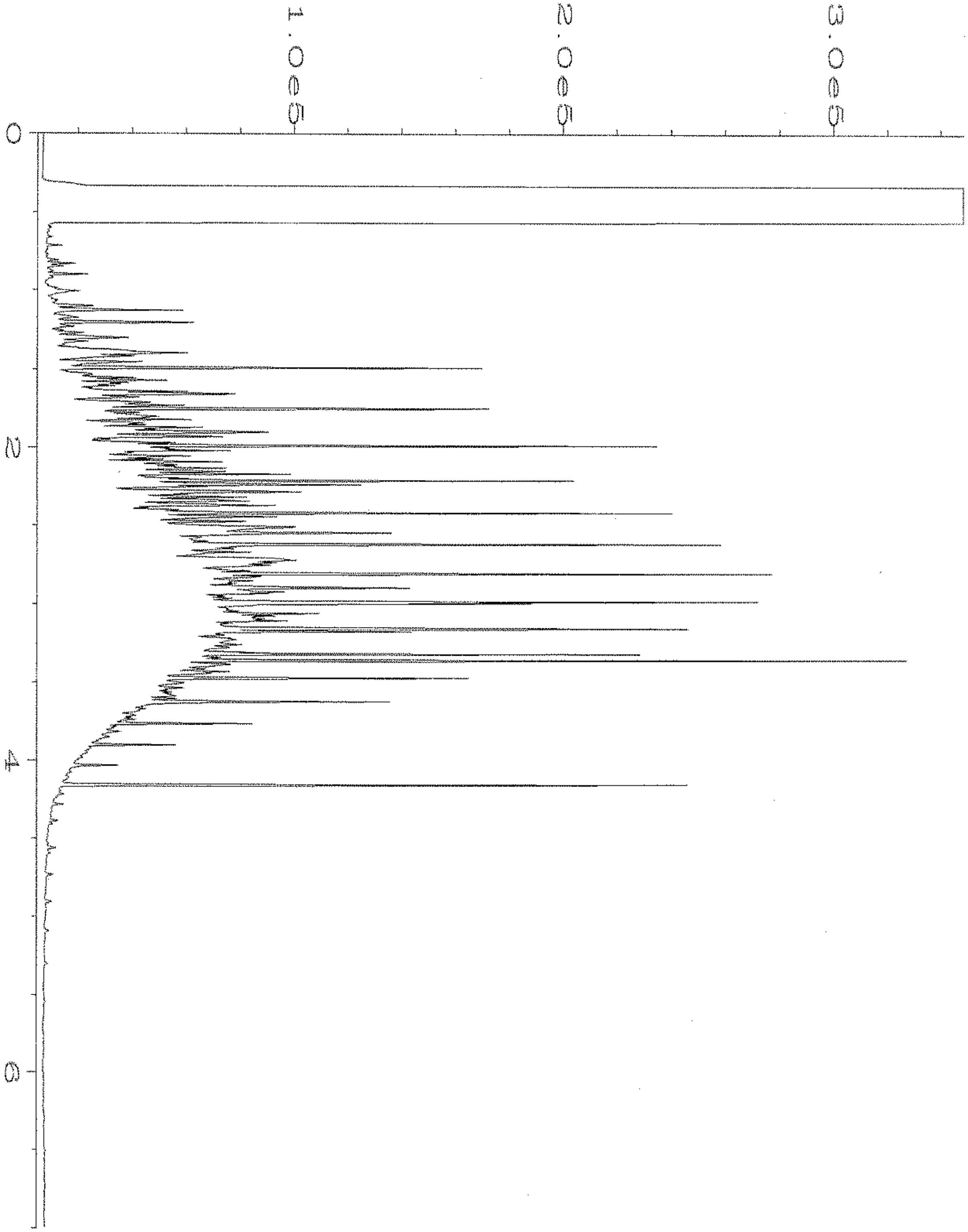
Data File Name    : C:\HPCHEM\6\DATA\03-04-19\014F0501.D
Operator          : TL                                      Page Number      : 1
Instrument        : GC6                                     Vial Number      : 14
Sample Name       : 09-459 mb                               Injection Number : 1
Run Time Bar Code:                                          Sequence Line    : 5
Acquired on       : 04 Mar 19   12:58 PM                    Instrument Method: DX.MTH
Report Created on: 05 Mar 19   08:46 AM                     Analysis Method  : DX.MTH
```



Data File Name   : C:\HPCHEM\6\DATA\03-04-19\053F1301.D
Operator   : TL
Instrument   : GC6
Sample Name   : 09-461 mb
Run Time Bar Code:
Acquired on   : 04 Mar 19   10:03 PM
Report Created on: 05 Mar 19   08:57 AM

Page Number   : 1
Vial Number   : 53
Injection Number : 1
Sequence Line   : 13
Instrument Method: DX.MTH
Analysis Method   : DX.MTH



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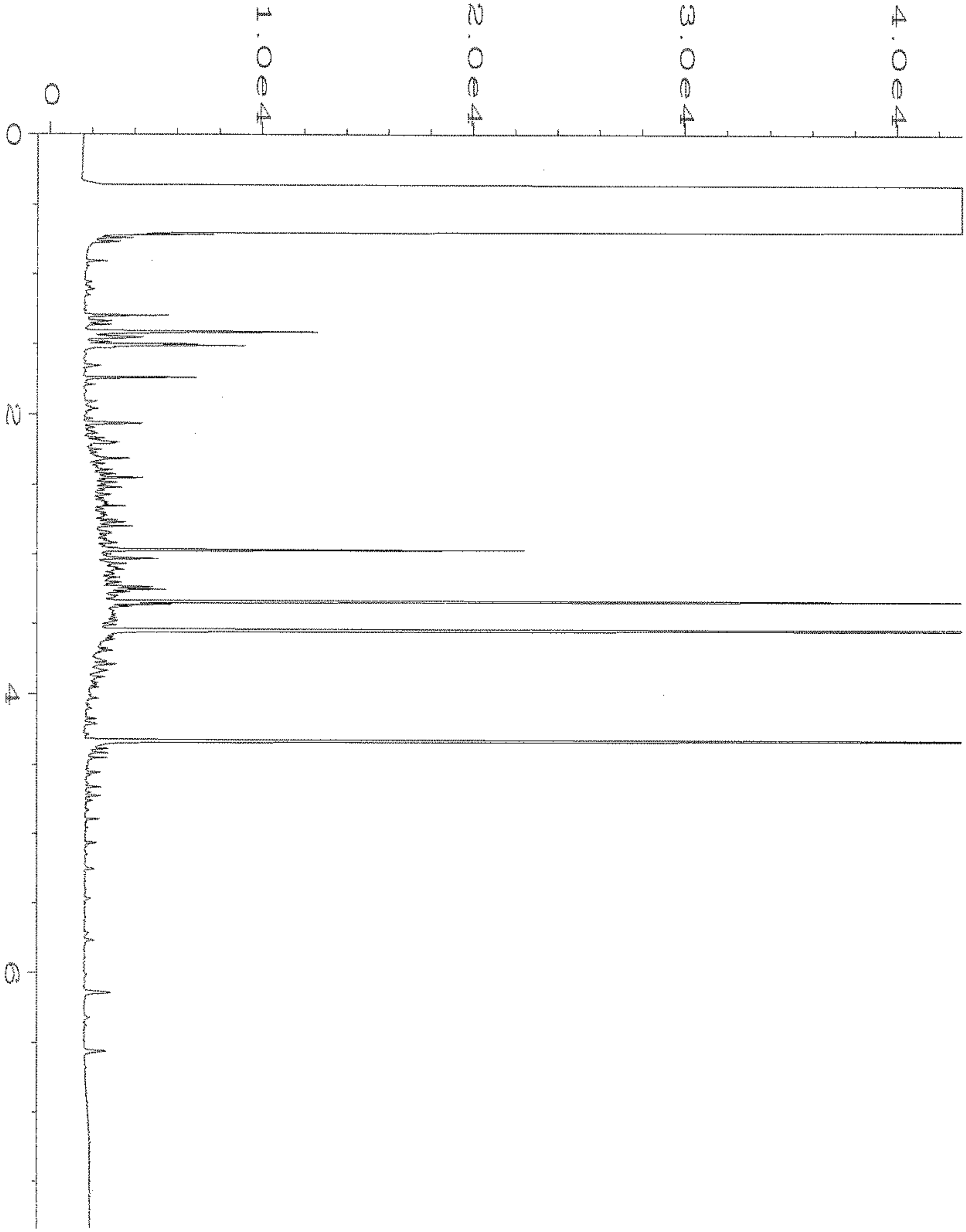
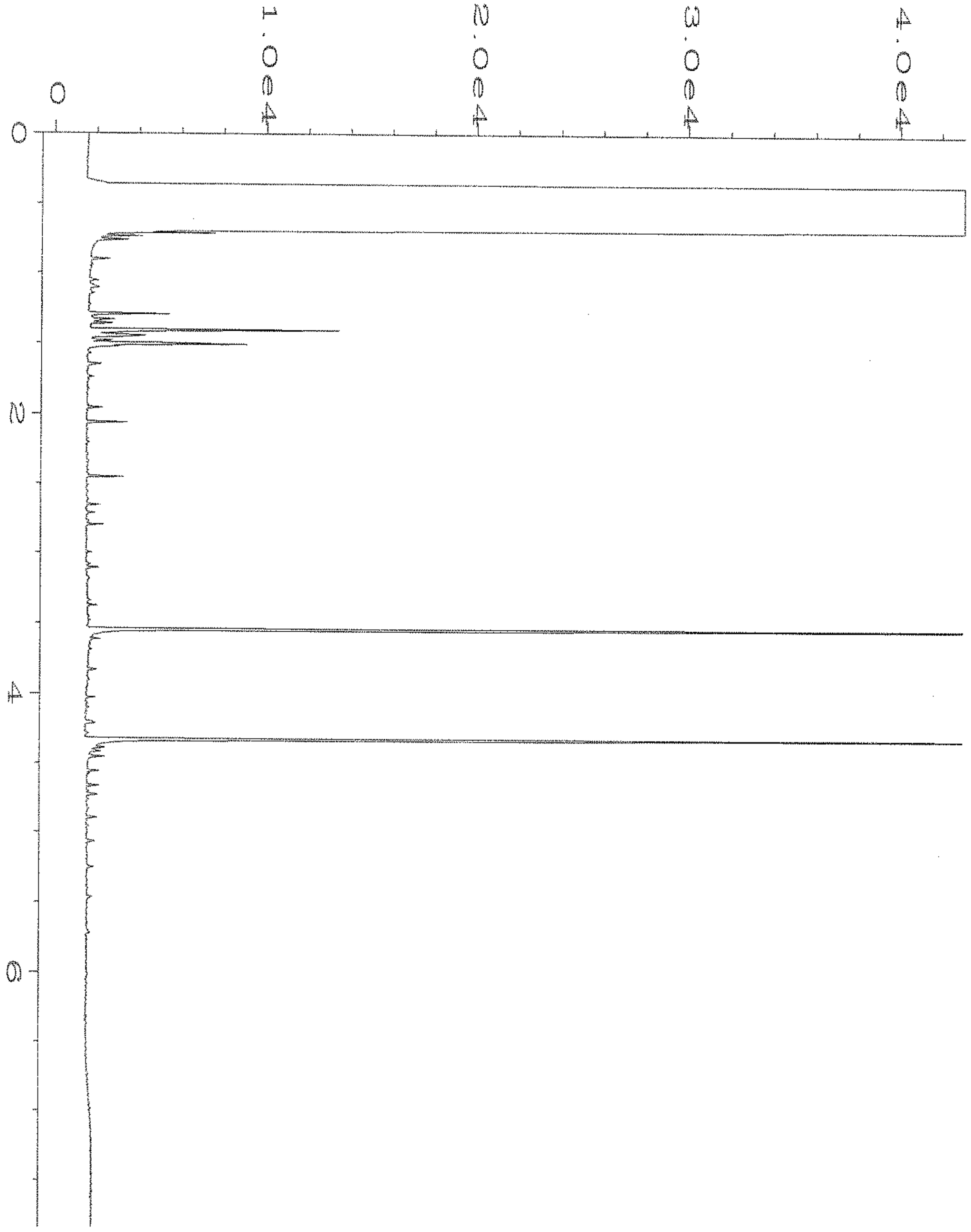
Data File Name    : C:\HPCHEM\6\DATA\03-04-19\005F1201.D
Operator          : TL                                     Page Number       : 1
Instrument        : GC6                                    Vial Number       : 5
Sample Name       : 1000 Dx 56-21C                         Injection Number  : 1
Run Time Bar Code:                                         Sequence Line     : 12
Acquired on       : 04 Mar 19   09:41 PM                   Instrument Method: DX.MTH
Report Created on: 05 Mar 19   08:59 AM                    Analysis Method   : DX.MTH
```



Data File Name : C:\HPCHEM\4\DATA\03-06-19\032F0601.D

Operator	: TL	Page Number	: 1
Instrument	: GC#4	Vial Number	: 32
Sample Name	: 903013-01 sg	Injection Number	: 1
Run Time Bar Code:		Sequence Line	: 6
Acquired on	: 06 Mar 19 05:13 PM	Instrument Method:	DX.MTH
Report Created on:	07 Mar 19 07:28 AM	Analysis Method	: DX.MTH



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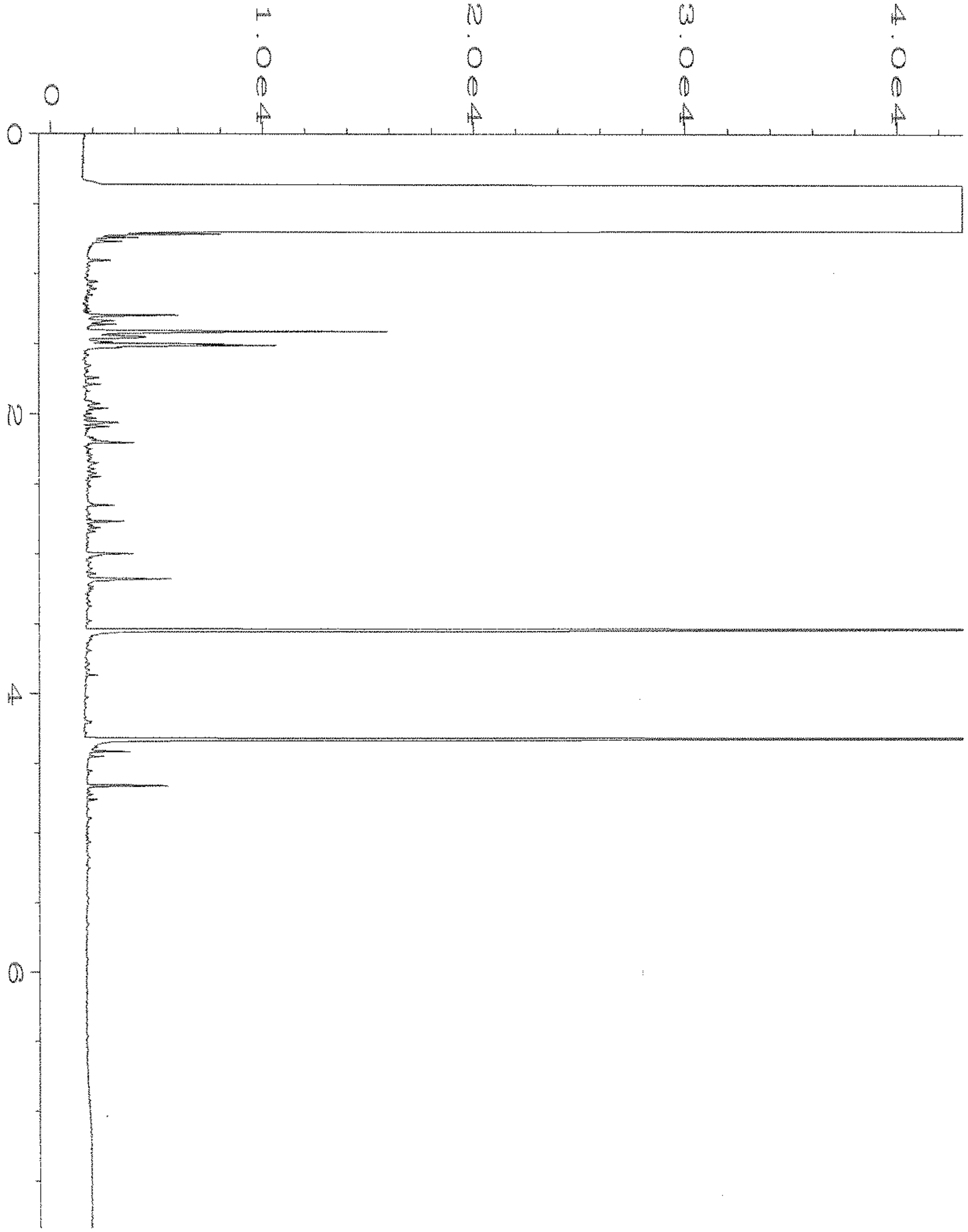
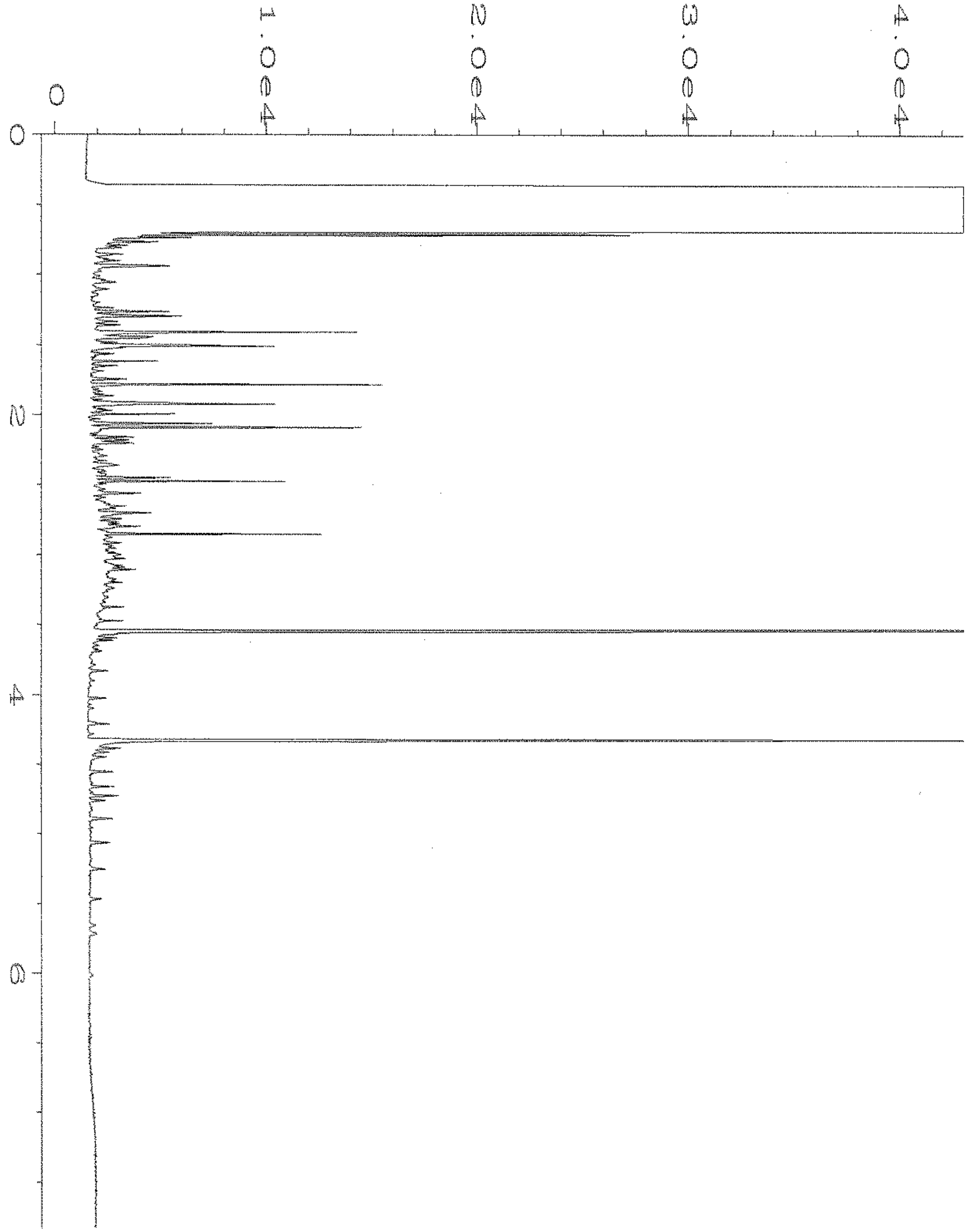
Data File Name    : C:\HPCHEM\4\DATA\03-06-19\033F0601.D
Operator          : TL                                 Page Number      : 1
Instrument        : GC#4                               Vial Number      : 33
Sample Name       : 903013-02 sg                       Injection Number : 1
Run Time Bar Code:                                     Sequence Line    : 6
Acquired on       : 06 Mar 19   05:25 PM               Instrument Method: DX.MTH
Report Created on: 07 Mar 19   07:28 AM                Analysis Method  : DX.MTH
```



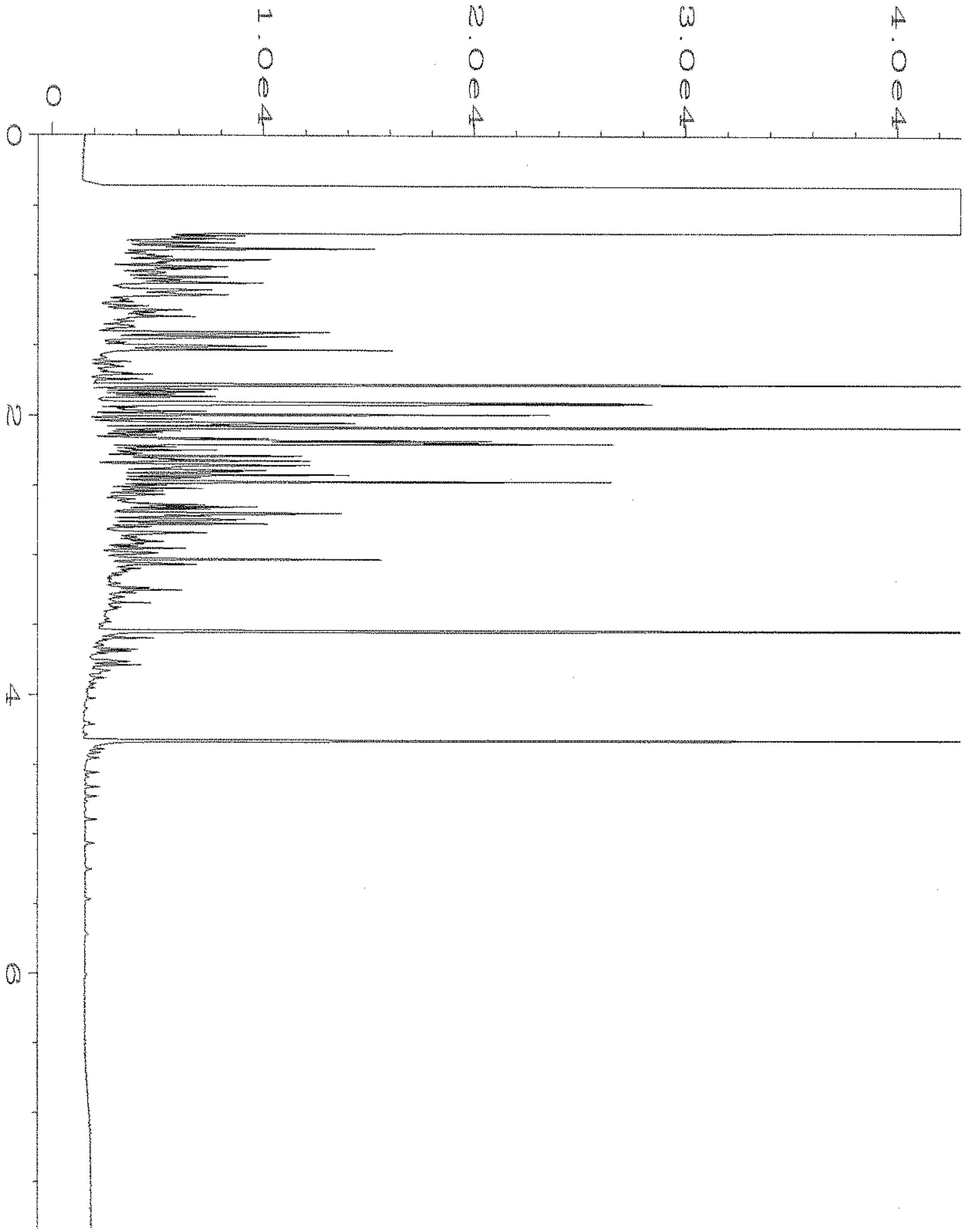
Data File Name   : C:\HPCHEM\4\DATA\03-06-19\034F0601.D
Operator   : TL
Instrument   : GC#4
Sample Name   : 903013-03 sg
Run Time Bar Code:
Acquired on   : 06 Mar 19   05:37 PM
Report Created on: 07 Mar 19   07:29 AM

Page Number   : 1
Vial Number   : 34
Injection Number : 1
Sequence Line   : 6
Instrument Method: DX.MTH
Analysis Method   : DX.MTH

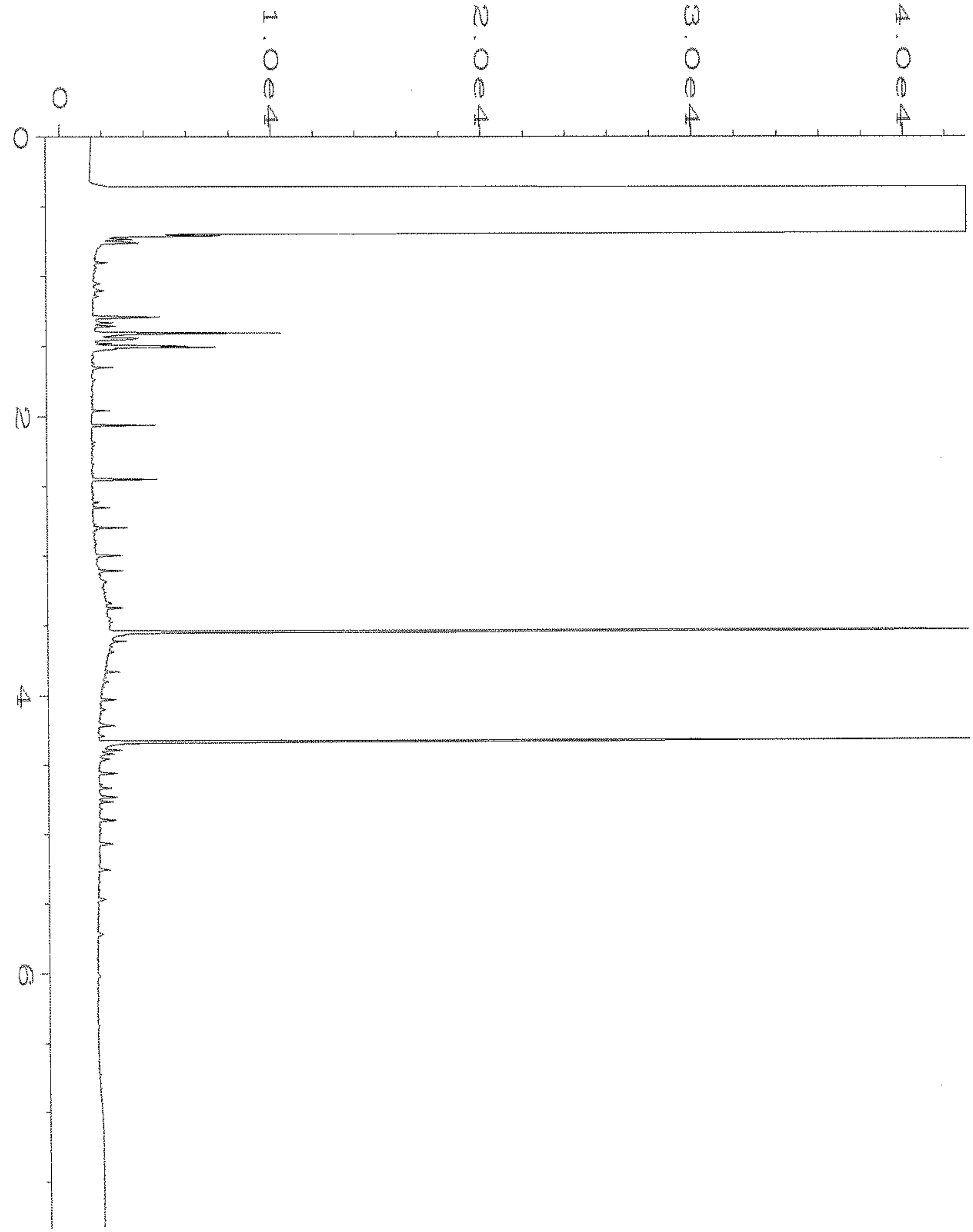


Data File Name : C:\HPCHEM\4\DATA\03-06-19\035F0801.D

Operator	: TL	Page Number	: 1
Instrument	: GC#4	Vial Number	: 35
Sample Name	: 903013-04 sg	Injection Number	: 1
Run Time Bar Code:		Sequence Line	: 8
Acquired on	: 06 Mar 19 06:13 PM	Instrument Method:	DX.MTH
Report Created on:	07 Mar 19 07:29 AM	Analysis Method	: DX.MTH

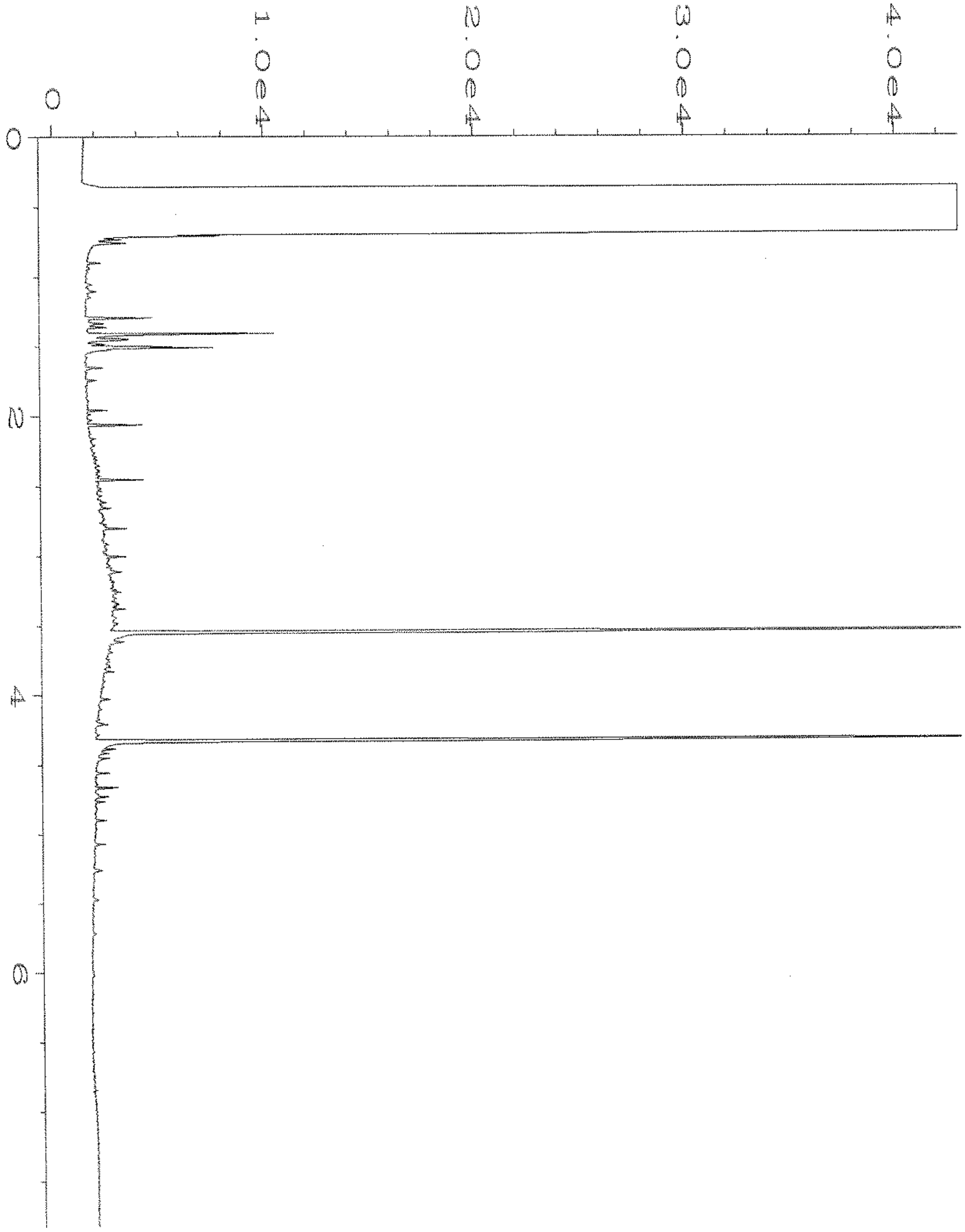


```
Data File Name    : C:\HPCHEM\4\DATA\03-06-19\036F0801.D
Operator          : TL                           Page Number       : 1
Instrument        : GC#4                         Vial Number       : 36
Sample Name       : 903013-05 sg                 Injection Number  : 1
Run Time Bar Code:                               Sequence Line     : 8
Acquired on       : 06 Mar 19   06:25 PM         Instrument Method: DX.MTH
Report Created on: 07 Mar 19   07:29 AM          Analysis Method   : DX.MTH
```



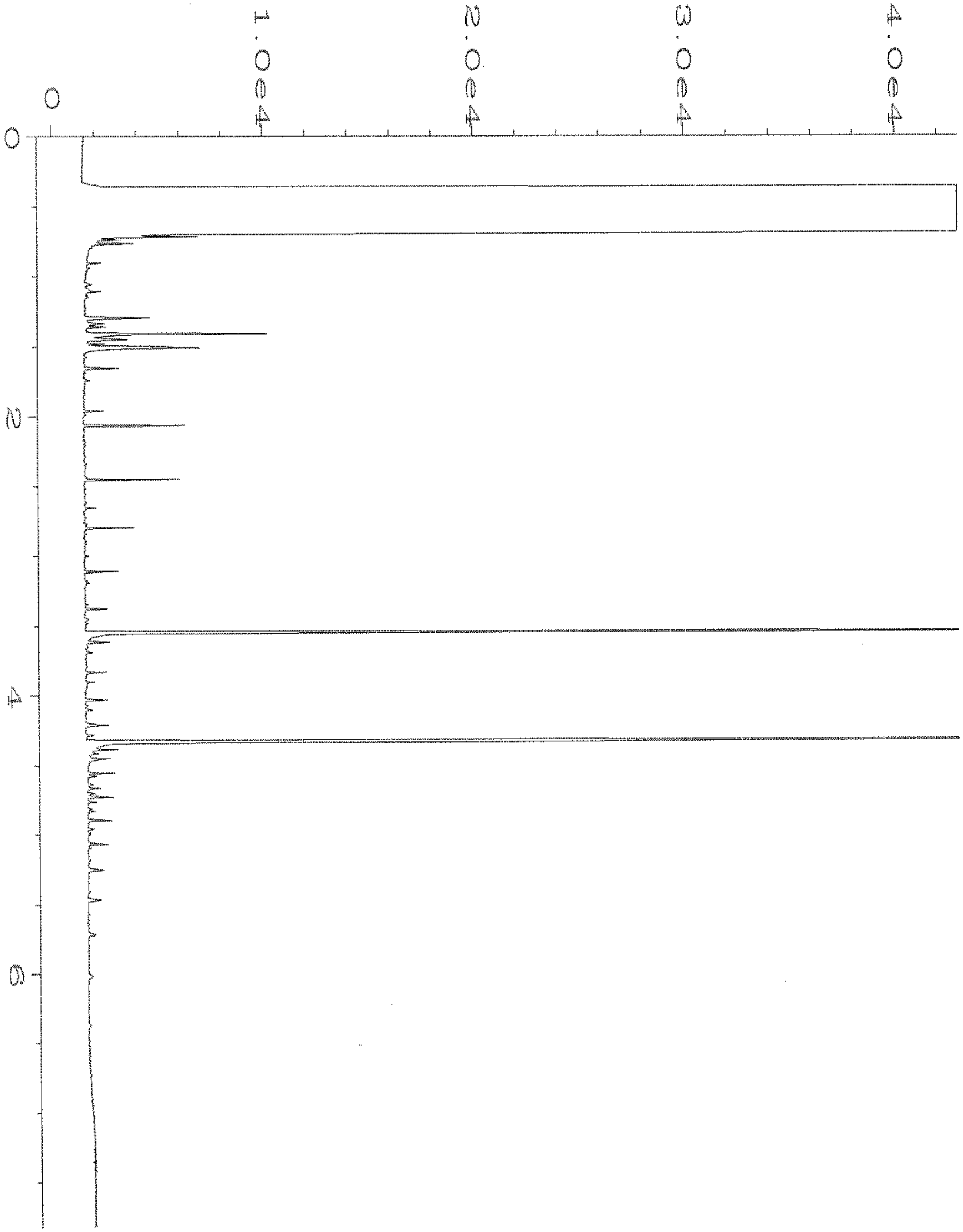
Data File Name : C:\HPCHEM\4\DATA\03-06-19\037F0801.D
Operator : TL
Instrument : GC#4
Sample Name : 903013-06 sg
Run Time Bar Code:
Acquired on : 06 Mar 19 06:37 PM
Report Created on: 07 Mar 19 07:29 AM

Page Number : 1
Vial Number : 37
Injection Number : 1
Sequence Line : 8
Instrument Method: DX.MTH
Analysis Method : DX.MTH



Data File Name : C:\HPCHEM\4\DATA\03-06-19\038F0801.D
Operator : TL
Instrument : GC#4
Sample Name : 903013-07 sg
Run Time Bar Code:
Acquired on : 06 Mar 19 06:48 PM
Report Created on: 07 Mar 19 07:29 AM

Page Number : 1
Vial Number : 38
Injection Number : 1
Sequence Line : 8
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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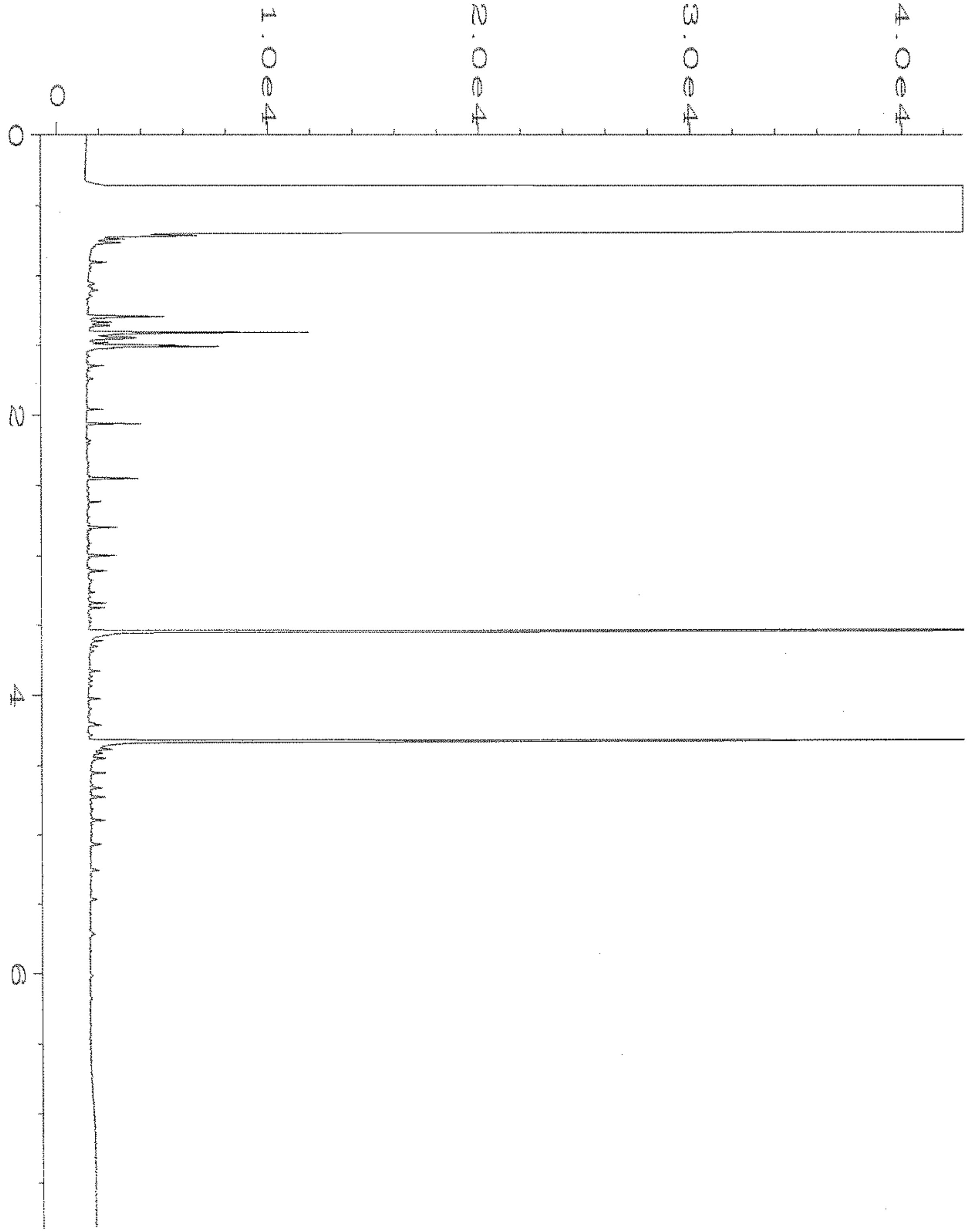
Data File Name    : C:\HPCHEM\4\DATA\03-06-19\039F0801.D
Operator          : TL                              Page Number      : 1
Instrument        : GC#4                            Vial Number      : 39
Sample Name       : 903013-08 sg                    Injection Number : 1
Run Time Bar Code:                                  Sequence Line    : 8
Acquired on       : 06 Mar 19   07:00 PM            Instrument Method: DX.MTH
Report Created on: 07 Mar 19   07:30 AM             Analysis Method  : DX.MTH
```



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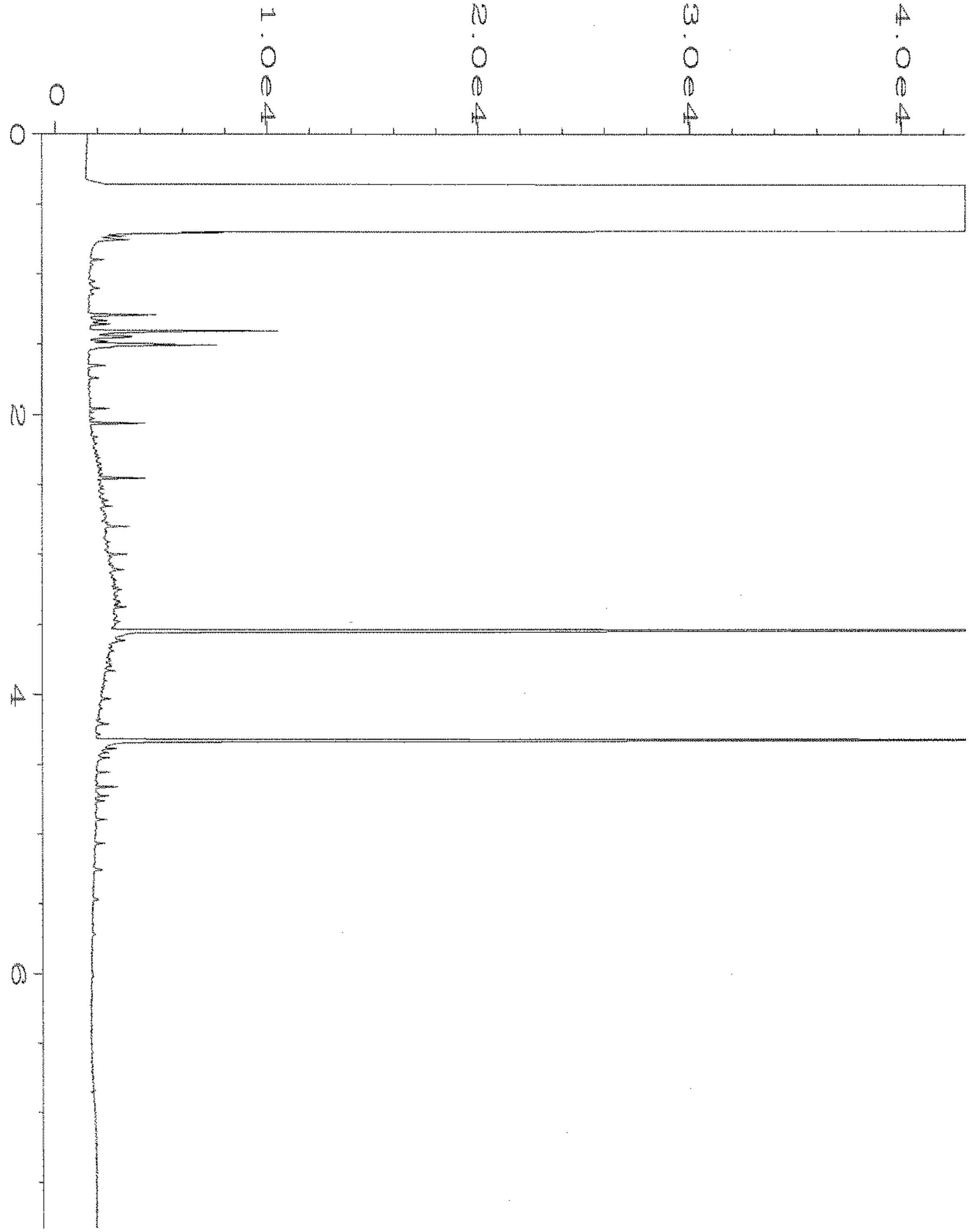
Data File Name    : C:\HPCHEM\4\DATA\03-06-19\041F0801.D
Operator          : TL                               Page Number       : 1
Instrument        : GC#4                             Vial Number       : 41
Sample Name       : 903013-10 sg                     Injection Number  : 1
Run Time Bar Code:                                   Sequence Line     : 8
Acquired on       : 06 Mar 19   07:24 PM             Instrument Method: DX.MTH
Report Created on: 07 Mar 19   07:30 AM              Analysis Method   : DX.MTH
```



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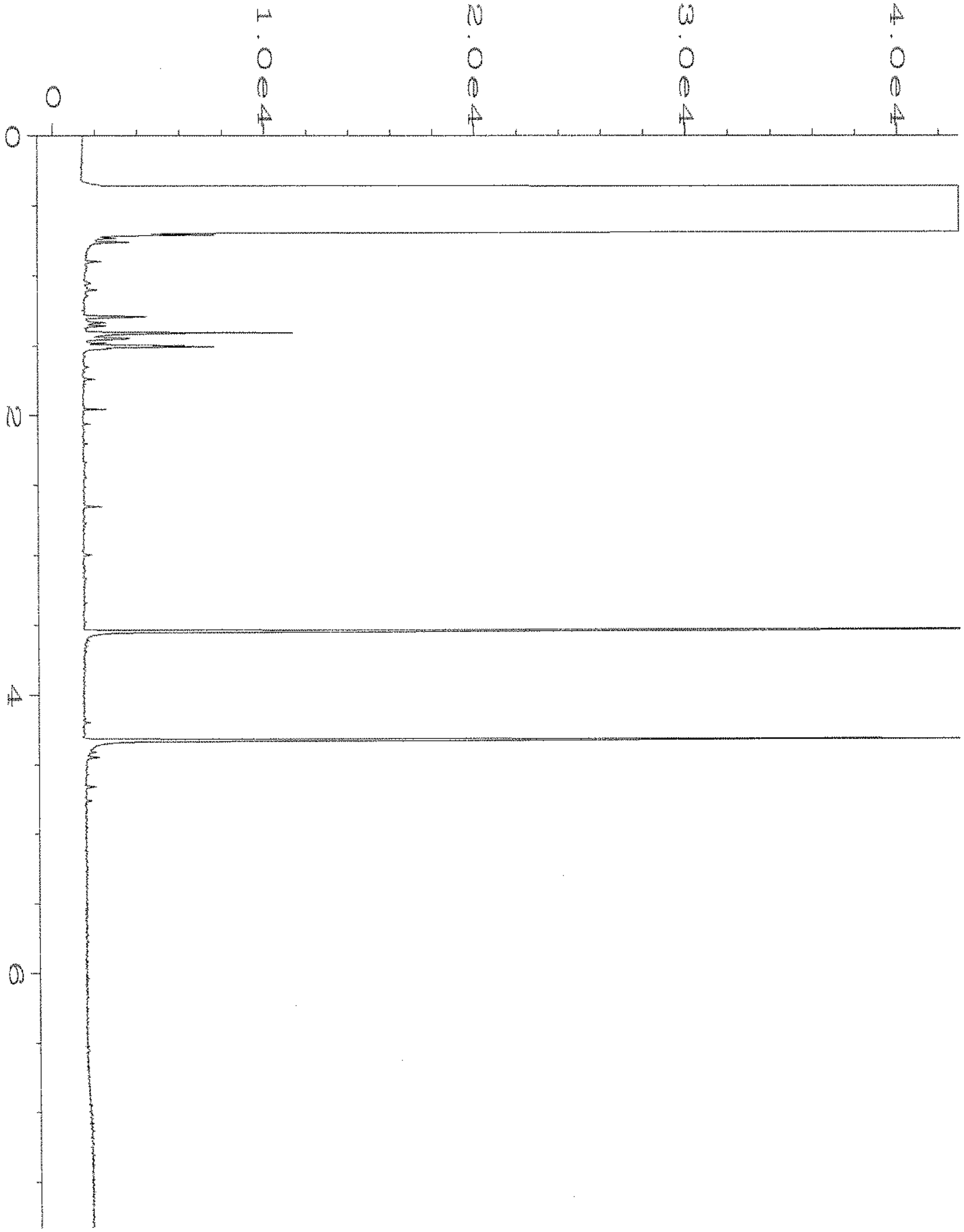
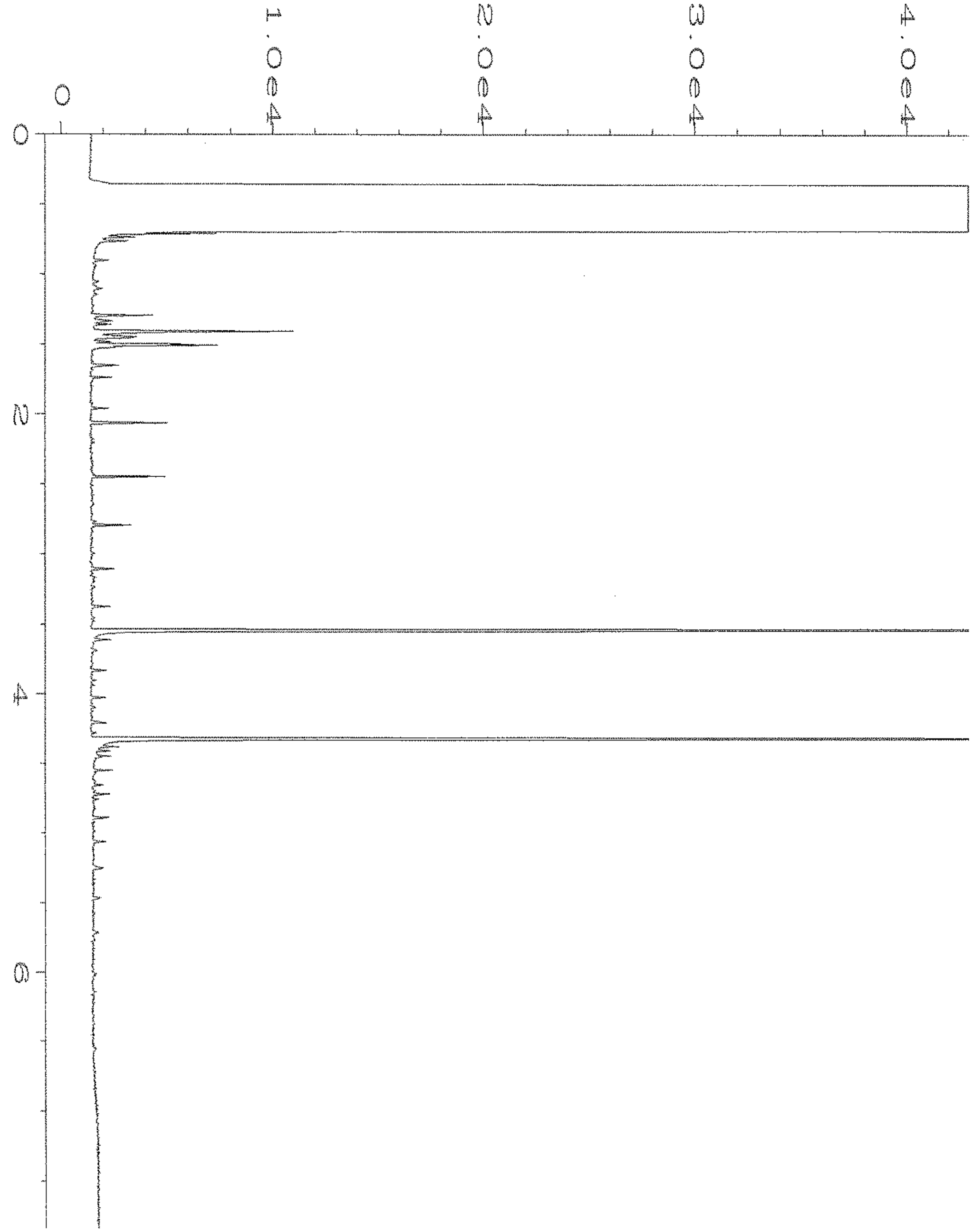
Data File Name    : C:\HPCHEM\4\DATA\03-06-19\038F0801.D
Operator          : TL                                  Page Number       : 1
Instrument        : GC#4                                Vial Number       : 38
Sample Name       : 903013-07 sg                        Injection Number  : 1
Run Time Bar Code:                                      Sequence Line     : 8
Acquired on       : 06 Mar 19   06:48 PM                Instrument Method: DX.MTH
Report Created on: 07 Mar 19   07:29 AM                 Analysis Method   : DX.MTH
```



Data File Name : C:\HPCHEM\4\DATA\03-06-19\042F0801.D
Operator : TL
Instrument : GC#4
Sample Name : 903013-11 sg
Run Time Bar Code:
Acquired on : 06 Mar 19 07:36 PM
Report Created on: 07 Mar 19 07:31 AM

Page Number : 1
Vial Number : 42
Injection Number : 1
Sequence Line : 8
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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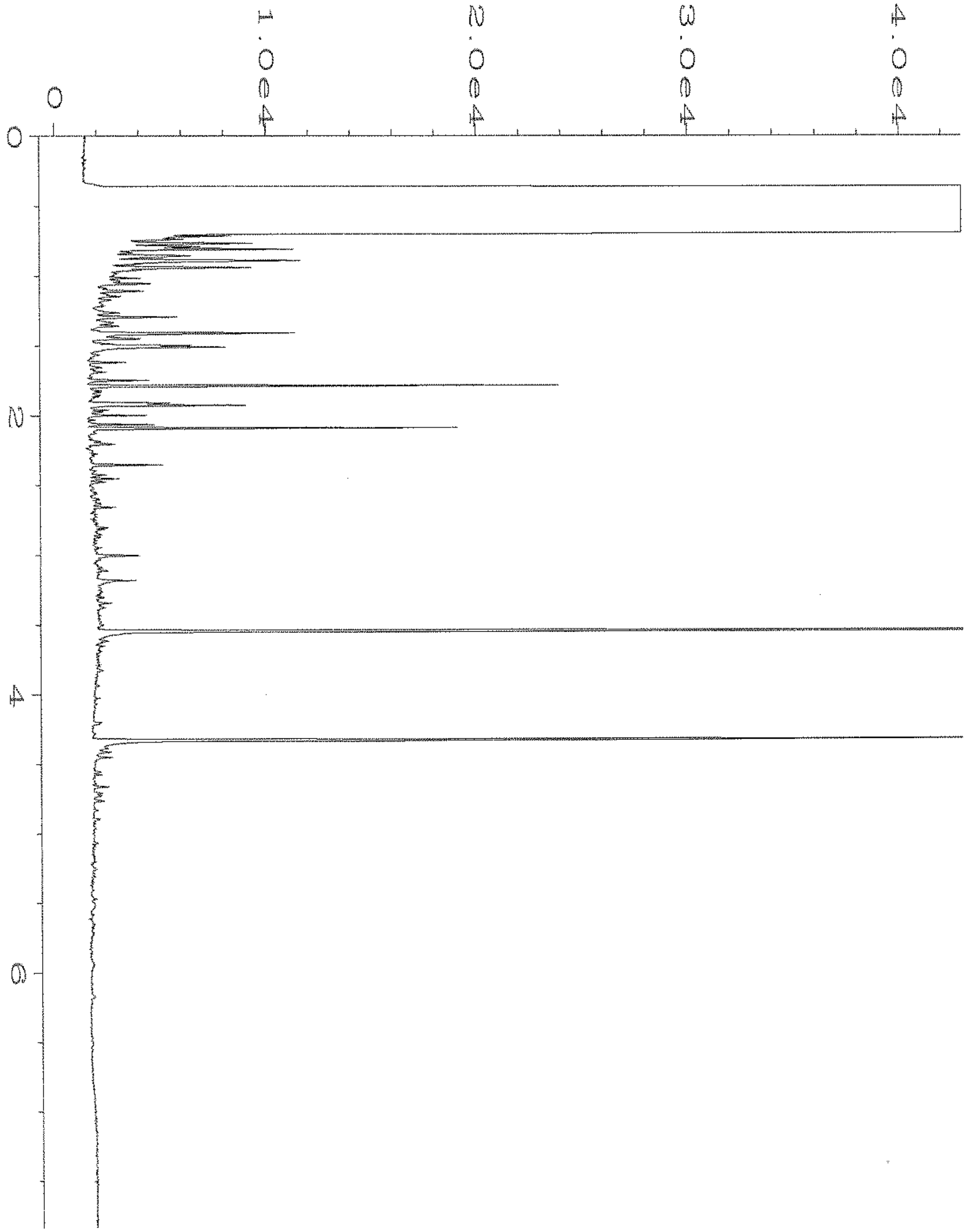
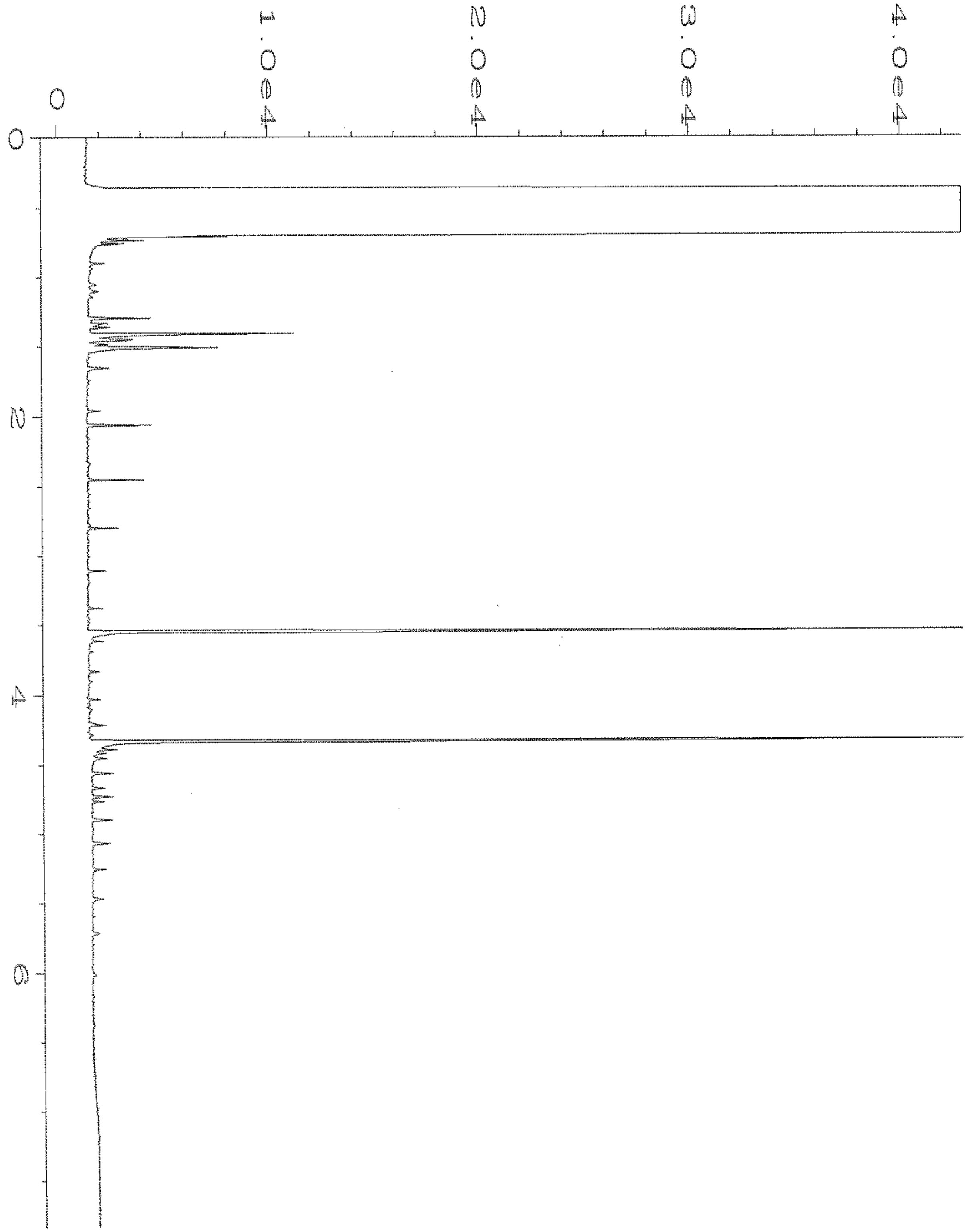
Data File Name    : C:\HPCHEM\4\DATA\03-06-19\043F0801.D
Operator          : TL                              Page Number      : 1
Instrument        : GC#4                            Vial Number      : 43
Sample Name       : 903013-12 sg                    Injection Number : 1
Run Time Bar Code:                                  Sequence Line    : 8
Acquired on       : 06 Mar 19   07:48 PM            Instrument Method: DX.MTH
Report Created on: 07 Mar 19   07:31 AM             Analysis Method  : DX.MTH
```



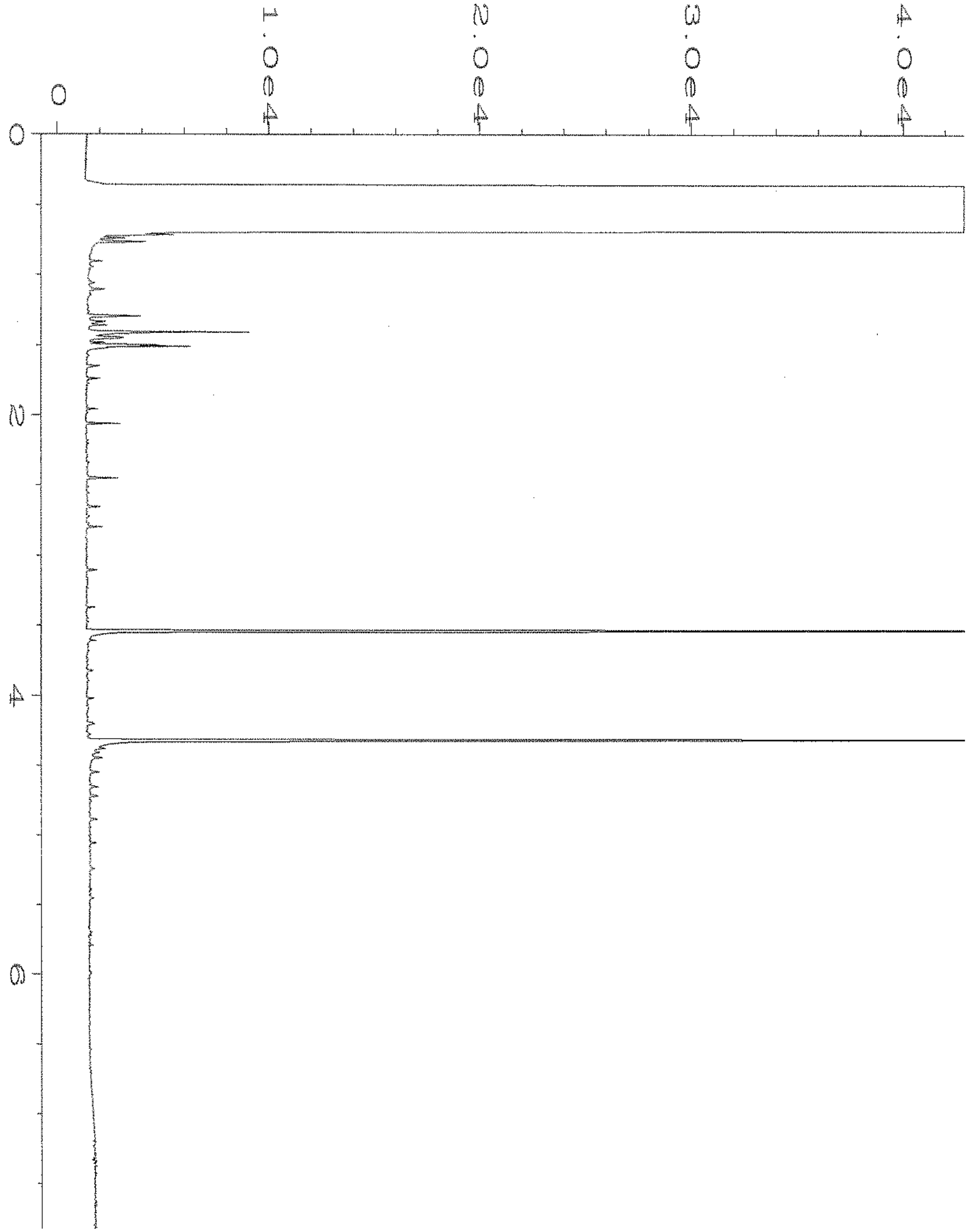
Data File Name : C:\HPCHEM\4\DATA\03-06-19\044F1001.D
Operator : TL
Instrument : GC#4
Sample Name : 903013-13 sg
Run Time Bar Code:
Acquired on : 06 Mar 19 08:24 PM
Report Created on: 07 Mar 19 07:31 AM

Page Number : 1
Vial Number : 44
Injection Number : 1
Sequence Line : 10
Instrument Method: DX.MTH
Analysis Method : DX.MTH

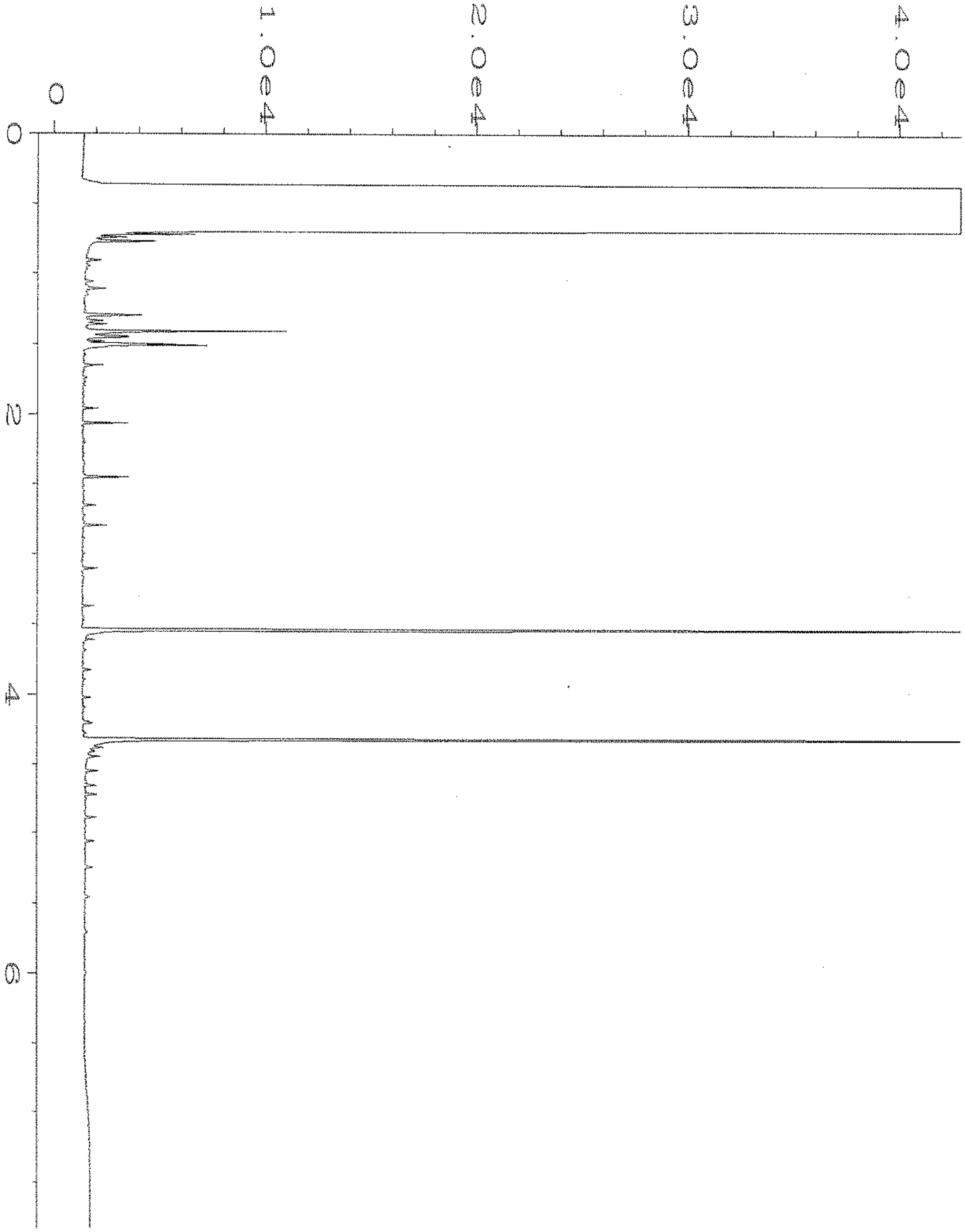


Data File Name   : C:\HPCHEM\4\DATA\03-06-19\045F1001.D
Operator   : TL
Instrument   : GC#4
Sample Name   : 903013-14 sg
Run Time Bar Code:
Acquired on   : 06 Mar 19   08:36 PM
Report Created on: 07 Mar 19   07:31 AM

Page Number   : 1
Vial Number   : 45
Injection Number : 1
Sequence Line   : 10
Instrument Method: DX.MTH
Analysis Method   : DX.MTH



```
Data File Name    : C:\HPCHEM\4\DATA\03-06-19\046F1001.D
Operator          : TL                          Page Number      : 1
Instrument        : GC#4                        Vial Number      : 46
Sample Name       : 903013-15 sg                Injection Number : 1
Run Time Bar Code:                              Sequence Line    : 10
Acquired on       : 06 Mar 19   08:48 PM        Instrument Method: DX.MTH
Report Created on: 07 Mar 19   07:31 AM         Analysis Method  : DX.MTH
```



Data File Name : C:\HPCHEM\4\DATA\03-06-19\047F1001.D

Operator : TL

Instrument : GC#4

Sample Name : 903013-16 sg

Run Time Bar Code:

Acquired on : 06 Mar 19 08:59 PM

Report Created on: 07 Mar 19 07:31 AM

Page Number : 1

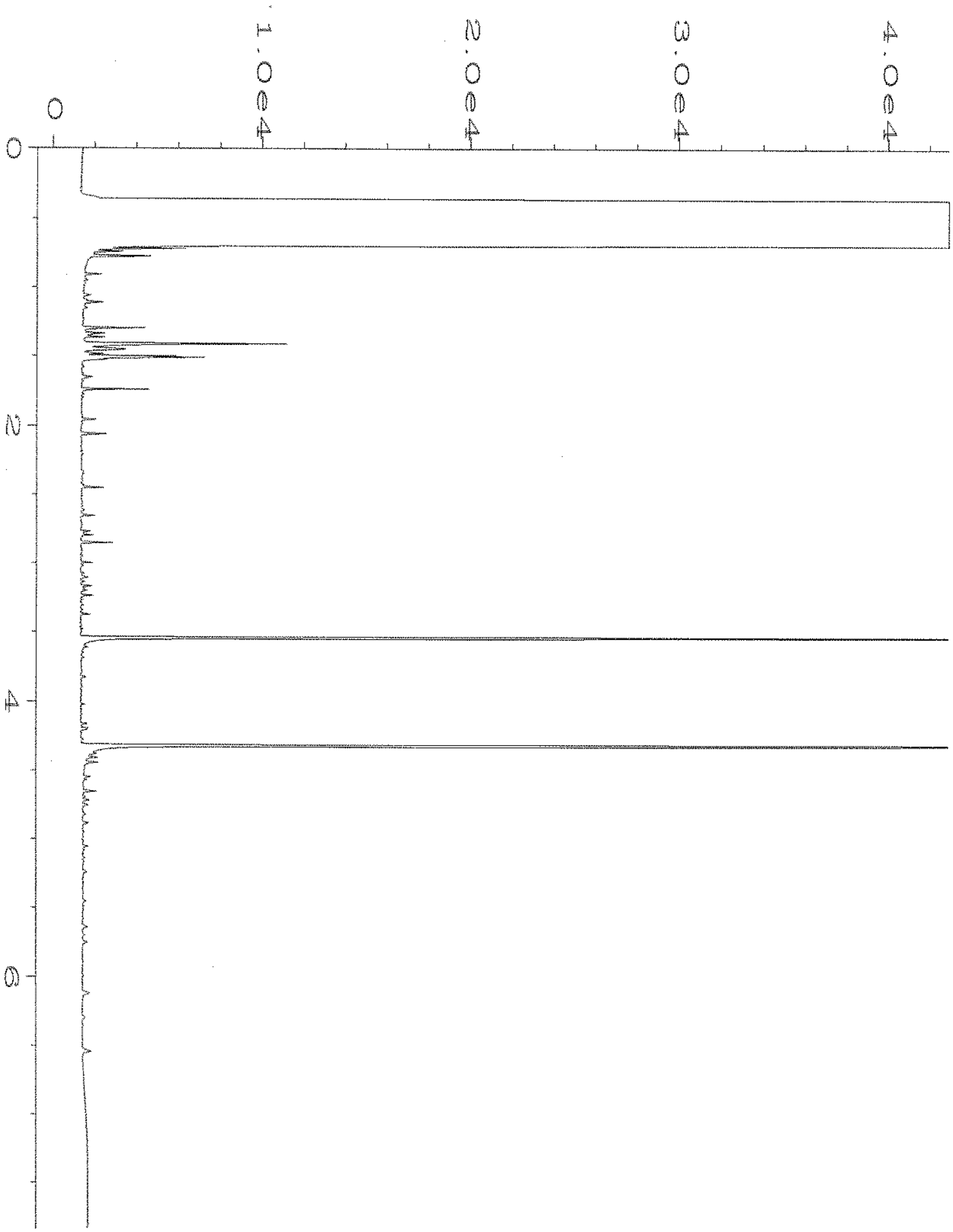
Vial Number : 47

Injection Number : 1

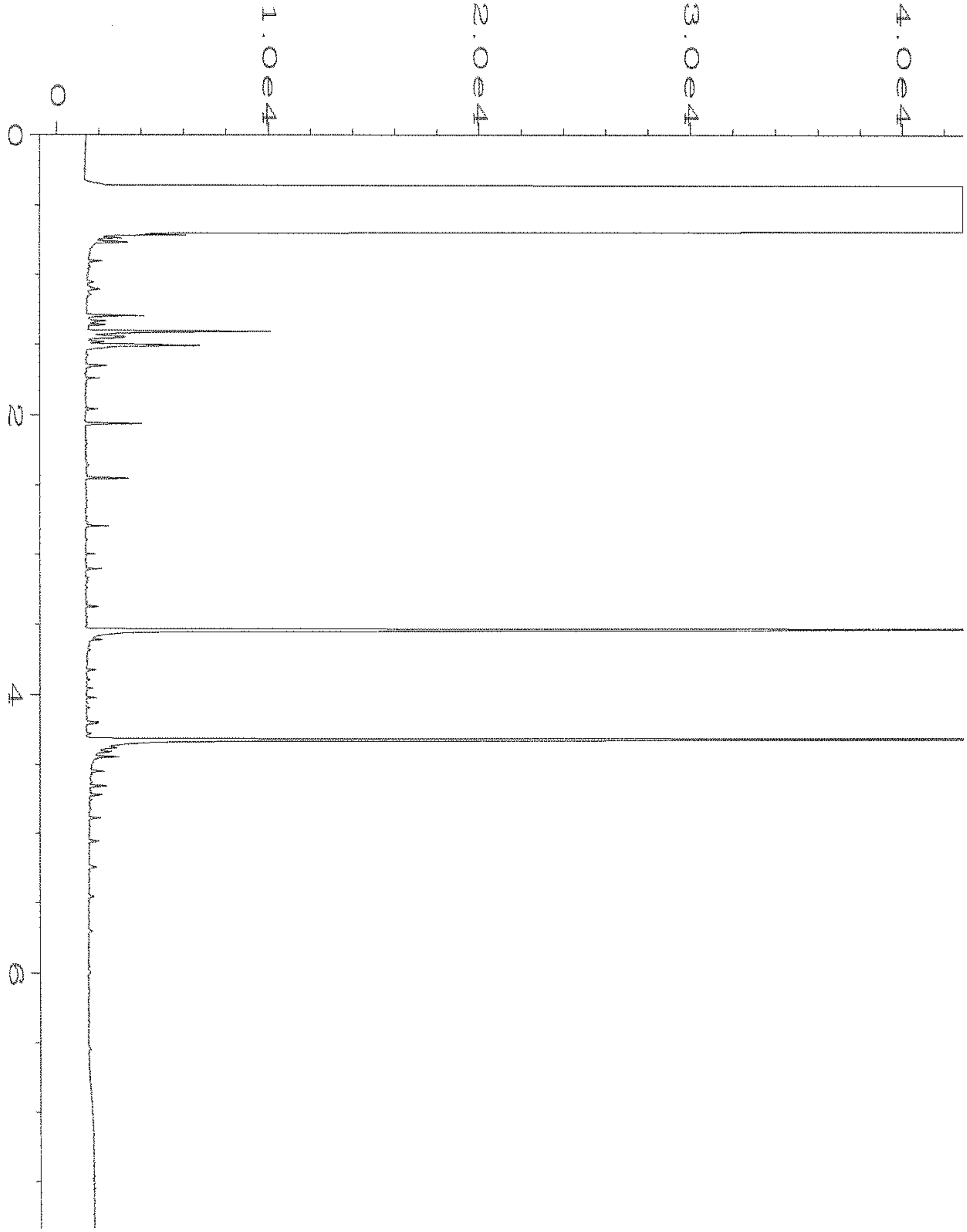
Sequence Line : 10

Instrument Method: DX.MTH

Analysis Method : DX.MTH



```
Data File Name    : C:\HPCHEM\4\DATA\03-06-19\048F1001.D
Operator          : TL                                       Page Number       : 1
Instrument        : GC#4                                     Vial Number       : 48
Sample Name       : 903013-17 sg                             Injection Number : 1
Run Time Bar Code:                                           Sequence Line     : 10
Acquired on       : 06 Mar 19   09:11 PM                     Instrument Method: DX.MTH
Report Created on: 07 Mar 19   07:31 AM                      Analysis Method   : DX.MTH
```



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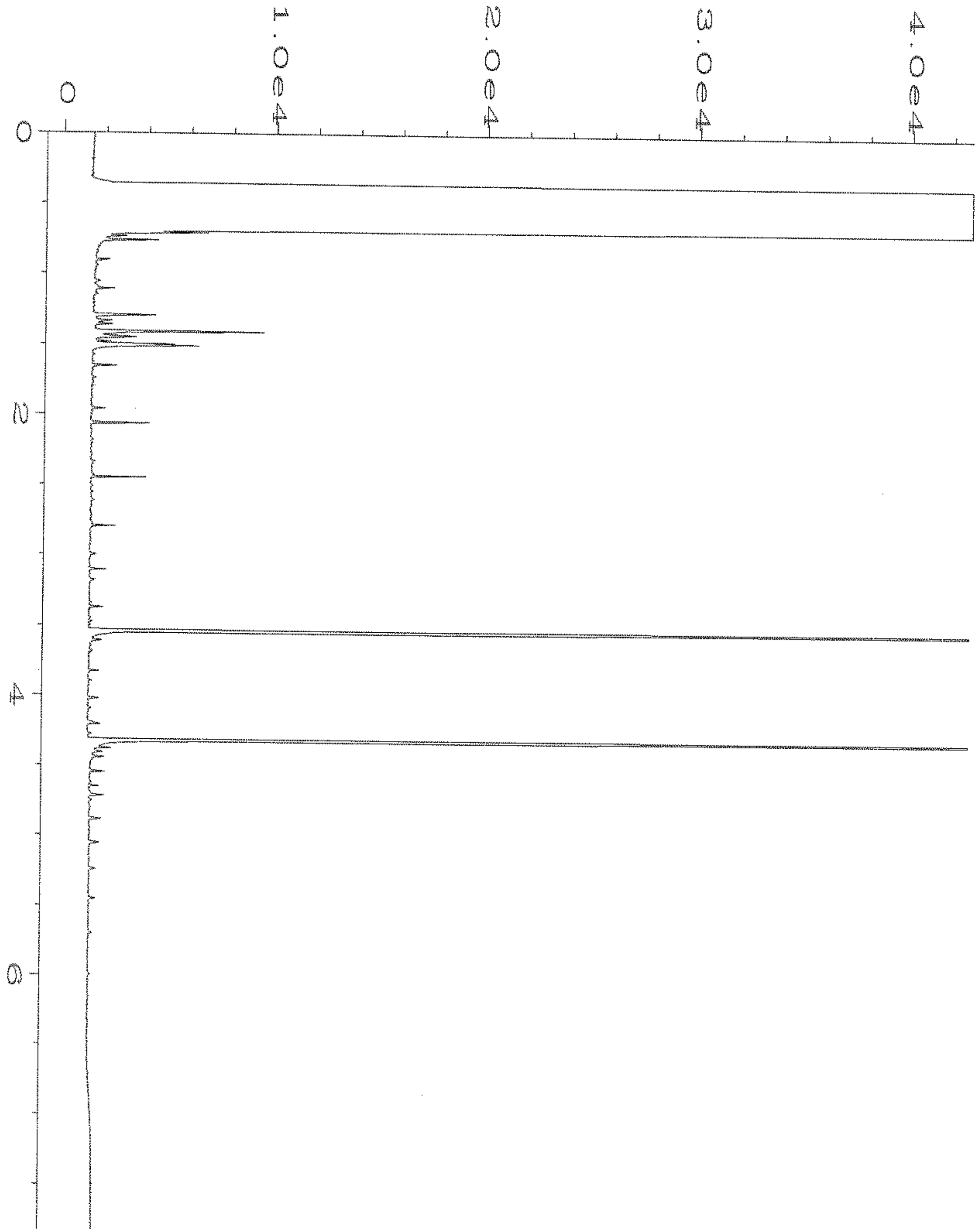
Data File Name    : C:\HPCHEM\4\DATA\03-06-19\049F1001.D
Operator          : TL                              Page Number       : 1
Instrument        : GC#4                            Vial Number       : 49
Sample Name       : 903013-18 sg                    Injection Number : 1
Run Time Bar Code:                                  Sequence Line     : 10
Acquired on       : 06 Mar 19   09:23 PM            Instrument Method: DX.MTH
Report Created on: 07 Mar 19   07:32 AM             Analysis Method  : DX.MTH
```



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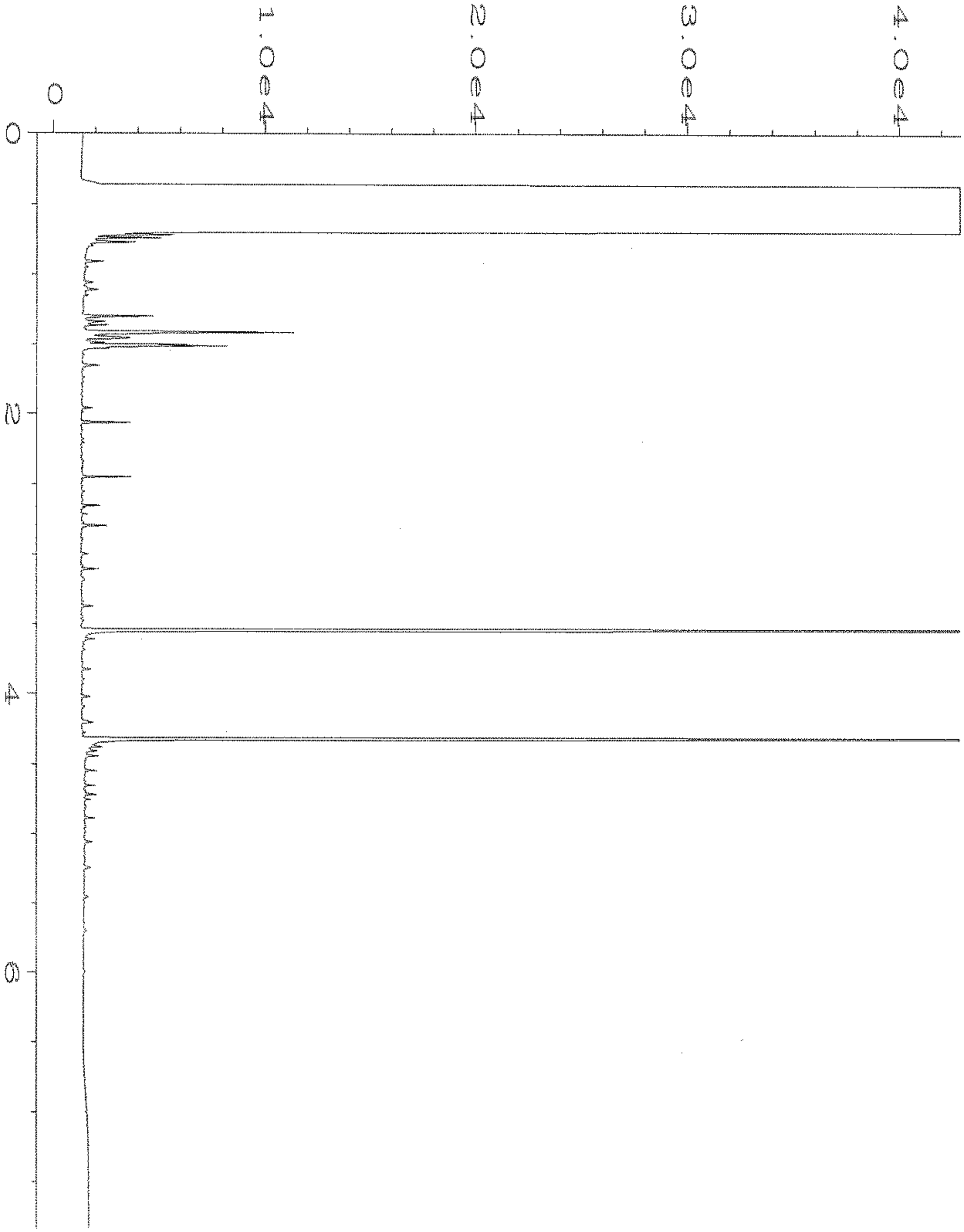
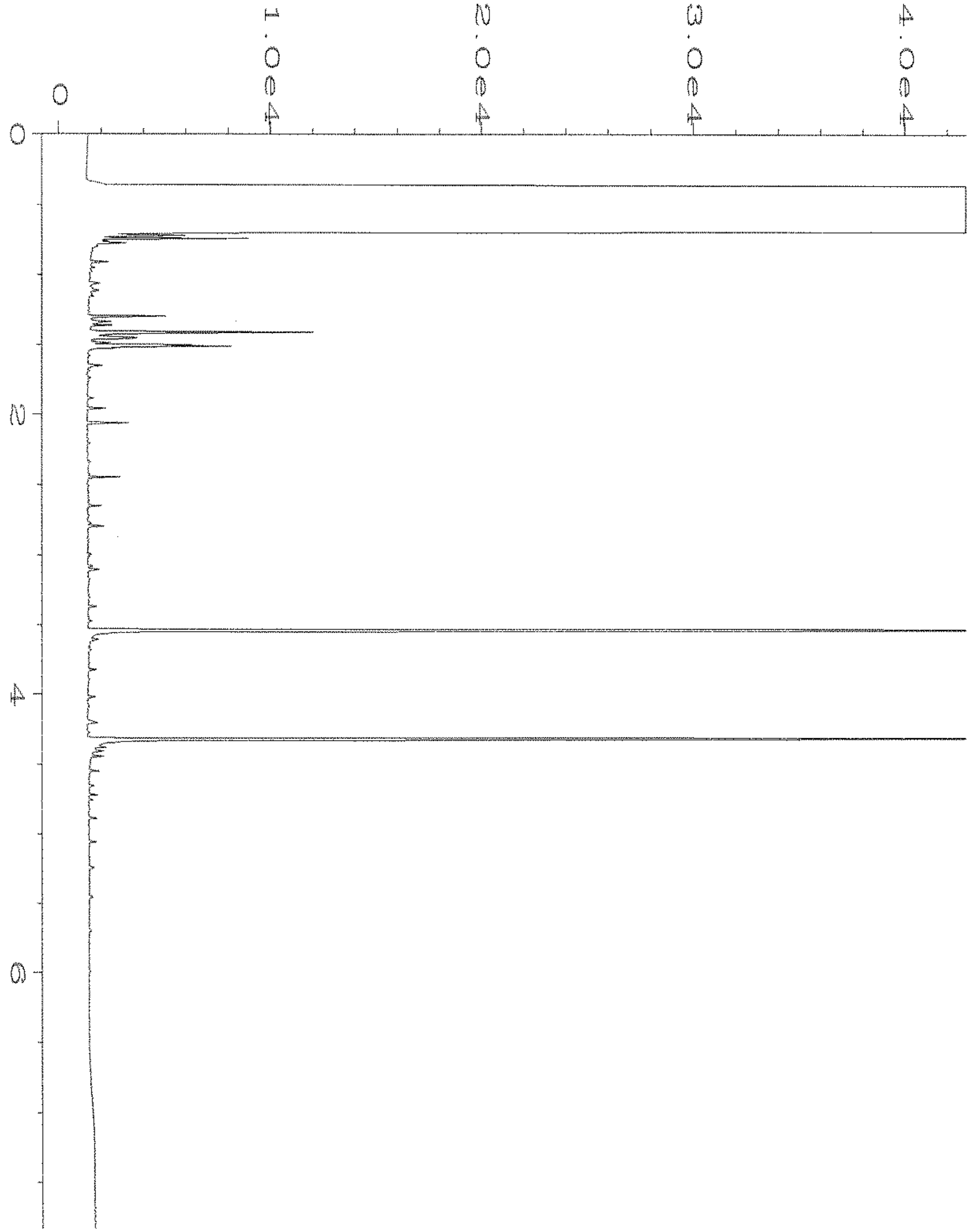
Data File Name    : C:\HPCHEM\4\DATA\03-06-19\050F1001.D
Operator          : TL
Instrument        : GC#4                              Page Number      : 1
Sample Name       : 903013-19 sg                      Vial Number      : 50
Run Time Bar Code:                                    Injection Number : 1
Acquired on       : 06 Mar 19  09:35 PM               Sequence Line    : 10
Report Created on: 07 Mar 19  07:32 AM                Instrument Method: DX.MTH
                                                      Analysis Method  : DX.MTH
```



Data File Name : C:\HPCHEM\4\DATA\03-06-19\053F1001.D
Operator : TL
Instrument : GC#4
Sample Name : 903013-20 sg
Run Time Bar Code:
Acquired on : 06 Mar 19 10:11 PM
Report Created on: 07 Mar 19 07:32 AM

Page Number : 1
Vial Number : 53
Injection Number : 1
Sequence Line : 10
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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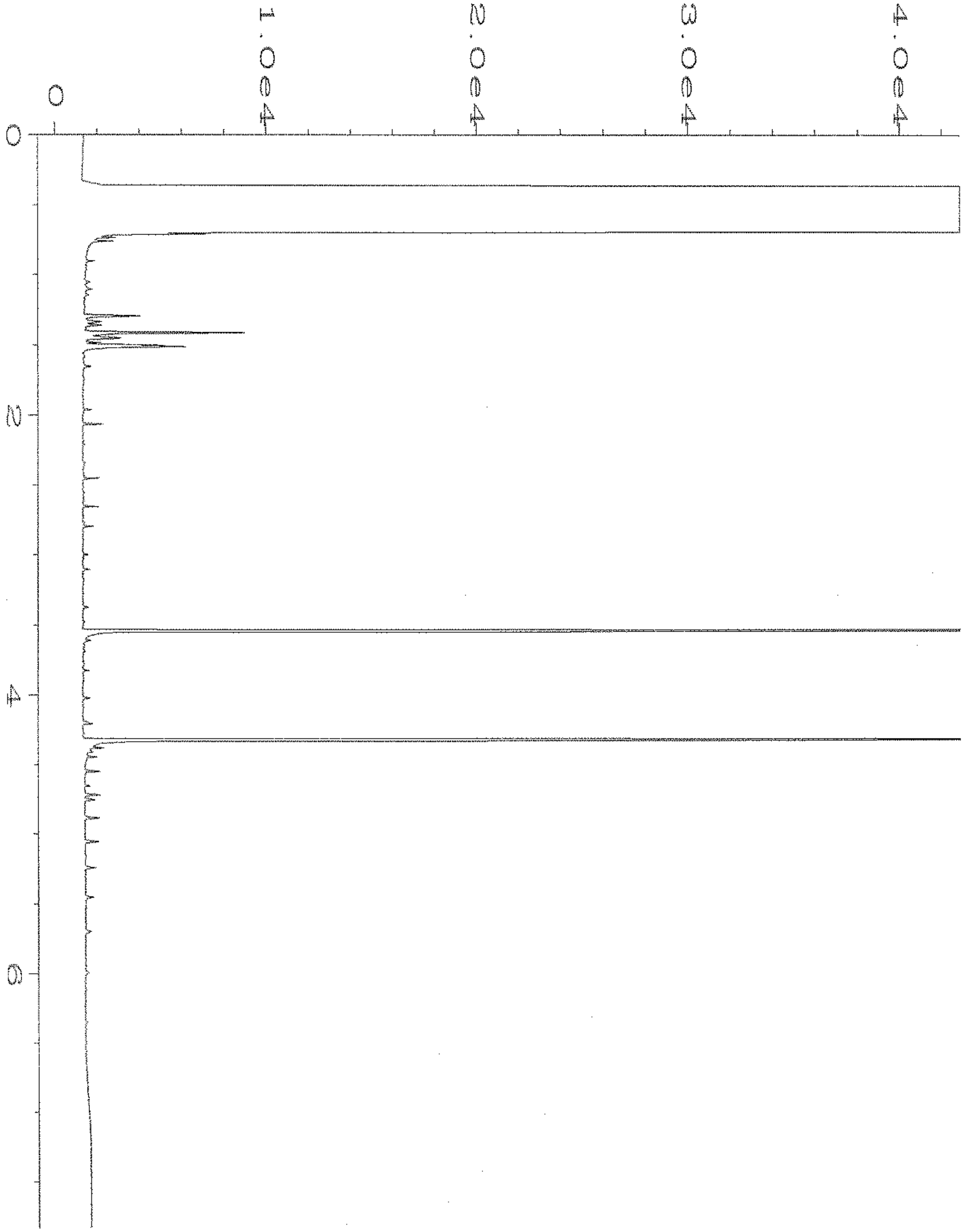
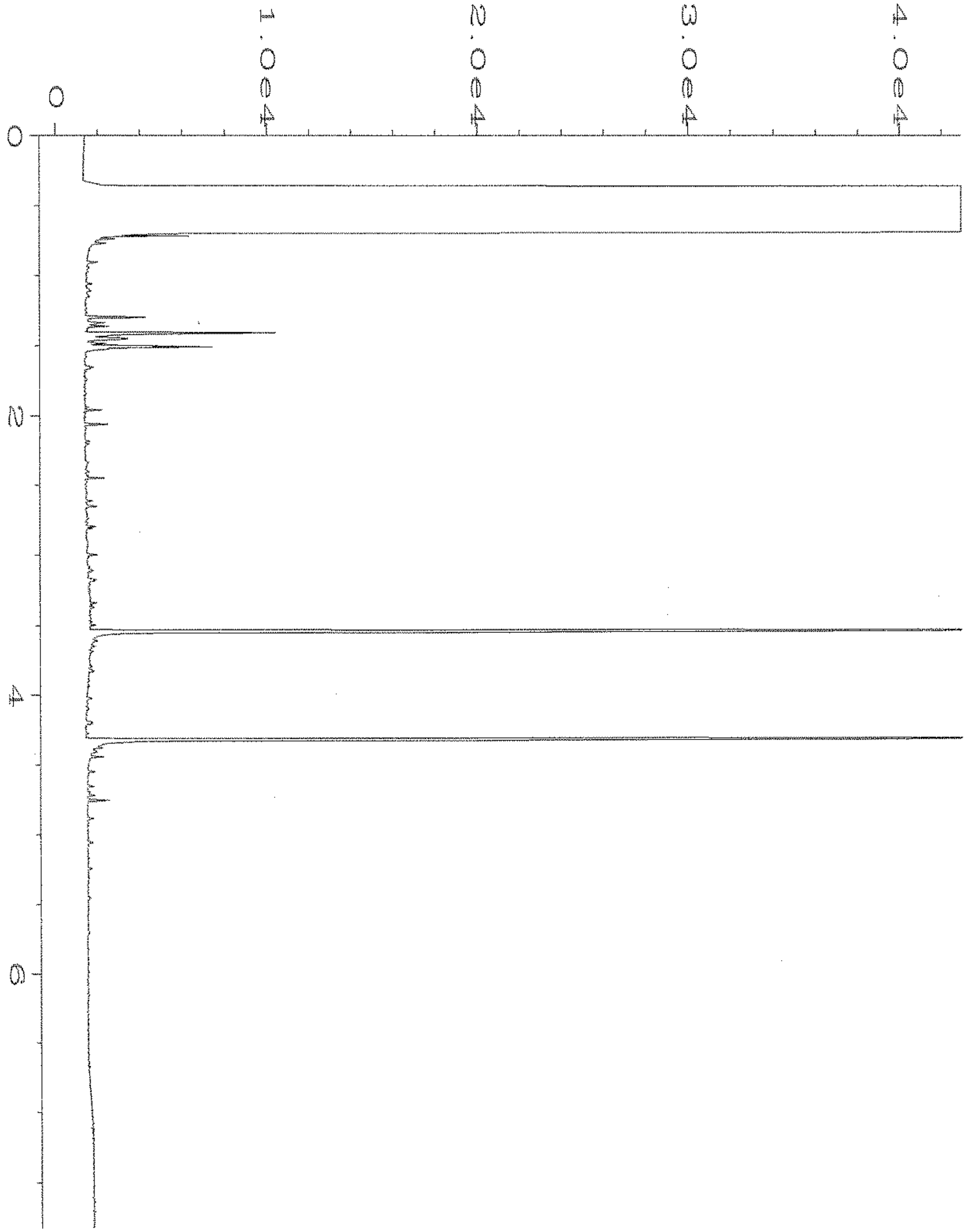
Data File Name    : C:\HPCHEM\4\DATA\03-06-19\054F1001.D
Operator          : TL                            Page Number      : 1
Instrument        : GC#4                          Vial Number      : 54
Sample Name       : 903013-21 sg                  Injection Number : 1
Run Time Bar Code:                                Sequence Line    : 10
Acquired on       : 06 Mar 19   10:23 PM          Instrument Method: DX.MTH
Report Created on: 07 Mar 19   07:32 AM           Analysis Method  : DX.MTH
```



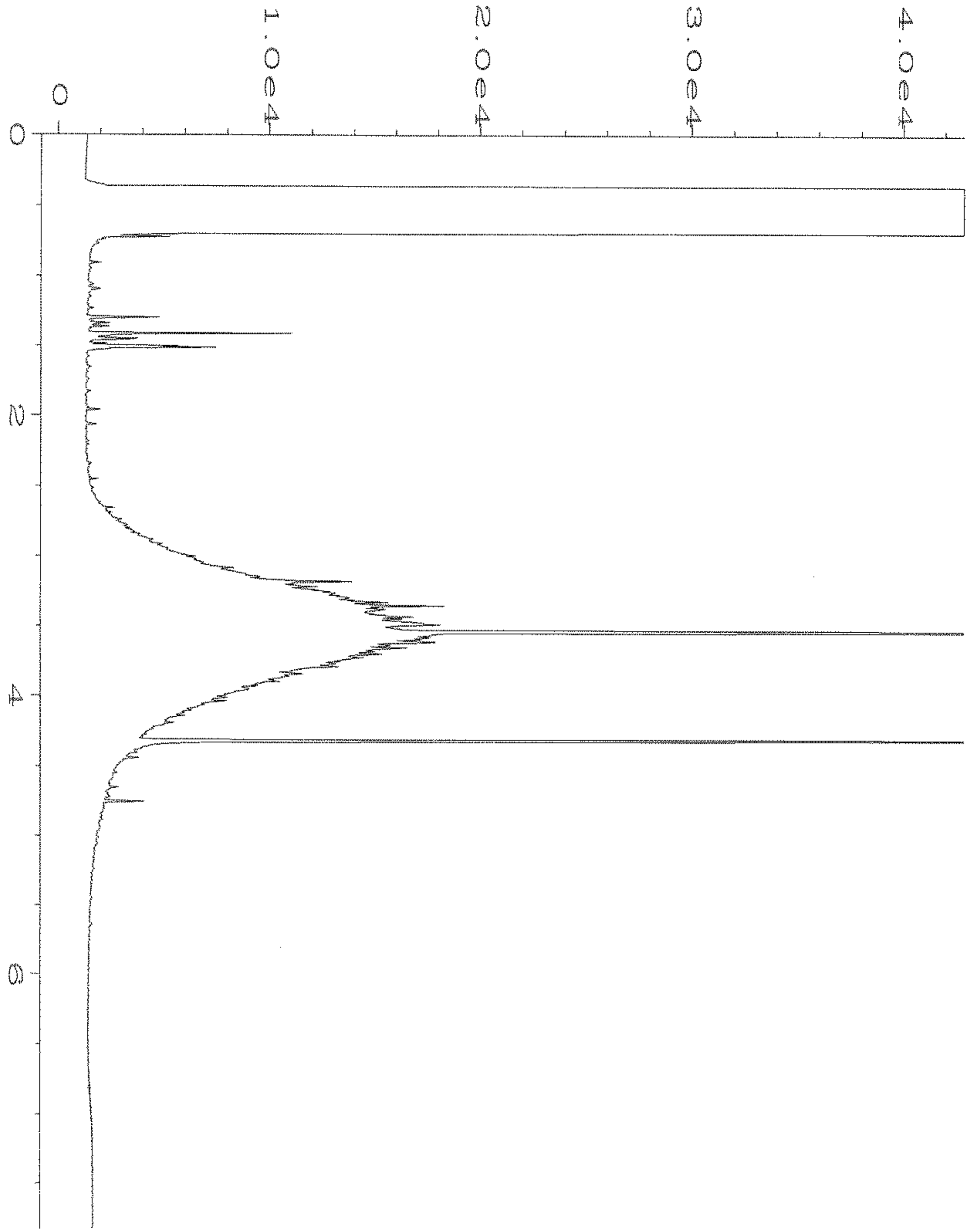
Data File Name : C:\HPCHEM\4\DATA\03-06-19\055F1001.D
Operator : TL
Instrument : GC#4
Sample Name : 903013-22 sg
Run Time Bar Code:
Acquired on : 06 Mar 19 10:35 PM
Report Created on: 07 Mar 19 07:33 AM

Page Number : 1
Vial Number : 55
Injection Number : 1
Sequence Line : 10
Instrument Method: DX.MTH
Analysis Method : DX.MTH

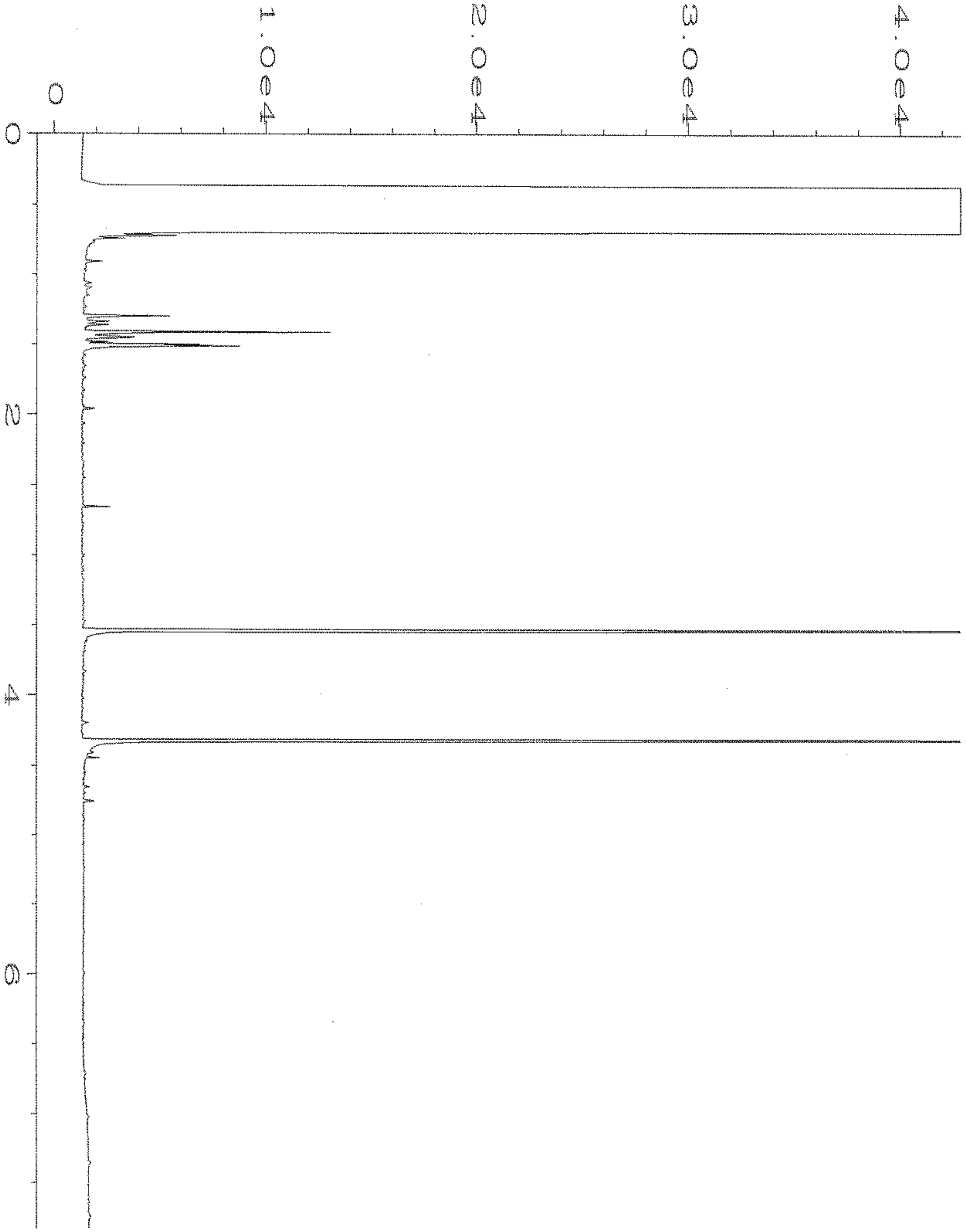


Data File Name : C:\HPCHEM\4\DATA\03-06-19\056F1201.D
Operator : TL
Instrument : GC#4
Sample Name : 903013-23 sg
Run Time Bar Code:
Acquired on : 06 Mar 19 11:10 PM
Report Created on: 07 Mar 19 07:33 AM

Page Number : 1
Vial Number : 56
Injection Number : 1
Sequence Line : 12
Instrument Method: DX.MTH
Analysis Method : DX.MTH



Data File Name   : C:\HPCHEM\4\DATA\03-06-19\057F1201.D
Operator   : TL   Page Number   : 1
Instrument   : GC#4   Vial Number   : 57
Sample Name   : 903013-24 sg   Injection Number : 1
Run Time Bar Code: Sequence Line   : 12
Acquired on   : 06 Mar 19 11:22 PM   Instrument Method: DX.MTH
Report Created on: 07 Mar 19 07:33 AM   Analysis Method : DX.MTH



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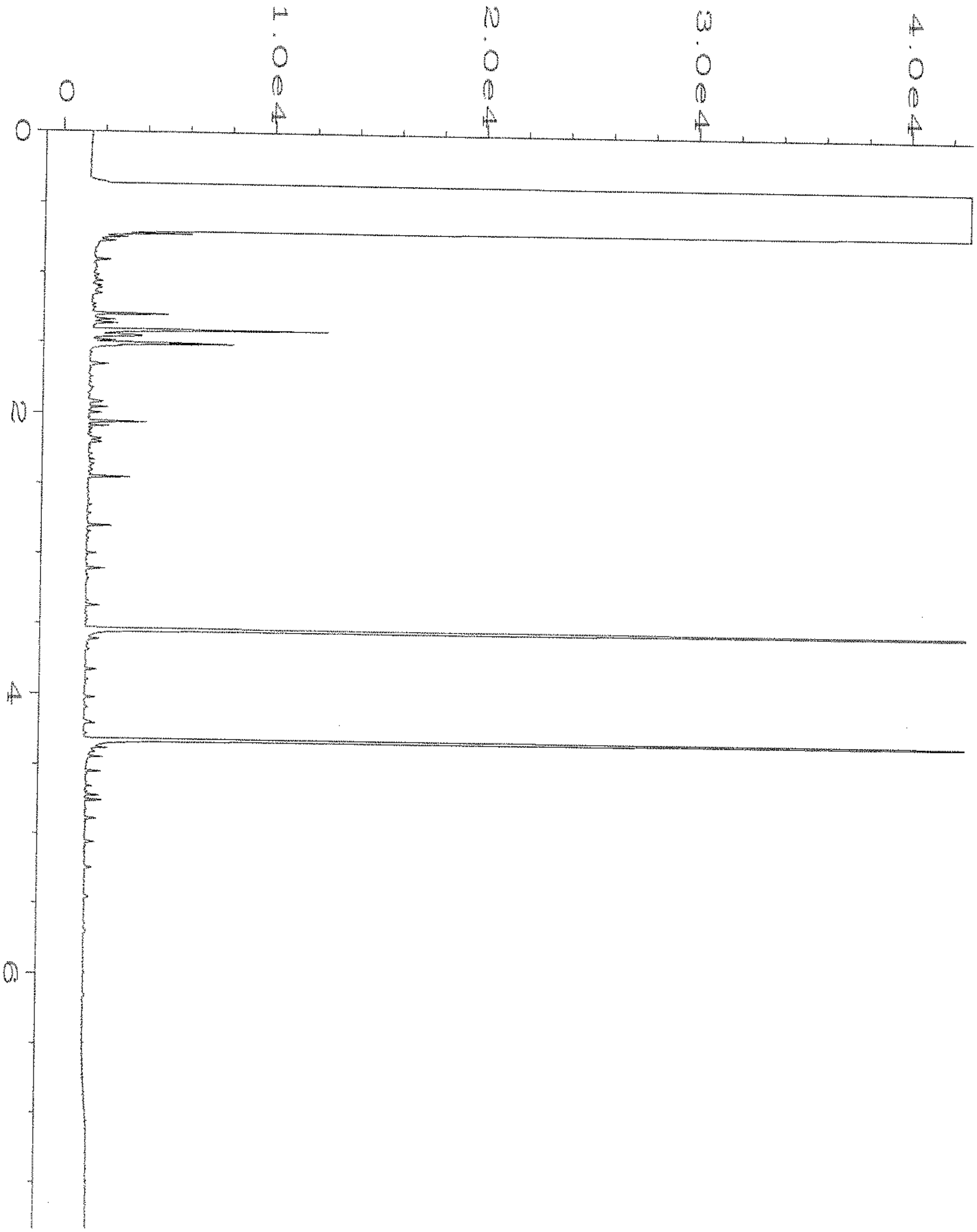
Data File Name    : C:\HPCHEM\4\DATA\03-06-19\058F1201.D
Operator          : TL                              Page Number      : 1
Instrument        : GC#4                            Vial Number      : 58
Sample Name       : 903013-25 sg                    Injection Number : 1
Run Time Bar Code:                                  Sequence Line    : 12
Acquired on       : 06 Mar 19   11:34 PM            Instrument Method: DX.MTH
Report Created on: 07 Mar 19   07:33 AM             Analysis Method  : DX.MTH
```



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Data File Name    : C:\HPCHEM\4\DATA\03-06-19\059F1201.D
Operator          : TL                          Page Number      : 1
Instrument        : GC#4                        Vial Number      : 59
Sample Name       : 903013-26 sg                Injection Number : 1
Run Time Bar Code:                              Sequence Line    : 12
Acquired on       : 06 Mar 19   11:46 PM        Instrument Method: DX.MTH
Report Created on: 07 Mar 19   07:33 AM         Analysis Method  : DX.MTH
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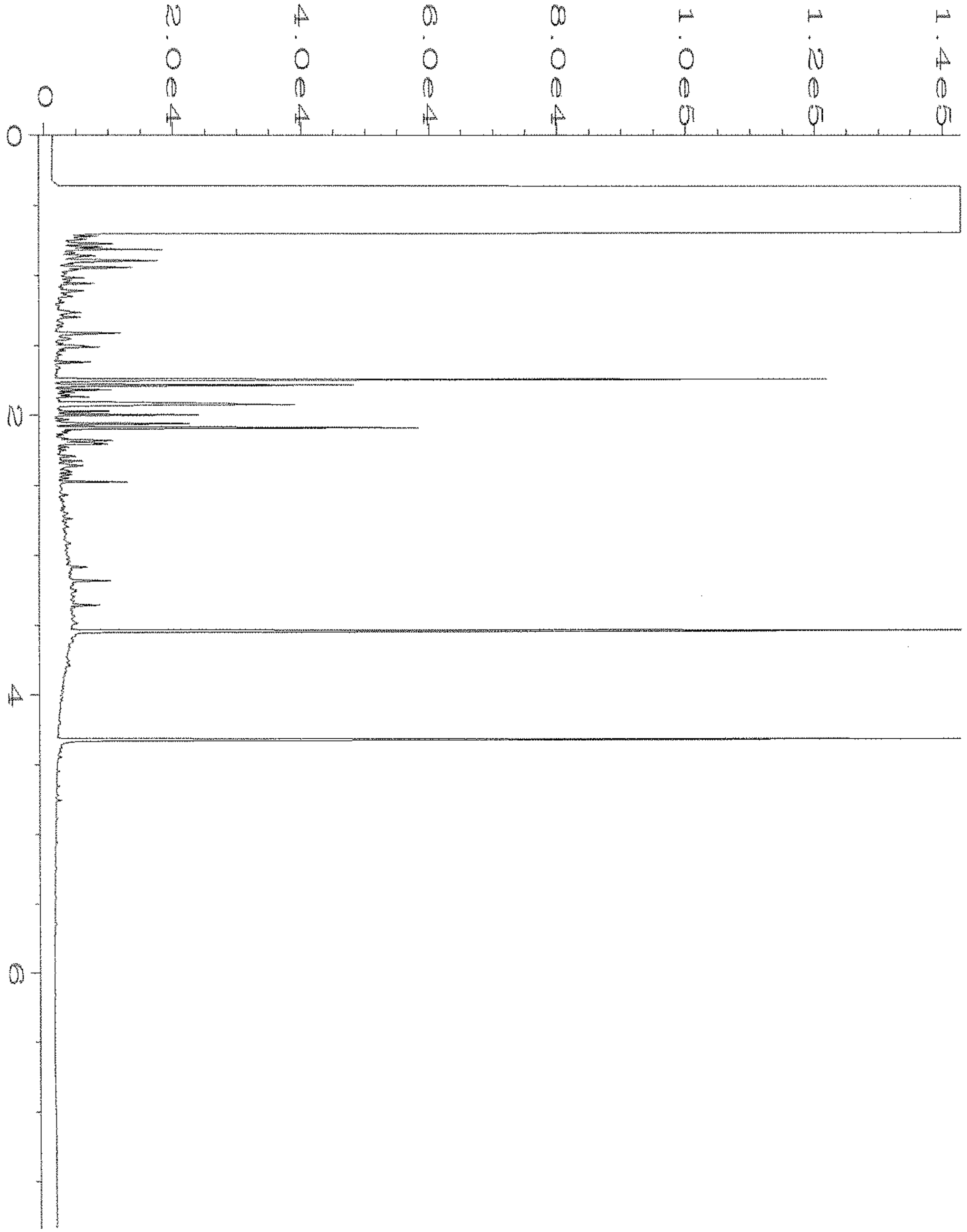
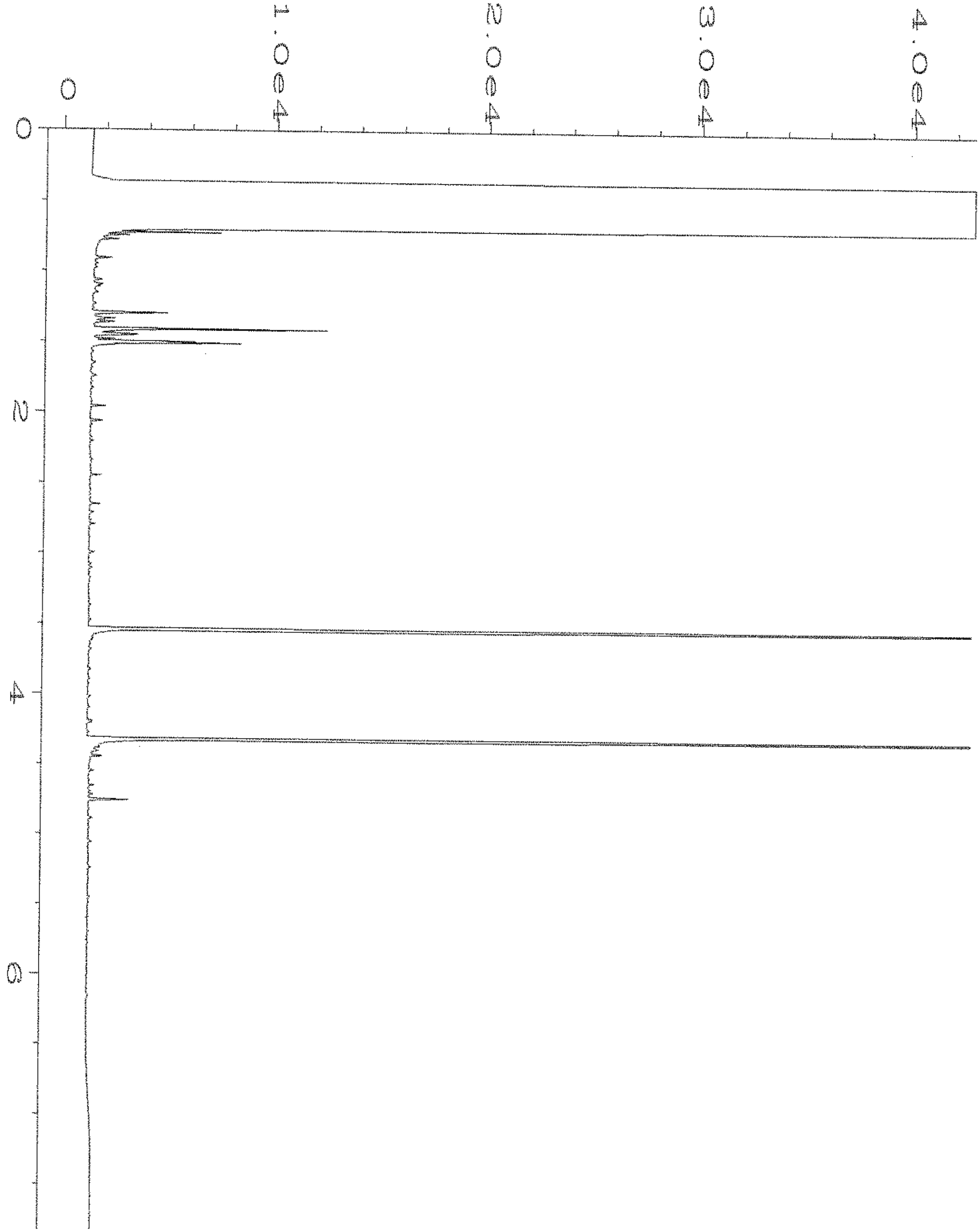


Data File Name : C:\HPCHEM\4\DATA\03-06-19\060F1201.D
Operator : TL
Instrument : GC#4
Sample Name : 903013-27 sg
Run Time Bar Code:
Acquired on : 06 Mar 19 11:58 PM
Report Created on: 07 Mar 19 07:34 AM

Page Number : 1
Vial Number : 60
Injection Number : 1
Sequence Line : 12
Instrument Method: DX.MTH
Analysis Method : DX.MTH



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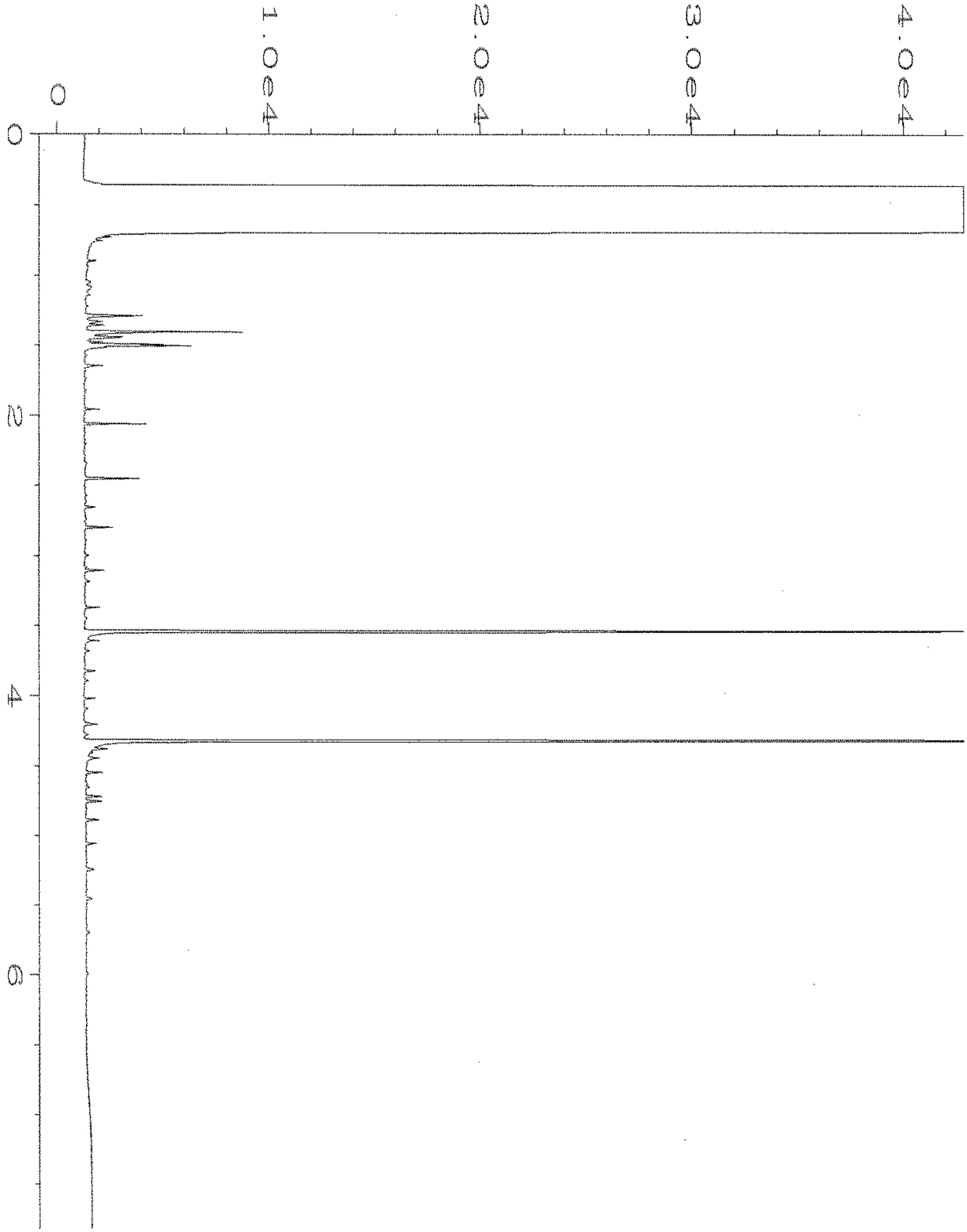
Data File Name    : C:\HPCHEM\4\DATA\03-06-19\061F1201.D
Operator          : TL                              Page Number       : 1
Instrument        : GC#4                            Vial Number       : 61
Sample Name       : 903013-28 sg                    Injection Number  : 1
Run Time Bar Code:                                  Sequence Line     : 12
Acquired on       : 07 Mar 19  00:10 AM             Instrument Method: DX.MTH
Report Created on: 07 Mar 19  07:34 AM              Analysis Method   : DX.MTH
```



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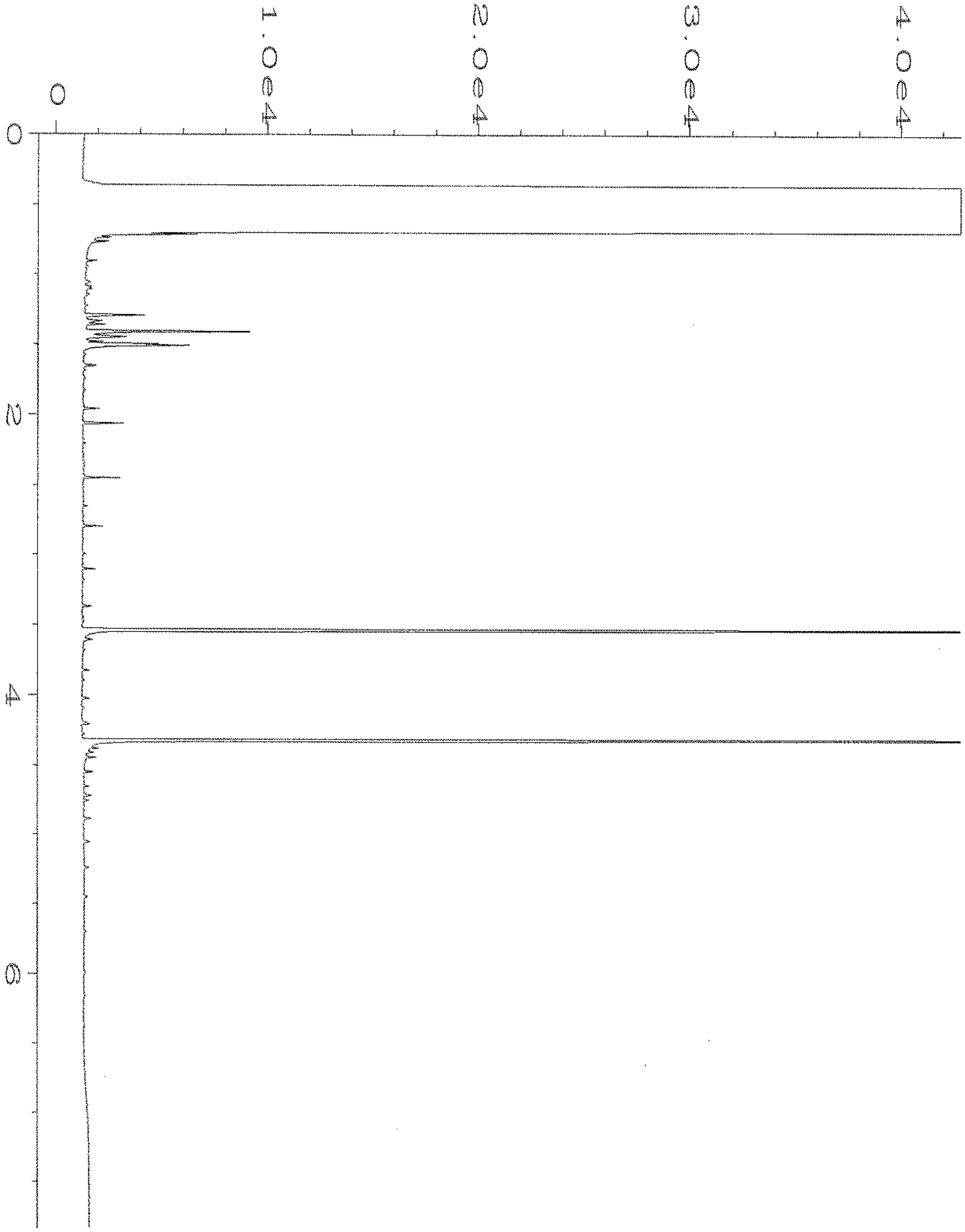
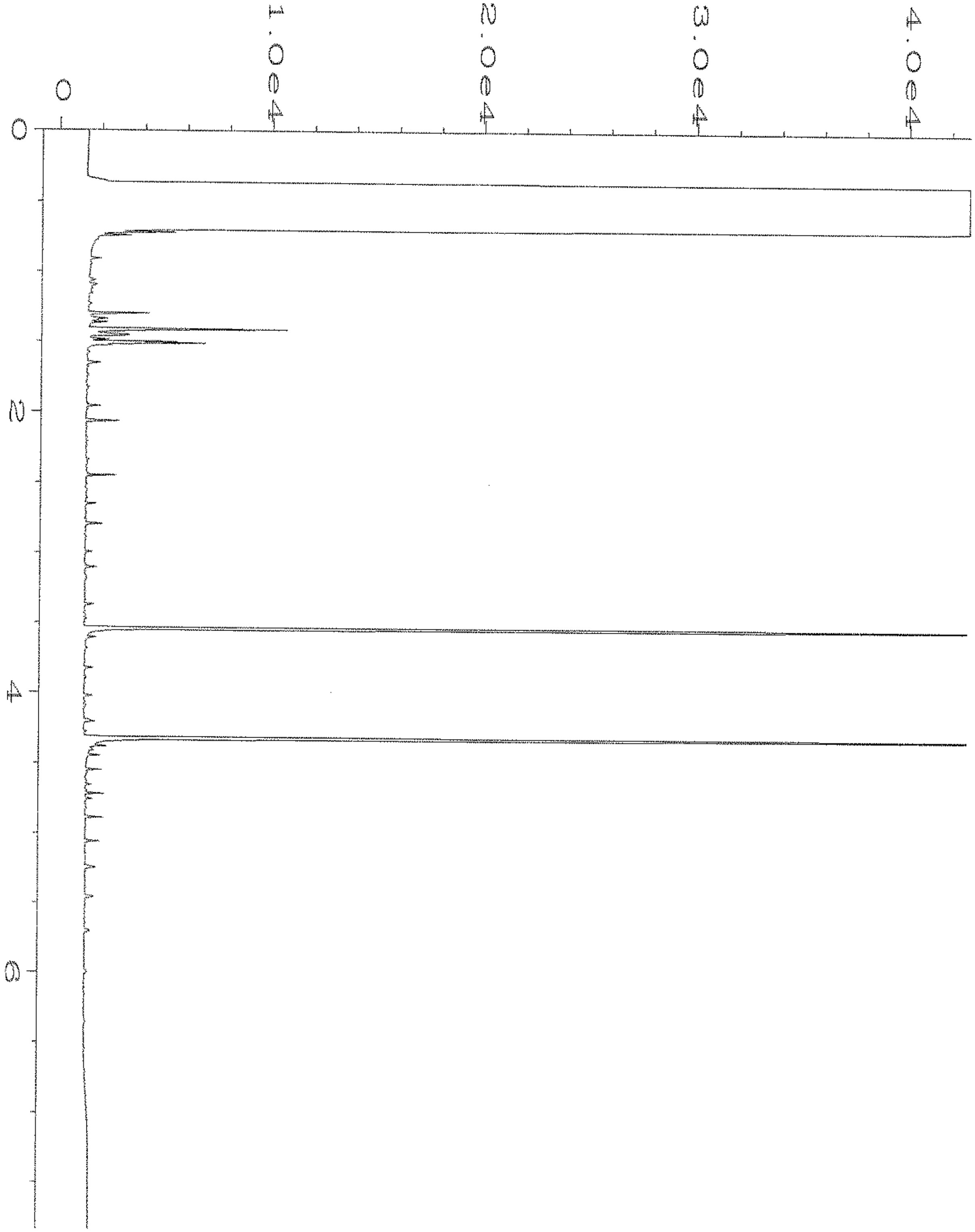
Data File Name    : C:\HPCHEM\4\DATA\03-06-19\062F1201.D
Operator          : TL                                   Page Number       : 1
Instrument        : GC#4                                 Vial Number       : 62
Sample Name       : 903013-29 sg                         Injection Number  : 1
Run Time Bar Code:                                       Sequence Line     : 12
Acquired on       : 07 Mar 19   00:22 AM                 Instrument Method: DX.MTH
Report Created on: 07 Mar 19   07:34 AM                  Analysis Method   : DX.MTH
```

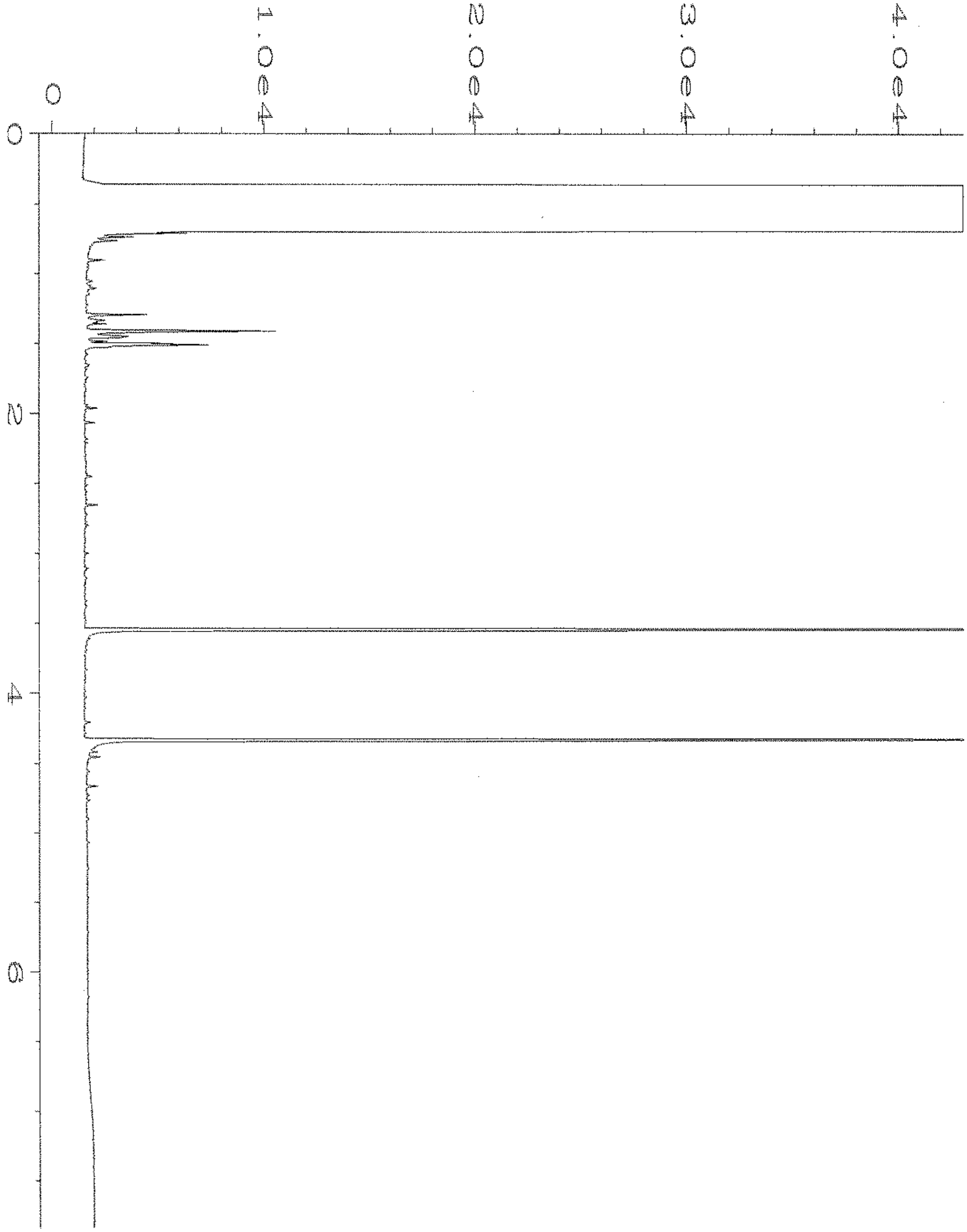


```
Data File Name    : C:\HPCHEM\4\DATA\03-06-19\063F1201.D
Operator          : TL                               Page Number       : 1
Instrument        : GC#4                             Vial Number       : 63
Sample Name       : 903013-30 sg                     Injection Number  : 1
Run Time Bar Code:                                   Sequence Line     : 12
Acquired on       : 07 Mar 19   00:34 AM             Instrument Method: DX.MTH
Report Created on: 07 Mar 19   07:34 AM              Analysis Method   : DX.MTH
```

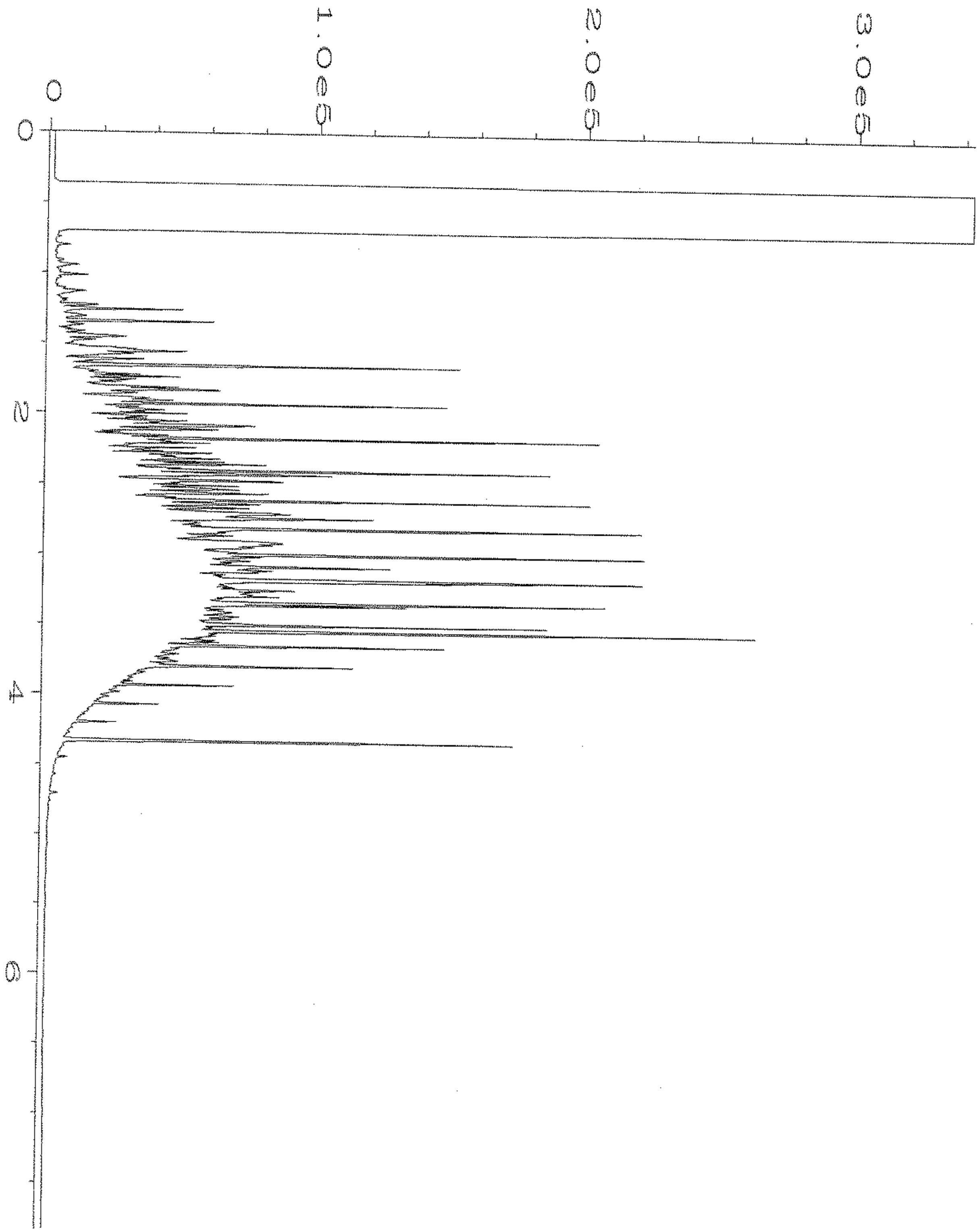


Data File Name   : C:\HPCHEM\4\DATA\03-06-19\064F1201.D
Operator   : TL
Instrument   : GC#4
Sample Name   : 903013-31 sg
Run Time Bar Code:
Acquired on   : 07 Mar 19   00:46 AM
Report Created on: 07 Mar 19   07:35 AM

Page Number   : 1
Vial Number   : 64
Injection Number : 1
Sequence Line   : 12
Instrument Method: DX.MTH
Analysis Method   : DX.MTH



```
Data File Name    : C:\HPCHEM\4\DATA\03-06-19\030F0601.D
Operator          : TL                              Page Number       : 1
Instrument        : GC#4                            Vial Number       : 30
Sample Name       : 09-459 mb sg                    Injection Number : 1
Run Time Bar Code:                                  Sequence Line     : 6
Acquired on       : 06 Mar 19   04:49 PM            Instrument Method: DX.MTH
Report Created on: 07 Mar 19   07:23 AM             Analysis Method   : DX.MTH
```



```
Data File Name    : C:\HPCHEM\4\DATA\03-06-19\005F0501.D
Operator          : TL
Instrument        : GC#4                            Page Number          : 1
Sample Name       : 1000 Dx 56-21C                  Vial Number          : 5
Run Time Bar Code:                                  Injection Number : 1
Acquired on       : 06 Mar 19   03:02 PM            Sequence Line        : 5
Report Created on: 07 Mar 19   07:28 AM             Instrument Method: DX.MTH
                                                    Analysis Method   : DX.MTH
```

903013

SAMPLE CHAIN OF CUSTODY

ME 03/01/19

VW5/E04

Page # 1 of 4

Report To Gabe Cisneros | Brett Beaulieu
Company Floyd|Snider
Address 601 Union St. Ste 600
City, State, ZIP Seattle 98101
Phone 206 292-2078 Email

SAMPLERS (*signature*)

PROJECT NAME POL-TPH

PO #

REMARKS Run Dx with & without Silica Gel

INVOICE TO

TURNAROUND TIME
☒ Standard Turnaround
☐ RUSH
Rush charges authorized by:

SAMPLE DISPOSAL
☐ Dispose after 30 days
☐ Archive Samples
☐ Other

						ANALYSES REQUESTED											
Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of Jars	TPH-HCID	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by 8260C	SVOCs by 8270D	PAHs 8270D SIM					Notes
MW-06-022719	01 A-D	2/27/19	1302	w			X	X	X								
MW-19-022719	02		1340				X	X	X								
MW-15-022719	03		1415				X	X	X								
MW-12-022719	04		1420				X	X	X								
MW-07-022719	05		1501				X	X	X								
MW-16-022719	06		1502				X	X	X								
MW-14-022719	07		1533				X	X	X								
MW-31-022719	08		1545				X	X	X								
MW-131-022119	09		1600				X	X	X								
MW-1-022719	10		1622				X	X	X								

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:	Gabriel Cisneros	Floyd/Snider	3/1/19	1315
Received by:	Matt Langstad	FBInc	3/1/19	1315
Relinquished by:				
Received by:		Samples received at 3 °C		

903013

SAMPLE CHAIN OF CUSTODY ME 03/01/19

VW5/E04

Report To Brett/Gabe
Company Floyd|Snider
Address 601 Union St. Ste 600
City, State, ZIP 98101
Phone 206 292-2078 Email

SAMPLERS (signature)

PROJECT NAME	PO #
P02-T/H	
REMARKS	**INVOICE TO**
Run with & without Silica Gel	

Page # 2 of 4

TURNAROUND TIME
☒ Standard Turnaround
☐ RUSH
Rush charges authorized by:

SAMPLE DISPOSAL
☐ Dispose after 30 days
☐ Archive Samples
☐ Other

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of Jars	TPH-HCID	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by 8260C	SVOCs by 8270D	PAHs 8270D SIM					Notes
MW-02-022719	11 A-D	2/27/19	1633	w	4	~~X~~	X	X	X								NO HCID
MW-05-022719	12		1701		4	~~X~~	X	X	X								NO HCID
MW-03 MW-~~10~~03-022719	13		1728		4	~~X~~	X	X	X								NO HCID
MW-10 MW-10~~5~~-022719	14		1733		4	~~X~~	X	X	X								NO HCID
UST-4-022~~7~~819	15	2/28	0817		4		X	X	X								
UST-104-022~~7~~819	16	2/28	0820		4		X	X	X								
MW-22-022819	17		0822		4		X	X	X								
MW-29-022819	18		0855		4		X	X	X								
MW-23-022819	19		0922		12		X	X	X								Run MS/MSD
MW-24-022819	20		0942		4		X	X	X								

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Seattle, WA 98119-2029
Ph. (206) 285-8282

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:	Gabriel Cisneros	Floyd|Snider	3/1/19	1315
Received by:	Matt Langston	FBInc	3/1/19	1315
Relinquished by:				
Received by:				

Samples received at 3 °C

903013

SAMPLE CHAIN OF CUSTODY

ME 03/01/19

vws/C04

Page # 3 of 4

Report To Gabe & Brett
Company Floyd|Snider
Address 601 Union St. Ste 600
City, State, ZIP Seattle 98101
Phone ______ Email ______

SAMPLERS (*signature*)

PROJECT NAME POL-TPH

PO #

REMARKS Run Dx with & without Silicagel cleanup

INVOICE TO

TURNAROUND TIME
☒ Standard Turnaround
☐ RUSH ______
Rush charges authorized by: ______

SAMPLE DISPOSAL
☐ Dispose after 30 days
☐ Archive Samples
☐ Other ______

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of Jars	TPH-HCID	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by 8260C	SVOCs by 8270D	PAHs 8270D SIM					Notes
MW-27-022819	21A-D	2/28/19	1015	W	4		X	X	X								
MW-13-022819	22		1100				X	X	X								
MW-26-022819	23		1029														
MW-28-022819	24		1130														
MW-11-022819	25		1145														
MW-25-022819	26		1233														
MW-20-022819	27		1245														
MW-17-022819	28		1333														
MW-18-022819	29		1344														
MW-32-022819	30 ↓	↓	1459	↓	↓		↓	↓	↓								

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:	Gabriel Cisneros	Floyd|Snider	3/1/19	1315
Received by:	Matt Langston	FBInc	3/1/19	1315
Relinquished by:				
Received by:		Samples received at	3 °C	

903013

SAMPLE CHAIN OF CUSTODY

ME 03/01/19

VW5/E0

Report To Gabe & Brett
Company Floyd|Snider
Address 601 Union St. Ste 600
City, State, ZIP Seattle ~~98125~~ 98101 SC
Phone 206 292-2078 Email

SAMPLERS (*signature*)
PROJECT NAME POL-TPH
PO #
REMARKS Run Dx with & without Silica Gel
INVOICE TO

Page # 4 of 4

TURNAROUND TIME
☐ Standard Turnaround
☐ RUSH
Rush charges authorized by:

SAMPLE DISPOSAL
☐ Dispose after 30 days
☐ Archive Samples
☐ Other

						ANALYSES REQUESTED											
Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of Jars	TPH-HCID	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by 8260C	SVOCs by 8270D	PAHs 8270D SIM					Notes
MW-04-022819	31 A-D	2/28	1518	W	4		X	X	X								
Trip Blank	32 A-D			W	4												ME 3/1

3/1/19

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:	Gabriel Cisneros	Floyd|Snider	3/1/19	1315
Received by:	Matt Langston	FBI	3/1/19	1315
Relinquished by:				
Received by:				

Samples received at 3 °C

Port of Longview TPH Site

Remedial Investigation Work Plan

Appendix E
Groundwater Field Sampling Forms

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection: 2/27/19
Project Number:
Field Personnel: P.O.

Purge Data

Well ID: MW-1
Secure: ☒ Yes ☐ No
Well Condition/Damage Description: good

Depth Sounder decontaminated Prior to Placement in Well: ☒ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 10.68'
Well Casing Type/Diameter/Screened Interval: 4" PVC / 6.3-16.3' bgs
After 5 minutes of purging (from top of casing): 10.71'
Begin purge (time): 1556
End purge (time): 1628
Gallons purged: 1.25gal
Purge water disposal method: drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments
1605	10.72'	2L	7.21	2.01	0.238	0.0	11.25	-59	
1610	10.72'	2.75L	7.39	0.58	0.230	0.0	12.11	-67	
1615	10.72'	3.5L	7.70	0.53	0.228	0.0	12.22	-74	
1620	10.72'	4.5L	7.46	0.51	0.228	0.0	12.23	-78	

Sampling Data

Sample No: MW-1-022719
Location and Depth: Shallow aquifer
Date Collected (mo/dy/yr): 2/27/19
Time Collected: 1622 ☐ AM ☒ PM
Weather: cloudy, cold
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other): Clear, no odor

Sample Analyses

TPH-D	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☒	BTEX	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
0.5L Amber	1	None	
40 mL VOA w/ HCl	3		

Signature:
Date: 2/27/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL- TPH
Date of Collection: 2/27/19
Project Number:
Field Personnel: G. Cisarro

Purge Data

Well ID: MW-2
Secure: ☐ Yes ☐ No
Well Condition/Damage Description: Stripped Bolts 4"

Depth Sounder decontaminated Prior to Placement in Well: ☐ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 8.92
Well Casing Type/Diameter/Screened Interval: 6.2 - 12.4' bgs
After 5 minutes of purging (from top of casing): 8.97
Begin purge (time): 1603
End purge (time): 1633
Liters ~~Gallons~~ purged: 4.8
Purge water disposal method: Drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged L	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments TDS g/L
1621	8.97	2.5	5.87	3.97	0.137	0.4	10.04	139	0.089
1624	8.97	3.0	5.80	3.92	0.138	0.1	10.04	144	0.089
1627	8.97	3.5	5.87	3.48	0.138	0.0	10.04	148	0.090
1630	8.97	4.0	5.84	3.37	0.138	0.0	10.02	153	0.090
1633	8.97	4.5	5.83	3.32	0.139	0.0	10.00	155	0.090

Sampling Data

Sample No: MW-02-022719
Location and Depth: vadose
Date Collected (mo/dy/yr): 2/27/19
Time Collected: 1633 ☐ AM ☒ PM
Weather:
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: Peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other): Slight yellow color; No odor

Sample Analyses

8021 SGC & w/out SGC

[✓ TPH-D]	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
[✓ TPH-G]	(HCl) ☒	[✓ BTEX]	(HCl) ☐	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
500ml Amber	1		1633
40ml Vials	3		

Signature:
Date: 2/27/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection: 2/27/19
Project Number:
Field Personnel: P.O.

Purge Data

Well ID: ~~MW-10~~ MW-3
Secure: ☒ Yes ☐ No
Well Condition/Damage Description: fine

Depth Sounder decontaminated Prior to Placement in Well: ☒ Yes ☐ No
One Casing Volume (gal): 8.4-18 4' bgs
Depth of water (from top of well casing): 13.14'
Well Casing Type/Diameter/Screened Interval: 4" / ~~18-23'~~ bgs
After 5 minutes of purging (from top of casing): 13.20'
Begin purge (time): ~~16:54~~ 1706
End purge (time): 1734
Gallons purged: 0.75 gal
Purge water disposal method: drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments
1711	13.20'	0.75L	6.60	2.40	0.445	0.0	11.17	-30	
1716	13.20'	1.5L	6.72	2.14	0.440	0.0	11.76	-47	
1721	13.22'	2.25L	6.73	1.71	0.441	0.0	12.02	-54	
1726	13.23'	3L	6.73	1.70	0.442	0.0	12.19	-59	

Sampling Data

Sample No: ~~MW-10-022719~~ MW-03
Location and Depth: Shallow aquifer MW-03
Date Collected (mo/dy/yr): 2/27/19
Time Collected: 1728 ☐ AM ☒ PM
Weather: cloudy, cold
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated **all** tubing; disposable and/or dedicated silicon and poly tubing Other:
Sample Description (Color, Turbidity, Odor, Other): Some flock - brown/black, moderate TPH odor

Sample Analyses

TPH-D	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☒	BTEX	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:
0.5 L Amber	1	None
40 mL VOA w/ HCl	3	

Comments:
Absorbent sock in well - tied up to be above water table until disposal can be arranged.
New tubing put in today.
This is Really MW-03

Signature:
Date: 2/27/19

F:\Technical\Field Prep\Field Forms\Groundwater Sample Collection Form.doc

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL- TPH
Date of Collection: 2/27/19 + 2/28/19
Project Number:
Field Personnel: P.O. /G.C.

Purge Data

Well ID: MW-4
Secure: ☒ Yes ☐ No
Well Condition/Damage Description: fine - no bolts

Depth Sounder decontaminated Prior to Placement in Well: ☒ Yes ☐ No
One Casing Volume (gal): 2.1 gal = 8 L
Depth of water (from top of well casing): 14.26'
Well Casing Type/Diameter/Screened Interval: 4" PVC/7.4-17.4' bgs
After 5 minutes of purging (from top of casing): 14.56'
Begin purge (time): 0938
End purge (time): 1010
Gallons purged: 1 gal
Purge water disposal method: drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ½"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

2/27

Time	Depth to Water	Vol. Purged	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments
0948	14.96'	2L	9.65	1.80	0.313	117	13.32	188	
0953	15.38'	3L	9.01	1.76	0.317	91.4	12.66	212	
0958	15.59'	3.5L	8.74	1.89	0.311	103	11.83	222	
1003	15.89'	4.25L	8.59	1.95	0.315	94.4	11.52	230	
1010	16.18'	— dry	— turned off		pump -				
1020	16.17'	well	not productive		- no sample collected				

Sampling Data

NO SAMPLE COLLECTED on 2/27: Collected NO Purge Sample on 2/28

Sample No: ~~MW-4-022719~~ MW-04-022819
Location and Depth:
Date Collected (mo/dy/yr): 2/28/19
Time Collected: 1518 ~~AM~~ ☒ PM
Weather: snowing
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other: No parameters collected on 2/28
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other):

Sample Analyses

TPH-D w/ + w/out silica gel	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☒	BTEX	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:
0.5 L Amber	1
40 mL VOA w/ HCl	3

Duplicate Sample Numbers: None

Comments:

Total depth = 17.45'

Purge water is orange/brown and cloudy

Drawdown indicates no productivity

No water level or WQ Parameters collected on 2/28.

Signature: Dul Ostriht
Date: 2/27/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection: 2/27/19
Project Number:
Field Personnel: G. Cisneros

Purge Data

Well ID: MW-5
Secure: ☒ Yes ☐ No
Well Condition/Damage Description: Bolts stripped

Depth Sounder decontaminated Prior to Placement in Well: ☒ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 14.95
Well Casing Type/Diameter/Screened Interval: 12.5-22.5' bgs
After 5 minutes of purging (from top of casing): 15.22
Begin purge (time): 1635
End purge (time): 1700
Liters ~~Gallons~~ purged:
Purge water disposal method: Drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	mg/L DO	mS/cm Conductivity	NTU Turbidity	°C Temp	mV ORP	g/L TDS Comments
1648	15.61	0.9L	5.51	0.00	0.157	21.7	9.21	179	0.102
1651	15.65	1.1	5.43	0.00	0.157	15.1	9.19	187	0.102
1654	15.53	1.3	5.48	0.00	0.158	5.9	9.15	189	0.103
1657	15.50	1.7	5.41	0.00	0.159	2.4	9.06	195	0.104
1700	15.49	2.0	5.41	0.00	0.160	2.0	9.02	196	0.104

Sampling Data

Sample No: MW-05-022719
Location and Depth: Shallow aquifer
Date Collected (mo/dy/yr): 2/27
Time Collected: 1701 ☐ AM ☐ PM
Weather: Cloudy 35°
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☐ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: Peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☐ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or dedicated silicon and poly tubing Other:
Sample Description (Color, Turbidity, Odor, Other): Orange tint NO odor

Sample Analyses

[✓ TPH-D]	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐		
[✓ TPH-G]	(HCl) ☒	[✓ BTEX]	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐		

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
500ml Amber	1		Bottom/Total Depth = 16.50
40ml Vials	3		1701 collect

Signature:
Date: 2/27/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: PDL-TPH
Date of Collection: 2/27/2019
Project Number:
Field Personnel: P.O.

Purge Data

Well ID: MW-6
Secure: ☒ Yes ☐ No
Well Condition/Damage Description: Fine. Well box missing bolts

Depth Sounder decontaminated Prior to Placement in Well: ☒ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 10.21'
Well Casing Type/Diameter/Screened Interval: 4" PVC/16-21' bgs
After 5 minutes of purging (from top of casing): 10.21'
Begin purge (time): 12:40
End purge (time): 13:06
Gallons purged: 1 gal
Purge water disposal method: drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments
12:45	10.21'	1L	7.78	3.57	0.322	16.2	10.83	-67	
12:50	10.21'	2L	7.33	3.27	0.315	6.0	11.73	-77	
12:55	10.21'	3L	7.18	3.30	0.313	3.4	11.90	-85	
13:00	" "	3.75L	7.11	3.56	0.314	0.0	11.93	-89	

Sampling Data

Sample No: MW-6-022719
Location and Depth: Shallow aquifer
Date Collected (mo/dy/yr): 2/27/19
Time Collected: 1302 ☐ AM ☒ PM
Weather: overcast, cold
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other): Clear, mild petroleum odor

Sample Analyses

TPH-D	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☒	BTEX	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
0.5L Amber	1	None	Total depth = 20.70'
40 mL VOA w/ HCl	3		

Signature:
Date: 2/27/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection: 2/27/19
Project Number:
Field Personnel: G Cisneros

Purge Data

Well ID: MW-7
Secure: ☒ Yes ☐ No
Well Condition/Damage Description: 4" PVC Bent casing @ top

Depth Sounder decontaminated Prior to Placement in Well: ☒ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 14.44
Well Casing Type/Diameter/Screened Interval: 18-23' bgs
After 5 minutes of purging (from top of casing): 14.45

1603

Begin purge (time): 1430
End purge (time): 1458
~~Gallons~~ Liters purged: 3.3 Liters
Purge water disposal method: Drum

3L

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged Liters	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments g/L TDS
1448	14.45	2.0	5.71	0.00	0.560	0.0	10.85	-4	0.359
1451	14.45	2.2	5.69	0.00	0.561	0.0	10.81	-3	0.359
1454	14.45	2.6	5.68	0.00	0.562	0.0	10.73	-4	0.359
1457	14.45	3.0	5.69	0.00	0.561	0.00	10.73	-3	0.359

Sampling Data

Sample No: MW-07-022719
Location and Depth: Shallow aquifer
Date Collected (mo/dy/yr): 2/27/19
Time Collected: 1501 ☐ AM ☐ PM
Weather: Cloudy 40°
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☒ Bailer [✓ ☒ Pump] Other:
Type: Peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; [✓ disposable and/or dedicated silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other): Clear No Odor

Sample Analyses

w/ & w/out SGC

TPH-D	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☒	BTEX 8021	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
500ml Ambers	1		Sock in well
40ml Vials	3		Left Raised so not IN water.

Signature:
Date: 2/27/18

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL- TPH
Date of Collection: 2/28/19
Project Number:
Field Personnel: G.C

Purge Data

Well ID: MW - 8
Secure: ☒ Yes ☐ No
Well Condition/Damage Description: Bolts stripped Cannot open well

Depth Sounder decontaminated Prior to Placement in Well: ☐ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing):
Well Casing Type/Diameter/Screened Interval: 18'- 23' bgs
After 5 minutes of purging (from top of casing):
Begin purge (time):
End purge (time):
Gallons purged:
Purge water disposal method:

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments

Sampling Data None collected

Sample No:
Location and Depth: Shallow aquifer
Date Collected (mo/dy/yr):
Time Collected: ☐ AM ☐ PM
Weather:
Type: ☐ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☐ Unfiltered Other:
Sample Collected with: ☐ Bailer ☐ Pump Other:
Type:
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☐ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or dedicated silicon and poly tubing Other:
Sample Description (Color, Turbidity, Odor, Other):

Sample Analyses

TPH-D	(HCl) ☐	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☐	BTEX	(HCl) ☐	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:

Signature:
Date:

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL- TPH
Date of Collection: 2/27/19
Project Number:
Field Personnel: G. CISNEROS

Purge Data

Well ID: ~~MW-9~~ MW-10 Secure: ☒ Yes ☐ No
Well Condition/Damage Description: Stripped bolts

Depth Sounder decontaminated Prior to Placement in Well: ☐ Yes ☐ No
One Casing Volume (gal): 4"
Depth of water (from top of well casing): 15.11
Well Casing Type/Diameter/Screened Interval: 18-23' bgs ~~8-18' bgs~~
After 5 minutes of purging (from top of casing): 15.25
Begin purge (time): 1510
End purge (time): 1733
Liters ~~Gallons~~ purged:
Purge water disposal method:

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	mS/cm Conductivity	NTU Turbidity	°C Temp	mV ORP	TDS g/L Comments
1720	15.28	0.8	5.68	10.91	0.023	0.0	9.68	210	0.015
1723	15.28	1.5	5.50	9.77	0.023	0.0	9.81	217	0.015
1726	15.28	2.1	5.46	9.64	0.023	0.0	9.80	219	0.015
1729	15.28	2.6	5.32	9.13	0.025	0.0	9.83	227	0.016
1732	15.28	3.1	5.26	9.00	0.027	0.00	9.85	228	0.018

Sampling Data

Sample No: MW-10-022719
Location and Depth: ~~Shallow aquifer~~ vadose MW-10
Date Collected (mo/dy/yr): 2/27/19
Time Collected: 1733 ☐ AM ☒ PM
Weather:
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: Peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other): Slight orange tint

Sample Analyses

TPH-D (HCl) ☒
TPH-G (HCl) ☒
Chlor / Fluor (unpres) ☐
BTEX (HCl) ☒
COD / TOC (H2SO4) ☐
Total Metals (HNO3) ☐
Orthophos (FILTER) ☐
TKN/Phos (N2SO4) ☐
Diss. Metals (HNO3) ☐
VOCs (HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:
500ml Ambers	1
40ml Vials	3

Duplicate Sample Numbers:

Comments: ~~MW~~ Originally mistaken MW-10 for MW-9

This is for MW-10

Signature:

Date: 2/27/19

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GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection: 2/28/18
Project Number:
Field Personnel: G. Cisneros

Purge Data

Well ID: MW-11
Secure: ☐ Yes ☐ No
Well Condition/Damage Description:

Depth Sounder decontaminated Prior to Placement in Well: ☐ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 7.26
Well Casing Type/Diameter/Screened Interval: 6.7 - 16.7' bgs
After 5 minutes of purging (from top of casing): 7.32
Begin purge (time): 1106
End purge (time):
Liters ~~Gallons~~ purged:
Purge water disposal method:

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	mS/cm Conductivity	NTU Turbidity	°C Temp	mV ORP	TDS g/L Comments
1135	7.35	3.5	6.08	1.07	0.553	0.0	10.46	62	0.353
1138	7.34	4.0	5.95	0.00	0.546	0.0	10.23	87	0.350
1141	7.34	3.3	5.89	0.00	0.545	0.0	10.14	101	0.349
1144	7.34	3.8	5.87	0.00	0.547	0.0	10.06	109	0.350

Sampling Data

Sample No: MW-11-022819
Location and Depth: Vadose - Perched
Date Collected (mo/dy/yr): 2/28/19
Time Collected: 1145 ☒ AM ☐ PM
Weather: Sunny
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: Peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other): orange tint; No odor

Sample Analyses

[✓ TPH-D]	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
[✓ TPH-G]	(HCl) ☒	[✓ BTEX]	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
500ml Amber	1		
40ml Vials	3		

Signature:
Date:

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH

Date of Collection: 2/27/19

Project Number:

Field Personnel: P.O.

Purge Data

Well ID: MW-12

Secure: ☒ Yes ☐ No

Well Condition/Damage Description: fine

Depth Sounder decontaminated Prior to Placement in Well: ☒ Yes ☐ No

One Casing Volume (gal):

Depth of water (from top of well casing): 13.34'

Well Casing Type/Diameter/Screened Interval: 4" PVC/22-27' bgs

After 5 minutes of purging (from top of casing): 13.33'

Begin purge (time): 1358

End purge (time): 1424

Gallons purged: 1gal

Purge water disposal method: drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments
1403	13.33'	1L	6.85	0.94	0.347	1.4	11.20	9	
1408	13.33'	2L	6.95	0.66	0.348	0.1	11.33	-1	
1413	13.33'	3L	6.99	0.57	0.347	0.0	11.53	-14	
1418	13.34'	4L	6.97	0.51	0.347	0.0	11.71	-27	

Sampling Data

Sample No: MW-12-022719

Location and Depth: shallow aquifer

Date Collected (mo/dy/yr): 2/27/19

Time Collected: 1420 ☐ AM ☒ PM

Weather: overcast, cold

Type: ☒ Ground Water ☐ Surface Water Other:

Sample: ☐ Filtered ☒ Unfiltered Other:

Sample Collected with: ☐ Bailer ☒ Pump Other:

Type: peristaltic

Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:

Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:

Sample Description (Color, Turbidity, Odor, Other): Clear w/ slight coppery coloring, v. slight TPH odor, mild effervescence.

Sample Analyses

TPH-D	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☒	BTEX	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
0.5L Amber	1	None	
40 mL VOA w/ HCl	3		

Signature:

Date: 2/27/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection: 2/28/19
Project Number:
Field Personnel: G. Cisneros

Purge Data

Well ID: MW-13
Secure: ☒ Yes ☐ No
Well Condition/Damage Description: Good

Depth Sounder decontaminated Prior to Placement in Well: ☒ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 10.85
Well Casing Type/Diameter/Screened Interval: 2" 13-18' bgs
After 5 minutes of purging (from top of casing): 11.55
Begin purge (time): 1020
End purge (time): 1100
Liters ~~Gallons~~ purged: 4.5
Purge water disposal method: Drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ½"	1.660"	1.380"	0.08	0.64
[✓ 2"]	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged lit.	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments TDS g/L
1047	11.41	3.0	5.79	0.00	0.698	6.4	10.81	-28	0.447
1050	11.30	3.5	5.86	0.00	0.696	5.2	10.72	-33	0.445
1053	1126	3.8	5.92	0.00	0.698	3.7	10.74	-37	0.446
1056	11.14	4.0	5.95	0.00	0.699	2.9	10.49	-40	0.442
1057	11.13	4.4	5.96	0.00	0.700	2.2	10.50	-42	0.448

Sampling Data

Sample No: MW-13-022819
Location and Depth: vadose
Date Collected (mo/dy/yr): 2/28
Time Collected: 1100 ☒ AM ☐ PM
Weather: Sunny 38°
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: Peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other): Brownish color to rusty, No odor

Sample Analyses

[✓ TPH-D]	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
[✓ TPH-G]	(HCl) ☒	[✓ BTEX]	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
500ml Amber	1		
40ml Vials	3		

Signature:
Date: 2/28/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH

Date of Collection: 2/27/19

Project Number:

Field Personnel: P.O.

Purge Data

Well ID: MW-14

Secure: ☒ Yes ☐ No

Well Condition/Damage Description: fine

Depth Sounder decontaminated Prior to Placement in Well: ☐ Yes ☐ No

One Casing Volume (gal):

Depth of water (from top of well casing): 5.78'

Well Casing Type/Diameter/Screened Interval: 4" PVC/7-12' bgs

After 5 minutes of purging (from top of casing): 5.93'

Begin purge (time): 15:10

End purge (time): 1536

Gallons purged: 0.8 gal

Purge water disposal method: drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments
15:15	5.93'	1L	7.01	1.20	0.450	0.0	10.39	80	
15:20	5.98'	2L	6.90	0.92	0.450	0.0	10.39	82	
15:25	6.00'	2.75L	6.87	0.88	0.451	0.0	10.37	80	
15:30	6.00'	3.5L	6.86	0.87	0.451	0.0	10.27	80	

Sampling Data

Sample No: MW-14-022719

Location and Depth: Vadose

Date Collected (mo/dy/yr): 2/27/19

Time Collected: 1533 ☐ AM ☒ PM

Weather: Cloudy, cold

Type: ☒ Ground Water ☐ Surface Water Other:

Sample: ☐ Filtered ☒ Unfiltered Other:

Sample Collected with: ☐ Bailer ☒ Pump Other:

Type: peristaltic

Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:

Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:

Sample Description (Color, Turbidity, Odor, Other): clear, no odor

Sample Analyses

TPH-D	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☒	BTEX	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
0.5 L Amber	1	None	
40 mL VOA w/ HCl	3		

Signature:

Date: 2/27/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection: 2/27/19
Project Number:
Field Personnel: G. Cisneros

Purge Data

Well ID: MW-15
Secure: ☐ Yes ☐ No
Well Condition/Damage Description: Good

4"

Depth Sounder decontaminated Prior to Placement in Well: ☐ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 13.82
Well Casing Type/Diameter/Screened Interval: 85-18.5' bgs
After 5 minutes of purging (from top of casing): 13.82
Begin purge (time): 1330
End purge (time): 1414
Liters ~~Gallons purged~~: 6.2 Liters
Purge water disposal method: Drums

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	mS/cm Conductivity	NTU Turbidity	°C Temp	mV ORP	TDS g/L Comments
1402	13.83	4	5.13	0.00	0.730	2.4	11.93	73	0.466
1405	13.83	4.5	5.19	0.00	0.720	2.3	12.02	62	0.461
1408	13.85	5.1	5.22	0.00	0.717	2.0	12.01	55	0.459
1411	13.87	5.5	5.26	0.00	0.715	2.0	12.05	53	0.458
1414	13.87	6.0	5.27	0.00	0.713	1.9	12.08	49	0.456

Sampling Data

Sample No: MW-15-022719
Location and Depth: Shallow aquifer
Date Collected (mo/dy/yr): 2/27/19
Time Collected: 1415 ☐ AM ☐ PM
Weather: Cloudy 40°
Type: ☑ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☑ Unfiltered Other:
Sample Collected with: ☐ Bailer ☑ Pump Other:
Type: Peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☐ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon] and poly tubing Other:
Sample Description (Color, Turbidity, Odor, Other): Slight orange tint ~~no color~~ No odor

Sample Analyses

w/ & without SGC

TPH-D	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☒	BTEX	(HCl) ☐	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
500ml Amber	1		
40ml Voas	3		

Signature:
Date: 2/27/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection: 2/27/19
Project Number:
Field Personnel: P.O.

Purge Data

Well ID: MW-16
Secure: ☐ Yes ☒ No
Well Condition/Damage Description: Bad - Needs to be replaced. Well box has dropped 0.4' so PVC sticking up + well cap does not seal

Depth Sounder decontaminated Prior to Placement in Well: ☒ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 6.67'
Well Casing Type/Diameter/Screened Interval: 4" PVC / 4.5 - 14.5' bgs
After 5 minutes of purging (from top of casing): 6.81'
Begin purge (time): 1434
End purge (time): 1506
Gallons purged: 1.25 gal
Purge water disposal method: drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments
1441	6.91'	1L	7.06	3.60	0.348	0.0	11.27	-27	
1446	7.00'	2L	6.82	2.43	0.346	0.0	11.35	+4	
1451	7.12'	3L	6.82	2.62	0.346	0.0	11.33	30	
1456	7.21'	4L	6.84	3.12	0.346	0.0	11.27	47	
1501	7.29'	5L	6.85	3.55	0.346	0.0	11.22	59	

Sampling Data

Sample No: MW-16-022719
Location and Depth: Vadose / perched aquifer?
Date Collected (mo/dy/yr): 2/27/19
Time Collected: 1502 ☐ AM ☒ PM
Weather: overcast, cold
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other): Clear w/ some coppery flock, no odor

Sample Analyses

TPH-D	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☒	BTEX	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
0.5L Amber	1	None	
40 mL VOA w/ HCl			

Signature:
Date: 2/27/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection: 2/28/2019
Project Number:
Field Personnel: P.O.

Purge Data

Well ID: MW-17
Secure: ☒ Yes ☐ No
Well Condition/Damage Description: fine

Depth Sounder decontaminated Prior to Placement in Well: ☒ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 7.80'
Well Casing Type/Diameter/Screened Interval: 4" / 7.5-17.5' bgs
After 5 minutes of purging (from top of casing): 7.95'
Begin purge (time): 13:05
End purge (time):
Gallons purged: 1 gal
Purge water disposal method: drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments
13:15	8.02'	2 L	7.47	6.80	0.340	0.0	11.82	-47	
13:20	8.04'	2.75 L	7.19	5.87	0.339	0.0	11.82	-30	
13:25	8.05'	3.5 L	7.24	5.73	0.339	0.0	11.79	-15	
13:30	8.06'	4.25 L	7.22	5.63	0.339	0.0	11.79	-5	

Sampling Data

Sample No: MW-17-022819
Location and Depth: vadose
Date Collected (mo/dy/yr): 2/28/19
Time Collected: 13:33 ☐ AM ☒ PM
Weather: overcast
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other): Clear, no odor

Sample Analyses

TPH-D	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☒	BTEX	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
0.5 L Amber	1	None	
40 mL VOA w/ HCl	3		

Signature:
Date: 2/28/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection:
Project Number:
Field Personnel: G. Cisneros

Purge Data

Well ID: MW-18
Secure: ☐ Yes ☐ No
Well Condition/Damage Description: Good

Depth Sounder decontaminated Prior to Placement in Well: ☐ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 11.10
Well Casing Type/Diameter/Screened Interval: 8-18' bgs
After 5 minutes of purging (from top of casing): 11.13
Begin purge (time): 1301
End purge (time): 1342
Liters ~~Gallons~~ purged: 3.2
Purge water disposal method: Drums

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Liters Vol. Purged	pH	mg/L DO	mS/cm Conductivity	NTU Turbidity	°C Temp	mV ORP	TDS g/L Comments
1329 ~~11.21~~	11.21	1.5	5.87	3.16	0.182	3.8	9.54	72	0.119
1332	11.25	1.8	5.86	0.98	0.180	1.8	9.57	81	0.117
1335	11.26	2.3	5.87	0.50	0.180	0.6	9.65	94	0.117
1338	11.27	2.8	5.93	0.00	0.180	0.5	9.67	97	0.180
1341	11.28	3.0	5.93	0.00	0.180	0.6	9.70	104	0.117

Sampling Data

Sample No: MW-18-022819
Location and Depth: vadose
Date Collected (mo/dy/yr): 2/28
Time Collected: 1344 ☐ AM ☐ PM
Weather: Sunny
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: Peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; [✓ disposable and/or dedicated silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other): Orange tint, no odor

Sample Analyses

TPH-D	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☒	BTEX	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
500ml Ambers	1		
40ml Vials	3		

Signature:
Date:

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH

Date of Collection: 2/27/2019

Project Number:

Field Personnel: P.O.

Purge Data

Well ID: MW-19

Secure: ☒ Yes ☐ No

Well Condition/Damage Description: good

Depth Sounder decontaminated Prior to Placement in Well: ☐ Yes ☐ No

One Casing Volume (gal):

Depth of water (from top of well casing): 12.93'

Well Casing Type/Diameter/Screened Interval: 4" PVC / 13.5-18.5' bgs

After 5 minutes of purging (from top of casing): 12.93'

Begin purge (time): 13:17

End purge (time): 13:46

Gallons purged: 0.75 gal

Purge water disposal method: drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments
1322	12.93'	1L	6.58	1.38	0.522	0.0	12.18	-13	
1327	12.93'	2L	6.50	0.86	0.516	0.0	12.42	+3	
1332	12.93'	2.5L	6.44	0.66	0.508	0.0	12.59	17	
1337	" "	3.5L	6.40	0.59	0.504	0.0	12.79	27	

Sampling Data

Sample No: MW-19-022719

Location and Depth: shallow aquifer

Date Collected (mo/dy/yr): 2/27/19

Time Collected: 1340 ☐ AM ☒ PM

Weather: overcast, cold / windy

Type: ☒ Ground Water ☐ Surface Water Other:

Sample: ☐ Filtered ☒ Unfiltered Other:

Sample Collected with: ☐ Bailer ☒ Pump Other:

Type: peristaltic

Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:

Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:

Sample Description (Color, Turbidity, Odor, Other): Clear, no odor

Sample Analyses

TPH-D	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☒	BTEX	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
0.5 L Amber	1	None	Total depth = 18.80'
40 mL VOA w/ HCl	3		

Signature:

Date: 2/27/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection: 2/28/19
Project Number:
Field Personnel: P.O.

Purge Data

Well ID: MW-20
Secure: ☒ Yes ☐ No
Well Condition/Damage Description: fine, inside of well is slimy.

Depth Sounder decontaminated Prior to Placement in Well: ☒ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 15.27'
Well Casing Type/Diameter/Screened Interval: 4" / 11.5-21.5' bgs
After 5 minutes of purging (from top of casing): 15.44'
Begin purge (time): 12:19
End purge (time): 12:51
Gallons purged: 1 gal
Purge water disposal method: drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments
12:24	15.44'	0.75L	6.92	1.13	0.923	0.0	12.24	-11	
12:29	15.62'	1.5L	7.06	1.01	0.926	0.0	12.37	-81	
12:34	15.71'	2.25L	7.17	0.95	0.932	0.0	12.42	-94	
12:39	15.77'	3L	7.23	1.05	0.937	0.0	12.45	-102	
12:44	15.83'	3.75L	7.25	1.30	0.942	0.0	12.46	-108	

Sampling Data

Sample No: MW-20-022819
Location and Depth: Shallow aquifer
Date Collected (mo/dy/yr): 2/28/19
Time Collected: 12:45 ☐ AM ☒ PM
Weather: overcast, cold
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other: New tubing
Sample Description (Color, Turbidity, Odor, Other): Brown discoloration, sheen blebs, mod-strong petrol. odor.

Sample Analyses

TPH-D	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☒	BTEX	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
0.5 L Amber	1	None	Removed absorbent sock
40 mL VOA w/ HCl	3		Slime inside of well has sheen, but there is no measurable product.
			Sheen in purge water (metallic)

Signature:
Date: 2/28/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL- TPH
Date of Collection: 2/28/2019
Project Number:
Field Personnel: P.O.

Purge Data

Well ID: MW-22
Secure: ☒ Yes ☐ No
Well Condition/Damage Description: good

Depth Sounder decontaminated Prior to Placement in Well: ☒ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 23.97'
Well Casing Type/Diameter/Screened Interval: 4"PVC/ 20.2-30.2' bgs
After 5 minutes of purging (from top of casing): 24.10'
Begin purge (time): 07:50
End purge (time): 08:27
Gallons purged: 1.1 gal
Purge water disposal method: drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments
07:55	24.10'	0.75L	7.08	2.55	0.245	0.0	14.14	216	
08:00	24.16'	1.5L	6.60	2.23	0.239	0.0	13.67	166	
08:05	24.21'	2.25L	6.48	2.39	0.237	0.0	13.53	127	
08:10	24.23'	3L	6.43	3.51	0.238	0.0	13.54	93	
08:15	24.23'	3.75L	6.41	0.97	0.240	0.0	13.46	76	
08:20	" "	4.5L	6.39	0.70	0.244	0.0	13.44	59	

Sampling Data

Sample No: MW-22-022819
Location and Depth:
Date Collected (mo/dy/yr): 2/28/2019
Time Collected: 08:22 ☒ AM ☐ PM
Weather: Sunny, cold
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other): Clear, no apparent odor

Sample Analyses

TPH-D	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☒	BTEX	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
0.5 L Amber	1	None	Tubing barely reaches into water.
40mL VOA w/ HCl	3		- May need to replace tubing and weigh it down.

Signature:
Date: 2/28/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection: 2/28/19
Project Number:
Field Personnel: P.O.

Purge Data

Well ID: MW-23
Secure: ☒ Yes ☐ No
Well Condition/Damage Description: good

Depth Sounder decontaminated Prior to Placement in Well: ☒ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 23.83
Well Casing Type/Diameter/Screened Interval: 4" PVC/ 22.4-32.4 'bgs
After 5 minutes of purging (from top of casing): 23.90'
Begin purge (time): 0846
End purge (time): 0938
Gallons purged: 1.4 gal
Purge water disposal method: drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments
0900	23.88'	1.5L	6.43	1.29	0.885	0.0	12.27	-35	
0905	23.79'	2.5L	6.59	0.99	0.919	0.0	12.72	-64	water rising?
0910	23.77'	3.5L	6.66	0.84	0.945	0.0	12.83	-76	
0915	23.74'	4.5L	6.72	0.15	0.970	0.0	12.83	-83	
0920	23.71'	5.5L	6.74	0.29	0.987	0.0	12.86	-88	

Sampling Data

Sample No: MW-23-022819
Location and Depth: ~~Shallow aquifer~~
Date Collected (mo/dy/yr): 2/28/19
Time Collected: 0922 ☒ AM ☐ PM
Weather: Sunny, cold
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other): clear, no odor.

Sample Analyses

TPH-D	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☒	BTEX	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:
0.5 L Amber	3	Extra volume for
40 mL VOA w/ HCl	9	MS/MSD

Comments:
Flock in purge water + depth of water making peristaltic pump have a hard time purging.

Signature:
Date: 2/28/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection: 2/28/19
Project Number:
Field Personnel: G. Cisneros

Purge Data

Well ID: MW-24
Secure: ☒ Yes ☐ No
Well Condition/Damage Description: 4" good

Depth Sounder decontaminated Prior to Placement in Well: ☒ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 11.32
Well Casing Type/Diameter/Screened Interval: 9.6-19.6' bgs
After 5 minutes of purging (from top of casing): 11-35
Begin purge (time): 0901
End purge (time): 0942
Liters ~~Gallons~~ purged: 4.3
Purge water disposal method: Drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
[✓ 4"]	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Liters Vol. Purged	pH	mg/L DO	mS/cm Conductivity	NTU Turbidity	°C Temp	mV ORP	TDS g/L Comments
0932	11.37	3.2	5.81	5.30	0.226	1.5	9.99	283	0.147
0935	11.37	3.5	5.82	0.30	0.225	3.9	10.10	284	0.147
0938	11.37	3.8	5.85	0.00	0.225	1.2	10.10	283	0.146
0941	11.37	4.1	5.86	0.00	0.225	2.8	10.11	283	0.146

Sampling Data

Sample No: MW-24
Location and Depth: vadose
Date Collected (mo/dy/yr): 2/28/19
Time Collected: 0942 ☐ AM ☐ PM
Weather: Sunny 35°
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: Peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other): slight orange tint, No odor;

Sample Analyses

[✓ TPH-D]	(HCl) ☐	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
[✓ TPH-G]	(HCl) ☒	BTEX	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
500ml Amber	1		
40ml Vials	3		

Signature:
Date: 2/28/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection:
Project Number:
Field Personnel: G. Cignarco

Purge Data

Well ID: MW-25
Secure: ☒ Yes ☐ No
Well Condition/Damage Description:

Depth Sounder decontaminated Prior to Placement in Well: ☒ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): ~~7.08~~ 6.90
Well Casing Type/Diameter/Screened Interval: 7.8 - 17.8' bgs
After 5 minutes of purging (from top of casing): ~~4.55~~ 7.45
Begin purge (time): 1152
End purge (time): 1232
Liters ~~Gallons~~ purged: 6.0
Purge water disposal method: Drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments TDS g/L
1222	07.40	4.0	5.72	0.00	0.569	0.0	9.45	27	03.64
1225	7.41	4.5	5.49	0.00	0.573	0.0	9.41	29	0.367
1228	7.40	5.0	5.33	0.00	0.576	0.0	9.39	29	0.368
1231	7.40	5.5	5.30	0.00	0.576	0.0	9.38	27	0.369

Sampling Data

Sample No: MW-25-022819
Location and Depth: Shallow aquifer
Date Collected (mo/dy/yr): 2/28/19
Time Collected: 1233 ☐ AM ☐ PM
Weather: sunny 40°
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: Peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; [✓ disposable and/or dedicated silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other):

Sample Analyses

TPH-D	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☒	BTEX	(HCl) ☐	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
500ml Amber	1		
40ml Vials	3		

Signature:
Date: 2/28/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection: 2/28/19
Project Number:
Field Personnel: P.D.

Purge Data

Well ID: MW-26
Secure: ☒ Yes ☐ No
Well Condition/Damage Description: ~3 ft of sediment built up in bottom of well.

Depth Sounder decontaminated Prior to Placement in Well: ☒ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 11.69'
Well Casing Type/Diameter/Screened Interval: 4" PVC | 9.4 - 19.4' bgs
After 5 minutes of purging (from top of casing): 11.92'
Begin purge (time): 10:01
End purge (time):
Gallons purged: 1 gal
Purge water disposal method: drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments
10:06	11.92'	0.75L	7.60	4.21	0.172	0.0	10.68	-68	
10:11	12.11'	1.5L	7.29	5.12	0.162	0.0	11.31	-19	
10:16	12.26'	2.25L	6.96	3.43	0.160	0.0	11.54	4	
10:21	12.34'	3 L	6.78	4.40	0.160	0.0	11.70	15	
10:26	12.45'	3.75L	6.88	4.59	0.161	0.0	11.88	28	

Sampling Data

Sample No: MW-26-022819
Location and Depth: Vadose
Date Collected (mo/dy/yr): 2/28/19
Time Collected: 10:29 ☒ AM ☐ PM
Weather: Sunny, cold
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other):

Sample Analyses

TPH-D	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☒	BTEX	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
0.5L Amber	1	None	
40 mL VOA w/ HCl	3		

Signature:
Date: 2/28/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection: 2/28/19
Project Number:
Field Personnel: G. Cisneros

Purge Data

Well ID: MW-27
Secure: ☒ Yes ☐ No
Well Condition/Damage Description: Good

Depth Sounder decontaminated Prior to Placement in Well: ☐ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 18.25
Well Casing Type/Diameter/Screened Interval: 2" 18-28' bgs
After 5 minutes of purging (from top of casing): 18.24
Begin purge (time): 0945
End purge (time):
Liters ~~Gallons~~ purged:
Purge water disposal method:

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
[✓ 2"]	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged Liters	pH	DO mg/l	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments g/L TDS
1004	18.21	2.0	5.50	0.00	0.758	1.2	11.28	36	0.484
1007	18.19	2.2	5.49	0.00	0.758	1.2	11.39	25	0.485
1010	18.18	2.8	5.50	0.00	0.757	0.0	11.50	19	0.485
1013	18.16	3.1	5.52	0.00	0.751	0.0	11.54	16	0.485

Sampling Data

Sample No: MW-27-022817
Location and Depth: shallow aquifer
Date Collected (mo/dy/yr): 2/28/19
Time Collected: 1015 ☐ AM ☐ PM
Weather:
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: Peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other): Clear No odor.

Sample Analyses

[✓ TPH-D]	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
[✓ TPH-G]	(HCl) ☒	[✓ BTEX]	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
500ml Amber	1		
40ml Vials	3		

Signature:
Date:

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection: 2/28/19
Project Number:
Field Personnel: P.O.

Purge Data

Well ID: MW-28
Secure: ☒ Yes ☐ No
Well Condition/Damage Description: fine

Depth Sounder decontaminated Prior to Placement in Well: ☒ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 12.39'
Well Casing Type/Diameter/Screened Interval: 2" / 9.8-19.8' bgs
After 5 minutes of purging (from top of casing): 12.51'
Begin purge (time): 11:06
End purge (time): 11:32
Gallons purged: 0.75gal
Purge water disposal method: drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments
11:11	12.51'	0.75 L	6.40	2.70	0.280	0.0	13.11	83	
11:16	12.56'	1.5 L	6.28	2.49	0.277	0.0	13.19	84	
11:21	12.62'	2.5L	6.29	3.40	0.276	0.0	13.19	85	
11:26	12.68'	3.25L	6.33	3.90	0.275	0.0	13.22	86	

Sampling Data

Sample No: MW-28-022819
Location and Depth: vadose
Date Collected (mo/dy/yr): 2/28/19
Time Collected: 11:30 ☒ AM ☐ PM
Weather: sunny, cold
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other: New tubing
Sample Description (Color, Turbidity, Odor, Other): clear, no odor

Sample Analyses

TPH-D	(HCl)	☒	Chlor / Fluor	(unpres)	☐	COD / TOC	(H2SO4)	☐	Orthophos	(FILTER)	☐
TPH-G	(HCl)	☒	BTEX	(HCl)	☒	Total Metals	(HNO3)	☐	TKN/Phos	(N2SO4)	☐

Diss. Metals	(HNO3)	☐
VOCs	(HCl)	☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
0.5L Amber	1	None	Replaced well cap ☆
40 mL VOA w/ HCl	3		

Signature:
Date: 2/28/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection: 2/28/19
Project Number:
Field Personnel: G. Cisneros

Purge Data

Well ID: MW-29
Secure: ☐ Yes ☐ No
Well Condition/Damage Description: 2" Good

Depth Sounder decontaminated Prior to Placement in Well: ☐ Yes ☐ No
One Casing Volume (gal):

Depth of water (from top of well casing): 15.51
Well Casing Type/Diameter/Screened interval: 15-27.7 'bgs

After 5 minutes of purging (from top of casing):

Begin purge (time): 0828

End purge (time): 0853

Liters ~~Gallons~~ purged:

Purge water disposal method: Dru

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments TDS g/L
0844	15.51	2.5	5.17	0.00	0.214	0.0	10.88	301	0.138
0847	15.51	3.0	5.51	0.00	0.214	0.0	10.92	299	0.139
0850	15.51	3.5	5.48	0.00	0.204	0.0	10.95	300	0.132
0853	15.51	4.1	5.50	0.00	0.199	0.0	10.95	298	0.130

Sampling Data

Sample No: MW-29-022819
Location and Depth: Shallow aquifer

Date Collected (mo/dy/yr): 2/28
Time Collected: 0855 ☒ AM ☐ PM
Weather: Sunny 30°

Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:

Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: Peristaltic

Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:

Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:

Sample Description (Color, Turbidity, Odor, Other): slight orange tint, No odor

Sample Analyses

[✓ TPH-D]	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
[✓ TPH-G]	(HCl) ☒	[✓ BTEX]	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
500ml Amber	1		
40ml Vials	3		

Signature:
Date: 2/28/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection: 2/27/19
Project Number:
Field Personnel: G. Cisneros

Purge Data

Well ID: MW-31 Secure: ☒ Yes ☐ No Well Condition/Damage Description:

Depth Sounder decontaminated Prior to Placement in Well: ☐ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 12.68
Well Casing Type/Diameter/Screened Interval: 9-19 ' bgs
After 5 minutes of purging (from top of casing): 12.77
Begin purge (time): 1515
End purge (time): 1544
~~Gallons~~ Liters purged: 2.4
Purge water disposal method: Drums

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Liter Purged	pH	mg/L DO	mS/cm Conductivity	NTU Turbidity	°C Temp	mV ORP	TDS g/L Comments
1529	1330	0.8 Liter	5.68	0.00	0.608	5.8	11.07	69	0.388
1532	1331	1.0 Liter	5.63	0.00	0.605	6.9	11.09	71	0.387
1535	1326	1.2 Liter	5.62	0.00	0.600	5.8	11.11	77	0.384
1538	1326	1.5L	5.61	0.00	0.596	5.8	11.18	80	0.381
1541	1326	1.9L	5.60	0.00	0.594	4.9	11.25	83	0.380
1544	1326	2.1L	5.60	0.00	0.591	4.7	11.28	85	0.379

Sampling Data

Sample No: MW-31-022719
Location and Depth: Shallow aquifer
Date Collected (mo/dy/yr): 2/27/19 Time Collected: 1545 ☐ AM ☒ PM Weather: Cloudy
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type:
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other): Slight orange color; no odor

Sample Analyses

w/ & w/out silica gel

TPH-D	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☒	BTEX	(HCl) ☐	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
2 500ml Amber	2	MW-131-022719	Dup collected
40ml Vials	6	@1600	MW-131-022719 @ 1600

Signature:

Date: 2/27/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection: 2/28/19
Project Number:
Field Personnel: P.O.

Purge Data

Well ID: MW-32
Secure: ☒ Yes ☐ No
Well Condition/Damage Description: okay, well box rim broken away

Depth Sounder decontaminated Prior to Placement in Well: ☒ Yes ☐ No
One Casing Volume (gal):
Depth of water (from top of well casing): 10.60'
Well Casing Type/Diameter/Screened Interval: 2" / 8-18' bgs
After 5 minutes of purging (from top of casing): 10.89'
Begin purge (time): 14:35
End purge (time): 1504
Gallons purged: 0.75 gal
Purge water disposal method: drum

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO mg/L	Conductivity mS/cm	Turbidity NTU	Temp °C	ORP mV	Comments
1440	10.89'	1L	7.25	0.88	0.449	6.9	12.22	-54	
1445	10.90'	1.5L	7.16	0.87	0.451	6.0	12.39	-74	
1450	11.09'	2.25L	7.09	0.916	0.454	0.4	12.62	-90	
1455	11.11'	3L	7.05	1.00	0.456	0.0	12.70	-100	

Sampling Data

Sample No: MW-32-022819
Location and Depth: Shallow aquifer
Date Collected (mo/dy/yr): 2/28/2019
Time Collected: 1459 ☐ AM ☒ PM
Weather: Showers, cold
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or [✓ dedicated silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other): clear, no obvious odor

Sample Analyses

TPH-D	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☒	BTEX	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
0.5 L Amber	1	None	
40 mL VOA w/ HCl	3		

Signature:
Date: 2/28/19

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name: POL-TPH
Date of Collection: 2/28/19
Project Number:
Field Personnel: G. Cisneros

Purge Data

Well ID: UST-4
Secure: ☐ Yes ☐ No
Well Condition/Damage Description:

Depth Sounder decontaminated Prior to Placement in Well: ☐ Yes ☐ No
One Casing Volume (gal): 2" No Bolts
Depth of water (from top of well casing): 17.09
Well Casing Type/Diameter/Screened Interval: 14.3-24.3' bgs
After 5 minutes of purging (from top of casing):
Begin purge (time): 0748
End purge (time): 816
Liters ~~Gallons~~ purged:
Purge water disposal method:

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.2
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	mg/L DO	mS/cm Conductivity	NTU Turbidity	°C Temp	mV ORP	TDS g/L Comments
0807	17.09	1.8	4.74	1.63	0.599	2.8	12.12	368	0.383
0810	17.09	2.2	4.64	1.03	0.581	0.8	11.62	367	0.374
0813	17.09	2.6	4.58	0.90	0.583	0.2	11.29	370	0.374
0816	17.09	3.0	4.56	0.78	0.588	0.0	11.16	371	0.378

Sampling Data

Sample No: UST-4-022819
Location and Depth: UST 4
Date Collected (mo/dy/yr): 2/28/19
Time Collected: 0817 ☐ AM ☐ PM
Weather: Sunny 30°
Type: ☒ Ground Water ☐ Surface Water Other:
Sample: ☐ Filtered ☒ Unfiltered Other:
Sample Collected with: ☐ Bailer ☒ Pump Other:
Type: Peristaltic
Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☒ Horiba U-50 Other:
Sample Decon Procedure: Sample collected with (circle one): decontaminated all tubing; disposable and/or dedicated [✓ New silicon and poly tubing] Other:
Sample Description (Color, Turbidity, Odor, Other): Clear No odor

Sample Analyses

[✓ TPH-D]	(HCl) ☒	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
[✓ TPH-G]	(HCl) ☒	BTEX	(HCl) ☒	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:
500ml Amber	2	UST-104-022819	
40ml ~~40~~ Vials	6	@ 0820	

Signature:
Date: 2/28/19

Port of Longview TPH Site

Remedial Investigation Work Plan

Appendix F
Sampling and Analysis Plan/ Quality Assurance Project Plan

Table of Contents

List of Tables

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List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
AOPC	Area of potential concern
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and xylenes
cPAH	Carcinogenic polycyclic aromatic hydrocarbon
DIP	Ductile iron pipe
DRO	Diesel-range organics
Ecology	Washington State Department of Ecology
EDB	Ethylene dibromide
EDC	Ethylene dichloride
EIM	Environmental Information Management
EPH	Extractable petroleum hydrocarbons
GRO	Gasoline-range organics
HCID	Hydrocarbon identification
HPT	Hydraulic profiling tool
IDW	Investigation-derived waste
LNAPL	Light non-aqueous-phase liquid

Acronym/ Abbreviation	**Definition**
mm	Millimeters
MNA	Monitored natural attenuation
MSL	Mean sea level
MTBE	Methyl *tert*-butyl ether
MTCA	Model Toxics Control Act
NAD 83	North American Datum of 1983
NAVD 88	North American Vertical Datum of 1988
OIP	Optical Image Profiler
ORO	Oil-range organics
PAH	Polycyclic aromatic hydrocarbon
PID	Photoionization detector
PLP	Potentially liable party
Port	Port of Longview
PPE	Personal protective equipment
QA	Quality assurance
QAPP	Quality Assurance Project Plan
QC	Quality control
RI	Remedial Investigation
SAP	Sampling and Analysis Plan
Site	Port of Longview Total Petroleum Hydrocarbons Site
Standard	Standard Oil Company
TPH	Total petroleum hydrocarbons
USEPA	U.S. Environmental Protection Agency
VOC	Volatile organic compound
VPH	Volatile petroleum hydrocarbons
Work Plan	Remedial Investigation Work Plan

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1.0 Introduction

This Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) presents the sample collection and laboratory analysis procedures that will be used to collect samples as part of the Remedial Investigation (RI) Work Plan (Work Plan) at the Port of Longview (Port) Total Petroleum Hydrocarbons (TPH) Site (the Site).

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2.0 Project Organization and Responsibility

The various quality assurance (QA) field, laboratory, and management responsibilities of key project personnel are defined below.

2.1 MANAGEMENT RESPONSIBILITIES

Lisa Hendriksen—PLP Group and Port of Longview

Lisa Hendriksen is the Project Coordinator for the potentially liable party (PLP) Group, and the primary point of contact for the PLP Group and Port. She will perform the following:

- Authorize and coordinate access for field activities.
- Coordinate PLP Group review and approval of reports (deliverables).
- Manage the disposal of any investigation-derived waste.

Scott Adamek—Floyd|Snider Project Manager

Scott Adamek, Project Manager, will have overall responsibility for project implementation. As Project Manager he will be responsible for maintaining QA on this project and ensuring that the sampling objectives are met. He will perform the following:

- Approve the SAP/QAPP.
- Monitor project activity and quality.
- Provide overview of field activities to the PLP Group.
- Prepare and review the draft investigation findings report.
- Provide technical review of findings during conference calls or meetings with the PLP Group.

Brett Beaulieu—Floyd|Snider Project Hydrogeologist

Brett Beaulieu, Project Hydrogeologist, will have overall responsibility for interpretation and presentation of data collected during the field investigation.

Specific responsibilities will include the following:

- Assist Project Manager and field lead with technical decisions including location changes, depth, and additional borings.
- Prepare and review draft investigation findings report, including assessment of groundwater flow and contaminant migration.

2.2 QUALITY ASSURANCE RESPONSIBILITIES

Chell Black—Floyd|Snider Data Manager

The Data Manager will be responsible for the data validation of all sample results from the analytical laboratories and entering the data into a database. Additional responsibilities include the following:

- Review of laboratory reports.
- Load analytical data to Washington State Department of Ecology's (Ecology's) Environmental Information Management (EIM) database.
- Advise on data corrective action procedures.
- QA and quality control (QC) on analytical data reports.
- Database management and queries.

2.3 LABORATORY RESPONSIBILITIES

An Ecology-accredited laboratory will perform all analytical services in support of the Work Plan activities.

Laboratory Project Manager

The Laboratory Project Manager will be responsible for the following:

- Coordinating laboratory analyses with Floyd|Snider.
- Reviewing and approving final analytical reports.
- Scheduling sample analyses.
- Overseeing data review.

2.4 FIELD RESPONSIBILITIES

Gabe Cisneros—Floyd|Snider Field Lead

The Field Lead will be responsible for leading and coordinating the day-to-day activities in the field. The Field Lead will report directly to the Floyd|Snider Project Manager.

Specific responsibilities include the following:

- Coordinating with the Project Manager.
- Coordinating and managing field staff including sampling staff and drillers.
- Reviewing field data including field logs and field measurement data.
- Adhering to the work schedule.
- Coordinating and overseeing subcontractors.
- Preparing the investigation findings report.

3.0 Data Quality Objectives

The objective of this section is to clarify QA objectives for field sampling and laboratory analyses. Specific procedures for sampling, chain of custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventative maintenance of field/laboratory equipment, and corrective action are described in the following sections.

3.1 LABORATORY QUALITY ASSURANCE OBJECTIVES

Laboratory results will be evaluated against QA objectives for:

- Precision, defined as the relative percent difference between results for matrix spike and matrix spike duplicate analyses:

$$\mathrm{RPD} = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2)/2}$$

Where:
RPD = relative percent difference
C_1 = larger of the two observed values
C_2 = smaller of the two observed values

- Accuracy, defined as the recovery of a spiked sample compared to a known quantity of spike:

$$\%R = 100\% \text{ x } (S\text{-}U)/C_{sa}$$

Where:
%R = percent recovery
S = measured concentration in the spiked aliquot
U = measured concentration in the unspiked aliquot
C_{sa} = actual concentration of spike added

- Comparability, defined as the confidence with which one dataset can be compared to another. Comparability is ensured by using standard U.S. Environmental Protection Agency (USEPA) methods and protocols.
- Completeness, defined as the proportion of data that are determined to be valid:

$$C = \frac{\text{(Number of acceptable data points) x 100}}{\text{(Total number of data points)}}$$

Results will be reviewed for analysis of method blanks, matrix spikes, duplicate samples, laboratory control samples, calibrations, performance evaluation samples, and interference checks as specified by the specific analytical methods. Laboratory QA objectives are summarized in Table F.1.

3.2 FIELD QUALITY CONTROL PROCEDURES

Trip blanks will be included in each cooler with samples being analyzed for gasoline-range organics (GRO) or volatile organic compounds (VOCs) including benzene, toluene, ethylbenzene, and xylenes (BTEX); petroleum additives; and others, to ensure that the sample containers do not contribute to any detected analyte concentrations and to identify any artifacts of improper sample handling, storage, or shipping. A rinsate blank QC sample will also be collected for each sampling event on the non-dedicated field equipment (i.e., stainless steel bowl and spoon) to ensure field decontamination procedures are effective. All field QC samples will be documented in the field logbook and verified by the Field Lead or designee.

All samples will be transported in secured coolers filled with ice and accompanied by chain-of custody forms reviewed by the Field Lead. The sample custodian at the laboratory will verify that custody forms are properly signed upon receipt of samples and notify the Field Lead immediately if discrepancies are discovered between the custody forms and sample shipment. Sample handling will be performed according to the requirements of the analytical method. Specific sample handling requirements, including container types, preservatives, and holding times, are summarized in Table F.2.

3.3 DATA REDUCTION, VALIDATION, AND REPORTING

Initial data reduction, evaluation, and reporting at the laboratory will be carried out as described in the appropriate analytical protocols and the laboratory's QA Manual. The laboratory will be responsible for internal checks on data reporting and will correct errors identified during the QA review. The laboratory will be required to report, when applicable, a project narrative, sample IDs, chain of custody records, sample results, QA/QC summaries, method blank analysis, surrogate spike recovery, matrix spike recovery, and matrix duplicates.

Data validation will be performed by Floyd|Snider to ensure that the laboratory QA objectives described in Table F.1 have been met and that the laboratory has reported the required information as described above. The data quality review will follow USEPA National Functional Guidelines in accordance with the QAPP limits (USEPA 2017a and 2017b).

Data usability, conformance with the data quality objectives, and any deviations that may have affected the quality of the data, as well as the basis of application of qualifiers, will be included in the final reporting of the data. Any required corrective actions based on the evaluation of the analytical data will be determined by the laboratory Project Manager in consultation with the Floyd|Snider QA Manager and may include qualification or rejection of the data.

The Data Validation summary report will be presented as an appendix to the RI. Validated data will be entered into the project database and uploaded to Ecology's EIM database system.

3.4 CORRECTIVE ACTIONS

The Field Lead will be responsible for correcting field errors in sampling or documenting equipment malfunctions during the field sampling effort and will be responsible for resolving situations in the field that may result in non-compliance with the SAP/QAPP. All corrective measures will be immediately documented in the field logbook. Substantial deviations will be reported immediately to the Project Manager.

The laboratory is required to comply with their Standard Operating Procedures. The Laboratory Project Manager will be responsible for ensuring that appropriate corrective actions are initiated as required for conformance with this SAP/QAPP. All laboratory personnel will be responsible for reporting problems that may compromise the quality of the data.

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4.0 Investigation Protocols

The field investigation will consist of a utility and pipeline survey activities, water level measurement, direct-push (i.e., Geoprobe) soil boring sampling, real-time hydrocarbon compound delineation, drilling, installation of monitoring wells, a survey of existing and new monitoring wells, and groundwater sampling via monitoring wells and temporary well points installed in Geoprobe borings, and aquifer testing. Sample collection needs by location are presented in Table F.3. Details on sample collection methodologies are included in Floyd|Snider's Standard Operation Procedures, a copy of which will be carried in the field.

Field work will occur in two phases/mobilizations. The first mobilization will consist of using an Optical Image Profiler [OIP] by Geoprobe® and hydraulic profiling tool (HPT) attached to a direct-push drill rig that will be used to investigate the potential for remaining light non-aqueous-phase liquid (LNAPL) and TPH impacts in the subsurface and to obtain hydrostratigraphic data in relevant areas of potential concern (AOPCs). The OIP can help provide rapid and cost-effective delineation of any remaining LNAPL or residual TPH impacts.

Technologies such as the OIP and Ultra Violet Optical Screening Tool can detect hydrocarbons within the GRO, diesel-range organics (DRO), and lighter polycyclic aromatic hydrocarbon (PAH) ranges but are not very effective identifying Bunker C. Technologies such as TarGOST can detect Bunker C but are not effective in detecting GRO and the lighter PAHs. Hence, due to the broad mix of petroleum fuel product impact to the subsurface, the OIP-HPT combination would provide the most effective direct sensing tools for high resolution site characterization of GRO, DRO, PAH, and Bunker C. OIP will provide visual and photographic confirmation of LNAPL. Product samples collected during the pipeline removal interim action activities will be sent to Columbia Technologies prior to conducting fieldwork in order to evaluate the LNAPL and applicable direct sensing tools.

The number of OIP borings may be increased or decreased in each AOPC, pending real-time OIP results, to delineate the extent of impacts based on OIP results in the field. The HPT, which will be used on select locations, utilizes pressure measurements to quantify the permeability of the medium the probe is being advanced through and estimate a hydraulic conductivity (k) value. To accomplish this, water is pumped through a down-hole transducer at approximately 250 milliliters per minute into the formation. Pressure and flow are plotted against depth, resulting in a line graph that provides permeability as a function of depth.

In addition to the OIP/HPT boring locations during the first phase, four to six direct-push boring locations will be advanced immediately adjacent to select OIP/HPT locations during the first phase of RI fieldwork in order to collect continuous soil samples and analytical data. The lithology and analytical results from these direct-push borings will be compared to the OIP/HPT results prior to proposing direct-push locations during the second phase of the RI activities. The select direct-push locations will be advanced in areas with significant impacts and varying geology to evaluate the OIP/HPT response data. The proposed OIP and HPT locations are shown on Figure F.1.

The second phase of field work will consist of a subsequent mobilization with a direct-push probe and a hollow-stem auger rig. The OIP results, along with results from previous investigations, will be used to determine where direct-push locations will be advanced. Samples collected from direct-push boring will help obtain quantitative soil and groundwater results. Direct-push locations will be selected to collect vertical and lateral confirmation samples in order to delineate the extent and to calculate the volume of any remaining TPH. At least one direct-push boring will be advanced in all AOPCs in order to obtain quantitative results and to delineate the vertical and lateral extent of TPH impacts. The second mobilization will also include the installation of monitoring wells with the hollow-stem auger rig and the installation of subslab Vapor Pins. The proposed monitoring well locations will be based on the OIP results and on data needs.

4.1 UTILITY LOCATE AND PIPELINE SURVEYS

The utility survey will be conducted using existing maps and conductible survey. For the conductible survey, a private utility will attach an electrical signal generator to conductible lines, to trace them at the ground surface. Boring locations will also be marked in advance as needed for public utility locate in order to avoid buried utilities during the investigation. If possible, marking will be done with a Port facilities representative present.

In addition, a limited video inspection will be conducted of accessible pipelines following the Pipeline Interim Action in conjunction with utility locating services. During the interim action, five distinct, exposed pipelines, labeled as lines A, B, C, D, and E, were cut and removed. Pipeline E was full of viscous Bunker C, and the product remaining in the pipeline north of the bulkhead was unable to be vacuumed out. All other pipelines had very little residual product, and the contents were vacuumed out. This is consistent with the Termination of License Agreement, in which Chevron Environmental Management Company reported that it had removed hydrocarbon liquids from the Standard Oil Company (Standard) pipelines, cleaned the Standard pipelines between the bulk tank farm and their terminus at the shipping berths, and flushed the Standard pipelines with water and air (Floyd|Snider 2019).

The pipelines are composed of ductile iron pipe (DIP) and are at least 6 inches and 8 inches in diameter. The previous utility locate conducted during the 2015 field investigation found that conductibility of pipes composed of DIP was low and using a radio frequency detector was useful only for a short range; as a result, the signal was lost beyond 50 feet from frequency source. A camera cable and sonde cable will be pushed, as far as reasonably possible (likely 100 – 200 feet northward from the access points near the bulkhead), into pipelines A, B, C, and D (refer to Drawing G1 of the Interim Action Completion Report; Floyd|Snider 2019) in order to video inspect the pipelines for cracks, holes, and the presence of remaining product, building on the results of the 2019 Pipeline Interim Action. An attempt will be made to use a tractor camera; however, it may not be feasible due to the small diameter of the pipelines and the presence of bends in the pipelines. Management of any remaining product encountered in the pipelines will be addressed in the Feasibility Study.

4.2 WATER LEVEL DATA COLLECTION

The depth to water at representative Site wells will be collected using an electronic water level tape. At wells where LNAPL has previously been present, an oil-water interface probe will be used to measure the depth to water and thickness of LNAPL floating on top of the water. While measuring the depth to water in wells that typically do not contain LNAPL, the electronic water level tape will be used and then inspected for sheen, drops of product, odor, or any other signs of LNAPL. If any signs of LNAPL on the water level tape exist, then the interface probe will be used to confirm the presence of LNAPL. Standard guidelines for water level measurement are included in Attachment F.1.

4.3 LASER-INDUCED FLUORESCENCE INVESTIGATION

An OIP sensor system and an HPT will be deployed with a standard direct-push drill rig. The OIP sensor is intended to provide rapid, real-time, in situ qualitative to semiquantitative information about the distribution of subsurface petroleum-impacted soil and extent of LNAPL both above and below the perched zone and lower water table. The sensor is intended as a method to delineate the boundaries of LNAPL extent and the subsurface contaminant plume prior to installing monitoring wells or collecting soil samples. It is not intended as a complete replacement for traditional soil samples and monitoring wells; but rather to maximize the effectiveness, and minimize the number, of conventional borings. The HPT, which will be used on select locations, utilizes pressure measurements to quantify the permeability of the medium the probe is being advanced through and estimate a hydraulic conductivity (k) value versus depth. Based on the semiquantitative OIP results and the HPT survey, additional strategic locations will be advanced with a direct-push rig in order to obtain quantitative soil and groundwater results. Subsequent direct-push borings will be advanced in order to collect vertical and lateral confirmation samples to delineate the potential extent and calculate a volume of TPH impacts remaining at the Site (refer to Section 4.4).

4.4 DIRECT-PUSH SOIL BORING SAMPLING

Based on the semiquantitative OIP results, additional strategic locations will need to be conducted with a direct-push rig in order to obtain quantitative soil and groundwater results. Direct-push locations will be selected to collect vertical and lateral confirmation samples to delineate the extent and calculate a volume of TPH contamination remaining at the Site. Direct-push locations will be spaced approximately every 50 feet to delineate the lateral extent of TPH impacted soil. In addition, at least one direct-push boring will be advanced in all areas that contains the greatest TPH contamination, based on OIP results, in order to collect soil samples and delineate the vertical extent TPH contamination.

Soil borings will be advanced using direct-push (i.e., Geoprobe) drilling, and the recovered soil samples will be logged continuously by field personnel. Field indications of contamination, including odor, staining, sheen, and elevated VOC concentrations measured by a photoionization detector (PID) will be recorded. Soil samples for laboratory analysis will be collected from the depth interval above the water table observed at the time of the drilling and the depth interval with the greatest field indications of contamination. In some locations (refer to Section 5.0 of the Work Plan), additional soil samples will be collected, including surface soil samples collected from the upper 2 feet of soil. The goal is to define the lateral and vertical extent of contamination in all data gap areas. Therefore, the need for additional soil boring locations will be determined in the field and based on field screening observations on the initial proposed locations. Standard guidelines for logging soil descriptions and collecting samples are included in Attachment F.1.

4.5 HAND AUGER SOIL BORING SAMPLING

Soil borings will be advanced using hand auger tools and the recovered soil samples will be logged continuously by field personnel. Field indications of contamination, including odor, sheen, and elevated VOC concentrations measured by a PID, will be recorded. Soil samples will be collected from the ground surface and additional soil samples will be collected at depth until field indications of contamination are no longer observed. Additional surface samples may be collected to delineate the impacted area. Standard guidelines for logging soil descriptions and collecting samples are included in Attachment F.1.

4.6 GROUNDWATER SAMPLING

4.6.1 Direct-Push Boring Groundwater Sampling

Groundwater screening samples will be collected, at depths based on the OIP and/or HPT surveys, from select direct-push soil borings, using temporary well screens to collect samples from the upper 5 to 10 feet of groundwater encountered and purging until the groundwater is visibly clear. Boring locations designated for groundwater grab samples are shown on Figure F.1 and standard guidelines for collecting groundwater sample using a Geoprobe are included in Attachment F.1.

4.6.2 Monitoring Well Groundwater Sampling

All Site monitoring wells will be sampled using standard low-flow procedures, if sufficient water is present. If excessive siltation is noted in sampled wells, such as in wells MW-20 and MW-26, they may be redeveloped before sampling. After two rounds of groundwater sampling results, the number of monitoring wells to be sampled may be reduced pending consecutive results of non-detect or less than cleanup levels. Standard guidelines for low-flow sampling and well development procedures are included in Attachment F.1.

4.6.3 Monitored Natural Attenuation

Groundwater data will be collected from a subset of monitoring wells for natural attenuation parameters (nitrate, sulfate, manganese, alkalinity, methane, and the additional field measurement of ferrous iron) to provide an updated understanding of groundwater parameters and constituents indicative of biological degradation, including key nutrients and energy sources used by relevant bacteria. Natural attenuation is the unaided reduction of contaminant concentration and mass by using the natural assimilative capacity of a groundwater/soil system in situ. This ubiquitous process includes a variety of physical, chemical, or biological attributes under favorable conditions to reduce the toxicity, mobility, and concentration of contaminants without human intervention. The reduction in concentrations is due primarily to several fate and transport processes including destructive processes, such as biodegradation, and nondestructive mechanisms, such as dilution, sorption, volatilization, and dispersion (USEPA 1999).

During the biodegradation process of contaminants, several chemical compounds in groundwater are produced and can be used as indicators of natural attenuation. The parameters of natural attenuation processes that will be measured are redox potential, pH, conductivity, dissolved oxygen, nitrate, sulfate, ferrous iron, alkalinity, and methane. Many of these parameters will be plotted against DRO, oil-range organics (ORO), and GRO and the approximate distance of the monitoring well from the former LNAPL plume boundary and source areas (Ecology 2005). Plots will be constructed in order to depict varying levels of biodegradation across the dissolved plume and into uncontaminated groundwater.

4.7 SAMPLE NOMENCLATURE

Soil samples will be named according to their direct-push boring location, top depth in feet below ground surface (bgs), and bottom depth in feet bgs, separated by dashes. For example, the soil sample collected from direct-push (i.e., Geoprobe) boring location 31 from 8 to 8.5 feet bgs would be named “GP-31-8-8.5.”

Monitoring well groundwater samples will be named according to the well location; for example, the sample collected from MW-23 on March 1, 2019, would be named “MW-23-030119.” Groundwater grab samples collected from direct-push borings will be named according to the boring location appended with “GW” and separated by dashes; for example, the groundwater grab sample collected from GP-1 would be named “GP-1-GW”.

4.8 SURVEY

A licensed surveyor will locate select station structures, property boundaries, and all existing and newly installed monitoring wells. At each monitoring well the top of the well casing and ground surface will be surveyed to the nearest 0.01 feet in the horizontal and vertical directions. Monitoring well coordinates will be reported relative to the in North American Datum of 1983(1991) (NAD 83[91]) Washington State Plane South. Elevations will be reported relative to the North American Vertical Datum of 1988 (NAVD 88) and Mean Sea Level (MSL). Well logs will include the Washington State Plane South coordinates of the well and the top of well casing elevation. The coordinate and elevation reference systems will be noted on the well logs. Sampling locations other than monitoring wells will be surveyed for horizontal location by field personnel using a hand-held sub-meter global positioning system.

4.9 SOIL VAPOR POINT INSTALLATION AND SAMPLING

A Cox-Colvin subslab Vapor Pin® will be installed in the northeastern corner of the former Warehouse slab in order to assess vapor intrusion from LNAPL present in monitoring well MW-9. The steps for Vapor Pin installation are as follows:

- Drill a 1.5-inch (38 millimeters [mm]) diameter hole at least 1.75 inches (45 mm) into the slab.
- Drill a 0.625-inch (16 mm) diameter hole through the slab and approximately 1 inch (25 mm) into the underlying soil to form a void. Hole must be 0.625 inches (16 mm) in diameter to ensure proper seal. Remove the drill bit, brush the hole with a bottle brush, and remove the loose cuttings with a vacuum.
- Place the lower end of Vapor Pin assembly into the drilled hole. Place the small hole located in the handle of the installation/extraction tool provided in the kit over the Vapor Pin to protect the barb fitting, and tap the Vapor Pin into place using a dead blow hammer or rubber mallet. Make sure the installation/extraction tool is aligned parallel to the Vapor Pin to avoid damaging the barb fitting.
- For flush mount installations, cover the Vapor Pin with a flush mount cover, using either the plastic cover or the optional stainless-steel secured cover also provided by Cox-Colvin.
- Allow 48 hours or more for the subslab soil-gas conditions to re-equilibrate prior to sampling.

After sufficient time has passed to allow for re-equilibrating, a 1-liter lab certified SUMMA® canister will be should be used for soil vapor collection, and a second SUMMA canister will be used for purging. Once the sample train has been set up and connected, a closed-valve test will be conducted, prior to soil vapor sample collection, to check for leaks in the sampling train. The closed-valve test will be conducted for approximately 5 minutes. After the closed-valve test, a minimum of three tubing volumes will be purged. Purging will be completed using a non-certified 1- or 6-liter SUMMA canister. After the sampling train has been purged, the subslab soil vapor sample will be collected over a 10-minute period at a flow rate of less than 167 milliliters per minute. The flow rate will be controlled by a flow regulator, which is set by the laboratory.

In addition to soil-gas sampling activities, leak testing will be conducted using either helium, isopropyl alcohol, or 1,1-difluoroethane (which is used in aerosol dusting sprays) as a tracer gas. Standard guidelines for Vapor Pin installation and soil vapor sampling are included in Attachment F.1.

4.10 DRAWDOWN TESTING

Drawdown testing will be conducted in accordance with standard methods for constant-rate discharge tests, as described in ASTM Method D4050 and summarized for Site use here.

Prior to the start of drawdown testing, a groundwater sample will be collected from the well to be pumped and will be analyzed for DRO, GRO, and BTEX in accordance with the procedures in the SAP/QAPP. The results of this analysis will be used to ensure that the recovered groundwater is managed in accordance with substantive regulatory requirements.

New wells will be surveyed (location and elevation) and developed prior to drawdown testing. Additionally, the distance of the observation wells to the pumping well will be measured.

Baseline water levels will be measured during setup and confirmed immediately prior to the start of the test. Transducers will be installed in all wells and calibrated with hand measurements. A variable-speed submersible pump of suitable capacity (up to approximately 10 gallons per minute; e.g., Grundfos Redi-Flo 2) will be lowered into the pumping well. Pumping rates will be measured during the test using a meter or by filling a container of known volume in a measured time. Transducer data-logging capability will be tested prior to the start of the test.

If aquifer yield is sufficient, a preliminary yield test will be performed prior to the pumping test. The well will be pumped at a series of increasing rates, and the maximum sustainable rate of the pumping well for the duration of the test will be estimated based on extrapolation of drawdown measured in the well. Water levels will be allowed to recover to pre-pumping levels following the yield test prior to initiation of the pumping test.

Pumping will be initiated at the maximum sustainable rate estimated from preliminary yield testing. Pumping rates will be measured at 15-minute or greater intervals throughout the test, noted in a field logbook, and regulated as necessary using the electronic pump controls and/or a valve. The pumping rate will be controlled so that there will be no more than a 10 percent variation in rate during the test. Water will be conveyed by hose or tubing to a storage container for analysis and disposal as investigation-derived waste (IDW; refer to Section 4.13). The frequency of measurement by electronic data-logging of transducer will be suitable for the selected pump test analysis method and is expected to be at least 10 measurements for each logarithmic interval of time, in accordance with the ASTM standard. The duration of the pumping will be scheduled to last at least 100 minutes.

After pumping is stopped, data will continue to be logged to measure the aquifer recovery. A similar duration of time will be required for monitoring aquifer recovery after pumping is halted. Data logging will continue until the aquifer has recovered to within 5 percent of the total drawdown in the well being pumped. If appropriate based on results, drawdown test results will be analyzed with software (e.g., Aqtesolv) that utilizes a solution appropriate for the data to determine the transmissivity, horizontal hydraulic conductivity, storativity (early drawdown), specific yield (late drawdown), and vertical hydraulic conductivity for unconfined aquifers.

4.11 TRANSDUCER STUDY

Six monitoring wells, including three alluvial aquifer monitoring wells and three perched zone monitoring wells, will be instrumented with pressure transducers capable of measuring changes in water level of 0.01 feet or greater accuracy. The water level in each monitoring well will be measured at the time of installation and removal of the transducers. The transducers will collect data for approximately 3 days, at measurement intervals of 15 to 20 minutes. If unvented transducers are used, measurements will be corrected for barometric pressure. Concurrent stage measurements from nearby National Oceanic and Atmospheric Administration monitoring station 9440422 on the Columbia River will be used for comparison to water levels in both the perched and the alluvial aquifer.

4.12 EQUIPMENT DECONTAMINATION

Field sampling equipment, such as stainless-steel bowls and the water level indicators, will be cleaned between uses at each sampling location. Equipment for reuse will be decontaminated according to the procedure below, before each sample interval:

1. Water will be sprayed over equipment to dislodge and remove any remaining soil.
2. Surfaces of equipment contacting sample material will be scrubbed with brushes using an Alconox solution.
3. Scrubbed equipment will be rinsed and scrubbed with clean water.
4. Equipment will undergo a final spray rinse of deionized water.
5. A rinsate blank QC sample will be collected by pouring laboratory-provided deionized water over the sampling equipment and collecting the rinsate in laboratory-provided bottles.

4.13 INVESTIGATION-DERIVED WASTE

Generated waste will be managed and disposed of in accordance with applicable waste management regulations. IDW includes the following liquids and solids:

- Purge water.
- Decontamination wash water.
- Soil drill cuttings, including non-soil debris that may be removed from the subsurface during drilling.
- Disposable materials used during field work that may be impacted by contaminated media, or decontamination wash water (e.g., disposable personal protective equipment [PPE], used filters, plastic sheeting, paper towels, and tubing).

IDW liquids, such as well development waters and decontamination fluids, will be placed in 55-gallon drums and appropriately labeled. The IDW will be stored on site pending waste profiling and proper disposal, which will be coordinated by the Port on behalf of the PLP Group. Material that is designated for offsite disposal will be transported to an offsite facility permitted to accept the waste. Manifests will be used as appropriate for disposal.

All disposable sampling material and PPE (e.g., paper towels, disposable coveralls, and gloves) used in sample processing will be placed in heavyweight garbage bags or other appropriate containers. Disposable supplies will be removed from the Site by sampling personnel and placed in a municipal solid waste refuse container for disposal at a solid waste landfill.

5.0 Laboratory Analysis

Given that the Site contains impacts from former diesel and/or gasoline sources, soil samples will initially be screened using hydrocarbon identification (HCID) by NWTPH-HCID. Soil samples will also be collected per Ecology guidance and USEPA Method 5035A for potential analysis of GRO and BTEX.

If the value of the HCID screening analysis for diesel or gasoline, or both, exceeds the reporting limits, then the appropriate analytical method will be analyzed for the product type detected, including the following:

- DRO and ORO by NWTPH-Dx (if diesel is detected by HCID)
- GRO by NWTPH-Gx (if gasoline is detected by HCID)
- BTEX by USEPA Method 8260 (if gasoline is detected by HCID)

Additional analyses will be conducted on selected soil samples if substantial petroleum impacts to soil are encountered, based on field screening observations. Additional analyses include the following:

- BTEX, methyl *tert*-butyl ether (MTBE), hexane, ethylene dibromide (EDB), and ethylene dichloride (EDC) by USEPA Method 8260C
- Carcinogenic polycyclic aromatic hydrocarbons (cPAHs) and naphthalenes by USEPA Method 8270D SIM
- Total lead by USEPA Method 6020
- Extractable petroleum hydrocarbons (EPH) and volatile petroleum hydrocarbons (VPH) by Methods NWEPH and NWVPH

The results from the additional analyses can be used to calculate Model Toxics Control Act (MTCA) Method B or Method C cleanup levels for TPH.

Groundwater samples collected from all wells at the Site will be analyzed for DRO, ORO, GRO, BTEX, and cPAHs. In accordance with MTCA Table 830-1, select wells located near former underground storage tanks will be analyzed for additional analyses, including naphthalenes, MTBE, EDB, EDC, and lead (Table F.3). Samples from another subset of spatially representative monitoring wells will be submitted for full suite of VOC analysis.

Select wells, shown in Table F.3, will be analyzed for monitored natural attenuation (MNA) parameters, and MNA monitoring will be conducted in accordance with Washington Administrative Code 173-340-820. Wells selected for MNA monitoring are based on source areas, well screen depths, and distance from source areas. After the first early rounds of groundwater monitoring results, the number of wells that will be monitored for natural attenuation may be adjusted. In addition to the above analyses, the following geochemical parameters will be recorded in the field for MNA monitoring:

- Dissolved oxygen (Horiba)
- Redox potential (Horiba)
- pH (Horiba)
- Conductivity (Horiba)
- Temperature (Horiba)
- Ferrous iron (Hach Field Kits)

Additional geochemical MNA indicators that will be submitted to a laboratory for analysis will consist of the following:

- Nitrate by USEPA Method 300.0
- Manganese (soluble) by USEPA Method 200.8
- Sulfate by USEPA Method 300.0
- Methane by RSK-175
- Alkalinity by SM 2320B

Laboratory analytical methods, including reporting limits and quantitation limits, are presented in Table F.4.

Subslab soil-gas samples will be analyzed for the following:

- Air-phase petroleum hydrocarbons, BTEX, naphthalene, and isopropyl alcohol (optional) by USEPA Method TO-15
- Helium (optional) using ASTM D1946 by TO-15 for leak detection

Soil vapor concentrations will be compared to screening levels presented in the updated Table F.1 of Ecology's *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action* (Ecology 2018).

6.0 References

Floyd|Snider. 2019. *Port of Longview TPH Site Interim Action Completion Report.* Prepared for Port of Longview. September.

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Washington State Department of Ecology. 2005. *Guidance on Remediation of Petroleum-Contaminated Ground Water by Natural Attenuation.* Publication No. 05-09-091. July.

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Port of Longview TPH Site

Remedial Investigation Work Plan

Appendix F
Sampling and Analysis Plan/ Quality Assurance Project Plan

Tables

Table F.1
Data Quality Assurance Criteria

Parameter	Reference	Precision (Relative Percent Difference)	Accuracy (Percent Difference from Standard)	Completeness (Percentage of Data Validated)
Soil				
DRO	NWTPH-Dx	± 20%	± 50%	95%
ORO	NWTPH-Dx	± 20%	± 50%	95%
GRO	NWTPH-Gx	± 20%	± 50%	95%
Volatile Organic Compounds				
Benzene	USEPA Method 8021 or 8260	± 20%	± 50%	95%
Toluene				
Ethylbenzene				
Xylenes				
Naphthalene	USEPA Method 8260			
Methyl tert-butyl ether				
Ethylene dichloride				
n-Hexane				
Ethylene dibromide				
Semivolatile Organic Compounds/Carcinogenic Polycyclic Aromatic Hydrocarbons				
Naphthalenes (1)	USEPA Method 8270D SIM	± 20%	± 50%	95%
Acenaphthylene				
Acenaphthene				
Fluorene				
Phenanthrene				
Anthracene				
Fluoranthene				
Pyrene				
Benzo(a)anthracene				
Chrysene				
Benzo(b)fluoranthene				
Benzo(k)fluoranthene				
Benzo(a)pyrene				
Indeno(1,2,3-c,d)pyrene				
Dibenzo(a,h)anthracene				
Benzo(g,h,i)perylene				
Metals				
Lead	USEPA Method 6020	± 20%	± 30%	95%
Physical Parameters and Conventionals				
Grain size	ASTM D6913	± 30%	± 50%	95%
Porosity	ASTM D7263	± 20%	± 30%	95%
Bulk density	ASTM D5057	± 30%	± 30%	95%
Total organic carbon	USEPA 9060	± 50%	± 50%	95%
Water				
DRO	NWTPH-Dx	± 20%	± 60%	95%
ORO	NWTPH-Dx	± 20%	± 60%	95%
GRO	NWTPH-Gx	± 20%	± 60%	95%
Volatile Organic Compounds				
Benzene	USEPA Method 8021 or 8260	± 20%	± 30%	95%
Toluene				
Ethylbenzene				
Xylenes				
Naphthalene	USEPA Method 8260 (2)			
Methyl tert-Butyl Ether				
Ethylene Dichloride				
n-Hexane				
Ethylene Dibromide	USEPA Method 8011			

Table F.1
Data Quality Assurance Criteria

Parameter	Reference	Precision (Relative Percent Difference)	Accuracy (Percent Difference from Standard)	Completeness (Percentage of Data Validated)
Water (cont.)				
Semivolatile Organic Compounds/Carcinogenic Polycyclic Aromatic Hydrocarbons				
Naphthalenes [(1)]	USEPA Method 8270D SIM	± 20%	± 30%	95%
Acenaphthylene				
Acenaphthene				
Fluorene				
Phenanthrene				
Anthracene				
Fluoranthene				
Pyrene				
Benzo(a)anthracene				
Chrysene				
Benzo(b)fluoranthene				
Benzo(k)fluoranthene				
Benzo(a)pyrene				
Indeno(1,2,3-c,d)pyrene				
Dibenzo(a,h)anthracene				
Benzo(g,h,i)perylene				
Monitored Natural Attenuation Parameters				
Nitrate	USEPA 300.0	± 20%	± 20%	95%
Sulfate	USEPA 300.0	± 20%	± 30%	95%
Manganese (soluble)	USEPA 200.8	± 20%	± 30%	95%
Alkalinity	SM 2320B	± 20%	± 20%	95%
Methane	RSK-175	± 20%	± 50%	95%
Ferrous iron (soluble)	Hach field kit	NA	NA	NA
Soil-Gas [(3)]				
APH [EC5-8 aliphatics] fraction	MA-APH	± 30%	± 30%	90%
APH [EC9-12 aliphatics] fraction				
APH [EC9-10 aromatics] fraction				
Benzene	USEPA Method TO-15			90%
Ethylbenzene				
Toluene				
Xylenes, total				
Naphthalene				
Isopropyl alcohol (optional)				
Helium (optional)	ASTM D1946			

Note:

1 Under the MTCA rule, "naphthalenes" is the total of naphthalene, 1-methyl naphthalene, and 2-methyl naphthalene, and the analysis will include all three.

2 Volatile organic compounds of interest will be analyzed by USEPA Method 8260; however, the full suite of analytes will be requested using standard reporting limits and practical quantitation limits.

3 Select analytes are shown on this table; however, any additional additives that are detected in soil or groundwater will be analyzed in soil gas samples.

Abbreviations:

APH	Air-phase petroleum hydrocarbons
DRO	Diesel-range organics
GRO	Gasoline-range organics
MTCA	Model Toxics Control Act
NA	Not applicable
ORO	Oil-range organics
TPH	Total petroleum hydrocarbons
USEPA	U.S. Environmental Protection Agency

Table F.2
Analytical Requirements, Methods, Preservation, Bottle Type, and Holding Times

Parameter	Reference	Bottle Type	Preservative	Holding Time
Soil				
DRO	NWTPH-Dx	(1) 4-oz WMG	None, cool to ≤6 °C	14 days to extract, then 40 to analyze
ORO				
GRO	NWTPH-Gx	(4) 40-mL glass VOA vials with PTFE Septum	Methanol and cool to ≤6 °C or none and cool to ≤6 °C	14 days to analyze with MeOH preservation or if none, 2 days at ≤6 °C, 14 days at ≤-7 °C
Volatile Organic Compounds				
Benzene	USEPA Method 8021 or 8260	(4) 40-mL glass VOA vials with PTFE Septum (GRO, VOCs, and SVOCs taken from the same four VOA vials)	Methanol and cool to ≤6 °C or none and cool to ≤6 °C	14 days to analyze with MeOH preservation or if none, 2 days at ≤6 °C, 14 days at ≤-7 °C
Toluene				
Ethylbenzene				
Xylenes				
Methyl tert-butyl ether	USEPA Method 8260			
Ethylene dichloride				
Naphthalenes				
n-Hexane				
Ethylene dibromide				
Semivolatile Organic Compounds/Carcinogenic Polycyclic Aromatic Hydrocarbons				
Naphthalenes (1)	USEPA Method 8270D SIM	(4) 40-mL glass VOA vials with PTFE Septum (GRO, VOCs, and SVOCs taken from the same four VOA vials)	Methanol and cool to ≤6 °C or none and cool to ≤6 °C	14 days to analyze with MeOH preservation or if none, 2 days at ≤6 °C, 14 days at ≤-7 °C
Acenaphthylene				
Acenaphthene				
Fluorene				
Phenanthrene				
Anthracene				
Fluoranthene				
Pyrene				
Benzo(a)anthracene				
Chrysene				
Benzo(b)fluoranthene				
Benzo(k)fluoranthene				
Benzo(a)pyrene				
Indeno(1,2,3-c,d)pyrene				
Dibenzo(a,h)anthracene				
Benzo(g,h,i)perylene				
Metals				
Lead	USEPA Method 6020	(1) 4-oz WMG	None, cool to ≤6 °C	6 months (or freeze for 1 year) 28 days for mercury
Conventionals				
Total organic carbon	USEPA 9060	500-mL plastic	None, cool to ≤6 °C	28 days
Water				
DRO	NWTPH-Dx	(2) 500-mL amber glass	None, cool to ≤6 °C	7 days to extract, then 40 days to analyze
ORO				
GRO	NWTPH-Gx	(5) 40-mL glass VOA vials with PTFE Septum	Hydrochloric acid to pH ≤2.0, cool to ≤6 °C	14 days to analyze
Volatile Organic Compounds				
Benzene	USEPA Method 8021 or 8260	(5) 40-mL glass VOA vials with PTFE Septum (GRO, VOCs, and SVOCs taken from the same five VOA vials)	Hydrochloric acid to pH ≤2.0, cool to ≤6 °C	14 days to analyze
Toluene				
Ethylbenzene				
Xylenes				
Methyl tert-butyl ether	USEPA Method 8260 (2)			
Ethylene dichloride				
Naphthalenes				
n-Hexane				
Ethylene dibromide	USEPA Method 8011			

Table F.2
Analytical Requirements, Methods, Preservation, Bottle Type, and Holding Times

Parameter	Reference	Bottle Type	Preservative	Holding Time
Water (cont.)				
Semivolatile Organic Compounds/Carcinogenic Polycyclic Aromatic Hydrocarbons				
Naphthalenes (1)	USEPA Method 8270D SIM	1-L amber glass	None, cool to ≤6 °C	Extract within 7 days, 40 days to analyze
Acenaphthylene				
Acenaphthene				
Fluorene				
Phenanthrene				
Anthracene				
Fluoranthene				
Pyrene				
Benzo(a)anthracene				
Chrysene				
Benzo(b)fluoranthene				
Benzo(k)fluoranthene				
Benzo(a)pyrene				
Indeno(1,2,3-c,d)pyrene				
Dibenzo(a,h)anthracene				
Benzo(g,h,i)perylene				
Monitored Natural Attenuation Parameters				
Nitrate	USEPA 300.0	250-mL poly	None, cool to ≤6 °C	48 hours to analyze
Sulfate	USEPA 300.0	250-mL poly	None, cool to ≤6 °C	28 days to analyze
Manganese (soluble)	USEPA 200.8	1-L poly	0.45 micron filter; nitric acid (HNO_3), cool to ≤6 °C	180 days to analyze
Alkalinity	SM 2320B	1-L poly	None, cool to ≤6 °C	28 days to analyze
Methane	RSK-175	(3) 40-mL glass VOA vials	Hydrochloric acid to pH ≤2.0, cool to ≤6 °C	14 days to analyze
Ferrous iron (soluble)	Hach field kit	NA	NA	24 hours
Soil-Gas (3)				
APH [EC5-8 aliphatics] fraction	MA-APH	1-L SUMMA silicone-coated canister	None	30 days
APH [EC9-12 aliphatics] fraction				
APH [EC9-10 aromatics] fraction				
Benzene	USEPA Method TO-15			
Ethylbenzene				
Toluene				
Xylenes, total				
Naphthalene				
Isopropyl alcohol (optional)				
Helium (optional)	ASTM D1946			

Note:

1 Under the MTCA rule, “naphthalenes” is the total of naphthalene, 1-methyl naphthalene, and 2-methyl naphthalene, and the analysis will include all three.

2 VOCs of interest will be analyzed by 8260; however, the full suite of analytes will be requested using standard reporting limits and practical quantitation limits.

3 Select analytes are shown on this table; however, any additional additives that are detected in soil or groundwater will be analyzed in soil gas samples.

Abbreviations:

°C	Degrees Celsius	ORO	Oil-range organics
APH	Air-phase petroleum hydrocarbon	oz	Ounces
DRO	Diesel-range organics	PTFE	Polytetrafluoroethylene (Teflon)
GRO	Gasoline-range organics	SVOC	Semivolatile organic compounds
L	Liters	TPH	Total petroleum hydrocarbons
MeOH	Methanol	USEPA	U.S. Environmental Protection Agency
mL	Milliliters	VOA	Volatile organic analysis
MTCA	Model Toxics Control Act	VOC	Volatile organic compound
NA	Not applicable	WMG	Wide-mouth glass jar

Table F.3
Sample Collection by Area of Potential Concern

	Soil Samples		Groundwater Samples		Soil-Gas Samples	
Sample Location ID (1)	**Sample Interval**	**Analyses (2)**	**Sample Interval**	**Analyses (3)**	**Sample Interval**	**Analyses**
Soil Beneath Transit Shed 2 and Southeastern and Southwestern Pipelines						
At least one boring location	Above water table, most contaminated	HCID (hold for DRO, ORO, GRO, BTEX, cPAHs)	At depths based on OIP and HPT survey	DRO, ORO, GRO, BTEX, cPAHs, and naphthalenes	--	--
At least one boring location	Above water table, most contaminated	HCID (hold for DRO, ORO, GRO, BTEX, cPAHs)	--	--	--	--
P3 and P4 (Southeastern Pipeline)	Surface sample and at depth until clean	DRO, ORO, GRO, BTEX, cPAHs	--	--	--	--
P5 and P6 (Southwestern Pipeline)	Surface sample and at depth until clean	DRO, ORO, GRO, BTEX, cPAHs	--	--	--	--
Soil and Groundwater Quality near Former Aboveground Storage Tank Excavation						
At least two direct-push location	Above water table, most contaminated	HCID (hold for DRO, ORO, GRO, BTEX, cPAHs)	At depths based on OIP and HPT survey	DRO, ORO, GRO, BTEX, cPAHs, and naphthalenes	--	--
At least two direct-push locations	Above water table Most contaminated	HCID (hold for DRO, ORO, GRO, BTEX, cPAHs)	At depths based on OIP and HPT survey	DRO, ORO, GRO, BTEX, cPAHs, and naphthalenes	--	--
Soil Quality Near Former Mechanic's Shop Underground Storage Tanks						
At least four direct-push locations	Above water table, most contaminated	HCID (hold for DRO, ORO, GRO, BTEX, cPAHs, and Lead)	--	--	--	--
Presence of LNAPL near MW-19						
At least two direct-push locations	Above water table, most contaminated	HCID (hold for DRO, ORO, GRO, BTEX, cPAHs)	At depths based on OIP and HPT survey	DRO, ORO, GRO, BTEX, cPAHs, and naphthalenes	--	--
--	Surface soil (0–2 feet), above water table, most contaminated	HCID (hold for DRO, ORO, GRO, BTEX, cPAHs)	At depths based on OIP and HPT survey	DRO, ORO, GRO, BTEX, cPAHs, and naphthalenes	--	--
Soil, Groundwater, and Soil Vapor Quality on the Former Calloway Ross Parcel						
At least two direct-push locations	Above water table, most contaminated	HCID (hold for DRO, ORO, GRO, BTEX, cPAHs, and Lead)	At depths based on OIP and HPT survey	DRO, ORO, GRO, BTEX, cPAHs, and naphthalenes	--	--
VP-1 and VP-2	--	--	--	--	1-inch sub-slab	APH, BTEX, naphthalene

Table F.3
Sample Collection by Area of Potential Concern

	Soil Samples		Groundwater Samples		Soil-Gas Samples	
Sample Location ID [1]	Sample Interval	Analyses [2]	Sample Interval	Analyses [3]	Sample Interval	Analyses
Soil and Groundwater Quality within Former Loading Rack Area						
MW-33	Above water table, most contaminated	HCID (hold for DRO, ORO, GRO, BTEX, cPAHs, and Lead)	At depths based on OIP and HPT survey	DRO, ORO, GRO, BTEX, cPAHs, and naphthalenes	--	--
At least two direct-push locations	Above water table, most contaminated	HCID (hold for DRO, ORO, GRO, BTEX, cPAHs)	--	--	--	--
At least one boring location	Above water table in a location that is not impacted	TOC	--	--	--	--
Soil and Groundwater Quality near MW-26 and MW-28						
MW-34	Above water table, most contaminated	HCID (hold for DRO, ORO, GRO, BTEX, cPAHs, and Lead)	--	--	--	--
At least two direct-push locations	Above water table, most contaminated	HCID (hold for DRO, ORO, GRO, BTEX, cPAHs)	--	--	--	--
At least one boring location	Above water table in a location that is not impacted	TOC	--	--	--	--
Army Reserve Underground Storage Tanks [4]						
Geoprobe Locations	Above water table, most contaminated	HCID (hold for DRO, ORO, GRO, BTEX, cPAHs)	At depths based on OIP and HPT survey	DRO, ORO, GRO, BTEX, cPAHs	--	--
Quarterly Site-Wide Groundwater Monitoring						
All Site Wells	--	--	Screened interval	DRO, ORO, GRO, BTEX, cPAHs	--	--
MW-10, MW-12, MW-19, MW-28, MW-23, MW-34, MW-35	--	--	Screened interval	VOCs [5]	--	--
MW-3, MW-7, MW-10, UST-4	--	--	Screened interval	Table 830-1 Parameters (lead, EDB, EDC, MTBE, and naphthalenes)	--	--
MW-10, MW-12, MW-14, MW-17, MW-18, MW-19, MW-20, MW-22, MW-23, MW-24, MW-25, MW-28, MW-29, MW-30, MW-31	--	--	Screened interval	Natural attenuation parameters [6] (nitrate, sulfate, manganese, alkalinity, methane, field measurements: ferrous iron, DO, redox, pH, temperature, conductivity)	--	--

Table F.3
Sample Collection by Area of Potential Concern

Sample Location ID [(1)]	Soil Samples		Groundwater Samples		Soil-Gas Samples	
	Sample Interval	Analyses [(2)]	Sample Interval	Analyses [(3)]	Sample Interval	Analyses
Physical Parameters						
MW-33, MW-34	Perched Zone (approximately 12 to 17 feet bgs) Silt underlying Perched Zone (approximately 17 to 20 feet bgs) Alluvial Aquifer (approximately 20 to 30 feet bgs)	Grain size analysis, porosity, bulk density, TOC			--	--

Notes:

-- Not applicable.
1 Geoprobe locations will be determined based on OIP results. At this time, Figure F.1 does not show proposed Geoprobe locations in this area, only proposed OIP locations. Locations and proposed boring IDs will be updated prior to the second mobilization.
2 Selected soil samples with substantial petroleum impacts will be submitted for additional analyses. Refer to Section 5.0 of this appendix.
3 Under the MTCA rule, “naphthalenes” is the total of naphthalene, 1-methyl naphthalene, and 2-methyl naphthalene, and the analysis will include all three.
4 Geoprobe locations will be determined based on initial building and historical reconnaissance and ground-penetrating radar survey. At this time, Figure F.1 does not show proposed Geoprobe locations in this area.
5 The VOCs of interest shown in Tables F.1 and F.4 will be analyzed by USEPA Method 8260; however, the full suite of analytes will be requested for this representative subset of monitoring wells using standard reporting limits and practical quantitation limits.
6 Proposed wells will be monitored for natural attenuation parameters and additional laboratory analyses. The number of wells and the selected wells may change after the initial results.

Abbreviations:

APH	Air-phase petroleum hydrocarbon
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and xylenes
cPAH	Carcinogenic polycyclic aromatic hydrocarbon
DO	Dissolved oxygen
EDB	Ethylene dibromide
EDC	Ethylene dichloride
DRO	Diesel-range organics
GRO	Gasoline-range organics
HCID	Hydrocarbon identification
HPT	Hydraulic profiling tool
LNAPL	Light non-aqueous-phase liquid
MTBE	Methyl tert-butyl ether
MTCA	Model Toxics Control Act
OIP	Optical Image Profiler
ORO	Oil-range organics
USEPA	U.S. Environmental Protection Agency
VOC	Volatile organic compound

Table F.4
Analytical Methods, Detection Limits, and Reporting Limits

Parameter	Reference	Units	Estimated Detection Limit	Reporting Limit/PQL
Soil				
DRO	NWTPH-Dx	mg/kg	5	25–50
ORO	NWTPH-Dx		5	25–50
GRO	NWTPH-Gx		0.3	2
Total organic carbon	USEPA 9060	mg/kg	0.06	0.1
Volatile Organic Compounds				
Benzene	USEPA Method 8021 or 8260C	mg/kg	0.006	0.02
Toluene			0.002	0.02
Ethylbenzene			0.002	0.02
Xylenes			0.006	0.06
Naphthalene	USEPA Method 8260C		0.002	0.02
Methyl tert-Butyl Ether			0.00004–0.00007	0.005
Ethylene Dibromide			0.0025	0.005
Ethylene Dichloride			0.00004–0.00007	0.005
n-Hexane			0.00004–0.00007	0.005
Semivolatile Organic Compounds/Carcinogenic Polycyclic Aromatic Hydrocarbons				
Naphthalenes (1)	USEPA Method 8270D SIM	mg/kg	0.000051	0.01
Acenaphthylene			0.000049	
Acenaphthene			0.000053	
Fluorene			0.000055	
Phenanthrene			0.000066	
Anthracene			0.000072	
Fluoranthene			0.000063	
Pyrene			0.000066	
Benzo(a)anthracene			0.00028	
Chrysene			0.00008	
Benzo(b)fluoranthene			0.00006	
Benzo(k)fluoranthene			0.000086	
Benzo(a)pyrene			0.000055	
Indeno(1,2,3-c,d)pyrene			0.00011	
Dibenzo(a,h)anthracene			0.000056	
Benzo(g,h,i)perylene			0.000054	
Metals				
Lead	USEPA Method 6020	mg/kg	0.02	1
Water				
DRO	NWTPH-Dx	µg/L	9	50
ORO	NWTPH-Dx		9	50
GRO	NWTPH-Gx		6	100
Volatile Organic Compounds				
Benzene	USEPA Method 8021 or 8260C	µg/L	0.02	1
Toluene			0.03	1
Ethylbenzene			0.03	1
Xylenes			0.09	3
Naphthalene	USEPA Method 8260C (2)		0.14	2
Methyl tert-Butyl Ether			0.07	2
Ethylene Dichloride			0.05	2
n-Hexane			0.17	5
Ethylene Dibromide	USEPA Method 8011B		0.002	0.01

Table F.4
Analytical Methods, Detection Limits, and Reporting Limits

Parameter	Reference	Units	Estimated Detection Limit	Reporting Limit/PQL
Water (cont.)				
Semivolatile Organic Compounds/Carcinogenic Polycyclic Aromatic Hydrocarbons				
Naphthalenes (1)	USEPA Method 8270D SIM	µg/L	0.008	0.04
Acenaphthylene			0.006	
Acenaphthene			0.007	
Fluorene			0.005	
Phenanthrene			0.01	
Anthracene			0.007	
Fluoranthene			0.006	
Pyrene			0.006	
Benzo(a)anthracene			0.007	
Chrysene			0.008	
Benzo(b)fluoranthene			0.007	
Benzo(k)fluoranthene			0.008	
Benzo(a)pyrene			0.012	
Indeno(1,2,3-c,d)pyrene			0.016	
Dibenzo(a,h)anthracene			0.026	
Benzo(g,h,i)perylene			0.024	
Monitored Natural Attenuation Parameters				
Nitrate	USEPA 300.0	µg/L	4.61	300
Sulfate	USEPA 300.0		1.45	100
Manganese (Soluble)	USEPA 200.8		0.0715	1
Alkalinity	SM 2320B		1,250	2,500
Methane	RSK-175		2.32	8.63
Ferrous Iron (Soluble)	Hach field kit		200	200
Soil-Gas (3)				
APH [EC5-8 aliphatics] fraction	MA-APH	µg/m^3	46	46
APH [EC9-12 aliphatics] fraction			35	35
APH [EC9-10 aromatics] fraction			25	25
Benzene	USEPA Method TO-15		0.022	0.32
Ethylbenzene			0.11	0.43
Toluene			0.13	0.38
Xylenes, total			0.33	1.6
Naphthalene			0.073	0.26
Isopropyl Alcohol (optional for leak detection)			0.59	3.0
Helium (alternative option for leak detection)	ASTM D1946		0.17	0.6

Note:

1 Under the MTCA rule, "naphthalenes" is the total of naphthalene, 1-methyl naphthalene, and 2-methyl naphthalene, and the analysis will include all three.

2 Volatile organic compounds of interest will be analyzed by USEPA Method 8260; however, the full suite of analytes will be requested using standard reporting limits and PQLs.

3 Select analytes are shown on this table; however, any additional additives that are detected in soil or groundwater will be analyzed in soil gas samples.

Abbreviations:

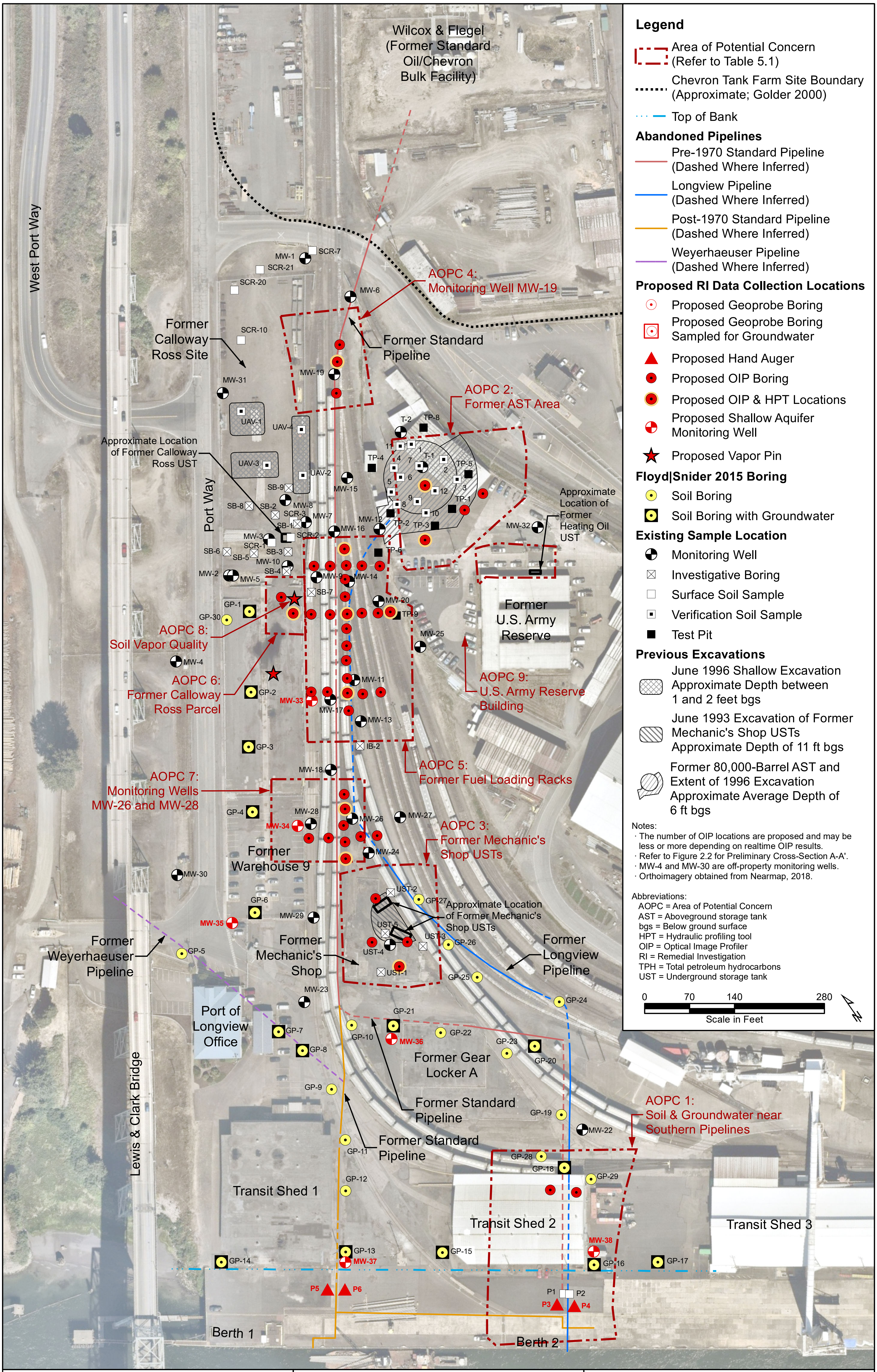
APH	Air-phase petroleum hydrocarbon
DRO	Diesel-range organics
GRO	Gasoline-range organics
µg/L	Micrograms per liter
µg/m^3	Micrograms per cubic meter
mg/kg	Milligrams per kilogram
MTCA	Model Toxics Control Act
ORO	Oil-range organics
PQL	Practical quantitation limit
USEPA	U.S. Environmental Protection Agency

Port of Longview TPH Site

Remedial Investigation Work Plan

Appendix F
Sampling and Analysis Plan/ Quality Assurance Project Plan

Figure



Notes:
- The number of OIP locations are proposed and may be less or more depending on realtime OIP results.
- Refer to Figure 2.2 for Preliminary Cross-Section A-A'.
- MW-4 and MW-30 are off-property monitoring wells.
- Orthoimagery obtained from Nearmap, 2018.

Abbreviations:
AOPC = Area of Potential Concern
AST = Aboveground storage tank
bgs = Below ground surface
HPT = Hydraulic profiling tool
OIP = Optical Image Profiler
RI = Remedial Investigation
TPH = Total petroleum hydrocarbons
UST = Underground storage tank

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Remedial Investigation Work Plan
Port of Longview TPH Site
Longview, Washington

Figure F.1
Areas of Potential Concern and
Proposed RI Data Collection Locations

I:\GIS\Projects\POL-TPH\MXD\Remedial Investigation Work Plan\Figure F.1 Areas of Potential Concern and Proposed Data Collection Locations.mxd
9/16/2019

Port of Longview TPH Site

Remedial Investigation Work Plan

Appendix F

Sampling and Analysis Plan/ Quality Assurance Project Plan

Attachment F.1

Standard Guidelines

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F|S STANDARD GUIDELINE

Groundwater Sample Collection with a Direct-Push (i.e., Geoprobe) Drill Rig

DATE/LAST UPDATE: September 2015

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field, but are not intended to be step-by-step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines for the sampling method they intend to use and should review and understand these procedures prior to going into the field. It is the responsibility of the field staff to review the standard guidelines with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines.

1.0 Scope and Purpose

This standard guideline provides details necessary for collecting representative groundwater samples using a direct-push drill rig. These guidelines are designed to meet or exceed guidelines set forth by the Washington State Department of Ecology (Ecology).

2.0 Equipment and Supplies

Groundwater Sampling Equipment and Tools:

- Peristaltic pump and battery (typically provided by driller; confirm prior to mobilization)
- Water level meter
- Multi-parameter water quality meter (if applicable)
- Polyethylene tubing, Teflon tubing, or similar
- MasterFlex (silicone) tubing
- Filters (if field filtering)

- Tube cutters, razor blade, or scissors
- 55-gallon drum and clamp (or 5-gallon drum) and labels
- 5-gallon bucket
- Paper towels
- Alconox (or similar decontamination solution)
- Distilled or deionized water
- Spray bottles
- Trash bags

Lab Equipment:

- Sample jars/various types of pre-cleaned bottles (as applicable)
- Coolers
- Chain-of-Custody Forms
- Labels
- Ice
- Ziploc bags

Paperwork:

- Field notebook with site maps and previous boring logs, if available
- Sampling forms
- Purge water plan
- Rite-in-the-Rain pens, paper, and permanent markers
- Site-Specific Health and Safety Plan (HASP)
- Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP), or other similar work plan

Personal Protective Equipment (PPE):

- Steel-toed boots
- Safety vest
- Hard hat
- Nitrile gloves
- Safety glasses

- Rain gear
- Work gloves

3.0 Standard Procedures

The following sections describe the procedure for sampling groundwater using direct-push methods. Before entering the field, project considerations including the target aquifer or depth for sampling and screen placement (i.e., across or within the water table) should be discussed with the Project Manager. Any deviations from these procedures should be approved by the Project Manager and fully documented. Groundwater sampling from a direct-push boring consists of purging and sampling water within the borehole with a peristaltic pump. Direct-push drilling activities will typically follow Floyd|Snider Standard Guidelines for Soil Sampling.

3.1 CALIBRATION OF WATER QUALITY METERS

Water quality meters used during groundwater sampling (if applicable) will be calibrated prior to each sampling event. Calibration procedures are outlined in each instrument's specific user manual.

3.2 PURGING AND SAMPLING PROCEDURES

Once the direct-push drilling activities have reached the desired depth, a new polyvinyl chloride (PVC) or decontaminated stainless steel casing and screen is temporarily installed in the borehole by the driller. Record the depth-to-water and total depth of the well to calculate the volume (this is calculated by multiplying the area inside the casing by the height of water in the casing). Slowly lower new polyethylene or Teflon tubing down the temporary casing and use a peristaltic pump to purge and collect groundwater samples. The discharge line should be directed to a 55-gallon drum (or 5-gallon drum or bucket), provided by the drilling subcontractor to contain the purge water generated. Purging will continue until the groundwater is visually clear (if achievable) or at least 3 well volumes have been removed.

After the well has been purged and the sample bottles have been labeled, the groundwater sample will be collected by directly filling the laboratory-provided bottles from the pump discharge line. All sample containers should be filled with minimum disturbance by allowing the water to flow down the inside of the bottle or vial. When collecting a volatile organic compound (VOC) sample, fill to the top to form a meniscus over the mouth of the vial prior to placing the cap in order to eliminate air bubbles. Do not overfill preserved sample jars or pre-cleaned Volatile Organic Analyte (VOA) sampling vials.

If sampling for dissolved analytes (such as metals), collect these samples last and with attention to the flow direction arrow, fit an in-line filter at the end of the discharge line. A minimum of 0.5 to 1 liter of groundwater must pass through the filter prior to collecting the sample.

Sample labels will clearly identify the project name, sampler's initials, sample location and unique sample ID, analysis to be performed, date, and time. Upon collection, samples will be placed in a cooler maintained at a temperature of approximately 4 to 6 degrees Celsius (°C) using ice. Chain-of-Custody Forms will be completed. Upon transfer of the samples to the laboratory, the Chain-of-Custody Form will be signed by the persons transferring custody of the sample containers to document change in possession.

When sample collection is completed at a designated location, remove and properly dispose of the tubing and temporary well screen and casing. In most cases, this waste is considered solid waste and can be disposed of as refuse.

4.0 Decontamination

Prior to moving to the next sampling location, all reusable equipment that has come into contact with groundwater should be decontaminated using the processes described in this section.

Water Level Meter: The water level indicator and tape will be decontaminated between direct-push sampling locations and at the end the day by spraying the entire length of tape that came in contact with groundwater with an Alconox (or similar)/water mixture followed by a thorough rinse with distilled or deionized water.

Water quality sensors and flow-through cell (if used): Use distilled or deionized water to rinse the water quality sensors and flow-through cell. No other decontamination procedures are recommended since the equipment is sensitive. After the sampling event, the water quality meters will be cleaned and maintained according to the specific manual.

Submersible Pump: Decontaminating the pump requires running the pump in three progressively cleaner grades of water.

1. Fill a bucket with approximately 4 gallons or more to sufficiently cover the pump of an Alconox (or similar)/clean water solution. Place the pump and the length of the power cord (if applicable) that was in contact with water into the bucket and run the pump for approximately two minutes or until the volume of water in the bucket has been exhausted.
2. Fill a second bucket containing approximately 4 gallons or more to sufficiently cover the pump of clean water. Place the pump and cord into this bucket and run the pump for approximately two minutes or until the volume of water in the bucket has been exhausted.
3. Fill a third bucket with approximately 4 gallons or more to sufficiently cover the pump of distilled or deionized water. Place the pump and cord into this bucket and run the pump for approximately two minutes or until the volume of water in the bucket has been exhausted.

The Alconox/water solution may be re-used; however rinse water should be collected for disposal as described in Section 5.0 below. When done for the day, dry the exterior of the pump and cord with clean towels to the extent practical prior to storage: all decontaminated water (including Alconox solution) should be managed in accordance with Section 5.0 below.

All reusable equipment on the drill rig (such as casings and rods) that comes into contact with soil or groundwater will be decontaminated by the driller between locations. The drilling subcontractor will store all decontaminated water in labeled 55-gallon drums on-site for proper disposal unless otherwise specified.

5.0 Investigation-Derived Waste (IDW)

Unless otherwise specified in the project-specific work plan, water generated during groundwater sampling activities will be contained and stored in a designated area until it can be transported and disposed of off-site in accordance with applicable laws.

The approach to handling and disposal of these materials for a typical cleanup site is as follows.

For IDW that is containerized, (such as purge water), 55-gallon drums (or other smaller sized drums) approved by the Washington State Department of Transportation will be used for temporary storage pending profiling and disposal. Each container holding IDW will be sealed and labeled as to its contents (e.g., “purge water”), the dates on which the wastes were placed in the container, the owner’s name, contact information for the field person who generated the waste, and the site name.

IDW containerized within drums will be characterized relative to applicable waste criteria using data from the sampling locations whenever possible. Material that is designated for off-site disposal will be transported to an off-site facility permitted to accept the waste. Manifests will be used, as appropriate, for disposal.

Disposable sampling materials and incidental trash such as paper towels and PPE used in sample processing will be placed in heavy-duty garbage bags or other appropriate containers and disposed of as trash in the municipal collection system.

6.0 Field Documentation

Drilling and groundwater sampling activities will be documented in field sampling forms and/or notebooks and Chain-of-Custody Forms. Information recorded will at a minimum include personnel present (including subcontractors), purpose of field event, weather conditions, sample collection date and times, sample analytes, depths to water, water quality field measurements (if collected), amount of purged water generated, and any deviations from the SAP.

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F|S STANDARD GUIDELINE

Low-Flow Groundwater Sample Collection

DATE/LAST UPDATE: September 2015

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field, but are not intended to be step-by-step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines for the sampling method they intend to use and should review and understand these procedures prior to going into the field. It is the responsibility of the field staff to review the standard guidelines with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines.

1.0 Scope and Purpose

This standard guideline provides details necessary for collecting representative groundwater samples from monitoring wells using low-flow methods. These guidelines are designed to meet or exceed guidelines set forth by the Washington State Department of Ecology (Ecology). Low-Flow sampling provides a method to minimize the volume of water that is purged and disposed from a monitoring well, and minimizes the impact that purging has on groundwater chemistry during sample collection.

2.0 Equipment and Supplies

Groundwater Sampling Equipment and Tools:

- For wells with head less than 25 feet:
    - Peristaltic pump with fully-charged internal battery or standalone battery and appropriate connectors

- For wells with head greater than 25 feet:
  - Bladder pump and controller, as well as an air cylinder, or air compressor (with extension cord if near an electrical outlet; with battery and appropriate connectors or generator if not near an outlet)

    OR
  - Low-flow submersible pump and controller (with extension cord if near an electrical outlet; with battery and appropriate connectors or generator if not near an outlet)
- Multi-parameter water quality meter
- Water level meter
- Poly tubing
- Silicone tubing
- Filters (if field filtering)
- Tools for opening wells (1/2-inch, 9/16-inch, and 5/8-inch sockets, ratchet, screwdriver)
- Well keys
- Tube cutters, razor blade, or scissors
- 5-gallon buckets and clamp
- Paper towels
- Bailer or pump to drain well box if full of stormwater
- Hammer
- Alconox (or similar decontamination solution), deionized water, spray bottles
- Tape measure
- Trash bags

Lab Equipment:

- Sample jars/bottles
- Coolers
- Chain-of-Custody Forms
- Labels
- Ice
- Ziploc bags

Paperwork:

- Field notebook with site maps
- Table of well construction details and/or well logs, if available
- Sampling forms
- Purge water plan
- Rite-in-the-Rain pens, paper, and permanent markers
- Site-Specific Health and Safety Plan (HASP)
- Sampling and Analysis Plan (SAP) and/or Quality Assurance Project Plan (QAPP) (including tables of analytes and bottle types)

Personal Protective Equipment (PPE):

- Boots/waders
- Safety vest
- Safety glasses
- Rain gear
- Nitrile gloves
- Work gloves

3.0 Standard Procedures

Low-Flow groundwater sampling consists of purging groundwater within the well casing at a rate equal to or less than the flow rate of representative groundwater from the surrounding aquifer into the well screen. The flow rate will depend on the hydraulic conductivity of the aquifer and the drawdown, with the goal of minimizing drawdown within the monitoring well. Field parameters are monitored during purging and groundwater samples are collected after field parameters have stabilized. Deviations from these procedures should be approved by the Project Manager and fully documented.

3.1 CALIBRATION OF WATER QUALITY METERS

All multi-parameter water quality meters to be used will be calibrated prior to each sampling event. Calibration procedures are outlined in each instrument's specific user manual.

3.2 MONITORING, MAINTENANCE, AND SECURITY

Prior to sampling, depth to water and total depth measurements will be collected and recorded for accessible monitoring wells onsite (or an appropriate subset for larger sites). Check for an existing measuring point (notch or visible mark on top of casing). If a measuring point is not observed, a measuring point should be established on the north side of the casing. The conditions of the well box and bolts will also be observed and deficiencies will be recorded on the sampling forms or logbook (i.e., missing or stripped bolt). The following should also be recorded:

- Condition of the well box, lid, bolts, locks, and gripper cap, if deficiencies
- Condition of gasket if deficient and if water is present in the well box
- Note any obstructions or kinks in the well casing
- Note any equipment in the well casing, such as transducers, bailers, or tubing
- Condition of general area surrounding the well, such as subsidence, potholes, or if the well is submerged within a puddle.

Replace any missing or stripped bolts, and redevelop wells if needed.

3.3 LOW-FLOW PURGING METHOD AND SAMPLING PROCEDURES

Groundwater samples will be collected using low-flow purging and sampling procedures consistent with Ecology guidelines and the U.S. Environmental Protection Agency (USEPA) standard operating procedures (USEPA 1996). The following describes the Low-Flow purging and sampling procedures for collecting groundwater samples using a peristaltic pump. If the water level is greater than 20 feet below ground surface (bgs), Grundfos or Geotech submersible pumps or bladder pumps can be used since their pumping rates can be adjusted to low-flow levels.

- Place the peristaltic pump and water quality equipment near the wellhead. Slowly lower new poly tubing down into the well casing approximately to the middle of the well screen. If the depth of the well screen is not known, lower the tubing to the bottom of the well, making sure that the tubing has not been caught on the slotted well casing, and then raise the tubing 3 to 5 feet off the bottom of the casing. Document the estimated depth of the tubing placement within the well. Connect the tubing to the peristaltic pump using new flex tubing and connect the discharge line to the flow-through cell of the water quality meter. The discharge line from the flow cell should be directed to a bucket to contain the purged water.
- If using a low-flow submersible pump, connect the pump head to dedicated or disposable tubing. If using a bladder pump, connect both the air intake and water discharge ports to decontaminated or disposable tubing, using the manufacturer's instructions to ensure a secure connection. Lower the pump with tubing into the well as described above and connect the water discharge tubing directly to the flow-through cell.
- Measure the depth to water to the nearest 0.01 foot with a decontaminated water level meter and record the information on a sampling form.
- Start pumping the well at a purge rate of 0.1 to 0.2 liters per minute and slowly increase the rate. Purge rate is adjusted using a speed control knob or arrows on peristaltic and low-flow submersible pumps. The purge rate for bladder pumps is controlled by the air compressor, which first pressurizes the pump chamber in order

to compress the flexible bladder and force water through the discharge line, and then vents the chamber in order to allow the bladder to refill with water.

  - A good rule of thumb is to pressurize to 10 psi + 0.5 psi/foot of tubing depth and begin with 4 discharge/refill cycles per minute; using greater air pressure and accelerating the pump cycles will increase the purge rate.

- Check the water level. If the water level is dropping, lower the purge rate. Maintain a steady flow with no or minimal drawdown (less than 0.33 feet according to USEPA 2002). Maintaining a drawdown of less than 0.33 feet may not be feasible depending on hydrogeological conditions. If possible, measure the discharge rate of the pump with a graduated cylinder or use a stopwatch when filling sampling jars (500 milliliters [mL] polyethylene or glass ambers) to estimate the rate. When purging water through a flow cell, the maximum flow rate for accurate water quality readings is about 0.5 liters per minute (L/minute).
- Monitor and record water quality parameters every three to five minutes after one tubing volume (including the volume of water in the flow cell) has been purged.
  - One foot of ¼-inch interior diameter tubing holds about 10 mL of water, and flow-through cells typically hold less than 200 mL of water; one volume should be purged after about 5 minutes at a flow rate of 0.1 L/minute.
- Water-quality indicator parameters that will be monitored and recorded during purging include:
  - pH
  - Specific conductivity
  - Dissolved oxygen
  - Temperature
  - Turbidity
  - Oxidation reduction potential (ORP)
- Purging will continue until temperature, pH, turbidity, and specific conductivity are approximately stable (when measurements are within 10 percent) for three consecutive readings, or 30 minutes have elapsed. Because these field parameters (especially dissolved oxygen and ORP) may not reach the stabilization criteria, collection of the groundwater sample will be based on the professional judgment of field personnel at the time of sampling.
- The water sample can be collected once the criteria above have been met.
- If drawdown in the well cannot be maintained at 0.33 feet or less, reduce the flow or turn off the pump for 15 minutes and allow for recovery. If the water quality parameters have stabilized, and if at least two tubing volumes and the flow cell volume have been purged, then sample collection can proceed when the water level has recovered and the pump is turned back on. This should be noted on the sampling form.

- To collect the water sample, maintain the same pumping rate. After the well has been purged and the sample bottles have been labeled, the groundwater sample will be collected by directly filling the laboratory-provided bottles from the pump discharge line prior to passing through the flow cell. All sample containers should be filled with minimum disturbance by allowing the water to flow down the inside of the bottle or vial. When collecting a volatile organic compound (VOC) sample, fill to the top to form a meniscus over the mouth of the vial prior to placing the cap to eliminate air bubbles. Be careful not to overflow preserved bottles/pre-cleaned Volatile Organic Analyte (VOA) vials.
- If sampling for filtered metals, collect these samples last and fit an in-line filter at the end of the discharge line. Take note of the flow direction arrow on the filter prior to fitting. A minimum of 0.5 to 1 liter of groundwater must pass through the filter prior to collecting the sample.
- Sample labels will clearly identify the project name, sampler's initials, sample location and unique sample id, analysis to be performed, date, and time. After collection, samples will be placed in a cooler maintained at a temperature of approximately 4 to 6 degrees Celsius (°C) using ice. Chain-of-Custody Forms will be completed. Upon transfer of the samples to the laboratory, the Chain-of-Custody Form will be signed by the persons transferring custody of the sample containers to document change in possession.
- When sample collection is complete at a designated location, remove and properly dispose of the non-dedicated tubing. In most cases, this waste is considered solid waste and can be disposed of as refuse. Close and lock the well.

4.0 Decontamination

All reusable equipment that comes into contact with groundwater should be decontaminated using the processes described in this section prior to moving to the next sampling location.

Water Level Meter: The water level indicator and tape will be decontaminated between sampling locations and at the end the day by spraying the entire length of tape that came in contact with groundwater with an Alconox (or similar)/clean water solution followed by a thorough rinse with distilled or deionized water.

Water Quality Sensors and Flow-Through Cell: Distilled water or deionized water will be used to rinse the water quality sensors and flow-through cell. No other decontamination procedures are recommended since they are sensitive equipment. After the sampling event, the water quality meters will be cleaned and maintained according to the specific manual.

Submersible Pump (if applicable: Decontaminating the pump requires running the pump in three progressively cleaner grades of water.

1. Fill a bucket with approximately 4 gallons or more to sufficiently cover the pump of an Alconox (or similar)/clean water solution. Place the pump and the length of the

power cord (if applicable) that was in contact with water into the bucket and run the pump for approximately two minutes or until the volume of water in the bucket has been exhausted.

2. Fill a second bucket containing approximately 4 gallons or more to sufficiently cover the pump of clean water. Place the pump and cord into this bucket and run the pump for approximately two minutes or until the volume of water in the bucket has been exhausted.
3. Fill a third bucket with approximately 4 gallons or more to sufficiently cover the pump of distilled or deionized water. Place the pump and cord into this bucket and run the pump for approximately two minutes or until the volume of water in the bucket has been exhausted.

Bladder Pump: Clean the inside and outside of the pump body with an Alconox (or similar)/clean water solution, followed by a thorough rinse with distilled or deionized water. The outside of the air supply line that came in contact with groundwater may also be cleaned with Alconox (or similar) solution and re-used; bladders and water discharge lines must be replaced after each sample is collected.

5.0 Investigation-Derived Waste (IDW)

Unless otherwise specified in the project work plan, water generated during groundwater sampling activities will be contained, transported, disposed of in accordance with applicable laws, and stored in a designated area until transported off-site for disposal.

The approach to handling and disposal of these materials for a typical cleanup site is as follows. For IDW that is containerized, such as purge water, 55-gallon drums (or other smaller sized drums) approved by the Washington State Department of Transportation will be used for temporary storage pending profiling and disposal. Each container holding IDW will be sealed and labeled as to its contents (e.g., “purge water”), the dates on which the wastes were placed in the container, the owner’s name and contact information for the field person who generated the waste, and the site name.

IDW containerized within drums will be characterized relative to applicable waste criteria using data from the sampling locations whenever possible. Material that is designated for off-site disposal will be transported to an off-site facility permitted to accept the waste. Manifests will be used, as appropriate for disposal.

Disposable sampling materials and incidental trash such as paper towels and PPE used in sample processing will be placed in heavy-duty garbage bags or other appropriate containers and disposed of as trash in the municipal collection system.

6.0 Field Documentation

Groundwater sampling activities will be documented in field sampling forms and/or field notebooks, and Chain-of-Custody Forms. Information recorded will, at a minimum, include personnel present (including subcontractors or client representatives), purpose of field event, weather conditions, sample collection date and times, sample analytes, depths to water, water quality parameters, well box/lid conditions, amount of purged water generated, and any deviations from the SAP. Photographs of damaged well casings or well boxes should be taken.

7.0 References

USEPA. 1996. Low-Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells, Revision 2. Region 1. July 30, 1996.

_____. 2002. Groundwater Sampling Guidelines for Superfund and CAR Project Managers. Office of Solid Waste and Emergency Response. EPA 542.S-02-001. May 2002.

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F|S STANDARD GUIDELINE

Soil Logging

DATE/LAST UPDATE: August 2018

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field, but are not intended to be step by step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines and should review and understand these procedures prior to going in the field. It is the responsibility of the field staff to review the standard guidelines with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines.

1.0 Scope and Purpose

These soil logging standard guidelines should be used by the field staff performing subsurface investigations, such as a direct push or roto-sonic soil boring, installation of a monitoring well via hollow stem auger, or roto-sonic or mud rotary drilling. While many projects will not necessarily have a Licensed Geologist (LG) or Hydrogeologist (LHG) who reviews and stamps every boring log, it is important that the field staff discusses the soil logging needs for a particular investigation with the project geologist, the project manager, or whoever will ultimately be responsible for interpreting the findings of the field investigation. This discussion is in addition to field training and general knowledge about soil logging, and should happen prior to entering the field, with additional follow-up before drafting a final set of electronic logs, after the investigation is complete.

2.0 Equipment and Supplies

Logging Equipment and Tools:

- 100-foot tape measure or measuring wheel
- Handheld Global Positioning System (GPS; optional)
- Unified Soil Classification System (USCS) Soil Classification Field Guide

- Soil logging kit containing:
    - Stainless steel spoons
    - Paint scraper or trowel
    - Small Ziploc bags
    - Small stainless steel bowls or black mining pans for sheen testing
    - Spray bottle filled with water
    - Paper towels (preferably white)
    - Engineers tape
    - Note cards
    - Optional items include:
        - Empty VOA vials or small glass jars
        - Munsell color chart
        - Sieves
        - White and grayscale color cards for photographs
- Plastic sheeting and duct tape or clamps to cover the sampling table
- Camera
- Trash bags
- Coolers
- Jars
- Labels
- Ice

Paperwork:

- Work Plan and/or Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP)
- Health and Safety Plan (HASP)
- Copies of figures showing previous boring locations and boring logs from previous investigations, if available
- Boring log forms appropriate for drilling method, printed in Rite in the Rain paper and/or bound field notebook
- Permanent markers and pencils

Personal Equipment:

- Steel-toed boots
- Hard hat

- Safety vest
- Safety glasses
- Nitrile gloves
- Ear plugs
- Rain gear
- Work gloves

3.0 Standard Procedures

3.1 OFFICE PREPARATION

First, meet with the project manager or field manager to identify the key information and goals of the soil boring investigation. These may include fill history, known or suspected sources of contamination and potential field indications of these contaminants, identification of specific units, or important geotechnical measurements. If possible, select a boring log template that is appropriate for the project needs.

Next, review the work plan and all available existing materials such as cross-sections or boring logs from previous investigations to familiarize yourself with the site geology. In addition (or alternatively if other information is not available), you may also review a geologic map of the area from a reputable source such as United States Geological Survey (USGS).

Finally, check the area of the site where drilling will occur for underground objects. At minimum, a OneCall locate request should be made at least one week in advance of drilling in order to give public utility locators time to mark known buried utility lines. All planned boring locations should be marked on the ground with white spray paint prior to making a locate request. In almost all cases, a private utility locator should also clear the area of drilling any underground objects using electromagnetic techniques. If drilling is to occur in close proximity to buried utilities, the work plan may specify use of an air knife or vacuum to clear the borehole to a depth below the utility lines.

3.2 COLLECTING SOIL SAMPLES FOR CLASSIFICATION

1. Before beginning drilling, record the following information on each log:
   a. Operator’s name and company, equipment make/model, equipment measurements (i.e., sampler length and diameter, hammer weight and stroke if using hollow stem auger, boring diameter)
   b. Your name, date, project, boring name and approximate descriptive location (i.e., where is the soil boring relative to known site features). Include a description of the ground surface and whether or not coring was necessary, if coring was necessary, include core diameter, concrete thickness, and subcontractor information.

   c. A small hand drawn map showing your location with measurements to a stationary reference point, or GPS coordinates (ideally, both). This is also a good place to note if you have had to move a boring location because of underground utilities, access issues, etc. It is important to note the reason for relocation and the direction and distance moved (i.e., moved 10 feet to the north due to presence of subsurface water line).

2. If you are using a hollow stem auger drilling method, it is important to communicate to the driller how often you would like a split spoon sample collected. Typically this would be continuous or every 5 feet but may be different depending on the project needs.
3. Note any feedback from the driller about the drilling conditions. This may include difficult drilling or rig chatter (usually caused by hard materials), heaving sands (usually caused by hydrostatic pressure on the borehole), caving, or hole instability.
4. For split spoon samples, record the number of hammer blows (blow counts) necessary to drive the sampler each 6-inch increment, as reported by the driller. If more than 50 blows are needed, record the distance that the sampler was driven in 50 blows (i.e., 2-inches in 50 blows). This is referred to as the standard penetration test.
5. Cover the sampling table with plastic sheeting. Lay an engineer's tape lengthwise across the sampling table. Once a sample has been collected, orient it on the table so that the top is aligned with the 0-foot mark on the tape.
6. Split open the sampler, core barrel liner, or sample collection bag. Record the depth interval that the sampler was driven and the depth interval of soil that was recovered. For split spoons or single-cased core barrels, such as Geoprobe direct-push rods, determine whether any loose 'slough' soil has been dislodged by the drilling equipment and deposited at the top of your core (AMS direct push rods are double cased and do not create slough). Do not include slough in the measurement of the soil recovered. Often the core will be filled with an uninterrupted column of soil that is shorter in length than the total drive interval. In such cases, record the recovery interval as it is situated in the core unless you are able to determine the actual depth where the soil sample originated. For the purposes of recording soil observations and collecting samples for analysis, assume that the recovered column of soil has been evenly compressed unless you are able to determine the interval(s) in which compression has occurred. Decompress the recovered soil when making further observations (e.g., if the recovered soil column is 80 percent of the length of the drive interval, assume 0.8 feet of recovered soil represent 1 foot of soil in situ).
7. Before further disturbing the soil, take volatile organic compound (VOC) measurements with a photoionization detector (PID), if using. Take measurements by making crevices in the soil with a spoon or scraper and inserting the PID probe into these openings. Alternatively, collect small spoonfuls of soil into Ziploc bag(s), seal the bag(s), gently shake the bag(s), and insert the PID probe through the top of the bag(s) and into the headspace once the soil vapor has been allowed to equilibrate with the

surrounding air (headspace method). The bag headspace screening method is typically more accurate and is useful at sites with low concentrations of VOCs, whereas the in-situ method is a faster and more qualitative method, best used at sites with higher VOC concentrations. If sampling for VOCs by the U.S. Environmental Protection Agency (USEPA) Method 5035, these soil samples should also be collected prior to disturbing the core. Soil sampling procedures using USEPA Method 5035 are described in detail in the Soil Sample Collection Standard Guideline.

8. Use a straight edge to scrape the soil level and expose the center of the core. Photograph the core alongside the measuring tape and an index card displaying the soil boring location/ID and depth interval.

3.3 SOIL CLASSIFICATION

Soils are described using the following characteristics: Color, consistency, MAJOR CONSTITUENT, minor constituent, geotechnical properties, moisture content, other observations (e.g. visual or olfactory indications of contamination). The USCS field guide is included in this guidance for reference. The steps below should help guide the logger in classifying soils according to the USCS.

1. Record the color of the soil. A descriptive color (i.e., light brown) or a color identified using the Munsell color chart are both valid.
2. Determine whether organic matter influences the properties of the material. If so, record as an organic soil.
3. If the soil is predominantly inorganic, identify whether the major constituent is coarse- or fine-grained. Coarse-grained soils include sands and gravels; fine-grained soils include silts and clays.
    a. For coarse grained soils, determine:
        i. Grain size(s) present including fine, medium, or coarse, and grain size distribution including well-graded (a mixture of fine to coarse grains) or poorly-graded (uniform in size). The USCS guide is helpful for determining grain sizes. If the major constituent is gravel, note its angularity using “rounded,” “sub-angular” or “angular.”
        ii. Minor constituent(s). If a minor constituent represents less than approximately 15% of the sample, note this as “with [minor constituent]” and optionally, whether it is “trace” (<5%) or “few” (5-15%). If a minor constituent represents more than 15% of the sample, use “[minor constituent]-y.” For example, a sand with 5% silt would be classified as a “SAND with trace silt” and sand with 30% silt would be classified as a “SILTY SAND.” For coarse-grained soils with fines between 5% and 15%, the USCS includes several dashed classifications, such as SW-SM. It is often helpful to record an estimated percentage for soil constituents to aid in classification according to the USCS.

   b. For fine-grained soils, determine:

      i. Major constituent. To determine whether a material is silt or clay, a simple settling test may be performed in a glass vial or gloved hand by spraying a small amount of the sample with water. Silt particles will settle out of suspension in water within a few minutes, whereas clay particles will remain suspended for a longer period of time.

      ii. Minor constituent(s). As described above, determine the approximate percentage and record as “with [minor constituent]” or “[minor constituent]-y” as appropriate. It is often helpful to record an estimated percentage to aid in classification according to the USCS.

      iii. Geotechnical properties. Depending on project data needs, geotechnical properties may be optional but often provide helpful information. Geotechnical properties include plasticity (ranging from “non-plastic” to “highly plastic” as determined by a thread test) and consistency (ranging from “loose” to “very dense” for coarse-grained soils and “soft” to “hard” for fine-grained soils). When using split spoon samplers, blow counts recorded during the standard penetration test (also referred to as N-values) are used to determine consistency; when using direct-push or sonic drilling, consistency is described qualitatively.

4. Using the USCS guide and the description of the soil, determine the appropriate USCS symbol and record it on the log. If it is difficult to distinguish the major constituent of a soil, a borderline “/” symbol may be used to denote the two potential major constituents present. This is not the same as the USCS classifications that utilize a dash, such as SW-SM.

5. Determine whether contacts between stratigraphic units are abrupt, or gradational. Note abrupt contacts using a solid line and gradational contacts using a dotted line. If the contact between units is not visible and was missed between sample depths, a dashed line is used.

6. If the site or area geology is known, and you are confident in your identification of a specific stratum, note the geologic unit. At a site where the geology is uncertain, you may make some more general notes about the depositional environment, such as identifying probable estuarine deposits, colluvium, glacial till, etc.

7. Note the moisture content of the soil, using “dry,” “moist,” “wet,” or “saturated.” Mark the water table at the time of drilling on the log at the depth where saturated soil is first observed.

3.4 OTHER OBSERVATIONS

1. Record other materials observed in the sample. These may include minor amounts of rootlets or other plant matter, evidence of organisms such as shell fragments, and/or anthropogenic debris such as brick fragments, plastic, or metal debris.
2. Record potential indications of contamination. These may include odors, colored or black staining on soils, colored crystals, hydrocarbon sheens, or non-aqueous phase liquid (NAPL) product.
    a. To test for hydrocarbon sheen, put a small amount of soil in a bowl, saturate with water and swirl, noting whether a rainbow sheen appears on the surface of the water. Alternatively, place a small amount of water in the bottom of the bowl and a small amount of soil along the side, then tilt the bowl so that the water slowly touches the soil. If observed, note the color of the sheen and describe as slight (discontinuous on the water surface), moderate (continuous but spreading slowly) or high (rainbow sheen covering entire surface water).
    b. To test for the presence of NAPL, use a clean paper towel to blot the surface of the core and note the proportion of the towel that is saturated with oil (be sure to allow the towel to dry when blotting moist to wet soils to distinguish between saturation due to NAPL and due to water).
3. Note the final depth of the boring and any reasons for early termination of the boring (i.e., refusal).
4. If monitoring wells will be installed, follow the Standard Guidelines for monitoring well construction and well development.

4.0 Decontamination

All reusable equipment that comes into contact with soil should be decontaminated as follows prior to moving to the next sampling location.

Split spoons, stainless steel bowls and spoons, and any other tools used for soil classification must be decontaminated between boring locations. If collecting soil samples for chemical analysis, split spoons and any tools used for sample processing must be decontaminated between each sample; alternatively, disposable bowls and spoons may be used. Equipment decontamination will consist of a tap water rinse to remove soil particles, followed by scrubbing with brushes and an alconox (or similar)/clean water solution and a final rinse with distilled or deionized water.

5.0 Investigation-Derived Waste

Unless otherwise specified in the project work plan, waste soils and other drilling materials generated during soil boring activities will be contained, transported, disposed of in accordance with applicable laws, and stored in a designated area until transported off-site for disposal.

The approach to handling and disposal of these materials is as follows. For investigation-derived waste (IDW) that is contained, such as waste soils, 55-gallon drums approved by the Washington State Department of Transportation (WSDOT) will be supplied by the driller and used for temporary storage pending profiling and disposal. Each container holding IDW will be sealed and labeled as to its contents (e.g., "soil cuttings"), the dates on which the wastes were placed in the container, the owner's name, contact information for the field person who generated the waste, and the site name.

Whenever possible, IDW contained within drums will be characterized relative to applicable waste criteria using data from the sampling locations. Material that is designated for off-site disposal will be transported to an off-site facility that is permitted to accept the waste. Manifests will be used as appropriate for disposal.

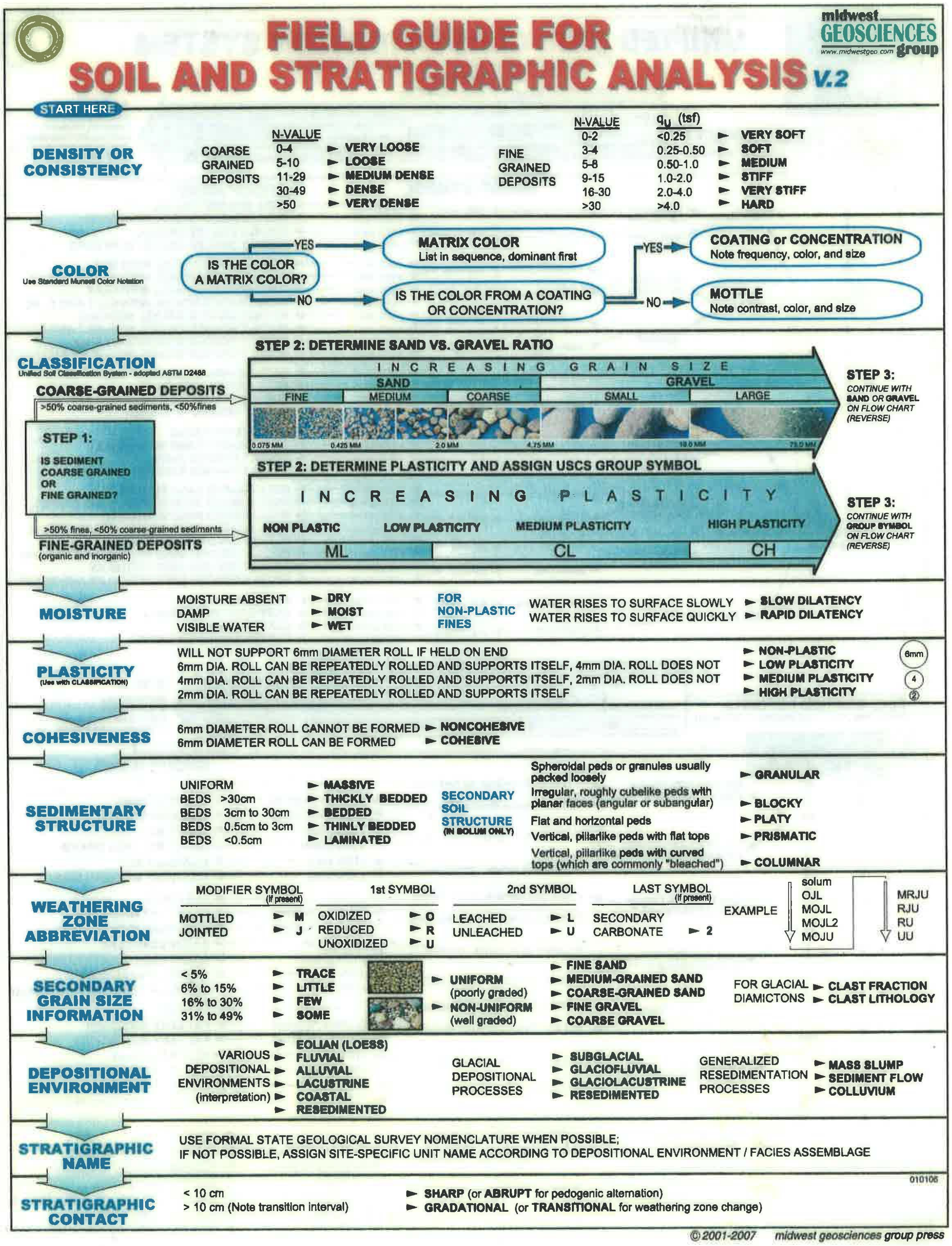
Disposable sampling materials and incidental trash such as paper towels and personal protective equipment (PPE) used in sample processing will be placed in heavy duty garbage bags or other appropriate containers and disposed of as solid waste in the municipal collection system (i.e., site dumpster).

6.0 Field Documentation

All observations should be recorded on a soil boring form appropriate for the drilling method or in a bound field notebook. Field staff should make an effort to record as much detail as possible in the field log. After the field work is complete, a set of final logs (usually electronic) that serve as the record for the project will be completed in consultation with the project manager or field manager.

Enclosure: USCS Soil Classification Field Guide

USCS SOIL CLASSIFICATION FIELD GUIDE



FIELD GUIDE FOR SOIL AND STRATIGRAPHIC ANALYSIS v.2

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START HERE

DENSITY OR CONSISTENCY

COARSE GRAINED DEPOSITS

N-VALUE	
0-4	► **VERY LOOSE**
5-10	► **LOOSE**
11-29	► **MEDIUM DENSE**
30-49	► **DENSE**
>50	► **VERY DENSE**

FINE GRAINED DEPOSITS

N-VALUE	q_u (tsf)	
0-2	<0.25	► **VERY SOFT**
3-4	0.25-0.50	► **SOFT**
5-8	0.50-1.0	► **MEDIUM**
9-15	1.0-2.0	► **STIFF**
16-30	2.0-4.0	► **VERY STIFF**
>30	>4.0	► **HARD**

COLOR
Use Standard Munsell Color Notation

IS THE COLOR A MATRIX COLOR?
- YES → **MATRIX COLOR** List in sequence, dominant first
- NO → IS THE COLOR FROM A COATING OR CONCENTRATION?
  - YES → **COATING or CONCENTRATION** Note frequency, color, and size
  - NO → **MOTTLE** Note contrast, color, and size

CLASSIFICATION
Unified Soil Classification System - adopted ASTM D2488

STEP 1: IS SEDIMENT COARSE GRAINED OR FINE GRAINED?

COARSE-GRAINED DEPOSITS
>50% coarse-grained sediments, <50%fines

STEP 2: DETERMINE SAND VS. GRAVEL RATIO

INCREASING GRAIN SIZE

SAND			GRAVEL	
FINE	MEDIUM	COARSE	SMALL	LARGE

0.075 MM 0.425 MM 2.0 MM 4.75 MM 19.0 MM 75.0 MM

STEP 3: *CONTINUE WITH **SAND OR GRAVEL** ON FLOW CHART (REVERSE)*

FINE-GRAINED DEPOSITS
(organic and inorganic)
>50% fines, <50% coarse-grained sediments

STEP 2: DETERMINE PLASTICITY AND ASSIGN USCS GROUP SYMBOL

INCREASING PLASTICITY

NON PLASTIC	LOW PLASTICITY	MEDIUM PLASTICITY	HIGH PLASTICITY
ML	CL		CH

STEP 3: *CONTINUE WITH **GROUP SYMBOL** ON FLOW CHART (REVERSE)*

MOISTURE

MOISTURE ABSENT ► **DRY**
DAMP ► **MOIST**
VISIBLE WATER ► **WET**

FOR NON-PLASTIC FINES
WATER RISES TO SURFACE SLOWLY ► **SLOW DILATENCY**
WATER RISES TO SURFACE QUICKLY ► **RAPID DILATENCY**

PLASTICITY
(Use with CLASSIFICATION)

WILL NOT SUPPORT 6mm DIAMETER ROLL IF HELD ON END ► **NON-PLASTIC**
6mm DIA. ROLL CAN BE REPEATEDLY ROLLED AND SUPPORTS ITSELF, 4mm DIA. ROLL DOES NOT ► **LOW PLASTICITY**
4mm DIA. ROLL CAN BE REPEATEDLY ROLLED AND SUPPORTS ITSELF, 2mm DIA. ROLL DOES NOT ► **MEDIUM PLASTICITY**
2mm DIA. ROLL CAN BE REPEATEDLY ROLLED AND SUPPORTS ITSELF ► **HIGH PLASTICITY**

6mm
4
②

COHESIVENESS

6mm DIAMETER ROLL CANNOT BE FORMED ► **NONCOHESIVE**
6mm DIAMETER ROLL CAN BE FORMED ► **COHESIVE**

SEDIMENTARY STRUCTURE

UNIFORM ► **MASSIVE**
BEDS >30cm ► **THICKLY BEDDED**
BEDS 3cm to 30cm ► **BEDDED**
BEDS 0.5cm to 3cm ► **THINLY BEDDED**
BEDS <0.5cm ► **LAMINATED**

SECONDARY SOIL STRUCTURE (IN SOLUM ONLY)
Spheroidal peds or granules usually packed loosely ► **GRANULAR**
Irregular, roughly cubelike peds with planar faces (angular or subangular) ► **BLOCKY**
Flat and horizontal peds ► **PLATY**
Vertical, pillarlike peds with flat tops ► **PRISMATIC**
Vertical, pillarlike peds with curved tops (which are commonly "bleached") ► **COLUMNAR**

WEATHERING ZONE ABBREVIATION

MODIFIER SYMBOL (if present)		1st SYMBOL		2nd SYMBOL		LAST SYMBOL (if present)	
MOTTLED	► M	OXIDIZED	► O	LEACHED	► L	SECONDARY CARBONATE	► 2
JOINTED	► J	REDUCED	► R	UNLEACHED	► U		
		UNOXIDIZED	► U				

EXAMPLE

solum	
OJL	MRJU
MOJL	RJU
MOJL2	RU
MOJU	UU

SECONDARY GRAIN SIZE INFORMATION

< 5% ► **TRACE**
6% to 15% ► **LITTLE**
16% to 30% ► **FEW**
31% to 49% ► **SOME**

► **UNIFORM** (poorly graded)
► **NON-UNIFORM** (well graded)

► **FINE SAND**
► **MEDIUM-GRAINED SAND**
► **COARSE-GRAINED SAND**
► **FINE GRAVEL**
► **COARSE GRAVEL**

FOR GLACIAL DIAMICTONS ► **CLAST FRACTION** ► **CLAST LITHOLOGY**

DEPOSITIONAL ENVIRONMENT

VARIOUS DEPOSITIONAL ENVIRONMENTS (interpretation)
► **EOLIAN (LOESS)**
► **FLUVIAL**
► **ALLUVIAL**
► **LACUSTRINE**
► **COASTAL**
► **RESEDIMENTED**

GLACIAL DEPOSITIONAL PROCESSES
► **SUBGLACIAL**
► **GLACIOFLUVIAL**
► **GLACIOLACUSTRINE**
► **RESEDIMENTED**

GENERALIZED RESEDIMENTATION PROCESSES
► **MASS SLUMP**
► **SEDIMENT FLOW**
► **COLLUVIUM**

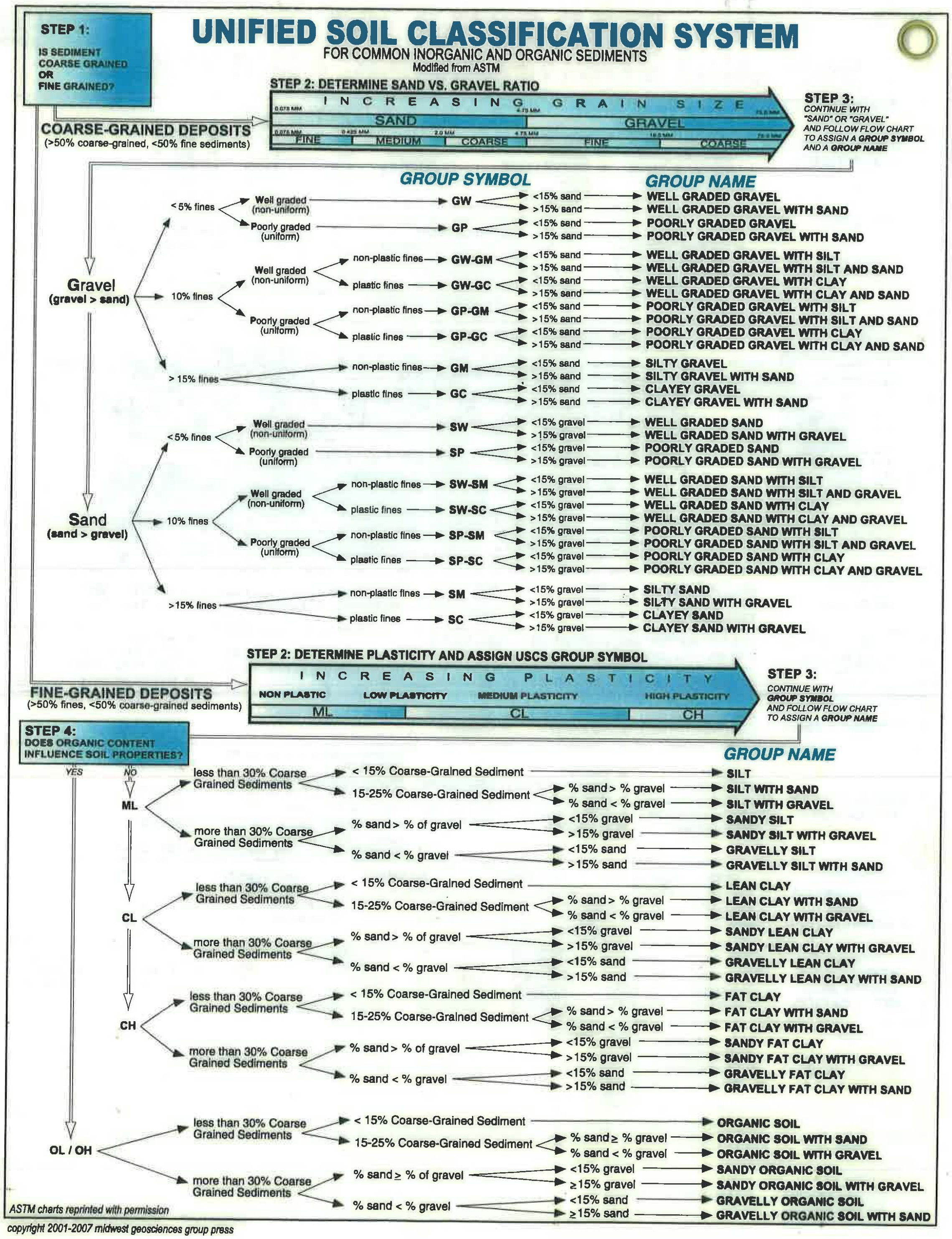
STRATIGRAPHIC NAME

USE FORMAL STATE GEOLOGICAL SURVEY NOMENCLATURE WHEN POSSIBLE;
IF NOT POSSIBLE, ASSIGN SITE-SPECIFIC UNIT NAME ACCORDING TO DEPOSITIONAL ENVIRONMENT / FACIES ASSEMBLAGE

STRATIGRAPHIC CONTACT

010106

< 10 cm ► **SHARP** (or **ABRUPT** for pedogenic alternation)
> 10 cm (Note transition interval) ► **GRADATIONAL** (or **TRANSITIONAL** for weathering zone change)


UNIFIED SOIL CLASSIFICATION SYSTEM
FOR COMMON INORGANIC AND ORGANIC SEDIMENTS
Modified from ASTM
STEP 1:
IS SEDIMENT COARSE GRAINED OR FINE GRAINED?
STEP 2: DETERMINE SAND VS. GRAVEL RATIO
INCREASING GRAIN SIZE
0.075 MM
4.75 MM
75.0 MM
SAND
GRAVEL
0.075 MM
0.425 MM
2.0 MM
4.75 MM
19.0 MM
75.0 MM
FINE
MEDIUM
COARSE
FINE
COARSE
COARSE-GRAINED DEPOSITS
(>50% coarse-grained, <50% fine sediments)
STEP 3:
CONTINUE WITH "SAND" OR "GRAVEL" AND FOLLOW FLOW CHART TO ASSIGN A GROUP SYMBOL AND A GROUP NAME
GROUP SYMBOL
GROUP NAME
Gravel
(gravel > sand)
< 5% fines
Well graded (non-uniform)
GW
<15% sand
>15% sand
WELL GRADED GRAVEL
WELL GRADED GRAVEL WITH SAND
Poorly graded (uniform)
GP
<15% sand
>15% sand
POORLY GRADED GRAVEL
POORLY GRADED GRAVEL WITH SAND
10% fines
Well graded (non-uniform)
non-plastic fines
GW-GM
<15% sand
>15% sand
WELL GRADED GRAVEL WITH SILT
WELL GRADED GRAVEL WITH SILT AND SAND
plastic fines
GW-GC
<15% sand
>15% sand
WELL GRADED GRAVEL WITH CLAY
WELL GRADED GRAVEL WITH CLAY AND SAND
Poorly graded (uniform)
non-plastic fines
GP-GM
<15% sand
>15% sand
POORLY GRADED GRAVEL WITH SILT
POORLY GRADED GRAVEL WITH SILT AND SAND
plastic fines
GP-GC
<15% sand
>15% sand
POORLY GRADED GRAVEL WITH CLAY
POORLY GRADED GRAVEL WITH CLAY AND SAND
> 15% fines
non-plastic fines
GM
<15% sand
>15% sand
SILTY GRAVEL
SILTY GRAVEL WITH SAND
plastic fines
GC
<15% sand
>15% sand
CLAYEY GRAVEL
CLAYEY GRAVEL WITH SAND
Sand
(sand > gravel)
<5% fines
Well graded (non-uniform)
SW
<15% gravel
>15% gravel
WELL GRADED SAND
WELL GRADED SAND WITH GRAVEL
Poorly graded (uniform)
SP
<15% gravel
>15% gravel
POORLY GRADED SAND
POORLY GRADED SAND WITH GRAVEL
10% fines
Well graded (non-uniform)
non-plastic fines
SW-SM
<15% gravel
>15% gravel
WELL GRADED SAND WITH SILT
WELL GRADED SAND WITH SILT AND GRAVEL
plastic fines
SW-SC
<15% gravel
>15% gravel
WELL GRADED SAND WITH CLAY
WELL GRADED SAND WITH CLAY AND GRAVEL
Poorly graded (uniform)
non-plastic fines
SP-SM
<15% gravel
>15% gravel
POORLY GRADED SAND WITH SILT
POORLY GRADED SAND WITH SILT AND GRAVEL
plastic fines
SP-SC
<15% gravel
>15% gravel
POORLY GRADED SAND WITH CLAY
POORLY GRADED SAND WITH CLAY AND GRAVEL
>15% fines
non-plastic fines
SM
<15% gravel
>15% gravel
SILTY SAND
SILTY SAND WITH GRAVEL
plastic fines
SC
<15% gravel
>15% gravel
CLAYEY SAND
CLAYEY SAND WITH GRAVEL
STEP 2: DETERMINE PLASTICITY AND ASSIGN USCS GROUP SYMBOL
INCREASING PLASTICITY
NON PLASTIC
LOW PLASTICITY
MEDIUM PLASTICITY
HIGH PLASTICITY
ML
CL
CH
FINE-GRAINED DEPOSITS
(>50% fines, <50% coarse-grained sediments)
STEP 3:
CONTINUE WITH GROUP SYMBOL AND FOLLOW FLOW CHART TO ASSIGN A GROUP NAME
STEP 4:
DOES ORGANIC CONTENT INFLUENCE SOIL PROPERTIES?
YES
NO
GROUP NAME
ML
less than 30% Coarse Grained Sediments
< 15% Coarse-Grained Sediment
SILT
15-25% Coarse-Grained Sediment
% sand > % gravel
SILT WITH SAND
% sand < % gravel
SILT WITH GRAVEL
more than 30% Coarse Grained Sediments
% sand > % of gravel
<15% gravel
SANDY SILT
>15% gravel
SANDY SILT WITH GRAVEL
% sand < % gravel
<15% sand
GRAVELLY SILT
>15% sand
GRAVELLY SILT WITH SAND
CL
less than 30% Coarse Grained Sediments
< 15% Coarse-Grained Sediment
LEAN CLAY
15-25% Coarse-Grained Sediment
% sand > % gravel
LEAN CLAY WITH SAND
% sand < % gravel
LEAN CLAY WITH GRAVEL
more than 30% Coarse Grained Sediments
% sand > % of gravel
<15% gravel
SANDY LEAN CLAY
>15% gravel
SANDY LEAN CLAY WITH GRAVEL
% sand < % gravel
<15% sand
GRAVELLY LEAN CLAY
>15% sand
GRAVELLY LEAN CLAY WITH SAND
CH
less than 30% Coarse Grained Sediments
< 15% Coarse-Grained Sediment
FAT CLAY
15-25% Coarse-Grained Sediment
% sand > % gravel
FAT CLAY WITH SAND
% sand < % gravel
FAT CLAY WITH GRAVEL
more than 30% Coarse Grained Sediments
% sand > % of gravel
<15% gravel
SANDY FAT CLAY
>15% gravel
SANDY FAT CLAY WITH GRAVEL
% sand < % gravel
<15% sand
GRAVELLY FAT CLAY
>15% sand
GRAVELLY FAT CLAY WITH SAND
OL / OH
less than 30% Coarse Grained Sediments
< 15% Coarse-Grained Sediment
ORGANIC SOIL
15-25% Coarse-Grained Sediment
% sand ≥ % gravel
ORGANIC SOIL WITH SAND
% sand < % gravel
ORGANIC SOIL WITH GRAVEL
more than 30% Coarse Grained Sediments
% sand ≥ % of gravel
<15% gravel
SANDY ORGANIC SOIL
≥15% gravel
SANDY ORGANIC SOIL WITH GRAVEL
% sand < % gravel
<15% sand
GRAVELLY ORGANIC SOIL
≥15% sand
GRAVELLY ORGANIC SOIL WITH SAND
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F|S STANDARD GUIDELINE

Soil Sample Collection

DATE/LAST UPDATE: May 2015

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field, but are not intended to be step by step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines for the sampling method they intend to use and should review and understand these procedures prior to going into the field. It is the responsibility of the field staff to review the standard guidelines with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines.

1.0 Scope and Purpose

This standard guideline presents commonly used procedures for collection of soil samples for characterization and laboratory analysis. The methods presented in this guideline apply to the collection of soil samples during the following characterization activities: soil borings via drilling, manual collection of shallow soil samples, test pit excavation, excavation confirmation, and stockpile characterization. Specific details regarding the collection of discrete and composite samples, and special sampling techniques for volatile organic compounds (VOCs) are also included. The guideline is intended to be used by staff who collect soil samples in the field.

It is important that the field staff completing the soil sample collection discusses the specific needs for a particular investigation with the project geologist, the project manager, or whoever will ultimately be responsible for interpreting the findings of the field investigation. This discussion is in addition to field training and general knowledge about soil sampling, and should happen prior to entering the field, with additional follow-up before finalizing the field forms, after the investigation is complete.

2.0 Equipment and Supplies

Soil Sampling Equipment and Tools:

- Tape measure or measuring wheel
- Stainless steel bowls and spoons
- Graduated plunger and collection tubes for VOC samples (if needed)
- Trash bags
- Decontamination tools including:
  - Paper towels
  - Spray bottles of alconox (or similar) solution
  - Deionized or distilled water
- Adhesive drum labels, or paint or grease pen
- Washington State Department of Transportation- (WSDOT) approved drums for investigation-derived waste (IDW) disposal, if needed (if drilling, to be provided by driller)
- Camera
- Hand-held global position system (GPS; optional)
- Coolers, sample jars, labels, ice

Paperwork:

- Work Plan and/or Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP)
- Health and Safety Plan (HASP)
- Sample collection forms printed in Rite in the Rain paper, or Rite in the Rain field notebook

Personal Equipment:

- Steel-toed boots
- Safety vest
- Safety glasses
- Nitrile gloves
- Rain gear
- Work gloves

3.0 Standard Procedures

3.1 OFFICE PREPARATION

Prior to going into the field, review the SAP/QAPP tables to become familiar with the desired sample intervals, nomenclature, field Quality Assurance (QA) samples, analytes, sample containers, and holding times for each analytical method.

At least one week prior to sampling, coordinate with the laboratory specified in the SAP/QAPP to get coolers and appropriate sample containers. Familiarize yourself with the volume requirements and container types, preservation methods, and holding times for each class of analytes.

3.2 GENERAL SOIL SAMPLE COLLECTION PROCEDURES

1. Locate the desired sample location and depth interval using a handheld GPS or by taking field measurements from known site features. Note the soil type and any other observations or indications of contamination on a soil boring log, soil sample collection form or field notebook, as described in the Soil Logging Standard Guideline. Note the location and depth of the sample and take a photograph, if possible.
2. Refer to subsections 3.2.1 through 3.2.4 for the appropriate soil collection procedures for drilling, shallow soil, test pit excavation, excavation confirmation, and stockpiles. If collecting samples for VOC analysis by the U.S. Environmental Protection Agency (USEPA) Method 5035, refer to Section 3.3 for specific sample collection procedures for this method. If composite soil sampling is recommended, refer to Section 3.4 for details.
3. Once soil has been collected from the desired depth or interval, mix thoroughly until the sample is homogenous in color, texture, and moisture.
4. Fill the required laboratory-provided jars, taking care not to overfill. If large gravels (diameter greater than ~ 1 inch) are encountered, these should be discarded to ensure that an adequate soil volume is collected for analysis. If necessary, use a clean paper towel to remove soil particles from the threaded mouth of the jar before securing lids to ensure a good seal.
5. Label each jar with the sample name, date, time, field staff initials and required analyses. If collecting a field duplicate, use the sample nomenclature specified in the work plan and note the field duplicate name and sample time in the sample log. If extra volume for matrix spike/matrix spike duplicate (MS/MSD) analysis is being collected, use the same name on all jars. Soil samples should be protected from moisture by placing the filled sample jars into separate sealed Ziploc bags before placing them into a cooler.

6. Complete a chain-of-custody form for all samples, including sample names, date and time of collection, number of containers, and required analyses and methods. Keep samples on ice to maintain temperatures of 4-6 degrees Celsius (°C) and transport to the laboratory under chain-of-custody procedures.

3.2.1 Soil Sample Collection via Drilling

These procedures should be used for drilling via direct-push, hollow stem auger, or roto-sonic methods where a pre-designated sample interval (i.e. 0 to 5 feet below ground surface [bgs]) is retrieved from the subsurface using a split spoon sampling device, lined core, or bag sampler.

1. Ensure that reusable sampling equipment has been thoroughly decontaminated prior to sampling.
2. Use a stainless steel spoon or trowel, or disposable scoop to remove an equal volume of soil across the targeted depth interval from the sampler.
    a. If using a split spoon sampler or other reusable sampler, avoid collecting the soil that is touching the sides of the sampler to the extent practical.
    b. If the soil touching a reusable sampler must be collected to obtain adequate volume for analysis, notify the PM and record in the field logbook.

3.2.2 Manual Collection of Shallow Soil Samples

These procedures should be used for shallow soil sampling via scoop, trowel, shovel, or hand auger.

1. Dig or auger to the bottom depth of the shallowest sample to be collected, using a tool that has been cleaned and decontaminated. Verify that the target depth has been reached using a measuring tape.
2. If using a scoop or trowel, collect the soil directly into a decontaminated stainless steel bowl.
3. If using a shovel, the soil may either be collected in bowls or set as aside on plastic sheeting in favor of collecting the sample from the sidewall of the hole. If sampling the sidewall, use a decontaminated or disposable scoop or trowel to collect soil from the target depth, or scrape along the sidewall to collect soil across a target depth interval. Transfer soil to a decontaminated stainless steel bowl, repeating until a sufficient volume has been collected.
4. If using a hand auger, empty the cylinder of the auger directly into a decontaminated stainless steel bowl. It may be necessary to empty the hand auger onto plastic sheeting or into a bowl in order to reach the target depth without overflowing the sampler.
5. Any soil from depth intervals that are not targeted for sampling should be set aside on plastic sheeting and returned to the hole after sampling.

3.2.3 Sample Collection from Test Pits or Limited Soil Excavations

These procedures should be used for collecting samples from test pit explorations excavated using a back hoe or excavator. These same general procedures should also be followed for post-excavation soil samples used to confirm that an excavation has removed contaminated material or to document post-excavation conditions after target excavation limits have been reached.

1. Measure the length, width, and depth of the test pit or excavation area to verify that the target extents have been reached. The lateral spacing of the test pit or excavation confirmation samples, or exact location of samples should be specified in the work plan and typically depend on the size of the excavation area but can vary significantly from project to project.
2. If not specified in the work plan, sidewall samples may be collected either midway between the ground surface and base of the excavation, or incrementally along the entire height of the sidewall. Both sidewall and base (bottom) samples should penetrate a minimum of 6 inches beyond the excavated surface.
3. If the test pit or excavation is less than 4 feet deep, or has been benched to accommodate safe entry, a sample may be collected directly from the sidewall(s). To collect soil from a sidewall, use a decontaminated or disposable scoop, trowel, or shovel to obtain soil from the desired depth or depth interval directly into a decontaminated stainless steel bowl.
4. If a test pit or excavation cannot be safely entered, instruct the excavator operator to scoop sidewall material from the target depth or depth interval. Collect the soil sample from the excavator bucket using a decontaminated stainless steel spoon, trowel, or disposal scoop, avoiding material that has come into contact with the teeth or sides of the bucket. Place an adequate volume of soil into a decontaminated stainless steel bowl. If necessary, follow the compositing procedures in Section 3.4.

3.2.4 Stockpile Sampling

These procedures should be used for classifying stockpiled soil, including excavated soil and imported backfill material.

1. Where potentially contaminated soils have been previously excavated and stockpiled on site, Washington State Department of Ecology (Ecology) guidance recommends using a decontaminated or disposable scoop or trowel, penetrating 6 to 12 inches beneath the surface of the pile at several locations until sufficient volume for analysis is achieved. A decontaminated shovel may also be used to facilitate collection of soil from large piles. The locations for soil collection should be where contamination is most likely to be present based on field screening (i.e. staining, odor, sheen, or elevated photoionization detector [PID] readings). If there are not field indications of contamination, the locations should be distributed evenly around the stockpile.

2. The stockpile may need to be broken up into sections for sample collection depending on the size of the pile (i.e., segregate the pile in half or quarters). If this is necessary, it is important to document where each set of samples were collected from (i.e., north quadrant) and create a field sketch of the pile for reference.
3. If a sampling frequency is not specified in the work plan, the general rule of thumb for contaminated soil stockpile profiling is to collect and submit 3 analytical samples (these samples can be multi-point composites or grabs) for stockpiles less than 100 cubic yards (CY), 5 samples for stockpiles between 100 and 500 CY, 7 samples for stockpiles 500 to 1,000 CY, 10 samples for stockpiles 1,000 to 2,000 CY, and 10 samples for stockpiles larger than 2,000 CY with an additional sample collected for every 500 CY of material. This rule of thumb is consistent with Ecology guidance for site remediation.
4. Samples for characterization of stockpiles of imported backfill or other presumed clean material should also be collected as described above. If not described in the work plan, the typical sample frequency for imported or clean material characterization is one sample per 500 CY.

3.3 SOIL SAMPLE COLLECTION FOR VOC ANALYSIS

If collecting soil samples for VOC analysis by USEPA Method 5035, collect these samples first before disturbing the soil. This method uses a soil volume gauge fitted with a disposable soil sampling plunger tube to collect a soil plug that can be discharged directly to a VOA vial, limiting the loss of volatiles during sampling. The collection of VOC samples using the 5035 method specifies use of an airtight VOA vial with a septum lid. Ecology's interpretation of the USEPA 5035 method allows for field preservation of the sample with methanol or sodium bisulfate, or laboratory preservation (i.e. field collection into an un-preserved vial). It is important to note that if laboratory preservation is the selected method, samples must be received at the laboratory within 48-hours of sample collection. The method of sample preservation for the 5035 method will vary for each site and is dependent on site-specific conditions. Preservation method selection should be coordinated with the laboratory and specified in the sampling plan.

1. Note the volume of soil needed for analysis as specified by the laboratory (commonly 5 or 10 grams). Raise the handle of the soil volume gauge to the slot in the gauge body corresponding to the desired volume and turn clockwise until the tabs in the handle lock into the slot.
2. Insert a sample tube at the open end of the gauge body and turn clockwise until the tabs on the tube lock into the "0 gram" slot. Remove the cap from the sample tube and press directly (where possible) into the shallow soil, soil core/sampler, excavation base or sidewall, or stockpile.
3. Continue pressing the sample tube until the plunger is stopped by the sample volume gauge. If a depth interval (for example 9 to10 feet) is targeted for VOC sampling, collect small volumes of soil across this interval until the sample tube is filled

4. Twist counterclockwise to disengage the sample tube, then depress the plunger to eject the soil plug directly into a laboratory-provided VOA vial. If multiple vials per sample are required, the same plunger may be re-used to fill the remaining vials.

3.4 COMPOSITE SAMPLE COLLECTION

For this guideline, composites are considered to be samples that are collected across more than one location, or multiple depth intervals at a single location. Samples collected over continuous depth intervals within a sampling device (i.e. split spoon) are addressed for each sampling method in Section 3.2 above.

Compositing of sample material may be performed in the field, or by the analytical laboratory. To collect a field composite sample, identify the locations and depth(s) that will comprise the composite. Collect soil from the first target sub-sample depth or depth interval and hold in a decontaminated stainless steel bowl, covered with aluminum foil to prevent cross contamination and label with the location and depth. Continue to collect and hold individual sub-samples until all components of the composite have been collected, then transfer an equal amount of each sub-sample to a clean bowl and homogenize. Fill necessary sample jars from homogenized composite. In some cases, project plans may require that each individual sample that comprised the composite be collected in jars and submitted to the laboratory in the event that individual sample analysis is desired, or if laboratory compositing is requested in addition to field compositing as a field quality control measure. In this case, label each individual jar, but indicate HOLD on the chain-of-custody, and note that the sample is part of composite XYZ.

To collect a laboratory composite sample, collect, and label each sub-sample using the procedures described above in Section 3.2. Record each sub-sample on the chain-of-custody form, and indicate on this form which samples should be composited by the laboratory and the desired name of the composite sample. It is important to communicate to the laboratory if discrete samples will also require analysis (in some cases) or only the composite sample.

4.0 Decontamination

All reusable equipment that comes into contact with soil should be decontaminated prior to moving to the next sampling location.

Stainless steel bowls and spoons, and any tools used for sample processing will be decontaminated between each sample; alternatively, disposable bowls and spoons may be used. Equipment decontamination will consist of a tap water rinse to remove soil particles, followed by scrubbing with brushes and an alconox (or other soap)/clean water solution and a final rinse with distilled or deionized water.

5.0 Investigation-Derived Waste

Unless otherwise specified in the project work plan, waste soils will be contained, transported, disposed of in accordance with applicable laws, and stored in a designated area until transported off-site for disposal.

The approach to handling and disposal of these materials is as follows. For IDW that is containerized, such as waste soils, 55-gallon drums approved by WSDOT will be used for temporary storage pending profiling and disposal. Each container holding IDW will be sealed and labeled as to its contents (e.g., “soil”), the dates on which the wastes were placed in the container, the owner’s name and contact information for the field person who generated the waste, and the site name.

IDW that is placed into drums for temporary storage will be characterized relative to applicable waste criteria using data from the sampling locations whenever possible. Material that is designated for off-site disposal will be transported to an off-site facility permitted to accept the waste. Manifests will be used, as appropriate for disposal.

Disposable sampling materials and incidental trash such as paper towels and personal protective equipment (PPE) used in sample processing will be placed in heavy duty garbage bags or other appropriate containers and disposed of as solid waste in the municipal collection system (i.e., site Dumpster).

6.0 Field Documentation

All observations including sample collection locations, soil descriptions, sample depths, collection times, analyses, and field QC samples should be recorded on a boring log, soil sample collection form, or bound field notebook. Information recorded should additionally include personnel present (including subcontractors), purpose of field event, weather conditions, sample collection date and times, sample analytes, and any deviations from the SAP.

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F|S STANDARD GUIDELINE

Vapor Intrusion

DATE/LAST UPDATE: February 2019

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field, but are not intended to be step-by-step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines for the sampling method they intend to use and should review and understand these procedures prior to going into the field. It is the responsibility of the field staff to review the standard guidelines with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines.

1.0 Scope and Purpose

This standard guideline provides details necessary to complete vapor intrusion monitoring, which may include soil vapor point and sub-slab installation, soil vapor point monitoring and/or sampling, indoor air sampling, and remediation system compliance monitoring. Field screening for volatile organic compounds (VOCs) is most often conducted with a photoionization detector (PID) and confirmed via analytical sample collection. The most common sampling methods are included herein. These guidelines are designed to meet or exceed guidelines set forth by the Draft Washington State Department of Ecology's (Ecology's), *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action* (Ecology 2015 and 2018a). In addition, refer to Ecology's *Updated Process for Initially Assessing the Potential for Petroleum Vapor Intrusion: Implementation Memorandum No. 14* (Ecology 2016), Ecology's *Petroleum Vapor Intrusion (PVI): Updated Screening Levels, Cleanup Levels, and Assessing PVI Threats to Future Buildings: Implementation Memorandum No. 18* (Ecology 2018b), and the U.S. Environmental Protection Agency's (USEPA's) *Technical Guide For Addressing Petroleum Vapor Intrusion At Leaking Underground Storage Tank Sites* and *OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air* (USEPA 2015a and 2015b). Defining the lateral and vertical inclusion zones will determine if soil vapor sampling is required. The Interstate Technology and Regulatory Council (ITRC) online guidance for soil vapor intrusion (ITRC 2014) is another good source of information.

2.0 Equipment and Supplies

The following is a list of typical equipment and supplies that may be necessary to complete vapor intrusion monitoring. It is important to note that this list is for a typical project; site-specific conditions may warrant additional or different equipment for completion of the work.

Sub-Slab, Soil Vapor Point, and Vapor Pin® Installation:

- Rotary hammer drill
- Drill bit
- Vapor point (AMS or similar)
- Stainless steel (SST) dummy tip (optional)
- Teflon™, nylon, or stainless steel tubing
- Sand pack
- Bentonite chips
- Protective cover for permanent point
- Swagelok® on/off valve (optional)
- Caps or compression fittings
- Quick set (concrete) or hydraulic cement
- Paper towels
- Nylon ferrules
- Vapor Pin® Kits (Cox-Colvin & Associates), which include the following:
    - Brass or stainless steel Vapor Pins®
    - Vapor Pin® sleeves
    - Vapor Pin® caps
    - Plastic or stainless steel flush mount covers
    - Spanner screwdriver
    - Stainless steel drilling guide
    - Installation and extraction tool
    - Bottle brush
    - Water dam for leak testing
    - Vapor Pin® Standard Operating Procedures (SOP)
- Shop vac

Soil Vapor Point or Remediation System Screening and/or Sampling:

- PID
- Connector
- Teflon™ or nylon tubing
- Air sampling pump or peristaltic pump
- Tedlar® bag or SUMMA® canisters
- Two adjustable wrenches (to tighten SUMMA® canister connections)
- Duplicate sampling (as necessary if duplicate sample collection is required)
- Soil gas manifolds
- Ferrules/fittings
- Helium (or other detection gas, such as isopropyl alcohol, if leak detection is necessary)
- Helium detector (if leak detection is necessary with helium)
- Soil vapor sampling sheet (attached)

Indoor Air Sampling:

- PID
- Flow regulator
- SUMMA® canisters (6-liter, lab certified)
- Sampling cane (optional)
- At least two adjustable wrenches
- Indoor air building survey form (enclosed)

3.0 Standard Procedures

Soil vapor samples and/or indoor air samples should be collected from a sufficient number of locations to assess the presence of VOCs and potential exposure to workers or occupants of potentially impacted buildings or future building locations.

3.1 PRE-SCREENING ASSESSMENT

When completing a vapor intrusion survey or indoor air sampling, it is important to complete a pre-sampling survey to document potential activities or storage items that may cause interference with sample results. Some important things to note (list is not comprehensive):

- If smoking has occurred in the building

- Storage of potential contaminants (cleaners, fuels, paints, or paint thinners, etc.)
- HVAC system operation (on or off)
- Temperature and weather (wind direction, barometric pressure, etc.)
- Vehicle maintenance or industrial activities on the property or in the immediate vicinity (especially upwind)
- If new carpet or furniture is present

A pre-sampling soil vapor building survey form can be found at the end of this document. Be mindful of your surroundings and make a comprehensive list of potential factors that may influence sample results.

3.2 SOIL VAPOR POINT INSTALLATION

Soil vapor points can be installed along the outside perimeter of a building or in the lowest level of a building directly through the slab (or beneath the floor into the subsurface if there is not a slab). It is important to evaluate the presence of utilities prior to drilling into the subsurface or through a concrete slab.

If the sampling point is for one time use, tubing inserted into a hole drilled in the slab is sufficient. However, if the sampling is to be part of a long-term monitoring program, a more robust sampler, such as a Geoprobe or AMS probe for permanent soil gas point is recommended. Five different methods for installing soil vapor installation points are described here.

1. For temporary sub-slab points:
   a. Drill a hole into the subsurface. Using a rotary hammer drill and a 3/8-inch drill bit (typical diameter size but not necessary), drill a hole through the concrete floor slab of the building and into the sub-slab material to some depth (e.g., 7 to 8 centimeters [cm] or 3 inches). Drilling into the sub-slab material will create an open cavity, which will prevent obstruction of the tubing intake by small pieces of gravel. Once the thickness of the slab is known, the tubing will be cut to ensure that the probe tubing does not reach the bottom of the hole in order to avoid obstruction with sub-slab material. Sample tubing can be placed directly into the sub-slab. Evaluate and note the sub-slab conditions.
   b. Care should be taken to reduce cross-contaminating sub-slab vapor and indoor air vapor. This may be done by sealing the sample point with VOC-free hydraulic cement, hydrated bentonite, or with VOC-free putty to the top of the slab. Once sealed, wait 15 to 30 minutes before sampling.

2. Installation guidelines for a sub-slab Vapor Pin®:[1]

Figure 1. Assembled VAPOR PIN®

   a. Check for buried obstacles and utilities. Set up wet/dry vacuum to collect drill cuttings. Also, look for nearby cracks or other holes in the slab that may cause short circuiting and influence from indoor air.
   b. Drill a 1.5-inch (38 millimeters [mm]) diameter hole at least 1.75 inches (45 mm) into the slab. Use of a Vapor Pin® drilling guide is recommended in the SOP.
   c. Drill a 0.625-inch (16 mm) diameter hole through the slab and approximately 1 inch (25 mm) into the underlying soil to form a void. Hole must be 0.625 inches (16 mm) in diameter to ensure proper seal. The Cox-Colvin SOP recommends using the drill guide provided in the kit. Remove the drill bit, brush the hole with the bottle brush provided in the kit, and remove the loose cuttings with a vacuum.
   d. Place the lower end of Vapor Pin® assembly into the drilled hole. Place the small hole located in the handle of the installation/extraction tool provided in the kit over the vapor pin to protect the barb fitting, and tap the Vapor Pin® into place using a dead blow hammer or rubber mallet. Make sure the installation/extraction tool is aligned parallel to the Vapor Pin® to avoid damaging the barb fitting.
   e. For flush mount installations, cover the Vapor Pin® with a flush mount cover, using either the plastic cover or the optional stainless-steel Secure Cover provided by Vapor Pin®.
   f. Allow 48 hours or more for the sub-slab soil-gas conditions to re-equilibrate prior to sampling.

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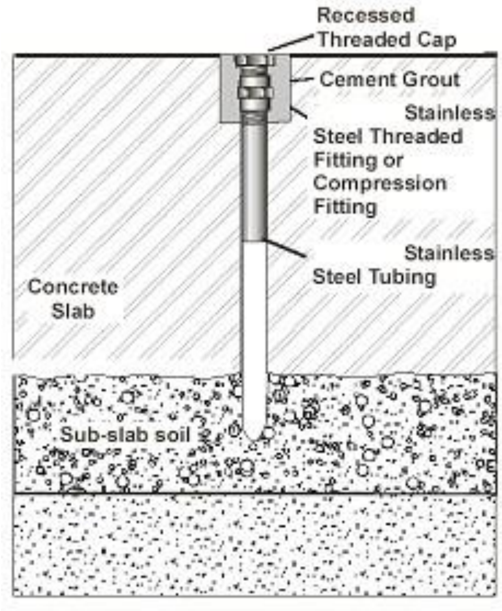
[1] Additionally, refer to Cox-Colvin SOP Installation and Extraction of the Vapor Pin®, which is included with the Vapor Pin® kit.

3. Suggested installation guidelines for temporary outdoor soil gas points using a rotary hammer and drill bit:
    a. Manufacturers, such as Geoprobe or AMS, make soil gas implant systems designed for use with their equipment. Stainless steel or polyvinyl chloride (PVC) screen can also be used to construct an appropriate soil gas point. The probe screen will be fitted with a Swagelok® or similar fitting and connected to a length of 0.25-inch outer diameter, rigid wall nylon or Teflon™ tubing that will be above grade. Refer to the manufacturer or driller's instructions for specific details regarding assembly and deployment.
    b. To seal the point, the implant should be surrounded with a clean sand pack. Concrete (VOC-free hydraulic cement preferred) should be used above the seal to the top of the slab. Placement of some sort of cap or protective device is recommended if the sampling point will remain in place for some time after the soil gas sample is collected. Once sealed, wait 15 to 30 minutes before sampling.
4. Suggested installation guidelines for outside permanent points installed with a Geoprobe rig or hand auger:
    a. Advance the boring using a geoprobe or hand auger to the required maximum depth. Install a 6-inch long by 0.75-inch diameter stainless steel screen that is capped on the bottom end and fitted with a Swagelok® fitting connected on the other end (or similar approved screen or soil vapor point). Attach a length of 0.25-inch outer diameter rigid wall nylon or Teflon™ tubing to the probe screen that will be above grade. The above grade end of the probe should be fitted with a stainless steel Swagelok® on/off control valve or similar valve (optional), which is used to prevent short-circuiting of ambient air into the probes and to conduct closed-valve tests. Teflon™ tape should be used on threaded joints to ensure a good seal. Depending on the work plan, it might be necessary to collect an air equipment blank sample through the vapor probe components prior to installation.
    b. The 6-inch screen tip should be vertically centered in a 1-foot long interval containing standard sand pack, resulting in 3 inches of sand above and below the screen. The sand pack will be covered with a 1-foot interval of dry granular bentonite, which should be covered with at least 2 feet of pre-hydrated granular bentonite. The dry granular bentonite is emplaced immediately above the sand pack to ensure that pre-hydrated granular bentonite slurry does not flow down to the probe screen and seal it. The remainder of the borehole will be filled with pre-hydrated granular bentonite slurry (mixed at the surface and poured in) to approximately 12 inches below ground surface (bgs). The top portion should be completed with a 1-foot thick cement cap. A flush-mounted well box or other suitable protective cover should be installed to protect the nylon/Teflon™ tubing and on/off control valve.

5. Suggested equipment and installation guidelines for permanent sub-slab vapor points within a building; however, site-specific conditions may warrant additional or different equipment for completion of the work:
    a. To install the sub-slab vapor probes, a rotary hammer drill will be used to create a “shallow” hole (e.g., ¼-inch deep) that partially penetrates the slab (do not completely penetrate the slab). A portable vacuum can be used to remove the drill cuttings from the hole without compromising the soil vapor samples. Next, a smaller diameter “inner” hole (e.g., 0.8 cm or 5/16 inch diameter) will be drilled through the remainder of the slab and into the sub-slab material to some depth (e.g., 7 to 8 cm or 3 inches). Drilling into the sub-slab material will create an open cavity which will prevent obstruction of the probes by small pieces of gravel. Once the thickness of the slab is known, the tubing will be cut to ensure that the probe tubing does not reach the bottom of the hole and in order to avoid obstruction with sub-slab material.
    b. Each sub-slab vapor point should consist of vacuum-rated Nylon, Teflon™, or stainless steel tubing with ¼-inch outer diameter by 0.15-inch inner diameter, and stainless-steel compression to thread fittings (e.g., ¼-inch outer diameter Swagelok® (SS-400-7-4) NPT female thread connectors or similar equipment). This will be capped with sub-slab tamper resistant cap or other similar protective caps that will be inset into the floor to avoid trip hazards. When time to sample, the sub-slab tamper resistant cap will be removed and Nylon tubing will be attached to the sub-slab vapor point with a ¼-inch out diameter (SS-400-1-4) male NPT. Prior to the installation of one of the sub-slab vapor probes, an air equipment blank sample will be collected if required by the work plan (See Section 3.4.3).
    c. Teflon™ tape should be used with all stainless steel treads. All fittings should be attached prior to installing the probe in the sub-slab. A sub-slab tamper resistant cap will be used to ensure that the top of the probe is flush with the surface so as not to interfere with day-to-day use of the building. Portland cement can be used as a surface seal and allowed to cure for at least 24 hours prior to sampling. Hydraulic cement may also be used if free of VOCs, and requires less cure time (typically less than one hour) prior to sample collection. A typical soil gas probe schematic is provided here for reference.



Sub-slab soil gas probe schematic (Source: Ecology 2016a)

3.3 SOIL VAPOR POINT SAMPLING USING TEDLAR® BAGS

The objective of the vapor sampling procedures is to collect representative samples of the targeted media and analyze the gas for the presence of VOCs. Typically, a low volume air pump is used to pull a sample through the sampling train.

1. Connect proper tubing to your sampling point and to your low volume air pump.
2. Purge for 3 to 5 minutes to ensure that you are collecting a representative sample.
3. After purging, connect your Tedlar® bag to your air pump and collect your sample (Note: Tedlar® bags should be filled at a rate of approximately 5 liters per minute).
4. A PID is typically used in conjunction with sample collection in a Tedlar® bag.
    a. Connect the PID probe to the sample container using a section of tubing
    b. Use the PID to read the organic vapor level present in the sample.

Soil Vapor samples are typically collected into 1-liter Tedlar® bags and have a short (typically less than 72-hours) holding time. Samples collected into Tedlar® bags should be transported to the laboratory immediately under chain-of-custody protocol and stored in a dark container at ambient temperature during transport out of direct UV-light. Do not ship Tedlar® bags to the laboratory using an air transportation method as the pressure could compromise the sample or the bag. If air transport is necessary, do not completely fill the Tedlar® to avoid bursting. Soil vapor grab samples can also be collected into 1-liter SUMMA® canisters to provide additional holding time, lower laboratory method detection limits for some analytes, or sample delivery alternatives.

3.4 SOIL VAPOR AND SUB-SLAB SAMPLING WITH SUMMA® CANISTERS

Prior to soil vapor sampling, check all soil vapor sampling supplies to ensure the right sampling equipment arrived from the lab including duplicate Tees, if duplicate sample collection is necessary, and purging canisters. Conduct the following:

- Confirm that all SUMMA® canisters have at least 27 to 30 inches of mercury (in. Hg) prior to going out in the field to sample.
- Check and record all manifold and SUMMA® canister tags and numbers.
- Make sure all connections on the SUMMA® canisters and manifolds are tight.
- Order Helium (or other tracer gas) if needed and rent a helium detector.

Once the sub-slab or soil vapor probes are installed and the concrete well seal at each vapor point has fully cured, vapor sampling activities may commence (ideally a minimum of 2 hours is necessary for probe equilibration, depending on surface seal cure time). Alternatively, existing monitoring wells that are appropriately screened for a vapor intrusion assessment may be used. If indoor air samples will be collected, they may be collected simultaneously during the sub-slab sampling activities (details found in Section 3.6) if required by the work plan. If feasible, vapor sampling should not be conducted during or immediately after a significant rain event (i.e., greater than an inch of rainfall) due to the reduced effective diffusion coefficient and decrease in relative vapor saturation in the unsaturated zone. For sub-slab or soil vapor probe sampling, 1-liter lab certified SUMMA® canisters should be used in order to minimize the volume of soil vapor collected.

A closed-valve test should be conducted prior to soil vapor sample collection to check for leaks in the sampling train. A closed-valve test is conducted by capping the ends with proper Swagelok caps and/or closing any valves at the sampling point and purge canister. Once all ends are closed tight, turn the sampling canister valve on for 5 minutes. If the sampling train maintains its original vacuum for 5 minutes, the equipment will be assumed to be functional and there are no leaks. If the vacuum reading starts to drop, turn off the valves right away, check all connections, tighten if necessary, and re-test. If this passes, the only location that a leak can occur is from the soil ground seal around the vapor probe, which will be tested using helium or another tracer gas during sampling (See Section 3.4.1).

After the close-valve test, a minimum of three tubing volumes should be purged. Purging can be completed using a non-certified 6-Liter SUMMA® canister or a vacuum pump. The maximum flow rate during purging will not exceed the flow rate limit used for subsequent sampling and care will be taken not to over purge. An excel spreadsheet to help calculate tubing volume and purging time can be found at the end of this document.

After the sampling train has been purged, sub-slab soil vapor samples will be collected over a 10 minute period at a flow rate of less than 167 milliliters per minute (mL/min). The flow rate will be controlled by a flow regulator, which is set by the lab. Sub-slab soil vapor samples will be collected in laboratory-certified and pre-evacuated 1-liter SUMMA® canisters. Each SUMMA®

canister will be supplied with an analytical test report certifying that the canister is "clean" to concentrations less than the respective method detection limits (MDLs). Each canister will be equipped with a pre-calibrated flow controller sampling train to allow collection of the desired sample. Prior to collecting the samples, the SUMMA® canister ID numbers will be recorded in the field notebook along with the initial canister vacuums, prior to sampling.

Soil vapor samples will be collected per the following steps:

1. Opening the valve on the top of the SUMMA® canister and recording the time in the log book;
2. Observing the vacuum gauge on the sampling train to ensure that the vacuum in the canister is decreasing over time;
3. Shutting off the valve once the vacuum gage reads between 4.0 and 5.0 inches of mercury (in. Hg).

3.4.1 Leak Testing

In addition to soil gas sampling activities, leak testing may be required at sampling locations and should be conducted using the following soil gas sampling set-up procedures:

When helium is being used as a tracer gas:

- Place a large plastic bag (or other acceptable shroud) around the SUMMA® canister, sampling apparatus, and vapor probe.
- Cut a small hole in the bag to allow tubing to be inserted to introduce tracer gas, such as helium, and to subsequently fill the plastic bag.
- Keep the tracer gas (i.e., helium) concentration in the bag at 10 percent by volume or higher.

When isopropyl alcohol is being used as a tracer gas:

- Soak towels in isopropyl alcohol.
- Place soaked towels over the sampling probe and wrap around all connections.

Detections of the tracer gas in the soil gas samples would indicate that the canister, valves, or ground surface seal to the sample probe have potentially leaked ambient air into the sample. Small amounts of sample train leakage is permissible; however, the leak percentage should not exceed 10 percent of the soil gas results. If the leak percentage exceeds 10 percent, the sampling point may have to be resampled. The integrity of the soil vapor samples can be assessed by estimating the percent leakage as shown here in micrograms per square meter ($\mu g/m^3$):

$$\% \text{ leakage} = 100 \text{ x } \frac{\text{helium concentration in soil vapor sample } [\mu g/m^3]}{\text{average helium concentration measured inside the shroud } [\mu g/m^3]}$$

The above equation for helium can be used because the known average helium concentration can be determined via field screening with a helium detector. Tracer gas leaks should not occur if the sampling train passes a properly performed closed-valve test and given the low flow rate of 167 mL/min.

3.4.2 Final Readings

Once the sampling is completed and the final vacuum is recorded, the sampling train will be removed from the canister and a Swagelok® cap will be tightly fitted to the inlet port of the canister. A PID can be used to record vapor readings from the manifold connection and logged in the notebook and/or soil vapor sampling sheet (enclosed). In addition, the initial canister vacuums, vacuum testing times, purging times, purged volumes, helium readings, sampling starts and times, final vacuum readings, and PID readings should be recorded on a vapor sampling sheet. Some of this information will also be required on the chain-of-custody.

3.4.3 Equipment Blank

Occasionally, the work plan requires an equipment blank to be collected. An equipment blank can be conducted by collecting a sample of clean air or nitrogen through the probe materials before installation in the ground. Analysis of the equipment blank can provide information on the cleanliness of new materials. Clean stainless steel, Nylon or Teflon® tubing and a certified regulator should be used. Lab-certified canisters (the sample canister and the source canister/cylinder, if applicable) or Tedlar® bags can be used to collect an equipment blank.

3.5 USE OF MONITORING WELLS FOR SOIL GAS SAMPLING

While dedicated soil gas probes are typically used to collect soil gas samples, existing monitoring wells that are appropriately located and screened can also be used for this purpose, with limitations. This is an advantage when evaluating the risk of vapor intrusion solely from contaminated aquifers (as compared to contaminated vadose zone soil) as the soil gas that will be sampled can reflect a soil gas sample that lies close to the zone of saturation and represents a worse case condition for equilibrium partitioning of contamination in groundwater to the gas phase. Also, monitoring wells are typically constructed at a deeper depth than soil vapor probes and are less influenced by changes in barometric pressure. They are also inherently constructed to be well sealed against breakthrough from atmospheric air (while purging and sampling). For an existing well to be used for soil gas sampling, it must have at least 2 to 3 feet of open screen above the water table during sample collection.

The main disadvantage of using existing monitoring wells is that the required purge volume would be much greater because of the significantly larger diameter of the well screen as compared to probes. This requires the use of a larger air pump or small blower instead of the SKC hand pump or peristaltic pump. While purging, care must be taken to minimize the vacuum in the well casing which may be large enough to raise the water column high enough to cover the exposed well screen and invalidate the use of the well for sampling soil gas. Appropriate temporary fittings will need to be installed to allow the reduction of the well casing sufficient to allow connection to the collection tubing.

3.6 INDOOR AIR AND OUTDOOR AMBIENT AIR SAMPLE COLLECTION

Indoor air sampling should be conducted in an environment that is representative of normal building use. Indoor air and outdoor ambient air samples are typically collected into 6-liter SUMMA® canisters and can either be a grab (not often recommended) or time weighted samples. For time weighted samples, the laboratory will provide preprogrammed flow controllers for the samples for your desired sample duration. An 8-hour flow controller is the most common to assess typical working conditions or to provide a time-weighted average (TWA) to assess residential risk (a 24-hour flow controller may also be used for residential assessments). SUMMA® canisters should be placed in an area that is close to the breathing zone (i.e., 3 to 5 feet above the floor level), a sampling cane can be connected to the SUMMA® canister to sample indoor air at breathing zone height.

As a basic guideline and starting point, indoor air samples should at a minimum be collected from the basement (if applicable), first floor living or work area, and from outdoors (ambient/upwind). For a typical-size, one-floor residential building or a commercial building less than 1,500 square feet, USEPA recommends the collection of one time-integrated sample within the occupied area (USEPA 2015b). Other site-specific factors will influence the specific placement location of the SUMMA® canisters, such as proximity to subsurface source area(s) or penetrations through the slab or foundation.

Ambient air samples should be collected from a location protected from the elements (wind, rain, snow, or ice) and vehicle traffic on the upwind side of the building (5 to 15 feet away) during the same sampling event the indoor air samples are collected in order to provide information about the outside influences on indoor air quality (i.e., vapors from automotive fuels and exhaust). USEPA recommends that ambient air sampling begin at least 1 hour prior to indoor air sampling and should continue at least 30 minutes before indoor monitoring is complete (USEPA 2015b).

3.6.1 Connection Guidelines

Refer to specific guidelines provided by the laboratory, as equipment can be slightly different from lab to lab. It is important to note the initial vacuum reading on the gauge as well as the post-sampling vacuum. For reference, initial vacuum should be between 27 and 30 inches of mercury, while post-sample vacuum should be between 4 and 5 inches of mercury. Sample collection start and finish times should also be recorded. After sample collection, the SUMMA® canister valve should be shut and the flow controllers should be disconnected from the SUMMA® canisters. Both the controller and the canister ID (unique laboratory tracking ID) should be recorded on the chain-of-custody and the samples should be packed appropriately for delivery to the laboratory following chain-of-custody protocol.

3.6.2 Testing Method and Reporting Limit Considerations

Indoor air samples can be analyzed using various methods, such as TO-15, TO-15 SIM, and TO-17. When considering which analytical method to use, always consider current and future site use and analytical reporting limits to ensure that reporting limits for the selected methods can meet the cleanup levels applicable for the site.

3.7 REMEDIATION SYSTEM VAPOR SAMPLE COLLECTION

Remediation systems that have a soil vapor extraction (SVE) component often require compliance monitoring to evaluate mass removal and effluent discharge limits. Both screening (with a PID) and sampling are routinely conducted during active operation. Tedlar® bags are often used to simplify SVE system screening. Fill a bag following the procedures described in this section and use a PID to measure the VOCs in the sample. Record the maximum observed concentration. Vapor samples for laboratory analysis are most often collected in 1-liter Tedlar® bags, but SUMMA® canisters can also be used. It is a good idea to fill out the label on the Tedlar® bag prior to sample collection.

If the sample port is under vacuum (i.e., SVE manifold or wellhead), it is often necessary to reduce the flow somewhat and to use a hand or mechanical pump to extract the vapor from the line. If the sample port is under a high vacuum, it may be necessary to step down the flow (i.e., close the flow valve) in order to collect a sample. Follow steps in Section 3.3 for sample collection and delivery.

If the sample port is under pressure (i.e., SVE system discharge), the sample can be collected without the use of a pump. Simply attach a clean piece of tubing securely to the sample port, connect the Tedlar® bag to the tubing, open the Tedlar® bag, slowly open the sample port valve, and be careful not to overfill the bag. Remove the Tedlar® bag when full, close the Tedlar® bag (do not over-tighten), and close the sample port valve. Follow steps in Section 3.3 for sample delivery.

4.0 Field Documentation

Soil vapor probe and monitoring point installation field activities should be documented in field notebooks and completion diagrams or boring logs should be completed to document construction. Information recorded will include personnel present, total depth, type and length of implant or screen, screen and filter pack intervals, bentonite seal intervals and surface completion details. Photographs of construction activities should be taken. After probe and monitoring point installation is complete, location coordinates should be recorded with a global positioning system (GPS). If GPS cannot be used (i.e., location within a building), it is important to document the location by recording representative measurements to fixed points.

All sampling activities must be documented in a field notebook and/or on field forms appropriate for the sampling activity. Information recorded will include at a minimum personnel present, date, and time of sample collection, length of sample purge time, and any deviations from the project's work plan or sampling and analysis plan.

Weather conditions should also be recorded and should include temperature, barometric pressure, wind direction and speed, humidity, and degree of cloud cover. Additional site-specific details should also be noted including surface soil conditions, presence of standing water, wet soil, irrigation activities, and if possible, groundwater elevations.

5.0 References

Interstate Technology Regulatory Council (ITRC). 2014. Petroleum Vapor Intrusion: Fundamentals of Screening, Investigation, and Management. <http://www.itrcweb.org/PetroleumVI-Guidance/>. October.

Washington State Department of Ecology (Ecology). 2015. Vapor Intrusion Table Update. (Replaces Table B-1 of Ecology's Guidance for Evaluating Soil Vapor Intrusion in Washington State). <https://ecology.wa.gov/Asset-Collections/Doc-Assets/Regulations-Permits/Guidance-technicalassistance/Vapor-Intrusion/2015VaporIntrusionUpdates>. 6 April.

_____. 2016. *Updated Process for Initially Assessing the Potential for Petroleum Vapor Intrusion: Implementation Memorandum No. 14*. Publication No. 16-09-046. 31 March.

_____. 2018a. *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action*. Review Draft. Prepared by the Toxics Cleanup Program. Publication No. 09-09-047. Originally published October 2009; revised April.

_____. 2018b. *Petroleum Vapor Intrusion (PVI): Updated Screening Levels, Cleanup Levels, and Assessing PVI Threats to Future Buildings: Implementation Memorandum No. 18*. Prepared by the Toxics Cleanup Program. Publication No. 17-09-043. January.

U.S. Environmental Protection Agency (USEPA). 2015a. *Technical Guidance for Addressing Petroleum Vapor Intrusion at Leaking Underground Storage Tank Sites*. Prepared by the Office of Underground Storage Tanks. EPA 510-R-15-001. June.

_____. 2015b. *OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air*. Prepared by the Office of Solid Waste and Emergency Response. OSWER Publication 9200.2-154. June.

Enclosures: Indoor Air Building Survey Form
Purge Volume Calculations during Soil Vapor Sampling
Soil Vapor Sampling Sheet

INDOOR AIR BUILDING SURVEY FORM

Date:

Site Name:

Title:

Building Use:

Occupants: ______________________________

Building Address: ______________________________

Property Owner: ______________________________

Contact's Phone: ______________________________

Number of Occupants: ______________________________

Business or Residential: ______________________________

Building Characteristics

Building Type: ☐ Residential ☐ Multifamily ☐ Office

☐ Commercial ☐ Industrial ☐ Mall

Describe Building:____

____

Number of Floors Below Grade: _____________ ☐ Basement ☐ Slab-On-Grade ☐ Crawl Space

Bldg Dimensions: Width:______ Length: ________ Height: _________

Basement Floor: Dirt / Concrete / Painted? Foundation Walls: Concrete / Cinder Blocks / Stone

VENTILATION SYSTEM

☐ Central Air Conditioning
☐ Conditioning Units
☐ Mechanical Fans
☐ Kitchen Range Hood
☐ Bathroom Vans
☐ Outside Air Intake

Other:_________________________

HEATING SYSTEM

☐ Hot Air Circulation
☐ Heat Pump
☐ Hot Air Radiation
☐ Hot Water Radiation
☐ Wood
☐ Kerosene Heater
☐ Steam Radiation
☐ Electric Baseboard

Other:_____________

<u>Outside Contaminant Sources</u>

Nearby surrounding property sources: Gas Stations / Emission Stacks

Soil Contamination: Petroleum Hydrocarbons / Solvents

Heavy Vehicle Traffic: Yes / No

Indoor Contaminant Sources

Identify all potential sources found in the building (including attached garages), the location of the source (floor and room), and whether the item was removed from the building 48 hrs prior to indoor sampling event. Any ventilation implemented after removal of the items should be completed at least 24 hours prior to the commencement of the indoor air sampling event.

Potential Sources	Location(s)	Removed (Yes / No / NA)
Gasoline storage cans		
Gas powered equipment		
Kerosene storage cans		
Paints / Thinners / Strippers		
Cleaning solvents / Dry cleaners		
Oven cleaners		
Carpet / upholstery cleaners		

Other house cleaning products		
Moth Balls		
Potential Sources	**Location(s)**	**Removed (Yes / No / NA)**
Polishes / waxes		
Insecticides		
Furniture / floor polish		
Nail polish / polish remover		
Hairspray		
Cologne / perfume		
Air fresheners		
Fuel tank (inside building)		
Wood stove or fireplace		
New furniture		
New carpeting / New flooring		
Hobbies – glues, paints		
Other: __________________		
Other: __________________		
Other: __________________		

SAMPLING INFORMATION

Sampler(s) ____

☐ Indoor Air / Outdoor Air ☐ Sub-slab ☐ Soil Vapor Point ☐ Exterior Soil Gas

☐ Tedlar® Bag ☐ Sorbent ☐ SUMMA® ☐ Other _________

Analytical Method: TO-15 / TO-17 / Other: _________________

WEATHER CONDITIONS

Was there a significant rain event in the last 24 hours? Yes / No

Temperature: _________ Atmospheric Pressure: _______________ Pressure: Rising or Falling?

Describe the general weather conditions: ____

Wind Speed and Direction: ____

PURGE VOLUME CALCULATIONS DURING SOIL VAPOR SAMPLING

Sample Tubing Purge

Tubing Length (feet)	Pi	Casing Radius (inches)	Area of Casing Radius (Pi(R^2)) (inches)	Length of casing (feet)	Conversion of feet to inches	Number of Casing Volumes to Purge	Conversion of cubic inches to mL	Purge Volume (mL)	Purge Volume (L)	Purge rate (mL/min)	Purge Time (min)	
5	3.141593	0.125	0.049087	5	60	1	16.387064	48.263888	0.048264	167	0.29	
5	3.141593	0.125	0.049087	5	60	3	16.387064	144.79166	0.144792	167	0.87	
5	3.141593	0.125	0.049087	5	60	7	16.387064	337.84721	0.337847	167	2.02	

Annular Space Purge

Annular Space Length (inches)	Pi	Boring Radius (inches)	Area of Boring Radius (radius^2)	Volume of Annular Space (inches)	Assumed Porosity of Sand Pack*	Air Filled Volume of Annular Space (cubic inches)	Number of Casing Volumes to Purge	Conversion of cubic inches to mL	Purge Volume (mL)	Purge Volume (L)	Purge rate (mL/min)	Purge Time (min)
12	3.141593	2	12.56637	150.7964	0.3	45.23893	1	16.387064	741.3333	0.741333	167	4.44
12	3.141593	2	12.56637	150.7964	0.3	45.23893	3	16.387064	2224	2.224	167	13.32
12	3.141593	2	12.56637	150.7964	0.3	45.23893	7	16.387064	5189.333	5.189333	167	31.07

Summary of Purge Durations	
One Purge Volume	4.73
Three Purge Volumes	14.18
Seven Volumes	33.10

SOIL VAPOR SAMPLING SHEET

Site Reference: ____________________________________

Date: ____________________________________

Address: ____________________________________

Personnel: ____________________________________

Soil Vapor Sampling Point ID	Vacuum Test		Purging				Helium		Sampling				PID		
	Time Start Vacuum Testing	Time Stop Vacuum Testing	Time Start Purging	Time Stop Purging	Purging Rate (mL/min)	Total Volume Purged (mL)	Time of Helium Reading	Helium Reading (%)	Time Start Sampling	Time Stop Sampling	Canister Vacuum Before Sampling (in Hg)	Canister Vacuum After Sampling (in Hg)	Time of PID Reading	PID Reading	Notes
					167										
					167										

Notes:

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F|S STANDARD GUIDELINE

Well Development

DATE/LAST UPDATE: May 2015

These procedures should be considered standard guidelines and are intended to provide useful guidance when in the field, but are not intended to be step-by-step procedures, as some steps may not be applicable to all projects.

All field staff should be sufficiently trained in the standard guidelines and should review and understand these procedures prior to going in the field. It is the responsibility of the field staff to review the standard guidelines with the field manager or project manager and identify any deviations from these guidelines prior to field work. When possible, the project-specific Sampling and Analysis Plan should contain any expected deviations and should be referenced in conjunction with these standard guidelines.

1.0 Scope and Purpose

This Standard Guideline for Well Development presents commonly used procedures for monitoring well development for newly installed monitoring wells and/or existing wells that may require redevelopment. Monitoring well development restores hydraulic conductivity with the surrounding formations that were disturbed during the drilling process. Development removes residual fines from well filter pack materials and the borehole wall and reduces the turbidity of the water, which provides more representative groundwater samples. These wells may include groundwater monitoring wells, piezometers, or groundwater extraction wells. This guideline describes the purge and surge method of development and is intended to be used by field staff who are overseeing or completing well development. Often, the drilling subcontractors are asked to complete well development activities subsequent to new well installations, in which case, Floyd|Snider staff would oversee the development. Other development methods, such as jetting, are not described herein, but may be used if specified in the project-specific Work Plan or Sampling and Analysis Plan (SAP).

Well development shall be completed by continuous pumping at a steady rate using a portable pump and polyethylene tubing, with regular surging (e.g., using a surge block) to force water through the filter pack and surrounding formation. Wells should ideally be developed either during installation (following sand placement but prior to sealing) or soon after installation, unless otherwise specified in the work plan, using the described methodologies or equivalents. For wells that are completed using a grout or concrete seal, if development does not take place prior to sealing, it should be completed within 48 hours following well installation in order allow for grout and concrete to cure.

2.0 Equipment and Supplies

Well Development Equipment and Tools:

- Appropriate high volume pump (centrifugal, submersible, etc.) and correct diameter tubing, or bailer
- Hose clamps (optional)
- Power source (generator, 12-volt battery, or car battery) and appropriate power adapter for pump
- Water quality meter or turbidity meter (if needed)
- 2-, 4-, or 6-inch surge block (typically provided by the driller)
- Water level meter
- Washington State Department of Transportation (WSDOT)-approved 55-gallon drums
- Equipment decontamination supplies including:
    - Scrub brushes
    - Alconox or other soap
    - Distilled or deionized water
    - Paper towels
- Trash bags
- Camera

Paperwork:

- Work Plan and/or SAP/Quality Assurance Project Plan (QAPP)
- Bound field notebook or appropriate field forms
- Well development form (printed on Rite in the Rain paper)
- Health and Safety Plan (HASP)
- Well installation forms (printed on Rite in the Rain paper)

Personal Equipment:

- Steel-toed boots

- Safety vest
- Safety glasses
- Nitrile gloves
- Rain gear
- Work gloves

3.0 Standard Procedures

3.1 OFFICE PREPARATION

Meet with the project manager to identify key information and goals of the well development, including how long after construction the wells should be developed. Determine if Floyd|Snider or the driller will be doing the development.

3.2 WELL DEVELOPMENT PROCEDURES

The following procedures are general guidelines for monitoring well development. These same procedures are also appropriate for extraction wells, injection wells, and/or piezometers. Specific instructions provided in individual work plans shall supersede these procedures in the event there are discrepancies.

Visually inspect all well development equipment for damage; repair as necessary.

1. Decontaminate all hoses, surge blocks, and/or submersible pump by scrubbing with brush and alconox or other soap solution and rinsing with deionized water.
2. Prior to development, use a water level meter to measure the depth in each well to the static water level and total depth to a reference mark on the top of the well casing.
3. Attach a length of clean or disposable tubing, approximately 5 feet longer than the well casing, to the outlet of the submersible pump.
4. Each well development cycle consists of surging followed by well evacuation (pumping). Surging may be accomplished with a surge block sized to fit snugly inside the well casing, or with the submersible pump. Surging using a pump increases the hydraulic gradient and velocity of groundwater near the well by drawing the water level down and moving more fine-grained soil particles into the well casing. Surging using a pump is only effective if the well produces enough water for continuous pumping and the pump is of a large enough diameter relative to the well casing. If pumping must be stopped to allow the well to recharge, a surge block is preferable for surging. If using a surge block, connect polyvinyl chloride (PVC) pipe or other rods longer than the well casing to the surge block. Lower the surging device into the well to a depth within the screened interval. A bailer can be used to surge in situations

when a surge block is not available and the well has insufficient recharge for the submersible pump.

5. During development, it is important to note the color and clarity of the water and any other visual or olfactory observations on the field form or in the field notebook. Note any significant changes as development progresses.
6. Surging should consist of a minimum of ten consecutive surges (i.e., quickly raise and lower surge block or pump in well) with an appropriately sized surge block or pump over the full length of the screen. For long well screens (greater than 10 feet), surging should be done in short intervals of 2 to 3 feet at a time. In cases where the screen extends to above the water table, clean water may have to be added to the well to develop the top of the filter pack.
7. After surging, water is purged from well until the pumped stream starts to run clear. At that point, stop pumping and initiate another surge cycle. If a well has more hydraulic head than the pump is able to overcome, or if an insufficient volume of water for pumping is present, a disposable bailer may also be used for purging.
8. Repeat this procedure until evacuated water is visibly clear and essentially free of sediment. Perform a minimum of three surge and pump cycles.
9. Well development will be terminated when the variation in the turbidity Nephelometric Turbidity Units (NTUs) readings is less than 10 percent or until the discharge is visibly clear and free of sediment after a minimum of three surge and purge cycles. As an alternative, periodic water samples can be collected for field measurements of temperature, specific conductivity, and pH; well development should continue until field parameters stabilize to within ±5 percent on three consecutive measurements or 10 well volumes have been purged. If it is not possible reduce the turbidity further, the well should be purged up to a maximum of four hours or as determined sufficient by the field geologist or project manager.
10. Report field observations and volume of water removed on the standard well development form (attached). Take final water level measurements and record then on the field form or in the field notebook.
11. Contain the purged water and manage in accordance with the project-specific SAP or Section 5.0 below. Prior to developing the next well or after the completion of development activities, decontaminate all reusable equipment used in development in accordance with Section 4.0 below.
12. If feasible, it is best to wait at least two weeks after development to sample the wells. Wells can be sampled a minimum of 48 hours after the completion of development if the project schedule requires a quick turnaround. However, the groundwater sample will be more representative of static conditions in the aquifer if allowed to stabilize for at least one to two weeks after development.

4.0 Decontamination

All reusable equipment that comes into contact with groundwater should be decontaminated as follows prior to moving to the next sampling location.

Water level meter and surge block: The water level indicator and tape will be decontaminated between sampling locations and at the end the day by spraying the entire length of tape that came in contact with groundwater with an Alconox (or similar)/clean water solution followed by a thorough rinse with distilled or deionized water. Surge block decontamination will consist of a tap water rinse to remove soil particles, followed by scrubbing with brushes and an alconox (or similar)/clean water solution and a final rinse with distilled or deionized water.

Submersible Pump: Decontaminating the pump requires running the pump in three progressively cleaner grades of water. Place the pump and the length of the power cord that was in contact with water into a bucket containing approximately four gallons of an Alconox (or similar)/clean water solution. Run the pump for approximately two minutes or until the volume of water in the bucket has been exhausted. Next, place the pump and cord into a second bucket containing approximately four gallons of clean water and run the pump for approximately two minutes or until the volume of water in the bucket is exhausted. Lastly, place the pump and power cord into a third bucket containing approximately four gallons of distilled or deionized water and run the pump for approximately two minutes or until the volume of water in the bucket is exhausted. The soap/water solution and rinse water may be re-used. When done for the day, dry the exterior of the pump and power cord with clean paper towels to the extent practical prior to storage. All decontamination water and rinse water (including soapy solution) should be managed in accordance with Section 5.0 below.

5.0 Investigation-Derived Waste

Unless otherwise specified in the project work plan, well development and decontamination water generated during development and any drilling materials will be contained and stored in a designated area until transported off-site for disposal in accordance with applicable laws.

The approach to handling and disposal of these materials is as follows. For investigation-derived waste (IDW) that is contained, such as well development water, WSDOT-approved 55-gallon drums will be supplied by the driller and used for temporary storage pending profiling and disposal. Each container holding IDW will be sealed and labeled as to its contents (e.g., “MW-1 Well development water”), the date(s) on which the wastes were placed in the container, the owner’s name, contact information for the field person who generated the waste, and the site name.

IDW contained within drums will be characterized relative to applicable waste criteria using data from the sampling locations whenever possible. Material that is designated for off-site disposal will be transported to an off-site facility permitted to accept the waste. Manifests will be used as appropriate for disposal.

Disposable sampling materials and incidental trash such as paper towels and personal protective equipment (PPE) used in sample processing will be placed in heavy duty garbage bags or other appropriate containers and disposed of as trash in the municipal collection system (i.e., site dumpster).

6.0 Field Documentation

Well development procedures will be documented on the well development field form (attached) or a bound field notebook. Information recorded will at a minimum include date, personnel present (including subcontractors), purpose of field event, weather conditions, depth of water, well construction details for the well(s) being developed (i.e., diameter, total depth, screen interval), water quality field measurements (if collected), amount of purged water generated, and any deviations from the SAP.

Enclosure: Well Development Field Form

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Well Development Field Form

Project Name:______________________________ Date: _________________

Project Number:______________________________ Field Personnel: ____________________________________

Driller (if applicable): ____________________________

Purge Data

Well ID:

Total Well Depth:

Well Condition/Damage Description:

Well Casing Type/Diameter/Screened Level:

One Casing Volume (gal):

Method of Development (Circle):

Surge Block Pump Surge Bailer

Equipment Used (type of pump, etc.):

Begin Purge (time):

End Purge (time):

Gallons Purged (time):

Purge Water Disposal Method (circle):

On-site Storage Tank On-site Treatment Drum Other:

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1 ¼”	1.660”	1.380”	0.08	0.64
2”	2.375”	2.067”	0.17	1.45
3”	3.500”	3.068”	0.38	3.2
4”	4.500”	4.026”	0.66	5.51
6”	6.625”	6.065”	1.5	12.5

Time	Depth to Water (feet)	Vol. Purged (gallons)	Rate (gpm)	pH	Conductivity	Turbidity	Temp	Comments
			--	--	--	--	--	Prior to purging

Notes:

Port of Longview TPH Site

Remedial Investigation Work Plan

Appendix G

Health and Safety Plan

Table of Contents

List of Figures

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List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
CRZ	Contamination reduction zone
EZ	Exclusion zone
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations Training
HSO	Health and Safety Officer
OIP	Optical image profiler
OSHA	Occupational Safety and Health Act
PID	Photoionization detector
PM	Project Manager
Port	Port of Longview
PPE	Personal protective equipment
Site	Port of Longview TPH Site
SS	Site Supervisor
SSO	Site Safety Officer
SZ	Support zone
WAC	Washington Administrative Code
WISHA	Washington Industrial Safety and Health Act

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1.0 Plan Objectives and Applicability

This Health and Safety Plan (HASP) has been written to comply with the standards prescribed by the Occupational Safety and Health Act (OSHA) and the Washington Industrial Safety and Health Act.

The purpose of this HASP is to establish protection standards and mandatory safe practices and procedures for all personnel involved with investigation activities including soil boring installation and soil and groundwater sample collection on behalf of the Port of Longview (Port) at the TPH Site (the Site). The Site is located at 10 E Port Way in Longview, Washington (Figure G.1). This HASP assigns responsibilities, establishes standard operating procedures, and provides for contingencies that may occur during field work activities. The plan consists of Site descriptions, a summary of work activities, an identification and evaluation of chemical and physical hazards, monitoring procedures, personnel responsibilities, a description of site zones, decontamination and disposal practices, emergency procedures, and administrative requirements.

The provisions and procedures outlined by this HASP apply to all Floyd|Snider personnel on-site. Contractors, subcontractors, other oversight personnel, and all other persons involved with the field work activities described herein are required to develop and comply with their own HASP. All Floyd|Snider staff conducting field activities are required to read this HASP and indicate that they understand its contents by signing the Health and Safety Officer/Site Supervisor's (HSO/SS) copy of this plan.

It should be noted that this HASP is based on information that was available as of the date indicated on the title page. It is possible that additional hazards that are not specifically addressed by this HASP may exist at the work site, or may be created as a result of on-site activities. It is the firm belief of Floyd|Snider that active participation in health and safety procedures and acute awareness of on-site conditions by all workers is crucial to the health and safety of everyone involved. Should project personnel identify a site condition that is not addressed by this HASP or have any questions or concerns about site conditions, they should immediately notify the HSO/SS and an addendum will be provided to this HASP.

The HSO/SS has field responsibility for ensuring that the provisions outlined herein adequately protect worker health and safety and that the procedures outlined by this HASP are properly implemented. In this capacity, the HSO/SS will conduct regular site inspections to ensure that this HASP remains current with potentially changing site conditions. The HSO/SS has the authority to make health and safety decisions that may not be specifically outlined in this HASP should site conditions warrant such actions. In the event that the HSO/SS leaves the Site while work is in progress, an alternate Site Safety Officer (SSO) will be designated. Personnel responsibilities are further described in Section 4.0.

This HASP has been reviewed by the Project Manager (PM) and the HSO/SS prior to commencement of work activities. All Floyd|Snider personnel shall review the plan and be familiar with on-site health and safety procedures. A copy of the HASP will be on-site at all times.

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2.0 Emergency Contacts and Information

2.1 DIAL 911

In the event of any emergency, DIAL 911 to reach fire, police, and first aid.

2.2 HOSPITAL AND POISON CONTROL

Nearest Hospital Location and Telephone: **(Refer to Figure G.2 for map and directions to the hospital.)**	PeaceHealth St. John Medical Center 1615 Delaware Street Longview, WA 98632
Washington Poison Control Center:	(800) 222-1222

2.3 PROVIDE INFORMATION TO EMERGENCY PERSONNEL

All Floyd|Snider project personnel should be prepared to give the following information:

Information to give to Emergency Personnel	
Site Location: **(Refer to Figure G.1 for directions and map to the Site.)**	Port of Longview 10 E Port Way Longview, WA 98632
Number that you are calling from:	Look on the phone you are calling from.
Describe accident and/or incident and numbers of personnel needing assistance:	Type of Accident Type(s) of Injuries

2.4 FLOYD|SNIDER AND PORT OF LONGVIEW EMERGENCY CONTACTS

After contacting emergency response crews as necessary, contact the Floyd|Snider PM or a Principal to report the emergency. The Principal may then contact the Port or direct the field staff to do so.

Floyd|Snider Emergency Contacts:

Tom Colligan	Office: (206) 292-2078	Cell: (206) 276-8527
Kate Snider	Office: (206) 292-2078	Cell: (206) 375-0762
Scott Adamek	Office: (206) 292-2078	Cell: (206) 696-8661

Port of Longview Emergency Contacts:

Lisa Hendriksen	Office: (360) 425-3305	Direct Line: (360) 703-0207
Sean Kelly	Office: (360) 425-3305	Direct Line: (360) 430-7134

Washington State Department of Ecology Emergency Contacts:

National Response Center: (800) 424-8802
Washington Emergency Management Division: (800) 258-5990
Southwest Regional Office: (360) 407-6300

3.0 Background Information

3.1 SITE BACKGROUND

Floyd|Snider will be conducting remedial investigation activities at the Site. The purpose of the investigation is to fill data gaps related to the extent of soil and groundwater contamination at the Site. This work is being performed to determine vertical and lateral extents and the fate and transport of contaminants prior to preparing a feasibility study.

3.2 SCOPE OF WORK

The remedial investigation will consist of the following:

- Conducting a public and private locate
- Measuring water level elevations from representative wells
- Collecting groundwater samples from Site monitoring wells
- Surface and hand auger samples adjacent to Berth 2
- Advancing direct-push soil borings with and without optical image profiler (OIP) technology.
- Analyzing selected soil samples
- Collecting groundwater samples from direct-push locations
- Installing monitoring wells
- Developing and redeveloping wells
- Preparing a report documenting investigation results

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4.0 Primary Responsibilities and Requirements

4.1 PROJECT MANAGER

The PM will have overall responsibility for the completion of the project, including the implementation and review of this HASP. The PM will review health and safety issues as needed, and as consulted, and will have authority to allocate resources and personnel to safely accomplish the field work.

The PM will direct all Floyd|Snider personnel involved in field work at the Site. If the project scope changes, the PM will notify the HSO/SS so that the appropriate addendum can be included in the HASP. The PM will ensure that all Floyd|Snider personnel on-site have received the required training, are familiar with the HASP, and understand the procedures to follow should an accident and/or incident occur on-site.

4.2 HEALTH AND SAFETY OFFICER AND SITE SUPERVISOR

The HSO/SS will approve this HASP and any amendments, thereof, and will ultimately be responsible for full implementation of all elements of the HASP.

The HSO/SS will advise the PM and project personnel on all potential health and safety issues of the field investigation activities to be conducted at the Site. The HSO/SS will specify required exposure monitoring to assess Site health and safety conditions, modify the Site HASP based on field assessment of health and safety accidents and/or incidents, and recommend corrective action if needed. The HSO/SS will report all accidents and/or incidents to the PM. If the HSO/SS observes unsafe working conditions by Floyd|Snider personnel or any contractor personnel, the HSO/SS will suspend all work until the hazard has been addressed.

4.3 SITE SAFETY OFFICER

The SSO may be a person dedicated to this task, to assist the HSO/SS during field work activities. The SSO will ensure that all personnel have appropriate personal protective equipment (PPE) on site and that PPE is properly used. The SSO will assist the HSO/SS in field observation of Floyd|Snider personnel safety. If a health or safety hazard is observed, the SSO shall suspend all work activity. The SSO will conduct on-site safety meetings daily before work commences. All health and safety equipment will be calibrated daily and records kept in the daily field logbook and/or accompanying field daily forms. The SSO may perform exposure monitoring if needed and will ensure that equipment is properly maintained.

4.4 FLOYD|SNIDER PROJECT PERSONNEL

All Floyd|Snider project personnel involved in field work activities will take precautions to prevent accidents and/or incidents from occurring to themselves and others in the work areas. Employees will report all accidents, incidents, and/or other unsafe working conditions to the

HSO/SS or SSO immediately. Employees will inform the HSO/SS or SSO of any physical conditions that could impact their ability to perform field work.

4.5 TRAINING REQUIREMENTS

All Floyd|Snider project personnel must comply with applicable regulations specified in the Washington Administrative Code (WAC) Chapter 296-843, Hazardous Waste Operations Training (HAZWOPER), administered by the Washington State Department of Labor and Industries. Project personnel will be 40-hour HAZWOPER trained and maintain their training with an annual 8-hour refresher. Personnel with limited tasks and minimal exposure potential will be required to have 24-hour training and a site hazard briefing, and be escorted by a trained employee. Personnel with defined tasks that do not include potential contact with disturbed site soils or waste, groundwater, or exposures to visible dust (e.g., surveying) are not required to have any level of hazardous waste training beyond a site emergency briefing and hazard orientation by the HSO/SS. Floyd|Snider project personnel will fulfill the medical surveillance program requirements.

In addition to the 40-hour course and 8-hour refreshers, the HSO/SS will have completed an 8-hour HAZWOPER Supervisor training as required by WAC 296-843-20015. At least one person on-site during field work will have current cardiopulmonary resuscitation/First Aid certification. All field personnel must have a minimum of 3 days of hazardous materials field experience under the direction of a skilled supervisor. Documentation is readily available at the Floyd|Snider’s main office.

Additional site-specific training that covers on-site hazards, PPE requirements, use and limitations, decontamination procedures, and emergency response information as outlined in this HASP will be given by the HSO/SS before on-site work activities begin. Daily health and safety meetings will be documented on the Daily Tailgate Safety Meeting form included as Attachment G.1.

4.6 MEDICAL SURVEILLANCE

All Floyd|Snider field personnel are required to participate in Floyd|Snider's medical surveillance program, which includes biennial audiometric and physical examinations for employees involved in HAZWOPER projects. The program requires medical clearance before respirator use or participating in HAZWOPER activities. Medical examinations must be completed before conducting field work activities and on a biennial basis.

5.0 Hazard Evaluation and Risk Analysis

In general, there are three broad hazard categories that may be encountered during site work: chemical exposure hazards, fire/explosion hazards, and physical hazards. Sections 5.1 through 5.3 discuss the specific hazards that fall within each of these broad categories.

5.1 CHEMICAL EXPOSURE HAZARDS

This section describes potential chemical hazards associated with soil boring installation and soil and groundwater sample collection. Based on previous site investigation information, the following chemicals have been detected at this Site:

- Diesel-range and heavy oil-range hydrocarbons in soil and groundwater
- Gasoline-range hydrocarbons in soil and groundwater
- Volatile organic compounds including benzene, toluene, ethylbenzene, and xylenes

Human health hazards of these chemicals are discussed in the table below. This information covers potential toxic effects which might occur if relatively significant acute and/or chronic exposure were to happen. This information does not mean that such effects will occur from planned site activities. Potential routes of exposure include inhalation, dermal contact, ingestion, and eye contact. The primary exposure route of concern during site work is ingestion of contaminated water or soil, though such exposure is considered unlikely and highly preventable. In general, the chemicals which may be encountered at this Site are not expected to be present at concentrations which could produce significant exposures. The types of planned work activities and use of monitoring procedures and protective measures will limit potential exposures at this Site. The use of appropriate PPE and decontamination practices will assist in controlling exposure through all pathways to the key contaminants of concern listed in the table below.

Chemical Hazard	DOSH Permissible Exposure Limits (8-hr TWA/STEL)	Greatest Historic Concentration	Routes of Exposure	Potential Toxic Effects
Diesel- and Heavy Oil-Range Hydrocarbons	None established	72,000 mg/kg (soil) 160,000 µg/L (groundwater)	Inhalation, skin/eye contact	Irritation to eyes, pulmonary function
Gasoline-Range Hydrocarbons	None	5,600 mg/kg (soil) 5,800 µg/L (groundwater)	Inhalation, skin absorption, ingestion, skin/eye contact	Irritation to eyes, skin, mucus membranes; headache; fatigue; blurred vision; dizziness; slurred speech; confusion; convulsions; liver, kidney damage

Chemical Hazard	DOSH Permissible Exposure Limits (8-hr TWA/STEL)	Greatest Historic Concentration	Routes of Exposure	Potential Toxic Effects
Laboratory Preservatives (HCl, MeOH, Sodium Bisulfate, HNO_3)	Not applicable	Not applicable	Dermal contact, eye contact	Irritation to skin or eyes; Avoid contact through proper use of PPE during sample handling and collection
Benzene	1 ppm/5 ppm	Unknown for soil 890 µg/L (groundwater)	Inhalation, skin absorption, ingestion, skin/eye contact	Irritation to eyes, skin, mucus membranes; headache; fatigue; blurred vision; dizziness; convulsions; liver, kidney damage; carcinogenic
cPAHs	0.2 mg/m^3 0.6 mg/m^3	0.95 mg/kg in soil (expressed in terms of benzo(a)pyrene TEQ)	Inhalation	Dermatitis; bronchitis; lung, skin, and stomach cancer

Abbreviations:

cPAH	Carcinogenic polycyclic aromatic hydrocarbon
DOSH	Department of Safety and Health
HCl	Hydrochloric acid
HNO_3	Nitric acid
MeOH	Methanol
µg/L	Micrograms per liter
mg/kg	Milligrams per kilogram
mg/m^3	Milligrams per cubic meter
ppm	Parts per million
STEL	Short-term exposure limit
TEQ	Toxic equivalent
TWA	Time-weighted average

Chemical and physical properties for hazardous substances expected at the Site, including those listed above are located in the Material Safety Data Sheets notebook maintained in the field vehicle.

5.2 FIRE AND EXPLOSION HAZARDS

Flammable and combustible liquid hazards may occur from fuels and lubricants brought to the property to support heavy equipment. When on-site storage is necessary, such material will be stored in containers approved by the Washington State Department of Transportation in a location not exposed to strike hazards and provided with secondary containment. A minimum 2-A:20-B fire extinguisher will be located within 25 feet of the storage location and where refueling occurs. Any subcontractors bringing flammable and combustible liquid hazards to the Site are responsible for providing appropriate material for containment and spill response, and such hazards should be addressed in their respective HASP. Transferring of flammable liquids (e.g., gasoline) will occur only after making positive metal to metal connection between the containers. A bonding strap may be necessary to achieve this. Storage of ignition and combustible materials will be kept away from storage and fueling operations.

5.3 PHYSICAL HAZARDS

When working in or around any hazardous or potentially hazardous substances or situations, all site personnel should plan all activities before starting any task. Site personnel shall identify health and safety hazards involved with the work planned and consult with the HSO/SS as to how the task can be performed in the safest manner. Personnel will also consult the HSO/SS if they have any concerns or uncertainties.

All field personnel will adhere to general safety rules including wearing appropriate PPE, hard hats, steel-toed boots, safety vests, and safety glasses. Eating, drinking, and/or use of tobacco or cosmetics will be restricted in all work areas. Personnel will prevent splashing of liquids containing chemicals and minimize dust emissions.

The following table summarizes a variety of physical hazards that may be encountered on the Site during work activities. For convenience, these hazards have been categorized into several general groupings with recommended preventative measures.

Hazard	**Cause**	**Prevention**
Head Strike	Falling and/or sharp objects, bumping hazards.	Hard hats will be worn by all personnel at all times when overhead hazards exist, such as during drilling activities and around large, heavy equipment.
Foot/ankle Twist, Crush, Slip/trip/fall	Sharp objects, dropped objects, uneven and/or slippery surfaces.	Steel-toed boots must be worn at all times on-site while heavy equipment is present. Pay attention to footing on uneven or wet terrain and do not run. Keep work areas organized and free from unmarked trip hazards.
Hand Cuts, Splinters, and Chemical Contact	Hands or fingers pinched or crushed, chemical hazards including dermal exposure to nitric acid or sulfuric acid preservative. Cut or splinters from handling sharp/rough objects and tools.	Nitrile safety gloves will be worn to protect the hands from dust and chemicals. Leather or cotton outer gloves will be used when handling sharp-edged rough materials or equipment. Refer to the preventive measures for Mechanical Hazards below.

Hazard	**Cause**	**Prevention**
Eye Damage from Flying Materials, or Splash Hazards	Sharp objects, poor lighting, exposure due to flying debris or splashes.	Safety glasses will be worn at all times on-site. If a pressure washer is used to decontaminate heavy equipment, a face shield will be worn over safety glasses or goggles. Care will be taken during decontamination procedures and groundwater sampling to avoid splashing or dropping equipment into decontamination water. Face shields may be worn over safety glasses if splashing is occurring during sampling or decontamination.
Electrical Hazards	Underground utilities, overhead utilities, electrical cord hazards.	Utility locator service will be used prior to any investigation to locate all underground utilities. Visual inspection of work areas will be conducted prior to starting work. Whenever possible, avoid working under overhead high voltage lines. Make sure that no damage to extension cords occurs. If an extension cord is used, make sure it is the proper size for the load that is being served and inspected prior to use for defects. The plug connection on each end should be of good integrity. Insulation must be intact and extend to the plugs at either end of the cord. All portable power tools will be inspected for defects before use and must either be a double-insulated design or grounded with a ground-fault circuit interrupter.
Mechanical Hazards	Heavy equipment such as drill rigs, service trucks, mowing equipment, saws, drills, etc. Conducting work in road right of ways (on the road shoulder).	Ensure the use of competent operators, backup alarms, regular maintenance, daily mechanical checks, and proper guards. Subcontractors will supply their own HASP. All project personnel will make eye contact with operator and obtain a clear "OK" before approaching or working within swing radius of heavy equipment, staying clear of swing radius. Obey on-site speed limits.
Traffic Hazards	Vehicle traffic and hazards when working near public right-of-ways. Railroad traffic and hazards when working near the rail line.	When working around active operations, orange cones and/or flagging will be placed around the work area. Multiple field staff will work together (buddy system) and spot traffic for each other if necessary. Avoid working with your back to traffic whenever possible. All work near the railroad tracks will be coordinated with the Port. Further details on traffic hazards are provided in Section 5.3.4.

Hazard	Cause	Prevention
Hearing Damage due to Noise	Machinery creating more than 85 decibels TWA, less than 115 decibels continuous noise, or peak at less than 140 decibels.	Wear earplugs or protective ear muffs when a conversational level of speech is difficult to hear at a distance of 3 feet; when in doubt, a sound level meter may be used on-site to document noise exposure.
Strains from Improper Lifting	Injury due to improper lifting techniques, overreaching/ overextending, or lifting overly heavy objects.	Use proper lifting techniques and mechanical devices where appropriate. The proper lifting procedure first involves testing the weight of the load by tipping it. If in doubt, ask for help. Do not attempt to lift a heavy load alone. Take a good stance and plant your feet firmly with legs apart, one foot farther back than the other. Make sure you stand on a level area with no slick spots or loose gravel. Use as much of your hands as possible, not just your fingers. Keep your back straight, almost vertical. Bend at the hips, holding load close to your body. Keep the weight of your body over your feet for good balance. Use large leg muscles to lift. Push up with one foot positioned in the rear as you start to lift. Avoid quick, jerky movements and twisting motions. Turn the forward foot and point it in the direction of the eventual movement. Never try to lift more than you are accustomed to.
Cold Stress	Cold temperatures and related exposure on and offshore.	Workers will wear appropriate clothing, stay dry, and take breaks in a heated environment when working in freezing temperatures. Further details on cold stress are provided in Section 5.3.1.
Heat Exposure	High temperatures exacerbated by PPE and/or dehydration.	Workers will ensure adequate hydration, shade, and breaks when temperatures are elevated. Further details on heat stress are provided in Section 5.3.2.
Accidents due to Inadequate Lighting	Improper illumination.	Work will proceed during daylight hours only or under sufficient artificial light.

Abbreviation:

PPE Personal protective equipment

5.3.1 Cold Stress

Exposure to moderate levels of cold can cause the body’s internal temperature to drop to a dangerously low level, causing hypothermia. Symptoms of hypothermia include slow, slurred speech; mental confusion; forgetfulness; memory lapses; lack of coordination; and drowsiness.

To prevent hypothermia, site personnel will stay dry and avoid exposure. Site personnel will have access to a warm, dry area, such as a vehicle, to take breaks from the cold weather and warm up. Site personnel will be encouraged to wear sufficient clothing in layers such that outer clothing is wind- and waterproof and inner layers retain warmth (wool or polypropylene), if applicable. Site personnel will keep hands and feet well protected at all times. The signs and symptoms and treatment for hypothermia are summarized below:

Signs and Symptoms

- Mild hypothermia (body temperature of 98–90 °F)
    - Shivering.
    - Lack of coordination, stumbling, fumbling hands.
    - Slurred speech.
    - Memory loss.
    - Pale, purplish gray, or dusky cold skin.
- Moderate hypothermia (body temperature of 90–86 °F)
    - Shivering stops.
    - Unable to walk or stand.
    - Confused and irrational.
- Severe hypothermia (body temperature of 86–78 °F)
    - Severe muscle stiffness.
    - Very sleepy or unconscious.
    - Ice-cold skin.
    - Death.

Treatment of Hypothermia (Proper treatment depends on the severity of the hypothermia.)

- Mild hypothermia
    - Move to warm area.
    - Stay active.
    - Remove wet clothes and replace with dry clothes or blankets and cover the head.
    - Drink warm (not hot) sugary drinks.
- Moderate hypothermia
    - All of the above, plus:
        - call 911 for an ambulance.
        - cover all extremities completely.
        - place very warm objects such as hot packs or water bottles on the victim's head, neck, chest, and groin.

- Severe hypothermia
  - Call 911 for an ambulance.
  - Treat the victim very gently.
  - Do not attempt to re-warm—the victim should receive treatment in a hospital.

Frostbite

Frostbite occurs when the skin actually freezes and loses water. In severe cases, amputation of the frostbitten area may be required. While frostbite usually occurs when the temperatures are 30 °F or lower, windchill factors can allow frostbite to occur in above-freezing temperatures. Frostbite typically affects the extremities, particularly the feet and hands. Frostbite symptoms include cold, tingling, stinging, or aching feelings in the frostbitten area followed by numbness and skin discoloration: Paler skin may change from red to purple, then to white or very pale, and darker skin may become pale, dusky, or purplish. Frostbitten skin will be waxy and firm while still frozen and may redden, swell, or blister when thawed. Should any of these symptoms be observed, wrap the area in soft cloth—do not rub the affected area—and seek medical assistance. Call 911 if the condition is severe.

Protective Clothing

Wearing the right clothing is the most important way to avoid cold stress. The type of fabric also makes a difference. Cotton loses its insulation value when it becomes wet. Wool, on the other hand, retains its insulation even when wet. The following are recommendations for working in cold environments:

- Wear at least three layers of clothing:
  - An outer layer to break the wind and allow some ventilation (like Gortex or nylon).
  - A middle layer of down or wool to absorb sweat and provide insulation even when wet.
  - An inner layer of cotton or synthetic weave to allow ventilation.
- Wear a hat—up to 40 percent of body heat can be lost when the head is left exposed.
- Wear insulated boots or other footwear.
- Keep a change of dry clothing available in case work clothes become wet.
- Do not wear tight clothing—loose clothing allows better ventilation.

Work Practices

- Drinking: Drink plenty of liquids, avoiding caffeine and alcohol. It is easy to become dehydrated in cold weather.
- Work Schedule: If possible, heavy work should be scheduled during the warmer parts of the day. Take breaks out of the cold in heated vehicles.
- Buddy System: Try to work in pairs to keep an eye on each other and watch for signs of cold stress.

5.3.2 Heat Stress

To avoid heat-related illness, current regulations in WAC 296-62-095 through 296-62-09570 will be followed during all outdoor work activities. These regulations apply to any outdoor work environment from May 1 through September 30, annually when workers are exposed to temperatures above 89 °F when wearing breathable clothing, above 77 °F when wearing double-layered woven clothing such as jackets or coveralls, or above 52 °F when wearing non-breathing clothing such as chemical resistant suits or Tyvek. Floyd|Snider will identify and evaluate temperature, humidity, and other environmental factors associated with heat-related illness including but not limited to the provision of rest breaks that are adjusted for environmental factors, and encourage frequent consumption of drinking water. Drinking water will be provided and made readily accessible in sufficient quantity to provide at least 1 quart per employee per hour. All Floyd|Snider personnel will be informed and trained for responding to signs or symptoms of possible heat-related illness and accessing medical aid.

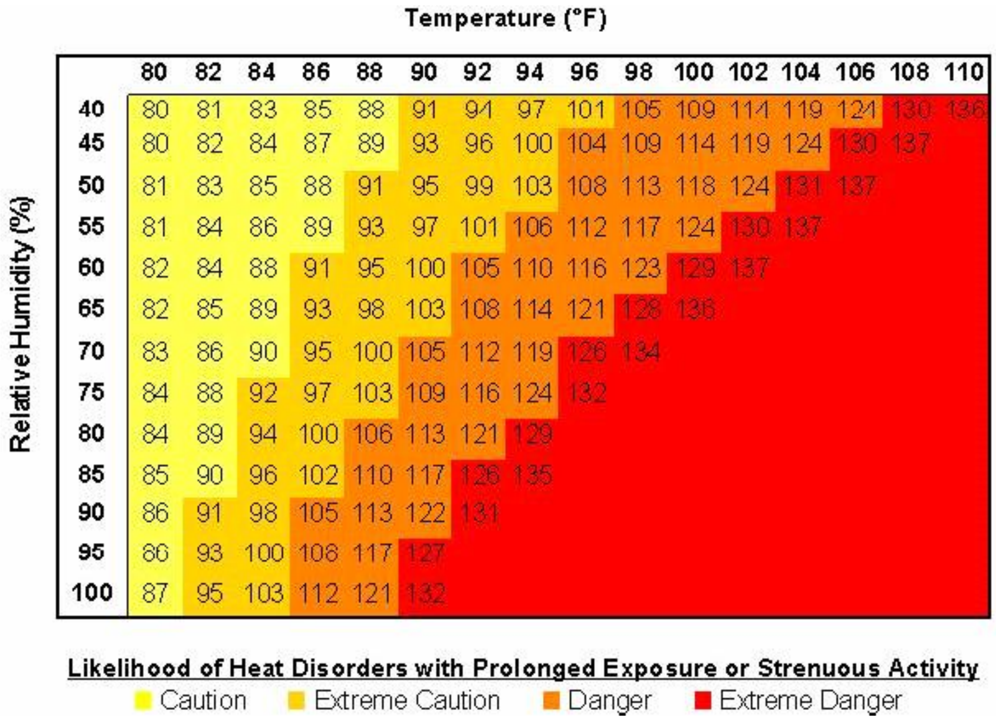
Employees showing signs or demonstrating symptoms of heat-related illness must be relieved from duty and provided with a sufficient means to reduce body temperature, including rest areas or temperature controlled environments (i.e., air conditioned vehicle). Any employee showing signs or demonstrating symptoms of heat-related illness must be carefully evaluated to determine whether it is appropriate to return to work or if medical attention is necessary.

Any incidence of heat-related illness must be immediately reported to the employer directly through the HSO/SS.

The signs, symptoms, and treatment of heat stress are given in the table on the next page.

Condition	**Signs/Symptoms**	**Treatment**
Heat Cramps	Painful muscle spasms and heavy sweating.	Increase water intake, rest in shade/cool environment.
Heat Syncope	Brief fainting and blurred vision.	Increase water intake, rest in shade/cool environment.
Dehydration	Fatigue, reduced movement, headaches.	Increase water intake, rest in shade/cool environment.
Heat Exhaustion	Pale and clammy skin, possible fainting, weakness, fatigue, nausea, dizziness, heaving, sweating, blurred vision, body temperature slightly elevated.	Lie down in cool environment, increase water intake, and loosen clothing; call 911 for ambulance transport if symptoms continue once in cool environment.
Heat Stroke	Cessation of sweating, skin hot and dry, red face, high body temperature, unconsciousness, collapse, convulsions, confusion or erratic behavior, life threatening condition.	**Medical Emergency! Call 911** for ambulance transport. Move victim to shade and immerse in water.

If site temperatures are forecast to exceed 85 °F and physically demanding site work will occur in impermeable clothing, the HSO/SS will promptly consult with a certified industrial hygienist (CIH) and a radial pulse monitoring method will be implemented to ensure that heat stress is properly managed among the affected workers. The following heat index chart indicates the relative risk of heat stress:



Temperature (°F)

Relative Humidity (%)

	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

🟨 Caution 🟨 Extreme Caution 🟧 Danger 🟥 Extreme Danger

5.3.3 Biohazards

Bees and other insects may be encountered during the field work tasks. Persons with allergies to bees will make the HSO/SS aware of their allergies and will avoid areas where bees are identified. Controls such as repellents, hoods, nettings, masks, or other personal protection may be used. Report any insect bites or stings to the HSO/SS and seek first aid if necessary.

Site personnel will maintain a safe distance from any urban wildlife encountered, including raccoons and rodents, to preclude a bite from a sick or injured animal. Personnel will be gloved and will use tools to lift covers from catch basins and monitoring wells.

5.3.4 Traffic Hazards

While work is being performed in active areas, barricades should be utilized. Spotters will be used to ensure traffic is monitored during work activities because signs, signals, and barricades do not always provide appropriate protection. All workers will wear reflective high visibility neon/orange vests. Work that will be conducted near the active railroad tracks will be coordinated with the Port to determine the best time to perform the work. Work will not be performed near the tracks during times when trains are active on the Site.

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6.0 Site Monitoring

This section describes site monitoring techniques and equipment that will be used during site field activities. The HSO/SS, or a designated alternate, is responsible for site control and monitoring activities.

Because the Site is currently active, and noise generating activities will be conducted within the site boundary, noise levels are expected to be below the allowable levels.

Visual monitoring for dust will be conducted by the HSO/SS to ensure inhalation of contaminated soil particles does not occur. It is not anticipated that dust will be generated, given that the Site is primarily concrete and asphalt. However, if visible dust is present in the work area, work will cease and the area will be cleared until the dust settles.

Contaminant concentrations in soil and groundwater at the Site are present at concentrations that are not expected to result in vapor concentrations that exceed allowable OSHA levels. All work will be conducted outdoors in an open-air ventilated environment. A photoionization detector (PID) will be used on-site for screening of soil samples collected. This PID will also be used to monitor vapor concentrations in breathing air of total volatile chemicals in parts per million that can be detected using this method. Should the PID read a sustained concentration of total volatile chemicals above the lowest action level for 15 minutes, the HSO/SS will stop work and evacuate the area until vapor concentrations return to background levels. As needed, actions may be taken to reduce exposure to vapor concentrations in the work area by covering exposed soil or drilling cuttings, and leaving the work area until odor dissipates.

The HSO/SS will visually inspect the work site at least daily to identify any new potential hazards. If new potential hazards are identified, immediate measures will be taken to eliminate or reduce the risks associated with these hazards.

Ambient air background PID readings should be measured prior to the start and during drilling activities to factor in other sources of volatiles, from upwind of the work area. Air monitoring levels from the work area should be adjusted to account for the background concentration.

Monitoring Equipment	Readings (1)	Action (2)
PID	<1 ppmv (8-hour TWA for volatiles); <5 ppm for 15 minutes	Continue operations in Level D PPE
	>5 and <10 ppmv; intermittent	Identify source of concentrations if possible (vehicle emissions, exposed contaminated material, etc.) Implement engineering controls to reduce concentrations for continued operations (move work area upwind of operating equipment, cover exposed contaminated material, etc.); resume work only if PID indicates levels less than the OSHA PEL of 5 ppm in breathing zone.
	>10 ppmv; sustained	Stop operations and evacuate area, identify source of concentrations if possible (vehicle emissions, exposed contaminated material, etc.) Implement engineering controls to reduce concentrations for continued operations (move work area upwind of operating equipment, cover exposed contaminated material, etc.); resume work only if PID indicates levels less than the OSHA PEL of 5 ppm in breathing zone.

Notes:

1. Action levels prior to and during drilling activities.
2. OSHA STEL is a 15-minute TWA exposure that should not be exceeded at any time during a workday.

Abbreviations:

PEL	Permissible Exposure Limit
PPMV	Parts per million volatile

7.0 Hazard Analysis by Task

The following section identifies potential hazards associated with each task listed in Section 3.2 of this HASP. Tasks have been grouped according to the types of potential hazard associated with them.

Task	**Potential Hazard**
Installation of Soil Borings, Soil Sampling and Groundwater Sampling from Direct-Push activities (Geoprobe and OIP)	Exposure to loud noise; overhead hazards; head, foot, ankle, hand, and eye hazards; electrical and mechanical hazards; lifting hazards; dust inhalation hazards; potential dermal or eye exposure to site contaminants in groundwater and soil; fall hazards; traffic hazards; and heat and cold exposure hazards.
Surface Soil and Hand Auger Soil Sampling	Chemical hazards include potential dermal or eye exposure to contaminants during soil sample collection and X-ray fluorescence readings. Physical hazards include slip, trip, or fall hazards, heat and cold exposure, biological hazards.
Well Redevelopment and Groundwater Sampling from Monitoring Wells	Chemical hazards include potential dermal or eye exposure to site contaminants in groundwater. Physical hazards include slip, trip, or fall hazards; heat and cold exposure hazards; and biological hazards.

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8.0 Personal Protective Equipment

All work involving heavy equipment or drilling will proceed in Level D PPE, which shall include hard hat, steel-toed boots, hearing protection, eye protection, and protective gloves.

All personnel will be properly fitted and trained in the use of PPE. The level of protection will be upgraded by the HSO/SS whenever warranted by conditions present in the work area. The HSO/SS will periodically inspect equipment such as gloves and hard hats for defects.

For all work involving potential exposure to soil or groundwater, workers will wear nitrile gloves and Level D PPE. Safety vests will be worn at all times on-site. Personnel will wear rain suits on windy, rainy days to prevent hypothermia.

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9.0 Site Control and Communication

9.1 SITE CONTROL

The Site is active and secured by the Port. Pedestrians and other unauthorized personnel will not be allowed in the work area. Access to the work site will be restricted to designated personnel. The purpose of site control is to minimize the public's potential exposure to site hazards, to prevent vandalism in the work area and access by children and other unauthorized persons, and to provide adequate facilities for workers. Work will only be conducted when rail-line activities are not in operation.

Work area controls and decontamination areas will be provided to limit the potential for chemical exposure associated with site activities, and transfer of contaminated media from one area of the Site to another. The support zone (SZ) for the work area includes all areas outside the work area and decontamination areas. An exclusion zone (EZ), contamination reduction zone (CRZ), and SZ will be set up for work being conducted within the limits of the Site. Only authorized personnel shall be permitted access to the EZ/CRZ. Staff will decontaminate all equipment and gear as necessary prior to exiting the work area.

9.2 COMMUNICATION

All site work will occur in teams and the primary means of communication on site and with offsite contacts will be via cell phones. An agreed-upon system of alerting via air horns and/or vehicle horns may be used around heavy equipment to signal an emergency if shouting is ineffective.

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10.0 Personal Decontamination

A majority of field activities and sampling events are expected to be conducted using Level D PPE. Decontamination procedures for PPE will be followed to prevent off-site spread of contaminated soil or water. The HSO/SS will assess the effectiveness of decontamination procedures by visual inspection. Hands must be thoroughly washed before leaving the Site to eat, drink, or use tobacco.

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11.0 Emergency Response and Contingency Plan

This section defines the emergency action plan for the Site. It will be rehearsed with all site personnel and reviewed whenever the plan is modified or the HSO/SS believes that site personnel are unclear about the appropriate emergency actions.

A point of refuge will be identified by the HSO/SS and communicated to the field team each day. This point will be clear of adjacent hazards and preferably upwind or crosswind for the entire day. In an emergency, all site personnel and visitors will evacuate to the point of refuge for roll call. It is important that each person on-site understand their role in an emergency, and that they remain calm and act efficiently to ensure everyone's safety.

After each emergency is resolved, the entire project team will meet and debrief on the incident—the purpose is not to fix blame, but to improve the planning and response to future emergencies. The debriefing will review the sequence of events, what was done well, and what can be improved. The debriefing will be documented in a written format and communicated to the PM. Modifications to the emergency plan will be approved by the PM.

Reasonably foreseeable emergency situations include medical emergencies, accidental release of hazardous materials (such as gasoline or diesel) or hazardous waste, and general emergencies such as vehicle accident, fire, thunderstorm, and earthquake. Expected actions for each potential incident are outlined below.

11.1 MEDICAL EMERGENCIES

In the event of a medical emergency, the following procedures should be used:

1. Stop any imminent hazard if you can safely do so.
2. Remove ill, injured, or exposed person(s) from immediate danger if moving them will clearly not cause them harm and no hazards exist to the rescuers.
3. Evacuate other on-site personnel to a safe place in an upwind or crosswind direction until it is safe for work to resume.

   If serious injury or life-threatening condition exists, call 911 for paramedics, the fire department, and police.

   Clearly describe the location, injury, and conditions to the dispatcher. Designate a person to go to the Site entrance and direct emergency equipment to the injured person(s). Provide the responders with a copy of this HASP to alert them to chemicals of potential concern.
4. Trained personnel may provide first aid/cardiopulmonary resuscitation if it is necessary and safe to do so. Remove contaminated clothing and PPE only if this can be done without endangering the injured person.
5. Call the HSO/SS and PM.
6. Immediately implement steps to prevent recurrence of the accident.

A map showing the nearest hospital location is attached to this HASP (refer to Section 2.0 for number and address).

11.2 ACCIDENTAL RELEASE OF HAZARDOUS MATERIALS OR WASTES

1. Evacuate all on-site personnel to a safe place in an upwind direction until the HSO/SS determines that it is safe for work to resume.
2. Instruct a designated person to contact the PM and confirm a response.
3. Contain the spill, if it is possible and can be done safely.
4. If the release is not stopped, call 911 to alert the fire department.
5. Contact the Washington State Emergency Response Commission at 1-800-258-5990 to report the release.
6. Initiate cleanup.
7. The PM will coordinate follow-up written reporting to Washington State Department of Ecology in the event of a reportable release of hazardous materials or wastes.

11.3 GENERAL EMERGENCIES

In the case of fire, explosion, earthquake, or imminent hazards, work shall be halted and all onsite personnel will be immediately evacuated to a safe place. The local police/fire department shall be notified if the emergency poses a continuing hazard by calling 911.

In the event of a thunderstorm, outdoor work will be discontinued until the threat of lightning has abated. During the incipient phase of a fire, the available fire extinguisher(s) may be used by persons trained in putting out fires, if it is safe for them to do so. Contact the fire department as soon as feasible.

11.4 EMERGENCY COMMUNICATIONS

In the case of an emergency, an air horn or car horn will be used as needed to signal the emergency. One long (5-second) blast will be given as the emergency/stop work signal. If the air horn is not working, a vehicle horn and/or overhead waving of arms will be used to signal the emergency. In any emergency, all personnel will evacuate to the designated refuge area and await further instruction.

11.5 EMERGENCY EQUIPMENT

The following minimum emergency equipment will be readily available on-site and functional at all times:

- First Aid Kit—contents approved by the HSO/SS.
- Sorbent materials capable of absorbing the volume of liquids/fuels brought to the Site by Floyd|Snider personnel.
- Portable fire extinguisher (2-A:10 B/C min).
- A copy of the current HASP.

12.0 Administrative

12.1 MEDICAL SURVEILLANCE

Floyd|Snider personnel involved with field activities must be covered under Floyd|Snider's medical surveillance program that includes biennial physical examinations. These medical monitoring programs must be in compliance with all applicable worker health and safety regulations.

12.2 RECORD KEEPING

The HSO/SS, or a designated alternate, will be responsible for keeping attendance lists of personnel present at site health and safety meetings, accident reports, and signatures of all personnel who have read this HASP.

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13.0 Approvals

Project Manager Date

Project Health & Safety Officer Date

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14.0 Signature Page

I have read this Health and Safety Plan and understand its contents. I agree to abide by its provisions and will immediately notify the HSO/SS if site conditions or hazards not specifically designated herein are encountered.

Name (Print)	**Signature**	**Date**

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Port of Longview TPH Site

Remedial Investigation Work Plan

Appendix G
Health and Safety Plan

Figures

FLOYD | SNIDER
strategy ▪ science ▪ engineering

Remedial Investigation Work Plan
Port of Longview TPH Site
Longview, Washington

Figure G.1
Project Location Map

I:\GIS\Projects\POL-TPH\MXD\HASP\Figure G.1 Project Location Map.mxd
5/14/2019

Hospital Address:
1615 Delaware Street
Longview, WA 98632

Site Address:
10 E Port Way
Longview, WA 98632

Directions to Hospital from Site:

- Start at 10 E Port Way, Longview, Washington 98632.
- Head southwest on Paper Way toward Terminal Way.
- Turn right onto Terminal Way.
- Turn right onto E Port Way.
- Slight right onto Oregon Way/WA-433.
- Continue onto 15th Ave.
- Turn left onto Delaware St.
- End at PeaceHealth St. John Medical Center
  1615 Delaware Street, Longview, Washington 98632

Driving distance: 1.9 miles, Driving time: 7 minutes

Note:
- Basemap provided by Esri.

FLOYD | SNIDER
strategy ▪ science ▪ engineering

Remedial Investigation Work Plan
Port of Longview TPH Site
Longview, Washington

Figure G.2
Route to Hospital

I:\GIS\Projects\POL-TPH\MXD\HASP\Figure G.2 Directions to Hospital Map.mxd
5/14/2019

Port of Longview TPH Site

Remedial Investigation Work Plan

Appendix G
Health and Safety Plan

Attachment G.1
Daily Tailgate Safety Meeting Form

Daily Tailgate Safety Meeting Form

Date: ____________________________ **Time:** _______________

Project Name: ____

Location: ____

Meeting Conducted By: ____

Topics Discussed: ____

Physical Hazards: ____

Chemical Hazards: ____

Personal Protection: ____

Decontamination: ____

Special Site Considerations: ____

____

____

On-site Emergency Contact: Health & Safety Officer/Site Supervisor Emergency Dispatch 911

Hospital: ____

Tailgate Safety Meeting Attendees

Name/Company (printed)	Signature

Conducted by: ______________________ ________________________ ______________

Name	Signature	Date

Port of Longview TPH Site

Remedial Investigation Work Plan

Appendix H
Boring Logs

Petroleum Services Unlimited, Inc.
1081 Columbia Blvd.
Longview, WA 98632

PROJECT NUMBER 40612

WELL NUMBER MW-1 SHEET 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT Port of Longview LOCATION 20 Port Way, Longview, Washington

ELEVATION ______ DRILLING CONTRACTOR Hokkaido Drilling and Developing

DRILLING METHOD AND EQUIPMENT Mobile B-61 Hollow Stem Auger Drilling Rig

START DATE 4-30-91, FINISH DATE 4-30-91 WATER LEVEL est. 8'6" depth LOGGER C. Grant

DEPTH BELOW SURFACE	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	WELL CONSTRUCTION
	INTERVAL	TYPE AND NUMBER	RECOVERY	6"-6"-6" (N)	NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	CASING TYPE, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK GRADATION & INTERVAL, GROUT INTERVAL, ETC.
	1.0					Flush mount monument casing
	2.5		10"	3-4-7 (11)	Silt, light brown, dry, silt (ML)	Bentonite seal to 1' 3 ea 50# bags Wyoben enviro plug med. used 6'3" of 4" dia sch 40 PVC blank casing
5	5.0					
	6.5		18"	2-3-2 (5)	Sand, brown, loose, med. graines, wet, to 5'5" then is a silt, grey, wet, w/charcoal and wood chips to 6'3", then is a silty clay, grey green, dry, clay with organic odor	10-20 CSSI sand pack to 6' depth 4" dia 20 slot sch 40 PVC screen - top of screen at 6'5" depth
	7.5					
	9.0		18"	3-2-6 (8)	Clay as above except moist, w/wood chips to 8'6", then is a fine sand dark grey, wet, loose, sand (SP)	∇ ATD
10	10.0					10' of 4" dia 20 slot sch 40 PVC screen used
	11.5		15"	2-2-2 (4)	Clay w/silt, grey, moist, soft, clay w/wood fibres (OH), to 11'2" then is a sand, saturated (SP)	6 ea 100# bags 10-20 CSSI silica sand used
	13.0		19"	6-4-3 (7)	Interbedded sands and clay, grey, wet, loose, interbeds (SC)	
15					End boring at 16'10"	Centralizing guides used 7" threaded bottom sump Bottom of screen @ 16'3"

Petroleum Services Unlimited, Inc.
1081 Columbia Blvd.
Longview, WA 98632

PROJECT NUMBER 40612

WELL NUMBER MW2

SHEET 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT Port of Longview

LOCATION 20 Port Way, Longview, Washington

ELEVATION

DRILLING CONTRACTOR Hokkaido Drilling and Developing

DRILLING METHOD AND EQUIPMENT Mobile B-61 Hollow Stem Auger Drilling Rig

START DATE 4-30-91

FINISH DATE 4-30-91

WATER LEVEL

LOGGER C. Grant

DEPTH BELOW SURFACE	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	WELL CONSTRUCTION
	INTERVAL	TYPE AND NUMBER	RECOVERY	6"-6"-6" (N)	NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	CASING TYPE, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK GRADATION & INTERVAL, GROUT INTERVAL, ETC.
	1.0				Top 1' of surface is a crushed rock pavement.	Flush mount monument with concrete seal locking compression cap
	2.5		10"	6-8-7 (15)	Poorly graded fine sand, brown, dry, sand (SP)	Bentonite plug to 1' 3 ea 50" bags Wyoben envir plug med used, sand pack to 4'
5	4.5				Poorly graded fine, sand w/silt brown to light grey, moist, sand with some silt (SP-SM)	
	6.0		18"	3-4-4 (8)		6' of 4" dia sch 40 PVC blank casing 6'2" top of screen
	7.5				Sand w/silt as above to 8'6" depth then grading to a silty fine sand saturated, loose, silty sand (SM)	4.5 ea 100# bags 10-20 SCC silica sand used ▽ATD
	9.0		15"	3-3-5 (8)		6'2" of 4" dia 20 slot sch 40 PVC screen
10						
	11.5				Silty sand (SM) as above to 11'9" then is a clay, dark grey, dry, clay w/wood fibres throughout and some silt and charcoal lenses (OH)	Bottom of screen at 12'5" slip cap bottom sump
	13		18"	2-2-4 (6)		
	14.5		18"	1-4-6 (10)	Clay (OH) as above to 14'2" then is a silt, dark grey, wet, loose silt (ML)	Bentonite plug seal from 12'5" to 14'5"
15					End boring at 14'6" depth	

Petroleum Services Unlimited, Inc.
1081 Columbia Blvd.
Longview, WA 98632

PROJECT NUMBER 40612

WELL NUMBER MW3

SHEET 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT Port of Longview

LOCATION 20 Port Way, Longview, Washington

ELEVATION

DRILLING CONTRACTOR Hokkaido Drilling and Developing

DRILLING METHOD AND EQUIPMENT Mobile B-61 Hollow Stem Auger Drilling Rig

START DATE 5-1-91

FINISH DATE 5-1-91

WATER LEVEL

LOGGER C. Grant

DEPTH BELOW SURFACE	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	WELL CONSTRUCTION
	INTERVAL	TYPE AND NUMBER	RECOVERY	6"-6"-6" (N)	NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	CASING TYPE, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK GRADATION & INTERVAL, GROUT INTERVAL, ETC.
	2.5				Poorly graded fine sand w/silt, brown to grey, dry, loose, sand w/silt (SP-SM) to 3'6", then is a silt, grey dry, silt w/some iron stain (ML) to 3'10", then is a well graded sand, dry, loose sand with gravel to 3/8" (SW)	Flush mount monument with concrete seal, locking compression cap on casing Bentonite seal to 1' depth 4 ea 50# bags Wyoben envir plug medium used
4	4.0		17"	1-2-3 (5)		8'3" of 4" dia sch 40 PVC blank casing used
	6.0					
	7.5		18"	2-3-4 (7)	Interbedded fine sands and silts, grey to brown, moist, loose, sand (SP-SM)	
8	9.0		18"	2-2-2 (4)	Sand and silt (SP-SM) as above except wet, to 8'10", then is a silt w/clay, dark grey, moist, plastic, silt (MH)	Top of sand pack @ 7'8" PID = 5ppm Top of screen @ 8'5"
	10.5		18"	4-3-4 (7)		PID = 757 ppm
	11.5				Interbedded clay silt/silt clay, wet w/wood fibres throughout (OH)	
12	13.0		15"	4-3-4 (7)	Poorly graded fine sand w/silt, blue grey, saturated, loose, sand with interbeds of clayey silt, (SP) with irridescent sheen	5 ea 100# bags 10-20 CSSI silica sand used 10' of 4" dia 20 slot sch 40 PVC screen used.
16	17.5					
	19.0		15"	3-4-9 (13)	Interbedded clayey silt and silt, dark grey, wet, med dense, silt (MH) to 18'3", then is a well graded sand, blue grey, wet, med dense, sand (SW)	Bottom of screen @ 18'5" 7" bottom sump
					End boring at 19'	

Petroleum Services Unlimited, Inc.
1081 Columbia Blvd.
Longview, WA 98632

PROJECT NUMBER 40612
WELL NUMBER MW4
SHEET 1 OF 1

MONITORING WELL DRILLING & CONSTRUCTION LOG

PROJECT Port of Longview
LOCATION 20 Port Way, Longview, Washington
ELEVATION
DRILLING CONTRACTOR Hokkaido Drilling and Developing
DRILLING METHOD AND EQUIPMENT Mobile B-61 Hollow Stem Auger Drilling Rig
START DATE 5-2-91
FINISH DATE 5-2-91
WATER LEVEL
LOGGER C. Grant

DEPTH BELOW SURFACE	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	WELL CONSTRUCTION CASING TYPE, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PACK GRADATION & INTERVAL, GROUT INTERVAL, ETC.
	INTERVAL	TYPE AND NUMBER	RECOVERY			
4					Crushed rock pavement to 1'	Flush mount monumnet with concrete seal, locking compression cap Bentonite seal to 1' 6 ea 50# bags Wyoben Enviro plug medium used 7'2" of 4" dia sch 40 PVC blank casing Sand pack to 5' 5 ea 100# bags 10-20 SCCI silica sand used
8	7.5 9.0		12"	5-10-17 (27)	Poorly graded fine to med sand, grey, moist, med dense, sand (SP)	Top of screen at 7'5"
	10.5		13"	6-9-9 (18)	Sand (SP) as above, except w/some silt and pumice fragments	10' of 4" dia 20 slot sch 40 PVC screen used
12	12.0		13"	6-9-10 (19)	Poorly graded fine sand w/silt, grey brown, wet, med dense sand w/silt (SP-SM) to 11'3", then is a silt 2/sand, grey, wet, med dense, silt (SM)	5 ea 100# bags 10-20 CSSI silica sand used
16						
	17.5 19.0		15"	3-7-7 (14)	Interbedded silt and silty fine sand and clayey silt, grey, wet med dense, silts (SC-SM)	Bottom of screen @ 17'5" 7" bottom sump
20					End boring @ 19'	

Deepest well

Petroleum Services Unlimited, Inc.
1081 Columbia Blvd.
Longview, WA 98632

PROJECT NUMBER 40612

WELL NUMBER MW5 SHEET 1 OF

MONITORING WELL DRILLING & CONSTRUCTION LO

PROJECT Port of Longview LOCATION 20 Port Way, Longview, Washington

ELEVATION DRILLING CONTRACTOR Hokkaido Drilling and Developing

DRILLING METHOD AND EQUIPMENT Mobile B-61 Hollow Stem Auger Drilling Rig

START DATE 5-3-91 FINISH DATE 5-3-91 WATER LEVEL LOGGER C. Grant

DEPTH BELOW SURFACE	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	WELL CONSTRUCTION
	INTERVAL	TYPE AND NUMBER	RECOVERY	6"-6"-6" (N)	NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	CASING TYPE, DIAMETER, SCREEN INTERVAL, SLOT SIZE, GRAVEL PAC GRADATION & INTERVAL, GROUT INTERVAL, ETC.
						Flush mount monument w concrete seal, locking compression cap Bentonite seal to 1' 8 ea 50# bags Wyoben Enviro plug medium use 12'1" of 2" dia sch 40 Blank casing used
4						
8						
	9.5					
	11.0		18"	6-4-4 (8)	Poorly graded fine sand w/silt, grey brown, wet, loose, sand w/ interbedded silt & silty clay layers to .25" (SP-SM)	
12	12.5		18"	3-4-6 (10)	Sand (SP-SM) as above, to 11'7" then is a clay w/silt, grey, moist plastic, clay (OH) to 12'3", then	Sand pack to 12'5" Top of screen @ 12'6"
	14.0		18"	3-4-3 (7)	is a clayey silt, grey moist, loose silt w/organic fibres (OH)	6 ea 100# bags 10-20 C silica sand used
	15.5		18"	3-3-4 (7)	Silty clay, grey, moist, firm, clay w/interbedded silt layers (OH	
16					Silty clay (OH), as above to 14'8". then is a poorly graded fine sand w/silt, grey, wet, loose sand w/ silty clay interbeds (SP-SM)	10' of 2" dia 20 slot sch 40 PVC screen used
20						
	21.0					
	22.5		10"	3-4-5 (9)	Well graded fine to med sand with silt, grey, ~~saturated,~~ loose, sand w/silt (SP-SM)	Bottom of screen @ 22' 5" bottom sump
					End boring at 22'8"	
24						

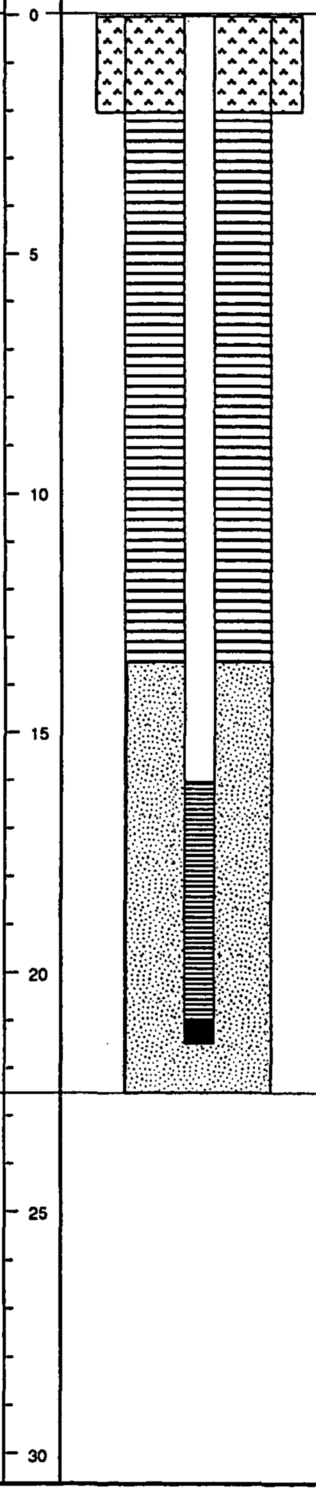
RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-6
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 933-9725
BOREHOLE LOCATION:
BOREHOLE CONDITION:

SHEET 1 OF 1
PROJECT: Port of Longview
BORING DATE: 12/9/92

STRATIGRAPHY

ELEV. DEPTH	DESCRIPTION	GRAPHIC LOG	WATER NOTES	BORING METHOD
0.0	Railroad ballast			Hollow Stem Auger
1.5	Brown, fine to medium SAND, trace gravel Iron staining @5.5' Increasing silt			
6.9	Gray silty CLAY to clayey SILT			
8.0	Gray, fine SAND grading coarser with depth Coarse pumice at 11.8'			
15.0	Light gray to light brown, fine to medium SAND, trace coarse sand and silt Pumice layers			
22.5	Bottom of Hole - 22.5' Below Ground Surface			



START OF INSTALLATION

HOLE DRILLED TO: 22.5'
OPEN TO:
DEPTH CASING AUGERS:
DEPTH TO W.L.:

INSTALLATION DETAILS

DEPTH	NOTES
0.0	Flush mounted steel cap
0.0-2.0	Cement seal
2.0-13.5	Bentonite chips
13.5-22.5	10x20 Sand
16.0-21.0	4" Schedule 40 0.010 slotted screen
21.0-21.5	Sump

DRILL RIG:
DRILLING CONTRACTOR: Geotech
DRILLER:

LOGGED: A. Templeton
CHECKED: T. Belunes
DATE: 7/26/93

Golder Associates

RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-7
RECORD OF MONITORING WELL INSTALLATION

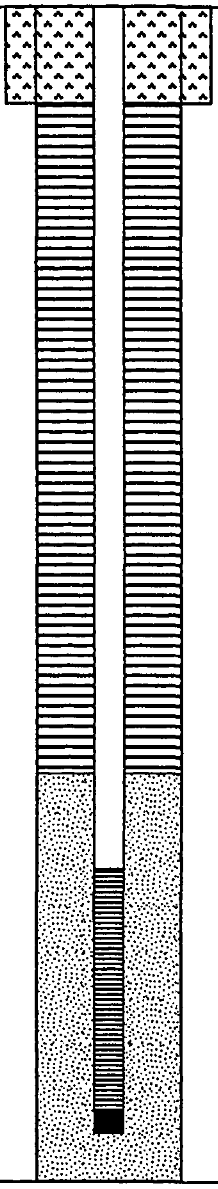
PROJECT NUMBER: 933-9725
BOREHOLE LOCATION:
BOREHOLE CONDITION:

SHEET 1 OF 1
PROJECT: Port of Longview
BORING DATE: 12/7/92

STRATIGRAPHY

ELEV. / DEPTH	DESCRIPTION	BORING METHOD
0.0	Brown to black silt, sand and gravel FILL	Hollow Stem Auger
1.7	Brown, silty, fine to medium SAND iron staining	
5.3	Gray and orange, silty CLAY, iron stained	
7.3	Light gray SILT	
8.0	Light gray, fine to medium SAND, with silt layers wet at 8.3', sheen	
10.7	Light gray, clayey SILT to silty CLAY	
13.5	Gray, fine to medium SAND, some silt coarse pumice layers saturated Saturated @14' Some SILT layers	
24.5	Bottom of Hole - 24.5' Below Ground Surface	

INSTALLATION SKETCH



START OF INSTALLATION
HOLE DRILLED TO: 24.5'
OPEN TO:
DEPTH CASING AUGERS:
DEPTH TO W.L.: 8.8

INSTALLATION DETAILS

DEPTH	NOTES
0.0	Flush mounted steel cap
0.0-2.0	Cement seal
2.0-16.0	Bentonite chips
16.0-24.5	10x20 Sand
18.0-23.0	4" Schedule 40 0.010 slotted screen
23.0-23.5	Sump

DRILL RIG:
DRILLING CONTRACTOR: Geotech
DRILLER:

LOGGED: A. Templeton
CHECKED: T. Belunes
DATE: 7/26/93

Golder Associates

RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-8
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 933-9725

BOREHOLE LOCATION:

BOREHOLE CONDITION:

SHEET 1 **OF** 1

PROJECT: Port of Longview

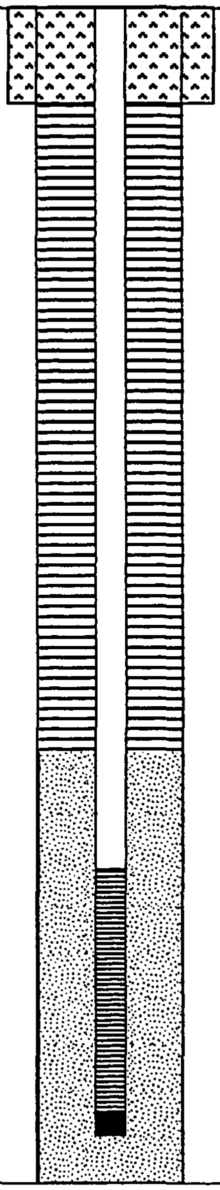
BORING DATE: 12/8/92

STRATIGRAPHY

ELEV. DEPTH	DESCRIPTION	GRAPHIC LOG	WATER NOTES	BORING METHOD
0.0	Brown SILT, SAND and gravel FILL			Hollow Stem Auger
1.6	Gray, silty fine to medium SAND Trace of roots			
7.8	Dark gray SILT and fine SAND			
8.2	Gray SILT Pink layer @ 9.2'			
9.6	Gray fine SAND			
12.0	Gray SILT			
13.9	Gray fine to medium SAND with SILT layers Saturated @16' Some SILT layers			
24.5	Bottom of Hole - 24.5' Below Ground Surface			

DEPTH IN FEET: 0, 5, 10, 15, 20, 25, 30

INSTALLATION SKETCH



START OF INSTALLATION

HOLE DRILLED TO: 24.5'

OPEN TO:

DEPTH CASING AUGERS:

DEPTH TO W.L.:

INSTALLATION DETAILS

DEPTH	NOTES
0.0	Flush mounted steel cap
0.0-2.0	Cement seal
2.0-15.35	Bentonite chips
15.35-24.5	10x20 Sand
18.0-23.5	4" Schedule 40 0.010 slotted screen
23.0-23.5	Sump

DRILL RIG: CME-55

DRILLING CONTRACTOR: Geotech

DRILLER:

LOGGED: A. Templeton

CHECKED: T. Belunes

DATE: 7/26/93

Golder Associates

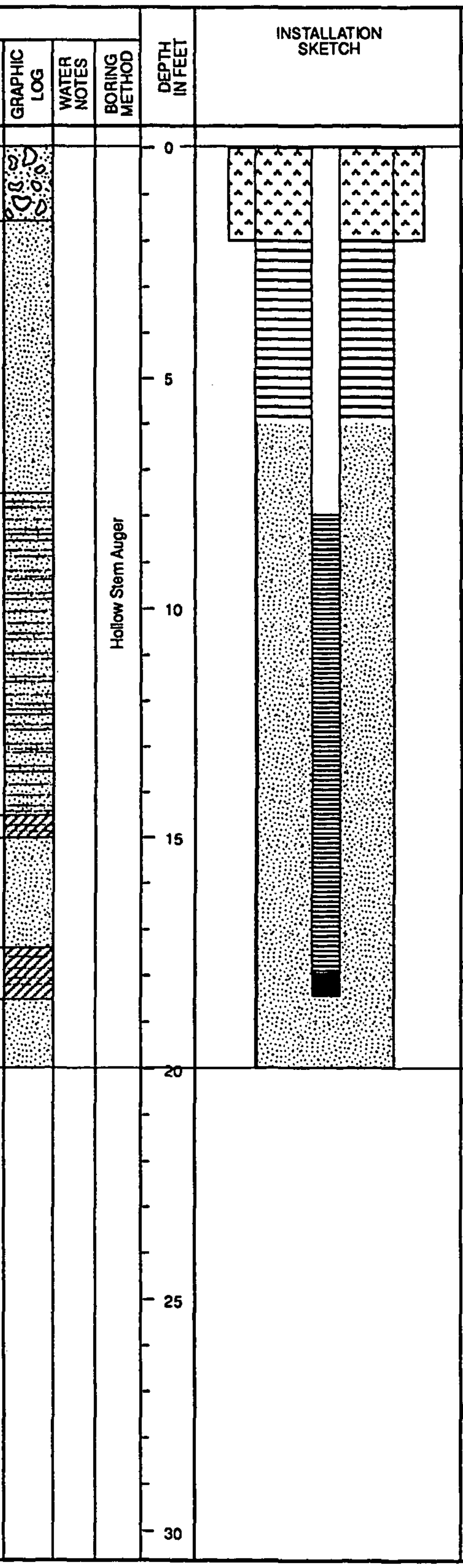
RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-9
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 933-9725
BOREHOLE LOCATION:
BOREHOLE CONDITION:

SHEET 1 OF 1
PROJECT: Port of Longview
BORING DATE: 12/2/92

STRATIGRAPHY

ELEV. DEPTH	DESCRIPTION
0.0	Brown, fine to coarse SAND and GRAVEL
1.5	Olive gray, fine to medium SAND Iron staining
7.5	Dark gray, fine to medium SAND, some SILT layers Odor, free product @10'
14.6	Pink silty CLAY to clayey SILT
15.0	Gray, fine to medium SAND, some silt
17.3	Gray-pink SILT and CLAY
18.5	Gray, fine to medium SAND
20.0	Bottom of Hole - 20.0' Below Ground Surface



START OF INSTALLATION

HOLE DRILLED TO: 20.0'
OPEN TO:
DEPTH CASING AUGERS:
DEPTH TO W.L.:

INSTALLATION DETAILS

DEPTH	NOTES
0.0	Flush mounted steel cap
0.0-2.0	Cement seal
2.0-6.0	Bentonite chips
6.0-20.0	10x20 Sand
8.0-18.0	4" Schedule 40 0.010 slotted screen
18.0-18.5	Sump

DRILL RIG:
DRILLING CONTRACTOR: Geotech
DRILLER:

LOGGED: A. Templeton
CHECKED: T. Belunes
DATE: 7/26/93

Golder Associates

RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-10
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 933-9725
BOREHOLE LOCATION:
BOREHOLE CONDITION:

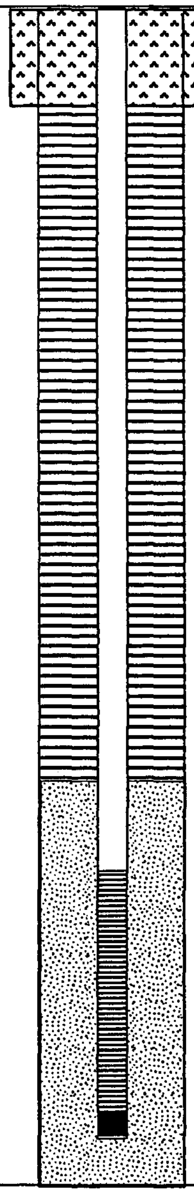
SHEET 1 **OF** 1
PROJECT: Port of Longview
BORING DATE: 12/7/92

STRATIGRAPHY

ELEV. DEPTH	DESCRIPTION	GRAPHIC LOG	WATER NOTES	BORING METHOD
0.0	Brown SAND and GRAVEL FILL			Hollow Stem Auger
1.7	Brown, fine to medium SAND, trace gravel Iron staining			
7.1	Gray SILT grading to fine to medium SAND			
8.4	Gray fine to medium SAND, trace gravel			
11.3	Gray SILT and SAND layers			
17.3	Gray fine to medium SAND, some silt layers			
20.0	Gray fine to medium SAND, trace coarse sand			
24.5	Bottom of Hole - 24.5' Below Ground Surface			

DEPTH IN FEET: 0, 5, 10, 15, 20, 25, 30

INSTALLATION SKETCH



START OF INSTALLATION

HOLE DRILLED TO: 24.5'
OPEN TO:
DEPTH CASING AUGERS:
DEPTH TO W.L.:

INSTALLATION DETAILS

DEPTH	NOTES
0.0	Flush mounted steel cap
0.0-2.0	Cement seal
2.0-16.0	Bentonite chips
16.0-24.5	10x20 Sand
18.0-23.0	4" Schedule 40 0.010 slotted screen
23.0-23.5	Sump

DRILL RIG:
DRILLING CONTRACTOR: Geotech
DRILLER:

LOGGED: A. Templeton
CHECKED: T. Belunes
DATE: 7/26/93

Golder Associates

RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-11
RECORD OF MONITORING WELL INSTALLATION

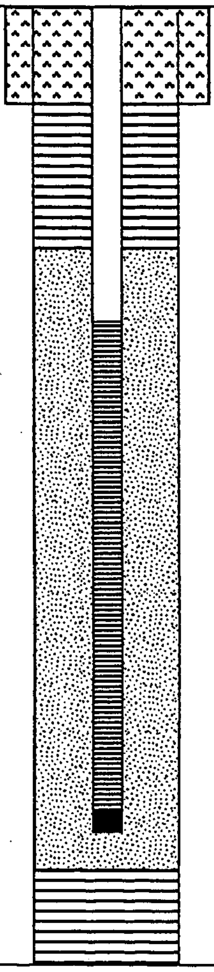
PROJECT NUMBER: 933-9725
BOREHOLE LOCATION:
BOREHOLE CONDITION:

SHEET 1 OF 1
PROJECT: Port of Longview
BORING DATE: 12/3/92

START OF INSTALLATION
HOLE DRILLED TO: 20.0'
DEPTH CASING AUGERS:
OPEN TO:
DEPTH TO W.L.:

STRATIGRAPHY					
ELEV. DEPTH	DESCRIPTION	GRAPHIC LOG	WATER NOTES	BORING METHOD	DEPTH IN FEET
0.0	Railroad ballast			Hollow Stem Auger	0
2.5	Gray, fine to medium SAND and GRAVEL				
3.4	Brown fine to medium SAND, trace gravel Iron staining				5
9.8	Light gray SILT, micaceous, petroleum odor				10
13.1	Gray and white, coarse SAND pumice layers				15
17.8	Gray silty CLAY to clayey SILT				
19.0	Light gray, fine to medium SAND				
20.0	Bottom of Hole - 20.0' Below Ground Surface				20
					25
					30

INSTALLATION SKETCH



INSTALLATION DETAILS	
DEPTH	NOTES
0.0	Flush mounted steel cap
0.0-2.0	Cement seal
2.0-5.0	Bentonite chips
5.0-18.0	10x20 Sand
6.6-16.66	4" Schedule 40 0.010 slotted screen
16.66-17.16	Sump
18.0-20.0	Bentonite chips

DRILL RIG:
DRILLING CONTRACTOR: Geotech
DRILLER:

LOGGED: A. Templeton
CHECKED: T. Belunes
DATE: 7/26/93

Golder Associates

RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-12
RECORD OF MONITORING WELL INSTALLATION

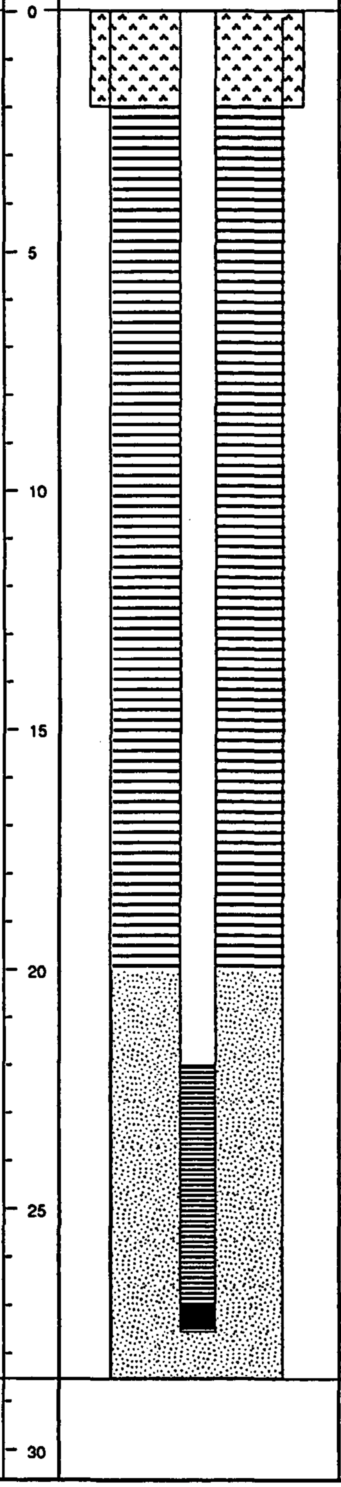
PROJECT NUMBER: 933-9725
BOREHOLE LOCATION:
BOREHOLE CONDITION:

SHEET 1 **OF** 1
PROJECT: Port of Longview
BORING DATE: 12/4/92

STRATIGRAPHY

ELEV. / DEPTH	DESCRIPTION	BORING METHOD
0.0	Railroad ballast	Hollow Stem Auger
2.0	Light to dark brown fine to medium SAND wet @4.5'	
5.4	Gray SILT and SAND layers	
7.8	Gray-blue SILT	
10.8	SILT and SAND layers	
11.8	Gray fine to medium SAND some silt layers Pink layer	
18.6	Gray silty CLAY to clayey SILT	
19.0	Gray, fine to medium SAND, some silt layers	
28.5	Bottom of Hole - 28.5' Below Ground Surface	

INSTALLATION SKETCH



START OF INSTALLATION

HOLE DRILLED TO: 28.5'
OPEN TO:
DEPTH CASING AUGERS:
DEPTH TO W.L.:

DEPTH	INSTALLATION DETAILS NOTES
0.0	Flush mounted steel cap
0.0-2.0	Cement seal
2.0-20.0	Bentonite chips
20.0-28.5	10x20 Sand
22.0-27.0	4" Schedule 40 0.010 slotted screen
27.0-27.5	Sump

DRILL RIG:
DRILLING CONTRACTOR: Geotech
DRILLER:

LOGGED: A. Templeton
CHECKED: T. Belunes
DATE: 7/26/93

Golder Associates

RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-13
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 933-9725

BOREHOLE LOCATION:

BOREHOLE CONDITION:

SHEET 1 **OF** 1

PROJECT: Port of Longview

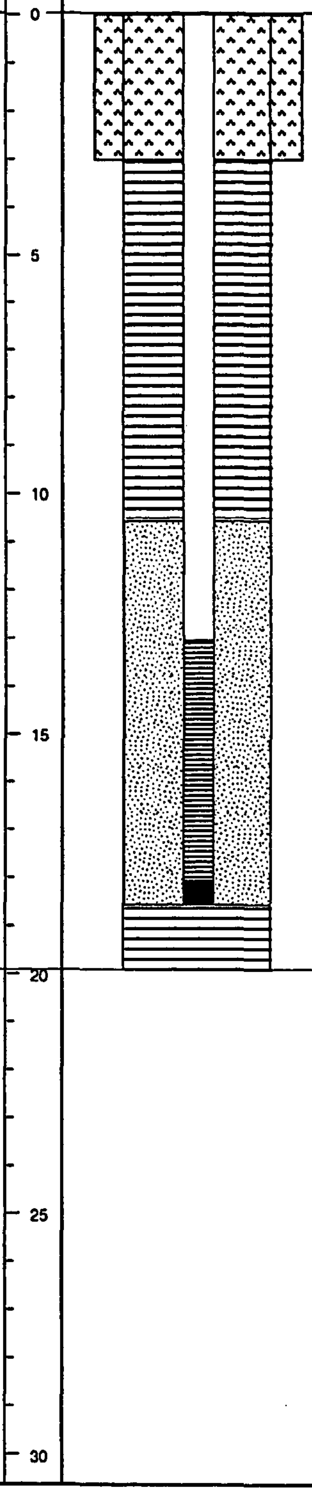
BORING DATE: 5/26/93

STRATIGRAPHY

ELEV. DEPTH	DESCRIPTION	GRAPHIC LOG	WATER NOTES	BORING METHOD
0.0	Railroad ballast			Hollow Stem Auger
1.0	Moist, brown, medium SAND, some silt and gravel			
3.8	Moist, brown, fine sandy SILT			
4.3	Moist, brown, silty medium SAND			
5.0	SILT			
5.2	Moist, brown, medium SAND, some silt			
8.5	Wet fine SAND			
8.9	Wet brown SILT			
10.0	Wet gray SILT			
11.5	Wet, gray CLAY		▼	
12.0	Wet, gray medium SAND			
16.5	Gray SILT			
17.5	Gray CLAY			
19.9	Bottom of Hole - 19.9' Below Ground Surface			

DEPTH IN FEET

INSTALLATION SKETCH



START OF INSTALLATION

HOLE DRILLED TO: 19.9'

OPEN TO:

DEPTH CASING AUGERS:

DEPTH TO W.L.: 12.0

INSTALLATION DETAILS

DEPTH	NOTES
0.0	Flush mounted steel cap
0.0-3.0	Cement seal
3.0-10.5	Bentonite chips
10.5-18.5	10x20 Sand
13.0-18.0	4" Schedule 40 0.010 slotted screen
18.0-18.5	Sump
18.5-19.9	Bentonite chips

DRILL RIG: CME-55

DRILLING CONTRACTOR: Geotech

DRILLER:

LOGGED: T. Belunes

CHECKED: T. Belunes

DATE: 7/26/93

Golder Associates

RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-14
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 933-9725
BOREHOLE LOCATION:
BOREHOLE CONDITION:

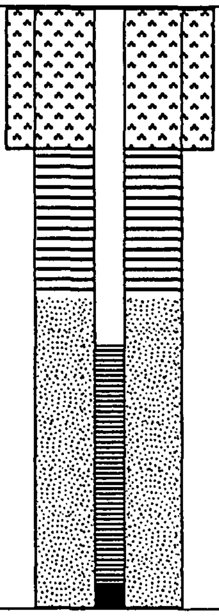
SHEET 1 OF 1
PROJECT: Port of Longview
BORING DATE: 5/17/93

STRATIGRAPHY

ELEV. DEPTH	DESCRIPTION	WATER NOTES	BORING METHOD
0.0	Railroad ballast		Hollow Stem Auger
2.0	Moist, brown, medium SAND		
3.0	Moist, brown, fine sandy SILT, with gravel, pieces of bunker?		
4.5	Moist, brown, clayey SILT		
5.0	Moist, brown, medium SAND Black staining, strong odor		
7.0	Wet, gray, clayey SILT, some wood, petroleum odor	▼	
10.2	Wet, gray, medium SAND, strong odor		
11.2	Wood-free product		
12.5	Bottom of Hole - 12.5' Below Ground Surface		

DEPTH IN FEET: 0, 5, 10, 15, 20, 25, 30

INSTALLATION SKETCH



START OF INSTALLATION
HOLE DRILLED TO: 12.5'
OPEN TO:
DEPTH CASING AUGERS:
DEPTH TO W.L.: 8.0

INSTALLATION DETAILS

DEPTH	NOTES
0.0	Flush mounted steel cap
0.0-2.9	Cement seal
2.9-6.0	Bentonite chips
6.0-12.5	10x20 Sand
7.0-12.0	4" Schedule 40 0.010 slotted screen
12.0-12.5	Sump

DRILL RIG: CME-55
DRILLING CONTRACTOR: Geotech
DRILLER:

LOGGED: T. Belunes
CHECKED: T. Belunes
DATE: 7/23/93

Golder Associates

RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-15
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 933-9725
BOREHOLE LOCATION:
BOREHOLE CONDITION:

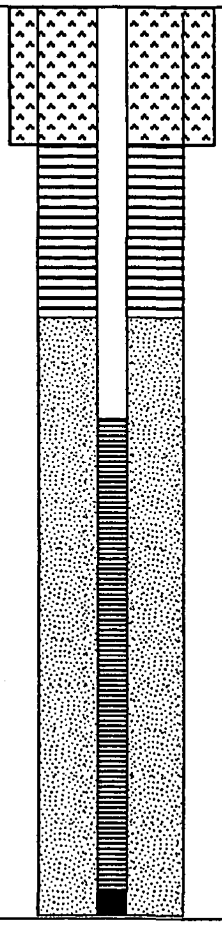
SHEET 1 OF 1
PROJECT: Port of Longview
BORING DATE: 5/18/93

STRATIGRAPHY

ELEV. DEPTH	DESCRIPTION
0.0	Railroad ballast
2.2	FILL
2.5	Moist, brown, clayey SILT
3.5	Moist, brown, medium SAND
5.6	Moist, brown, clayey SILT
6.6	Wet, gray and brown, clayey SILT
7.0	Wet, gray, silty fine SAND
7.6	Moist, gray SILT petroleum odor @ 8.5'
9.0	Moist, gray, clayey SILT slight odor
11.5	Moist, gray, medium SAND petroleum odor @13.5
17.0	Wet, gray SILT
19.0	Bottom of Hole - 19.0' Below Ground Surface

GRAPHIC LOG | WATER NOTES | BORING METHOD: Hollow Stem Auger | DEPTH IN FEET: 0, 5, 10, 15, 20, 25, 30

INSTALLATION SKETCH



START OF INSTALLATION
HOLE DRILLED TO: 19.0'
OPEN TO:
DEPTH CASING AUGERS:
DEPTH TO W.L.: 12.5

INSTALLATION DETAILS

DEPTH	NOTES
0.0	Flush mounted steel cap
0.0-2.8	Cement seal
2.8-6.5	Bentonite chips
6.5-19.0	10x20 Sand
8.5-18.5	4" Schedule 40 0.010 slotted screen
18.5-19.0	Sump

DRILL RIG: CME-55
DRILLING CONTRACTOR: Geotech
DRILLER:

LOGGED: T. Belunes
CHECKED: T. Belunes
DATE: 7/26/93

Golder Associates

RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-16
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 933-9725
BOREHOLE LOCATION:
BOREHOLE CONDITION:

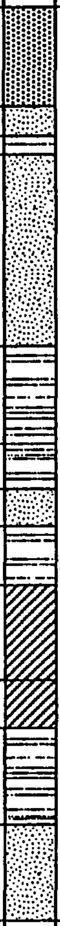
SHEET 1 **OF** 1
PROJECT: Port of Longview
BORING DATE: 5/18/93

START OF INSTALLATION
HOLE DRILLED TO: 19.0'
DEPTH CASING AUGERS:
OPEN TO:
DEPTH TO W.L.:

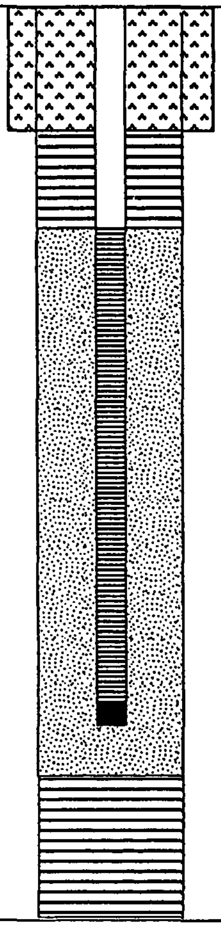
STRATIGRAPHY

ELEV. / DEPTH	DESCRIPTION	WATER NOTES	BORING METHOD
0.0	Railroad ballast		Hollow Stem Auger
2.0	Moist, brown, silty, medium SAND		
2.7	SILT		
3.0	Moist, brown, medium SAND		
7.0	Moist to wet, gray, clayey SILT		
9.0	Wet, gray, clayey SILT Free product		
10.0	Wet, gray, medium SAND Free product		
10.8	Wet, gray, clayey SILT Strong odor		
12.0	Wet, gray, silty CLAY Strong odor; some product		
14.0	CLAY free product		
15.0	Wet, gray SILT, slight odor		
17.0	Wet, gray medium SAND		
19.0	Bottom of Hole - 19.0' Below Ground Surface		

GRAPHIC LOG



INSTALLATION SKETCH



INSTALLATION DETAILS

DEPTH	NOTES
0.0	Flush mounted steel cap
0.0-2.5	Cement seal
2.5-4.5	Bentonite chips
4.5-16.0	10x20 Sand
4.5-14.5	4" Schedule 40 0.010 slotted screen
14.5-15.0	Sump
16.0-19.0	Bentonite chips

DRILL RIG: CME-55
DRILLING CONTRACTOR: Geotech
DRILLER:

LOGGED: T. Belunes
CHECKED: T. Belunes
DATE: 7/23/93

Golder Associates

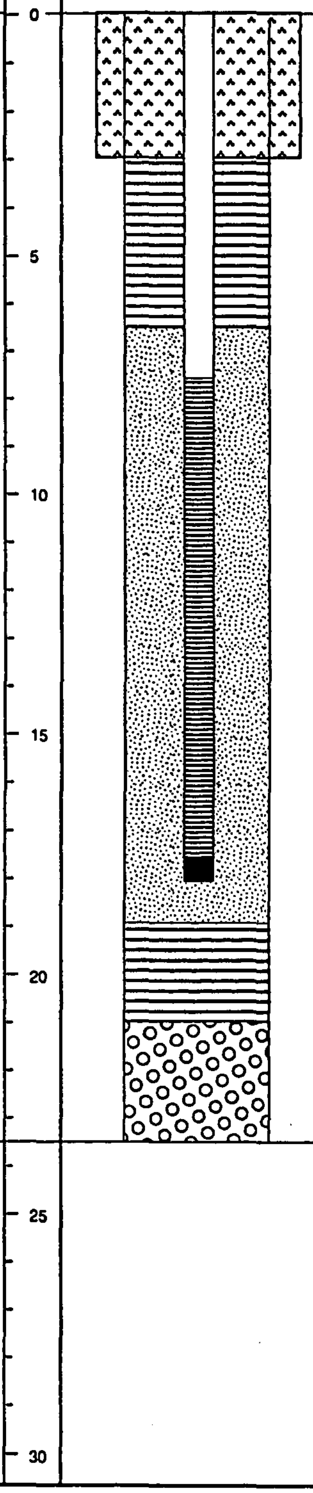
RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-17
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 933-9725
BOREHOLE LOCATION:
BOREHOLE CONDITION:

SHEET 1 **OF** 1
PROJECT: Port of Longview
BORING DATE: 5/19/93

STRATIGRAPHY

ELEV. DEPTH	DESCRIPTION	GRAPHIC LOG	WATER NOTES	BORING METHOD
0.0	Railroad ballast			Hollow Stem Auger
1.0	Moist brown medium SAND Bunker C			
2.0	Moist brown medium SAND Wet @ 8.0'			
10.2	Moist to wet gray clayey SILT slight odor			
12.2	Wet gray medium SAND strong odor			
13.5	Wet gray medium SAND Free product strong odor			
18.5	Wet gray medium SAND slight odor			
19.5	Moist gray clayey SILT			
20.0	Wet gray medium SAND			
23.5	Bottom of Hole - 23.5' Below Ground Surface			



START OF INSTALLATION
HOLE DRILLED TO: 23.5'
OPEN TO:
DEPTH CASING AUGERS:
DEPTH TO W.L.:

INSTALLATION DETAILS

DEPTH	NOTES
0.0	Flush mounted steel cap
0.0-3.0	Cement seal
3.0-6.5	Bentonite chips
6.5-19.0	10x20 Sand
7.5-17.5	4" Schedule 40 0.010 slotted screen
17.5-18.0	Sump
19.0-21.0	Bentonite chips
21.0-23.5	Heave

DRILL RIG: CME-55
DRILLING CONTRACTOR: Geotech
DRILLER:

LOGGED: T. Belunes
CHECKED: T. Belunes
DATE: 7/23/93

Golder Associates

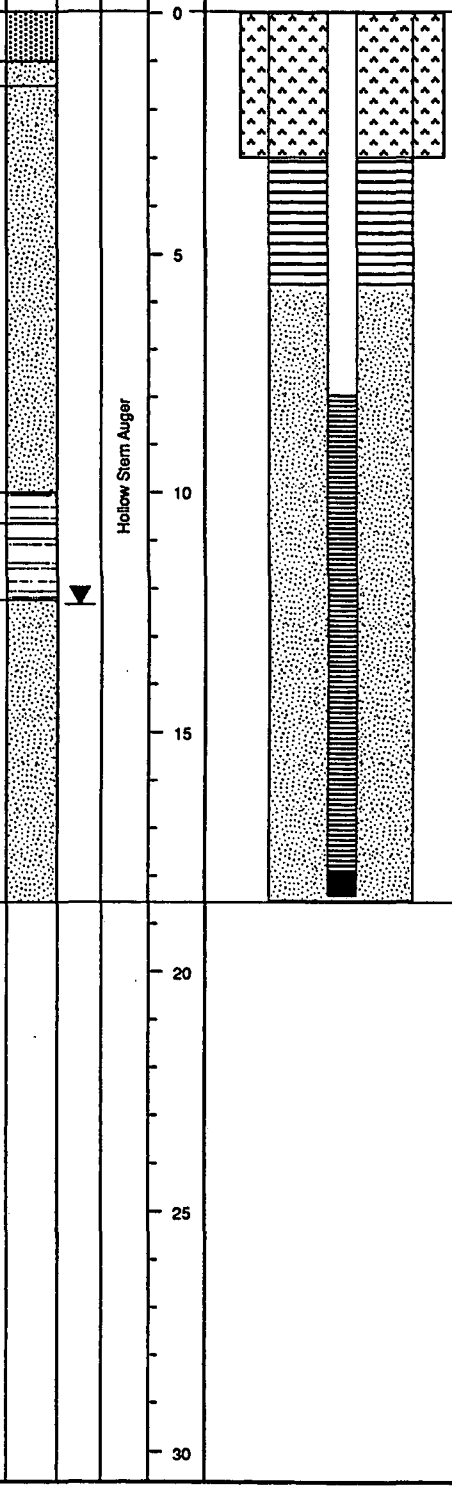
RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-18
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 933-9725
BOREHOLE LOCATION:
BOREHOLE CONDITION:

SHEET 1 **OF** 1
PROJECT: Port of Longview
BORING DATE: 5/19/93

STRATIGRAPHY

ELEV. DEPTH	DESCRIPTION
0.0	Railroad ballast
1.0	SAND with crushed rock
1.5	Moist, brown, medium SAND (massive)
10.0	Moist, brown, clayey SILT
10.6	Moist, gray, clayey SILT
12.25	Moist to wet, gray, medium SAND
18.5	Bottom of Hole - 18.5' Below Ground Surface



START OF INSTALLATION

HOLE DRILLED TO: 18.5'
OPEN TO:
DEPTH CASING AUGERS:
DEPTH TO W.L.:

INSTALLATION DETAILS

DEPTH	NOTES
0.0	Flush mounted steel cap
0.0-3.0	Cement seal
3.0-6.75	Bentonite chips
6.75-18.5	10x20 Sand
8.0-18.0	4" Schedule 40 0.010 slotted screen
18.0-18.5	Sump

DRILL RIG: CME-55
DRILLING CONTRACTOR: Geotech
DRILLER:

LOGGED: T. Belunes
CHECKED: T. Belunes
DATE: 7/26/93

Golder Associates

RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-19
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 933-9725
BOREHOLE LOCATION:
BOREHOLE CONDITION:

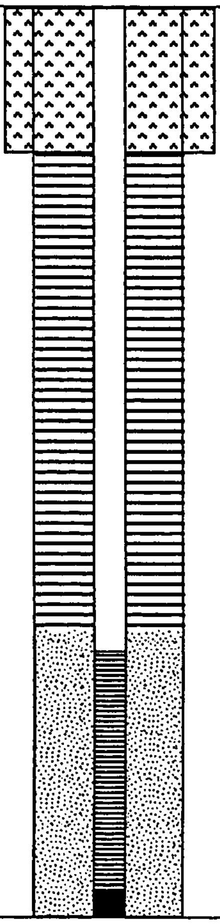
SHEET 1 **OF** 1
PROJECT: Port of Longview
BORING DATE: 5/20/93

STRATIGRAPHY

ELEV. / DEPTH	DESCRIPTION	GRAPHIC LOG	WATER NOTES	BORING METHOD
0.0	Railroad ballast			Hollow Stem Auger
2.0	Moist, black SAND Free product, Bunker?			
4.0	Moist, gray, silty CLAY Free product @ 6.6			
8.5	Moist, brown, fine to medium SAND Slight odor @ 10.5 Wet @12.8'			
19.0	Bottom of Hole - 19.0' Below Ground Surface			

DEPTH IN FEET: 0, 5, 10, 15, 20, 25, 30

INSTALLATION SKETCH



START OF INSTALLATION

HOLE DRILLED TO: 19.0'
OPEN TO:
DEPTH CASING AUGERS:
DEPTH TO W.L.:

INSTALLATION DETAILS

DEPTH	NOTES
0.0	Flush mounted steel cap
0.0-3.0	Cement seal
3.0-13.0	Bentonite chips
13.0-19.0	10x20 Sand
13.5-18.5	4" Schedule 40 0.010 slotted screen
18.5-19.0	Sump

DRILL RIG: CME-55
DRILLING CONTRACTOR: Geotech
DRILLER:

LOGGED: J. Bach
CHECKED: T. Belunes
DATE: 7/26/93

Golder Associates

RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-20
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 933-9725

BOREHOLE LOCATION:

BOREHOLE CONDITION:

SHEET 1 **OF** 1

PROJECT: Port of Longview

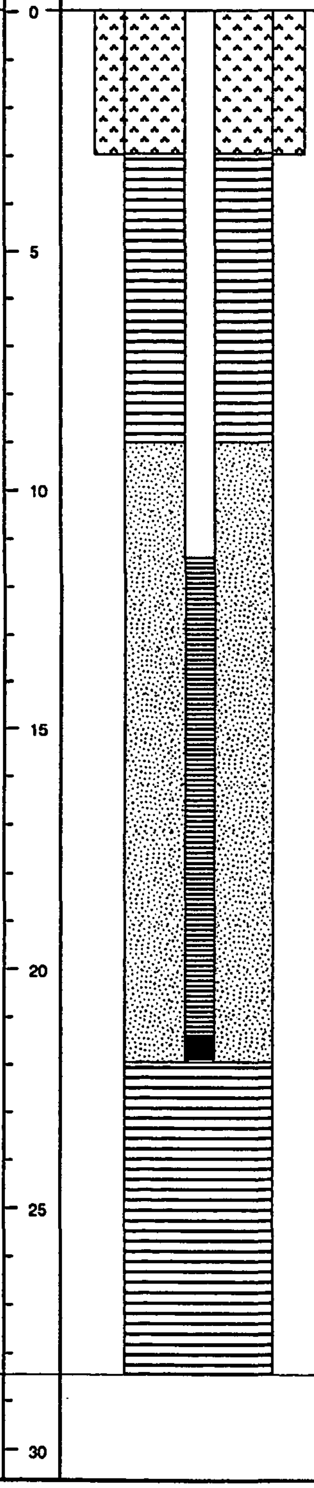
BORING DATE: 5/20/93

STRATIGRAPHY

ELEV. DEPTH	DESCRIPTION	GRAPHIC LOG	WATER NOTES	BORING METHOD
0.0	Railroad Ballast			Hollow Stem Auger
3.0	Moist, hard, blackish brown to gray, sandy GRAVEL			
3.5	Bunker C (?) Moist, gray CLAY and GRAVEL			
5.0	Moist, gray, silty, fine SAND with gravel			
10.5	Dark gray, sandy CLAY Wet @10.5			
12.2	Moist to wet, gray fine SAND with gravel Free product at 13.0'			
14.0	Wet, gray CLAY Sheen on water at 15.0'			
16.0	Gray, fine to medium SAND with gravel			
28.5	Bottom of Hole - 28.5' Below Ground Surface			

DEPTH IN FEET

INSTALLATION SKETCH



START OF INSTALLATION

HOLE DRILLED TO: 28.5'

OPEN TO:

DEPTH CASING AUGERS:

DEPTH TO W.L.:

INSTALLATION DETAILS

DEPTH	NOTES
0.0	Flush mounted steel cap
0.0-3.0	Cement seal
3.0-9.0	Bentonite chips
9.0-22.0	10x20 Sand
11.5-21.5	4-inch schedule 40 0.010 slotted PVC screen
21.5-22.0	Sump
22.0-28.5	Bentonite chips

DRILL RIG: CME-55

DRILLING CONTRACTOR: Geotech

DRILLER:

LOGGED: J. Bach

CHECKED: T. Belunes

DATE: 7/26/93

Golder Associates

RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-21
RECORD OF MONITORING WELL INSTALLATION

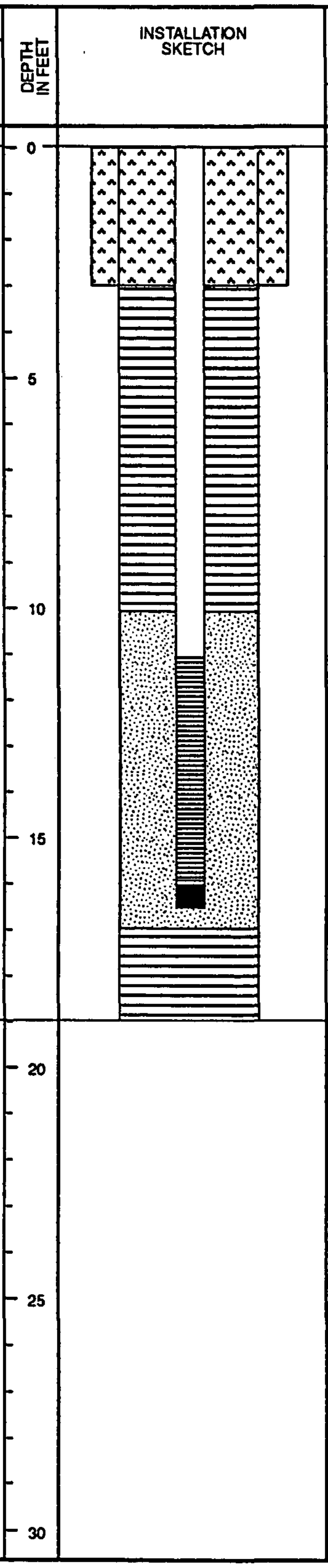
PROJECT NUMBER: 933-9725
BOREHOLE LOCATION:
BOREHOLE CONDITION:

SHEET 1 **OF** 1
PROJECT: Port of Longview
BORING DATE: 5/21/93

START OF INSTALLATION
HOLE DRILLED TO: 19.0'
OPEN TO:
DEPTH CASING AUGERS:
DEPTH TO W.L.:

STRATIGRAPHY

ELEV. DEPTH	DESCRIPTION	GRAPHIC LOG	WATER NOTES	BORING METHOD
0.0	Gravel fill			Hollow Stem Auger
1.5	Moist, medium gray, silty CLAY			
2.5	Moist, gray, silty, fine SAND			
2.9	Moist, CLAY			
3.2	Moist, gray, silty, fine to medium SAND Wet @4.5 Increased clay content			
8.0	Wet, gray, sandy CLAY			
9.0	Wet, gray CLAY			
10.0	Wet, gray, silty, fine SAND			
17.0	Wet, gray SILT			
19.0	Bottom of Hole - 19.0' Below Ground Surface			



INSTALLATION DETAILS

DEPTH	NOTES
0.0	Flush mounted steel cap
0.0-3.0	Redi-Mix
3.0-11.0	Bentonite chips
10.0-17.0	10/20 Sand
11.0-16.0	10-slot screen
17.0-19.0	Bentonite chips

WELL DEVELOPMENT NOTES

Drillers surged the sand pack at the completion of well installation

DRILL RIG: CME-55
DRILLING CONTRACTOR: Geotech
DRILLER: Brad/Tim

LOGGED: J. Bach
CHECKED: T. Belunes
DATE: 7/26/93

Golder Associates

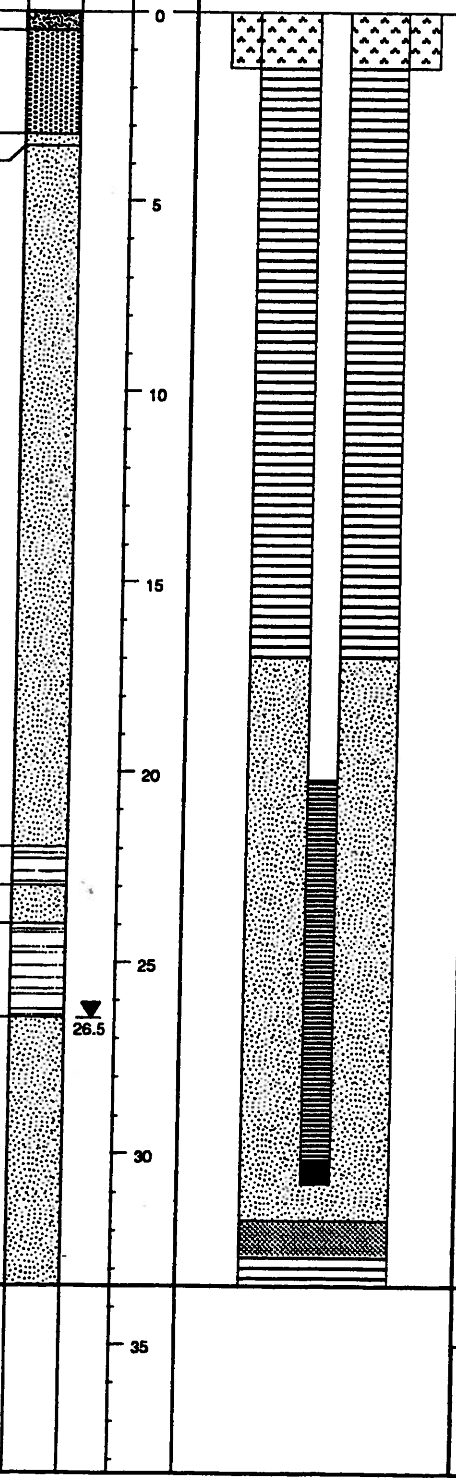
RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-22
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 943-9735
BOREHOLE LOCATION:
BOREHOLE CONDITION:

SHEET 1 **OF** 1
PROJECT: Port of Longview
BORING DATE: 3/1/94

STRATIGRAPHY

ELEV. DEPTH	DESCRIPTION
0.0	Asphalt
0.5	Railroad Ballast PID = 0
3.2	Brown medium SAND (FILL) PID = 0
3.6	PID = 0 Brown medium SAND, trace gravel
22.0	Brown SILT
23.0	Brown medium SAND with gravel
24.0	Gray clayey SILT, moist
26.5	Gray fine to medium SAND with SILT layers,
33.4	Bottom of Hole - 33.4' Below ground surface



START OF INSTALLATION
HOLE DRILLED TO: 33.4
OPEN TO:
DEPTH CASING AUGERS:
DEPTH TO W.L.:

INSTALLATION DETAILS

DEPTH	NOTES
0.0-1.5	Cement Seal
1.5-17.0	3/8" Bentonite Chips
17.0-31.8	10-20 SAND
20.2-30.2	4" Schedule 40 PVC 0.010 Slotted Screen
30.2-30.7	Sump
31.8-32.8	Sluff
32.8-33.4	Bentonite Chips

WELL DEVELOPMENT NOTES

Well Development Notes

DRILL RIG:
DRILLING CONTRACTOR:
DRILLER:

LOGGED: T. Norton
CHECKED:
DATE:

Golder Associates

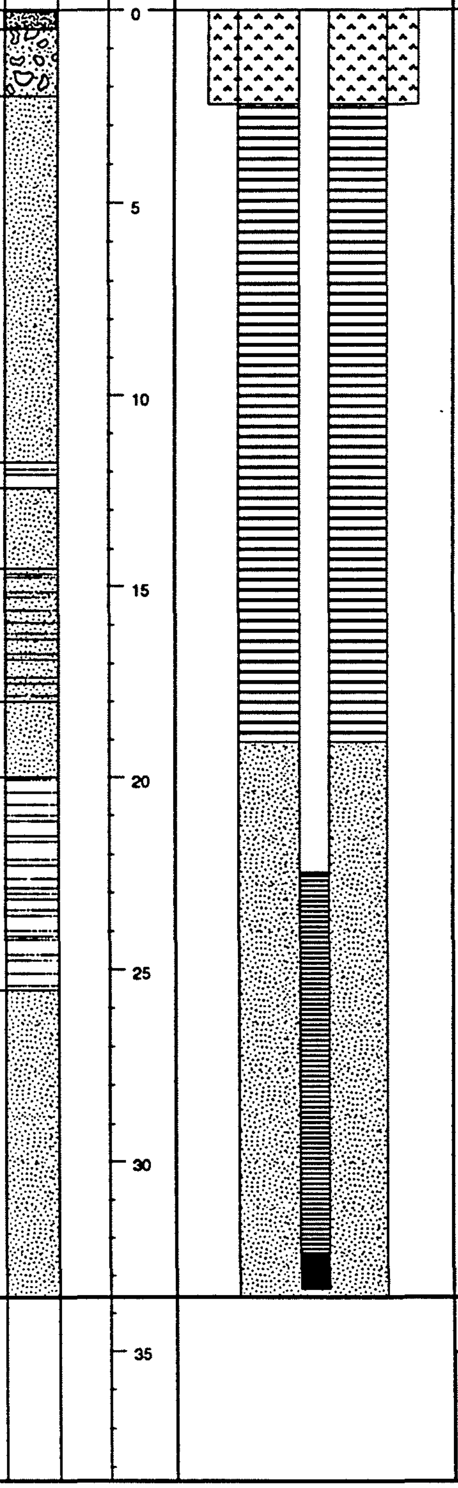
RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-23
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 943-9735
BOREHOLE LOCATION:
BOREHOLE CONDITION:

SHEET 1 **OF** 1
PROJECT: Port of Longview
BORING DATE: 3/2/94

STRATIGRAPHY

ELEV. DEPTH	DESCRIPTION
0.0	Asphalt
0.5	Brown silty GRAVEL
2.2	IBrown medium SAND (damp)
11.8	IBrown SILT
12.3	IBrownish-gray fine SAND
14.5	Interbedded brown SILT and SAND
18.0	Brown medium SAND
20.0	Gray clayey SILT wet to moist at 24 '
25.5	Gray medium SAND, wet
33.6	Bottom of Hole - 33.6' Below ground surface



START OF INSTALLATION
HOLE DRILLED TO: 33.4
OPEN TO:
DEPTH CASING AUGERS:
DEPTH TO W.L.:

INSTALLATION DETAILS

DEPTH	NOTES
0.0-2.5	Cement Seal
2..5-19.0	3/8" Bentonite Chips
19.0-33.6	10-20 SAND
22.4-32.4	4" Schedule 40 PVC 0.010 Slotted Screen
32.4-33.3	Sump

WELL DEVELOPMENT NOTES

Well Development Notes

DRILL RIG:
DRILLING CONTRACTOR:
DRILLER:

LOGGED: T. Norton
CHECKED:
DATE:

Golder Associates

RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-24
RECORD OF MONITORING WELL INSTALLATION

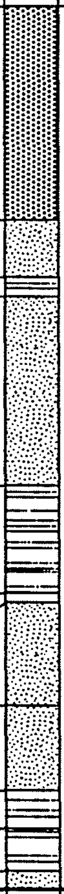
PROJECT NUMBER: 943-9735
BOREHOLE LOCATION:
BOREHOLE CONDITION:

SHEET 1 **OF** 1
PROJECT: Port of Longview
BORING DATE: 3/3/94

STRATIGRAPHY

ELEV. DEPTH	DESCRIPTION
0.0	Railroad Ballast
5.5	Brown medium SAND
7.0	Brown SILT
7.5	PID = 0 Brownish-gray fine to medium SAND
12.4	Gray SILT
15.2	Gray clayey SILT, moist, odor
15.4	PID = 1.2 Gray medium SAND, trace gravel, wet, odor, sheen on water
18.2	Gray fine SAND, wet
20.4	Gray SILT, wet
21.4	Gray clayey SILT
22.6	Gray SAND (wet)
23.0	Bottom of Hole - 23.0' Below ground surface

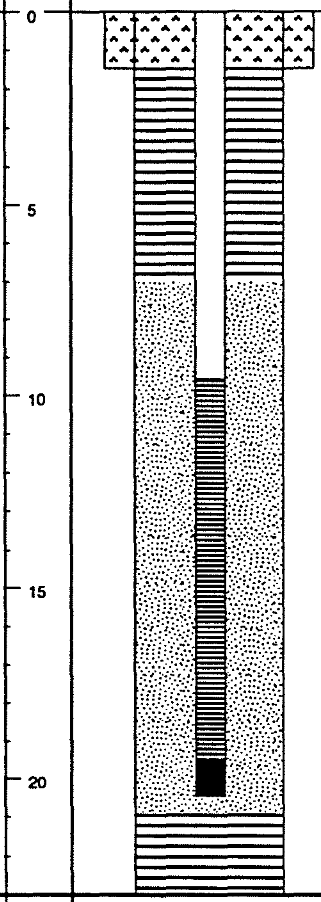
GRAPHIC LOG



WATER NOTES

DEPTH IN FEET

INSTALLATION SKETCH



START OF INSTALLATION

HOLE DRILLED TO: 23.0
DEPTH CASING AUGERS:
OPEN TO:
DEPTH TO W.L.:

INSTALLATION DETAILS

DEPTH	NOTES
0.0-1.5	Cement Seal
1.5-7.0	3/8" Bentonite Chips
7.0-20.9	10-20 SAND
9.6-19.6	4" Schedule 40 PVC 0.010 Slotted Screen
19.6-20.5	Sump
20.9-23.0	Bentonite Chips

WELL DEVELOPMENT NOTES

Well Development Notes

DRILL RIG:
DRILLING CONTRACTOR:
DRILLER:

LOGGED: T. Norton
CHECKED:
DATE:

Golder Associates

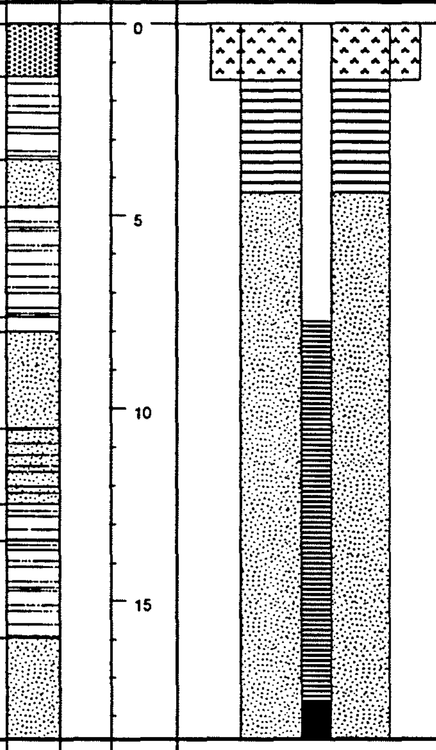
RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-25
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 943-9735
BOREHOLE LOCATION:
BOREHOLE CONDITION:

SHEET 1 **OF** 1
PROJECT: Port of Longview
BORING DATE: 3/2/94

STRATIGRAPHY

ELEV. DEPTH	DESCRIPTION
0.0	Railroad Ballast
1.3	Brown SILT
3.6	Gray medium SAND
4.8	Gray SILT 7.4-7.7 Organic Layer
7.7	Gray SILT
8.0	Gray fine SAND wet at 9.5
10.5	silty clay zone Gray SILT and fine SAND, wet
12.5	Gray SILT
13.4	Gray SILT to SILTY CLAY, wet
16.0	Gray medium SAND, wet
18.7	Bottom of Hole - 18.7' Below ground surface



START OF INSTALLATION
HOLE DRILLED TO: 18.7
OPEN TO:
DEPTH CASING AUGERS:
DEPTH TO W.L.:

INSTALLATION DETAILS

DEPTH	NOTES
0.0-1.5	Cement Seal
1.5-4.5	3/8" Bentonite Chips
4.5-18.7	10-20 SAND
7.8-17.8	4" Schedule 40 PVC 0.010 Slotted Screen
17.8-18.7	Sump

WELL DEVELOPMENT NOTES

Well Development Notes

DRILL RIG:
DRILLING CONTRACTOR:
DRILLER:

LOGGED: T. Norton
CHECKED:
DATE:

Golder Associates

RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-26
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 943-9735
BOREHOLE LOCATION:
BOREHOLE CONDITION:

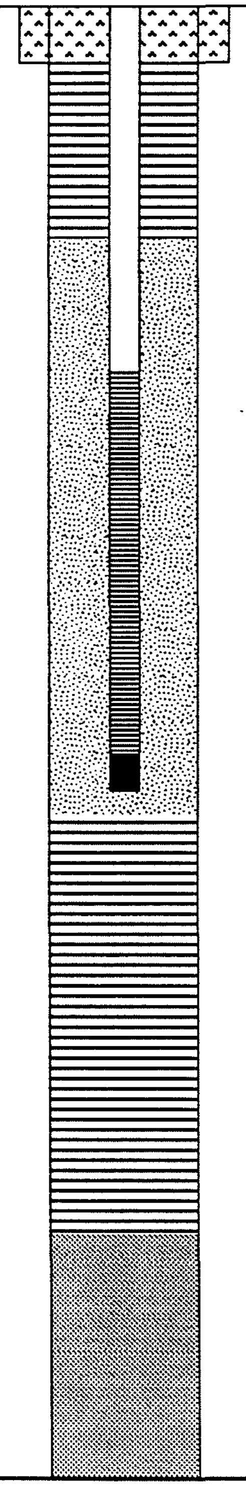
SHEET 1 OF 2
PROJECT: Port of Longview
BORING DATE: 3/3/94

STRATIGRAPHY

ELEV. DEPTH	DESCRIPTION
0.0	Railroad Ballast
1.0	Brown medium SAND PID = 0
11.5	Gray clayey SILT
12.8	Slight petroleum odor Gray medium SAND, moist to wet, sheen on water
15.5	Gray SILT, wet
16.5	PID = 100 at 17 ' Gray fine SAND, wet, sheen on warter
20.8	Gray SILT, wet
21.8	Gray silty CLAY, odor
22.6	PID = 65 at 22' strong odor gray medium SAND, wet strong odor Silt at 28', sheen on water
29.0	Gray SILT, wet
30.4	Gray clayey SILT, wet
31.2	slight odor Gray medium SAND, wet PID = 0 at 37.5 ft. Continued

GRAPHIC LOG | WATER NOTES | DEPTH IN FEET: 0, 5, 10, 15, 20, 25, 30, 35

INSTALLATION SKETCH



START OF INSTALLATION

HOLE DRILLED TO: 43.5
OPEN TO:
DEPTH CASING AUGERS:
DEPTH TO W.L.:

INSTALLATION DETAILS

DEPTH	NOTES
0.0-1.5	Cement Seal
1.5-6.0	3/8" Bentonite Chips
6.0-21.0	10-20 SAND
9.4-19.4	4" Schedule 40 PVC 0.010 Slotted Screen
19.4-20.3	Sump
21.0-32.0	3/8" Bentonite Chips
32.0-43.5	Sluff, collapsed hole

WELL DEVELOPMENT NOTES

Well Development Notes

DRILL RIG:
DRILLING CONTRACTOR:
DRILLER:

LOGGED: T. Norton
CHECKED:
DATE:

Golder Associates

RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-26
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 943-9735
BOREHOLE LOCATION:
BOREHOLE CONDITION:

SHEET 2 **OF** 2
PROJECT: Port of Longview
BORING DATE: 3/3/94

START OF INSTALLATION
HOLE DRILLED TO: 43.5
OPEN TO:
DEPTH CASING AUGERS:
DEPTH TO W.L.:

STRATIGRAPHY					
ELEV. DEPTH	DESCRIPTION	GRAPHIC LOG	WATER NOTES	DEPTH IN FEET	INSTALLATION SKETCH
35.0	Slight odor Gray medium SAND, wet PID = 0 at 37.5'	▨		35 40	▨
43.5	Bottom of hole - 43.5' Below ground surface			45 50 55 60 65 70	

INSTALLATION DETAILS

DEPTH	NOTES
32.0-43.5	Sluff, collapsed hole

WELL DEVELOPMENT NOTES
Well Development Notes

DRILL RIG:
DRILLING CONTRACTOR:
DRILLER:

LOGGED: T. Norton
CHECKED:
DATE:

Golder Associates

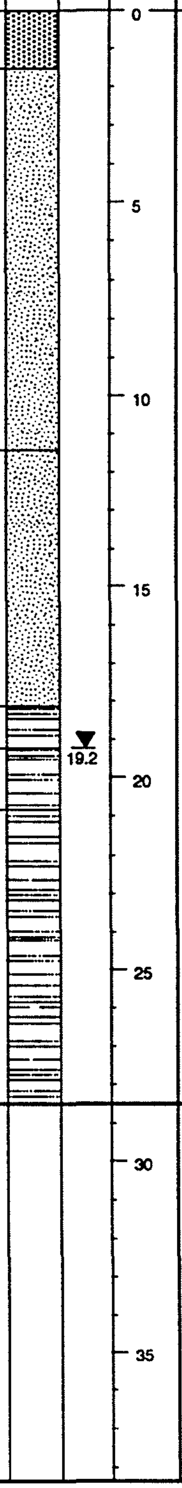
RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-27
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 943-9735
BOREHOLE LOCATION:
BOREHOLE CONDITION:

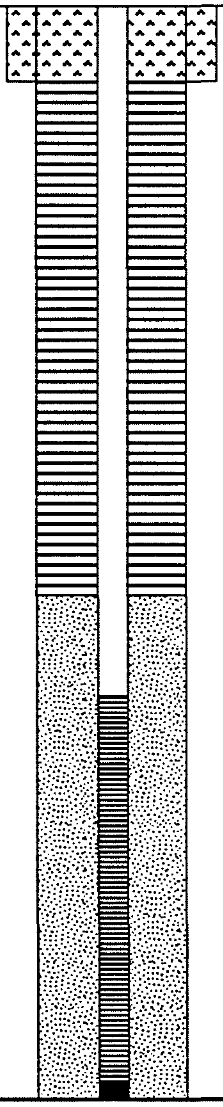
SHEET 1 OF 1
PROJECT: Port of Longview
BORING DATE: 3/21/94

STRATIGRAPHY

ELEV. DEPTH	DESCRIPTION	WATER NOTES
0.0	Railroad Ballast	
1.5	Gray medium SAND, damp 7.0-8.8 Gravels	
11.4	PID = 0 Gray fine SAND, damp	
18.1	Gray sandy SILT PID = 0	
19.2	Moist to moist Gray clayaey SILT	▼ 19.2
20.9	Gray fine sandy SILT, wet PID = 0 Silt	
28.6	Bottom of Hole - 28.6' Below ground surface	



INSTALLATION SKETCH



START OF INSTALLATION
HOLE DRILLED TO: 28.6
OPEN TO:
DEPTH CASING AUGERS:
DEPTH TO W.L.:

INSTALLATION DETAILS

DEPTH	NOTES
0.0-2.0	Cement Seal
2.0-15.3	3/8" Bentonite Chips
4.5-18.7	10-20 SAND
18.0-28.0	2" Schedule 40 PVC 0.010 Slotted Screen
28.0-28.6	Sump

WELL DEVELOPMENT NOTES

Well Development Notes

DRILL RIG:
DRILLING CONTRACTOR:
DRILLER:

LOGGED: T. Norton
CHECKED:
DATE:

Golder Associates

RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-28
RECORD OF MONITORING WELL INSTALLATION

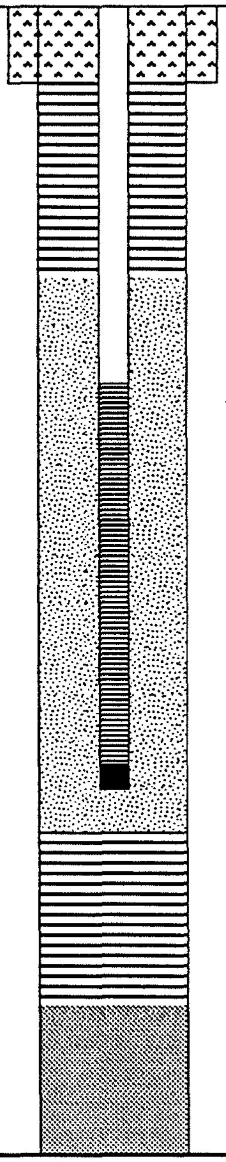
PROJECT NUMBER: 943-9735
BOREHOLE LOCATION:
BOREHOLE CONDITION:

SHEET 1 OF 1
PROJECT: Port of Longview
BORING DATE: 3/22/94

STRATIGRAPHY

ELEV. / DEPTH	DESCRIPTION	DEPTH IN FEET
0.0	Asphalt	0
0.5	Railroad Ballast	
3.3	Brown fine to medium SAND FILL	5
6.3	Gray fine to medium SAND, moist wood at 11' trace gravel at 12.8-13.3 PID = 58.7 at 14.6' wet at 15' odor, sheen on water PID = 60 at 15.5'	10 15
16.5	Gray clayey SILT	
17.4	Gray silty fine SAND, wet PID = 20 at 20' sheen	20
22.3	Interbedded CLAY and SILT, petroleum odor	
23.3	Gray medium SAND, wet PID = 20 at 26'	25
29.0	Gray SILT, wet PID = 0	
29.9	Bottom of Hole - 29.9' Below ground surface	30 35

INSTALLATION SKETCH



START OF INSTALLATION

HOLE DRILLED TO: 29.9
OPEN TO:
DEPTH CASING AUGERS:
DEPTH TO W.L.:

INSTALLATION DETAILS

DEPTH	NOTES
0.0-2.0	Cement Seal
2.0-7.0	3/8" Bentonite Chips
7.0-21.5	10-20 SAND
9.8-19.8	2" Schedule 40 PVC 0.010 Slotted Screen
19.8-20.4	Sump
21.5-26.0	Bentonite Chips
26.0-29.9	Sluff

WELL DEVELOPMENT NOTES

Well Development Notes

DRILL RIG:
DRILLING CONTRACTOR:
DRILLER:

LOGGED: T. Norton
CHECKED:
DATE:

Golder Associates

RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. MW-29
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 943-9735

BOREHOLE LOCATION:

BOREHOLE CONDITION:

SHEET 1 **OF** 1

PROJECT: Port of Longview

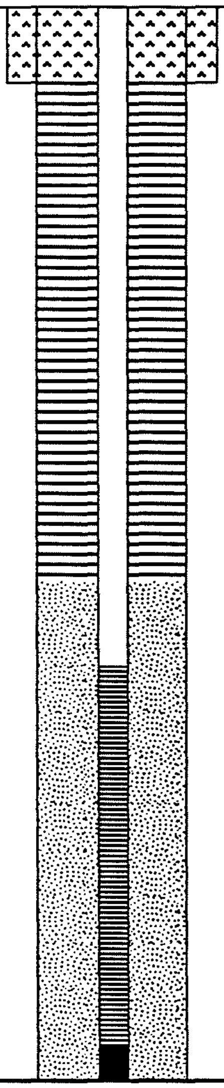
BORING DATE: 6/3/94

STRATIGRAPHY

ELEV. DEPTH	DESCRIPTION	WATER NOTES
0.0	Asphalt	
0.3	Railroad Ballast	
3.5	Brown fine to medium SAND, trace silt and gravel	
15.0	Brown clayey SILT	
15.7	Brown fine to medium SAND, moist	
22.0	Gray silty fine SAND, wet	
23.0	Gray clayey SILT, wet	▼ 23.4
25.0	Gray silty fine to medium SAND, moist	
28.0	Bottom of Hole - 28.0' Below ground surface	

DEPTH IN FEET: 0, 5, 10, 15, 20, 25, 30, 35

INSTALLATION SKETCH



START OF INSTALLATION

HOLE DRILLED TO: 28.0

OPEN TO:

DEPTH CASING AUGERS:

DEPTH TO W.L.: 22.0

INSTALLATION DETAILS

DEPTH	NOTES
0.0-2.0	Flush mounted steel cap Cement Seal
2.0-15.0	3/8" Bentonite Chips
15.0-27.7	10-20 SAND
17.2-27.2	2" Schedule 40 PVC 0.010 Slotted Screen
27.2-27.7	Sump

WELL DEVELOPMENT NOTES

Well Development Notes

DRILL RIG:

DRILLING CONTRACTOR:

DRILLER:

LOGGED: T. Norton

CHECKED:

DATE:

Golder Associates

PROJECT: Port of Longview/CAP/WA

RECORD OF BOREHOLE MW-30

SHEET 1 OF 1

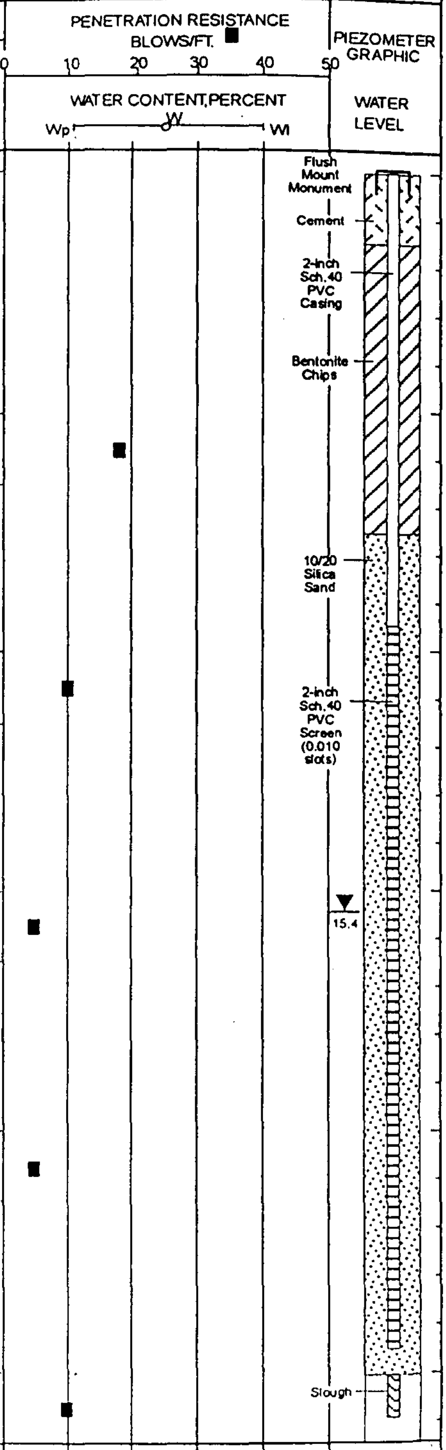
DATUM:

PROJECT NUMBER: 983 9710

BORING LOCATION:

BORING DATE: 6/24/98

DEPTH FEET	BORING METHOD	SOIL PROFILE			SAMPLES					
		DESCRIPTION	USCS	GRAPHIC LOG	NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PID
0	4 1/4-inch I.D. HSA	Loose to compact, olive gray (5Y 4/1), fine to medium SAND, little silt, moist	SP							
5					1	SS	5-8-10	18	14/18	0.0
10		Loose, olive gray (5Y 4/1), fine to coarse SAND, little silt, trace fine to coarse rounded gravel, moist	SP		2	SS	6-5-5	10	15.5/18	0.0
15		Loose, medium gray (N5), fine to medium SAND, wet	SP		3*	SS	5-3-2	5	18/18	0.0
		Olive gray (5Y 3/2), fine sandy SILT with thin laminations of clayey silt, roots, wet	SM							
20		Loose, dark gray (N3), silty fine to medium SAND, few silt lenses, wet	SP		4	SS	3-2-3	5	18/18	0.0
25					5*	SS	3-4-6	10	18/18	0.0
		Total depth 26.5 ft bgs * Samples submitted to a laboratory for analysis of total petroleum hydrocarbons								
30										



DRILL RIG: Mobile B-59

DRILLING CONTRACTOR: Geo-Tech Explorations

DRILLER: A. Pablo

LOGGED: R. Blegen

CHECKED:

DATE: 10/9/98

Golder Associates

PROJECT: Port of Longview/CAP/WA

RECORD OF BOREHOLE MW-31

SHEET 1 OF 1

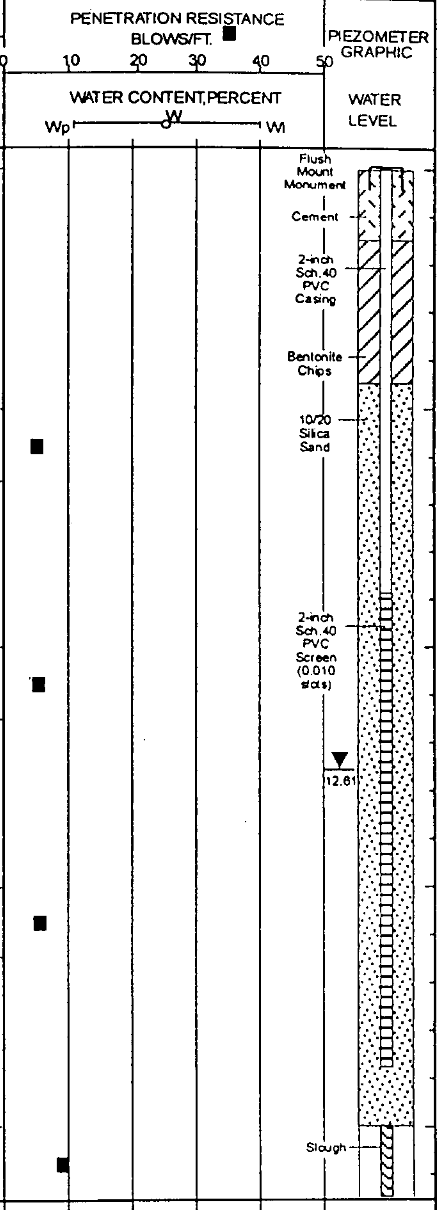
DATUM:

PROJECT NUMBER: 983 9710

BORING LOCATION:

BORING DATE: 6/24/98

DEPTH FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	SAMPLES NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PID
0	4 1/4-inch I.D. HSA	Thin surface soil							
		Loose, dark yellowish brown (10YR 4/2), fine to medium SAND, slightly moist	SM						
5		Loose, moderate yellowish brown (10YR 5/4), fine sandy SILT with thin sand laminations	SM	1	SS	2-3-3	6	1.2/1.5	0.0
		Loose, moderate yellowish brown (10YR 5/4), silty fine SAND, moist to wet, iron oxide staining from 10.0 to 10.5 ft	SM						
10				2*	SS	3-3-3	6	1.3/1.5	0.0
		Loose, medium gray (N5), medium to coarse SAND, trace fine sand, wet, pumice common from 20.0 to 21.5 ft, 1-inch silt lense at 20.4 ft	SP						
15				3	SS	3-3-3	6	1.4/1.5	1.8
20				4*	SS	3-4-5	9		0.0
		Total depth 21.5 ft bgs * Samples submitted to a laboratory for analysis of total petroleum hydrocarbons							
25									
30									



DRILL RIG: Mobile B-59

DRILLING CONTRACTOR: Geo-Tech Explorations

DRILLER: A. Pablo

LOGGED: R. Blegen

CHECKED:

DATE: 10/9/98

Golder Associates

PROJECT: Port of Longview/CAP/WA

RECORD OF BOREHOLE MW-32

SHEET 1 OF 1

DATUM:

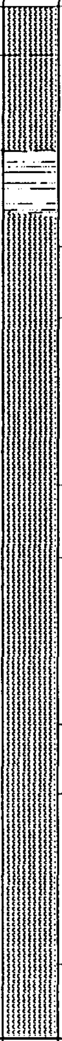
PROJECT NUMBER: 983 9710

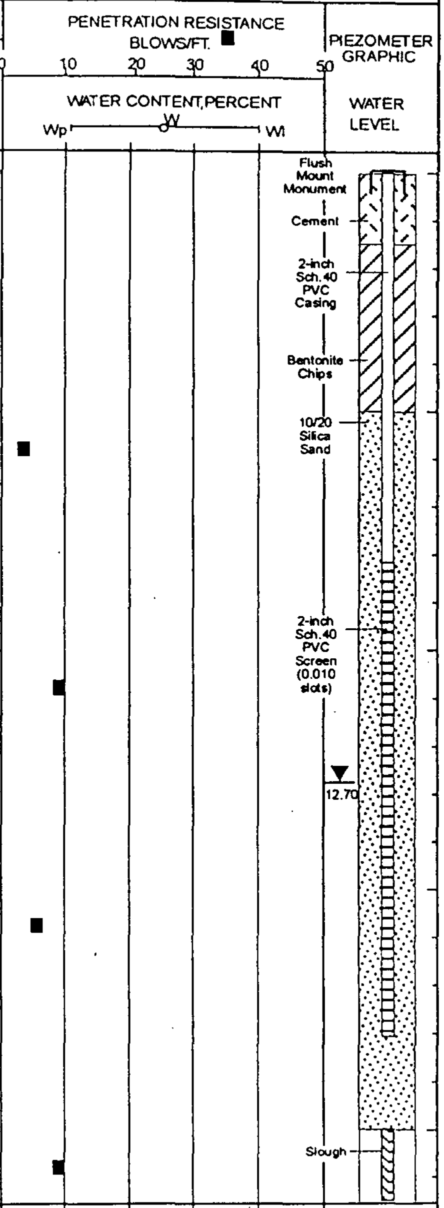
BORING LOCATION:

BORING DATE: 6/24/98

DEPTH FEET	BORING METHOD	SOIL PROFILE		SAMPLES					
		DESCRIPTION	USCS	NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PID
0	4 1/4-inch I.D. HSA	Gravel Roadbed (cuttings)							
		Moderate yellowish brown (10YR 5/4), silty SAND (cuttings)							
		Gray SILT (cuttings)							
5		Very loose, dark gray (N3), silty fine SAND (cuttings)	SM	1	SS	3-2-2	4	0/1.8	
10		Lose, interfingering layers of olive gray (5Y 3/2), silty fine SAND and SILT, roots and wood fragments common, wet	SM	2*	SS	3-4-5	9	1.5/1.5	0.0
15				3	SS	4-5-7	12	1.5/1.5	0.0
20		Compact, medium gray (N5), silty fine SAND, interfingering with SILT, trace coarse sand, wet	SM	4*	SS	4-5-5	10	1.5/1.5	0.0
		Total depth 21.5 ft bgs * Samples submitted to a laboratory for analysis of total petroleum hydrocarbons							
25									
30									

GRAPHIC LOG





DRILL RIG: Mobile B-59

DRILLING CONTRACTOR: Geo-Tech Explorations

DRILLER: A. Pablo

LOGGED: R. Blegen

CHECKED:

DATE: 10/9/98

Golder Associates

PROJECT: Port of Longview/UST Characterization/WA

RECORD OF BOREHOLE UST-1

SHEET 1 **OF** 1

DATUM: MSL

PROJECT NUMBER: 933-9729

BORING LOCATION: Port of Longview Maintenance/Shop Facility

BORING DATE: 7/22/93

DEPTH FEET	BORING METHOD	SAMPLING METHOD	SOIL PROFILE				SAMPLES		ANALYTICAL RESULTS		HEADSPACE ANALYSIS (ppm)	WELL CONSTRUCTION DIAGRAM	NOTES
			DESCRIPTION	GRAPHIC LOG	USCS	DEPTH (feet)	REC/ATT	NUMBER	BTEX (ppm)	TPH (ppm)			PIEZOMETER STANDPIPE INSTALLATION
0	6.25" O.D. Hollow Stem Auger	3.5" O.D. Split Barrel Core Tube	3" Asphalt			0.0	5%						Borehole Abandoned 1207 Start drilling
			GRAVEL SUBGRADE										
			Dark yellowish brown (10YR 4/2), fine to medium SAND, little silt, dry, (FILL)		SM	1.0							
							25%						
5								1					1229 - Sample No. UST1-7/22-5
			Moderate reddish-brown (10YR 4/6), silty, fine to medium SAND, trace gravel (iron-oxide staining)										
			Interlaminated, dark yellowish brown (10 YR 4/2), fine to medium SAND and pale brown fine, sandy SILT, slightly moist		SM	9.2	50%						
10					SP/ML	10.0							
			Brownish-gray (5YR 4/1), clayey SILT, moist		CL-ML	10.4							
			Dark yellowish brown (10YR 4/2), fine to coarse SAND, trace gravel, trace silt		SW	11.0							
			Dark yellowish brown (10YR 4/2), fine to coarse SAND, little silt		SM	14.0	40%	2			0.0		1235 - Sample No. UST1-7/22-14
15													
							25%				0.0		
20													
			Medium dark gray (10YR 4/2), fine to medium sandy SILT, little gravel, WET (First water)		ML	23.0					0.0	▼	
			Olive gray (5YR 3/2) fine sandy SILT. Trace rootlets. Wet.		ML	24.0	100%	3					1258 - Sample No. UST1-7/22-24
25													
							100%						
			Dark gray (N3), fine to coarse SAND, little silt, wet		SM	27.0							1337 - End Drilling
			Bottom of Hole @29.0' Below Ground Surface			29.0							
30													
35													

DRILL RIG: CME-55

DRILLING SUBCONTRACTOR: Geo-Tech Explorations, Inc.

DRILLER: D. Abernathy

LOGGED: R. Blegen

CHECKED: MDL

DATE: 7/30/93

Golder Associates

PROJECT: Port of Longview/UST Characterization/WA

RECORD OF BOREHOLE UST-2

SHEET 1 **OF** 1

DATUM: MSL

PROJECT NUMBER: 933-9729

BORING LOCATION: Port of Longview Maintenance/Shop Facility

BORING DATE: 7/23/93

DEPTH FEET	BORING METHOD	SAMPLING METHOD	SOIL PROFILE				SAMPLES		ANALYTICAL RESULTS		HEADSPACE ANALYSIS (ppm)	WELL CONSTRUCTION DIAGRAM	NOTES PIEZOMETER STANDPIPE INSTALLATION
			DESCRIPTION	GRAPHIC LOG	USCS	DEPTH (feet)	REC/ATT	NUMBER	BTEX (ppm)	TPH (ppm)			
0	6.25" O.D. Hollow Stem Auger	3.5" O.D. Split Barrel Core Tube	Dark yellowish brown (10YR 4/2), silty, sandy GRAVEL (Railroad Ballast and Fill)			0.0	100%						0850-Start drilling Borehole Abandoned
			Dark yellowish brown (10YR 4/2), fine to medium SAND, little silt, (FILL)		SM								Tip reading 2.7 ppm
							100%						
5								1			0.0		0859 - Sample No. UST2-7/23-5
							100%						
											0.0		
							100%						
10								2					0910 - Sample No. UST2-7/23-10
			Olive gray (5Y 3/2), fine to medium SAND, some coarse sand, little silt				100%						
			Olive gray (5Y 3/2), fine to medium SAND, some coarse sand, little silt		SM	13.5							
			Dark yellowish brown (10 YR 4/2) silty fine SAND, some iron-oxide staining		SM	13.8	100%						
					CL-ML	14.6							
15			Dark gray (N3), clayey SILT, little fine sand, moist		SM	15.2		3					1020 - Sample No. UST2-7/23-15
			Dark gray (N3), fine to medium SAND, little silt, moist				60%						
			Moderate yellowish brown (10YR 5/4) gravelly, medium SAND, gravel consists of pumice fragments		SW	18.0							
					SW	18.5						▼	
			Dark gray (N3), fine to coarse SAND, wet, pumice fragments common				75%				0.0		
20								4					1031 - Sample No. UST2-7/23-20
											0.0		
			Olive gray (5Y 4/1), clayey SILT, laminated with light brownish gray (5YR 6/1), clayey SILT		CL-ML	22.0	100%						
			Olive gray (5Y 3/2) silty fine SAND, wet		SM	22.6							
			Bottom of Hole @24.0' Below Ground Surface			24.0							
25													
30													
35													

DRILL RIG: CME-55

DRILLING SUBCONTRACTOR: Geo-Tech Explorations, Inc.

DRILLER: D. Abernathy

LOGGED: R. Blegen

CHECKED: MDL

DATE: 7/30/93

Golder Associates

PROJECT: Port of Longview/UST Characterization/WA

RECORD OF BOREHOLE UST-3

SHEET 1 **OF** 1

DATUM: MSL

PROJECT NUMBER: 933-9729

BORING LOCATION: Port of Longview Maintenance/Shop Facility

BORING DATE: 7/23/93

DEPTH FEET	BORING METHOD	SAMPLING METHOD	SOIL PROFILE				SAMPLES		ANALYTICAL RESULTS		HEADSPACE ANALYSIS (ppm)	WELL CONSTRUCTION DIAGRAM	NOTES PIEZOMETER STANDPIPE INSTALLATION
			DESCRIPTION	GRAPHIC LOG	USCS	DEPTH (feet)	REC/ATT	NUMBER	BTEX (ppm)	TPH (ppm)			
0	6.25" O.D. Hollow Stem Auger	3.5" O.D. Split Barrel Core Tube	Dark yellowish brown (10YR 4/2), gravelly SAND (FILL and BALLAST)			0.0	100%						1309-Start drilling Borehole Abandoned
			Dark yellowish brown (10YR 4/2), silty, fine to medium SAND (FILL)		SM	1.25							
							100%						
5								1					1319 - Sample No. UST3-7/23-5
							100%						
			Iron-oxide staining at 8 feet										
			Dark gray (N3), fine to medium SAND, little silt, slightly moist		SM	8.5							
							100%				0.0		
10			Dark yellowish brown (10YR 4/2), silty, fine to medium SAND, thin laminations of iron-oxide stained material		SM	9.3		2					1328 - Sample No. UST3-7/23-10
							100%						
			Dark gray (N3), silty fine SAND		SM	12.7							
			Dark gray (N3) fine to coarse SAND. Little fine gravel. Trace silt. Moist, slight petroleum odor.		SW	13.0							
							100%				16.4		
15								3					1409 - Sample No. UST3-7/23-14.5
											0.0		
							60%						
			Wet material at 18 feet					4				▼	1415 - Sample No. UST3-7/23-18
			Dark yellowish brown (10YR 4/2), silty, fine to medium SAND		SM	18.5							
							75%						
20			Interlaminated, olive gray (5Y 3/2), silty, fine SAND and clayey SILT		SM/ML	19.5							
			Olive gray (5Y 3/2) clayey SILT, plant roots common		CL-ML	20.5							1420 - End Drilling
			Bottom of Hole @21.5' Below Ground Surface			21.5	100%						
25													
30													
35													

DRILL RIG: CME-55

DRILLING SUBCONTRACTOR: Geo-Tech Explorations, Inc.

DRILLER: D. Abernathy

LOGGED: R. Blegen

CHECKED: MDL

DATE: 7/30/93

Golder Associates

PROJECT: Port of Longview/UST Characterization/WA

RECORD OF BOREHOLE UST-4

SHEET 1 **OF** 1

DATUM: MSL

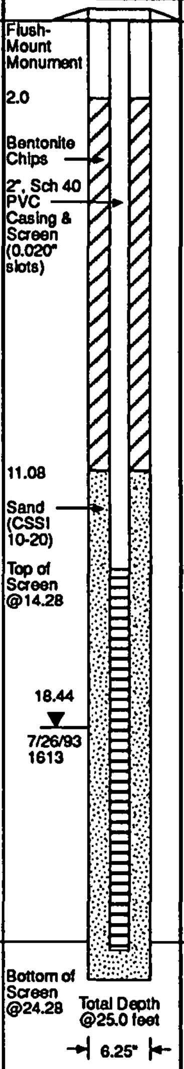
PROJECT NUMBER: 933-9729

BORING LOCATION: Port of Longview Maintenance/Shop Facility

BORING DATE: 7/26/93

DEPTH FEET	BORING METHOD	SAMPLING METHOD	SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	DEPTH (feet)	SAMPLES REC/ATT	SAMPLES NUMBER	ANALYTICAL RESULTS BTEX (ppm)	ANALYTICAL RESULTS TPH (ppm)	HEADSPACE ANALYSIS (ppm)	NOTES PIEZOMETER STANDPIPE INSTALLATION
0	6.25" O.D. Hollow Stem Auger	3.5" O.D. Split Barrel Core Tube	4" Asphalt			0.0	5%					0937-Start drilling
			Gravel subgrade									
			Dark yellowish brown (10YR 4/2) fine to medium SAND, little silt (FILL)		SM	1.0						
							100%					
5								1			5.6	1004 - Sample No. UST4-7/26-5
							100%					
							100%					
10								2			110	1021 - Sample No. UST4-7/28-10
			Olive gray (5Y 3/2), silty fine SAND iron-oxide staining, petroleum odor		SM	10.3						
			Light olive gray (5Y 5/2) to dark yellowish brown (10YR 4/2) fine to medium SAND, little silt		SM	11.0	100%				111	
			Light olive gray (5Y 5/2) to olive gray (5Y 3/2) silty fine to medium SAND		SM	14.0	100%					
15								3			41.7	1106 - Sample No. UST4-7/26-15
							100%					
			Dark gray (N3), medium SAND, little coarse sand, trace silt		SP	18.2						
			Dark gray (N3), silty, fine to medium SAND, little coarse sand, wet		SM	19.0	90%					
20								4				1127 - Sample No. UST4-7/26-20
											101	
			Dark gray (N3) gravelly, fine to coarse SAND		SW	22.5						
			Olive gray (5Y 3/2), silty fine SAND, few wood fragments, wet		SM	22.8						
			Bottom of Hole @24.0' Below Ground Surface			24.0						
25												
30												
35												

WELL CONSTRUCTION DIAGRAM



Note: Driller overdrilled to 25 feet while cleaning out borehole.

DRILL RIG: CME-55

DRILLING SUBCONTRACTOR: Geo-Tech Explorations, Inc.

DRILLER: D. Abernathy

LOGGED: R. Blegen

CHECKED: MDL

DATE: 7/30/93

Golder Associates

PROJECT: Port of Longview

PROJECT NUMBER: 943 9735

RECORD OF BOREHOLE
UST 5

BORING LOCATION:

SHEET 1 **OF** 1

DATUM: MSL

BORING DATE: 6/3/94

DEPTH FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 6 IN. 140 lb. hammer 30 inch drop	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ 0 10 20 30 40 50 WATER CONTENT,PERCENT Wp W WI	PIEZOMETER GRAPHIC WATER LEVEL
0	4-Inch HSA	Brown SAND and coarse GRAVEL FILL			0.0							
5		Brown fine to medium SAND, some gravel, black staining at 8.0-10.0'			6.0							
10												
15		Gray fine to medium SAND, trace silt and gravel 15.0-19.0 staining			15.0							19.0
20		Brown medium to coarse SAND and fine to coarse GRAVEL			20.0							
		Gray to brown silty fine to coarse SAND, trace gravel, wet			21.0							
		Bottom of Hole at 24.0'			24.0							
25												
30												

DRILL RIG: CME-75

DRILLING CONTRACTOR:

DRILLER:

Golder Associates

LOGGED:

CHECKED:

DATE: 8/2/94

RECORD OF STANDPIPE/PIEZOMETER INSTALLATION BOREHOLE NO. IB-2
RECORD OF MONITORING WELL INSTALLATION

PROJECT NUMBER: 933-9725

BOREHOLE LOCATION:

BOREHOLE CONDITION:

SHEET 1 **OF** 1

PROJECT: Port of Longview

BORING DATE: 12/4/92

START OF INSTALLATION

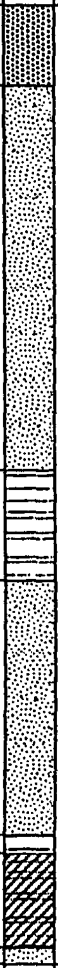
HOLE DRILLED TO: 20.0'

OPEN TO:

DEPTH CASING AUGERS:

DEPTH TO W.L.: 13.0

STRATIGRAPHY



ELEV. DEPTH	DESCRIPTION	WATER NOTES	BORING METHOD
0.0	Railroad ballast		Hollow Stem Auger
1.6	Gray, fine to medium SAND, trace gravel Iron Staining		
9.7	Gray SILT, iron stained		
12.0	Gray, fine to medium SAND, some silt layers	▼	
17.3	SILT		
17.8	Gray SILT to silty CLAY pink layer		
19.6	Gray, fine to medium SAND		
20.0	Bottom of Hole - 20.0' Below Ground Surface		

DEPTH IN FEET: 0, 5, 10, 15, 20, 25, 30

INSTALLATION SKETCH

INSTALLATION DETAILS DEPTH	NOTES

DRILL RIG:

DRILLING CONTRACTOR: Geotech

DRILLER:

LOGGED: A. Templeton

CHECKED: T. Belunes

DATE: 8/5/93

Golder Associates

Petroleum Services Unlimited, Inc.
1081 Columbia Blvd.
Longview, WA 98632

PROJECT NUMBER 40612
BORING NUMBER SB1
SHEET 1 OF 1

SOIL BORING LOG

PROJECT Port of Longview
LOCATION 20 Port Way, Longview, Washington
ELEVATION
DRILLING CONTRACTOR Hokkaido Drilling and Developing
DRILLING METHOD AND EQUIPMENT Mobile B-61 Hollow Stem Auger Drilling Rig
WATER LEVEL AND DATE
START 5/1/91
FINISH 5/1/91
LOGGER C. Grant

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)				
	1.0				Top 1' - crushed rock pavement		
2.5	2.5		0	3-7-7 (14)	No recovery		
			0 8"	6-9-7 (16) 2-3-11 (14)	No recovery w/1.5" ID split spoon w/3" ID split spoon poorly graded sand, grey, dry, med dense, sand (SP)		Rock in sampler head Redrive 3" ID split spoon
5.0	5.5		17"	4-3-3 (6)	Poorly graded sand as above to 4'5" then in contact with a silt grey, moist, loose silt w/some iron stain and fine grained sand lenses throughout (ML)		
	7.0		10"	3-4-4 (8)	Silt (ML) as above to 6'8", then is a poorly graded sand, grey, wet, loose, fine to coarse sand w/an odor of petroleum (SP)		PID = 27 ppm Irridescent sheen on spoon
7.5	8.5		16"	3-2-2 (4)	Sand (SP) as above, except saturated to 8' - then is a silt, grey, wet, loose silt (ML)		GW at approx 7' depth PID = 167 ppm
					End boring at 8.5"		6 ea 50# bags Wyoben enviro plug medium used to abandon boring
10							

Petroleum Services Unlimited, Inc.
1081 Columbia Blvd.
Longview, WA 98632

PROJECT NUMBER 40612

BORING NUMBER SB2 SHEET 1 OF 1

SOIL BORING LOG

PROJECT Port of Longview LOCATION 20 Port Way, Longview, Washington

ELEVATION DRILLING CONTRACTOR Hokkaido Drilling and Developing

DRILLING METHOD AND EQUIPMENT Mobile B-61 Hollow Stem Auger Drilling Rig

WATER LEVEL AND DATE START 5-1-91 FINISH 5-1-91 LOGGER C. Grant

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					3" asphalt pavement cover		
2.5	2.5 4.0		15"	3-3-6 (9)	Poorly graded fine sand w/silt brown, dry, sand w/occasional charcoal lenses to 3'2", then is a silt, grey, silt w/wood fibres to 3'6" then is a well graded sand, grey, moist, fine to coarse sand (SW)		PID = 7.1 ppm odor of petroleum
5.0							
	6.0 7.5		15"	4-3-3 (6)	At 6' is a well graded sand as above to 6'8", then is a poorly graded fine sand w/silt, dark grey, wet, loose, sand to 7'3", then is a clay w/ silt, dark grey, plastic clay (OH)		PID = 1000+ ppm
7.5	9.0		18"	2-2-2 (4)	Clay, as above, except wet with occasional fine grained sand lenses, to 8'8", then is a poorly graded fine sand w/silt, grey, wet, loose, fine sand (SP-SM)		PID = 2000 ppm odor of petroleum
10.0	10.5		17"	5-4-6 (10)	Sand as above to 9'3", then is a clay w/silt, grey blue, wet, plastic, clay w/wood fibres to 9'8", then is a poorly graded fine sand w/silt, grey blue, wet, loose, fine sand (SP-SM)		PID = 690 ppm odor of petroleum
12.5					End boring at 10.5'		

Petroleum Services Unlimited, Inc.
1081 Columbia Blvd.
Longview, WA 98632

PROJECT NUMBER	BORING NUMBER		
40612	SB3	SHEET 1	OF 1

SOIL BORING LOG

PROJECT Port of Longview LOCATION 20 Port Way, Longview, Washington

ELEVATION DRILLING CONTRACTOR Hokkaido Drilling and developing

DRILLING METHOD AND EQUIPMENT Mobile B-61 Hollow Stem Auger Drilling Rig

WATER LEVEL AND DATE START 5-1-91 FINISH 5-1-91 LOGGER C. Grant

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
2.5							
5	4.0 5.5		18"	2-2-3 (5)	Poorly graded fine sand w/silt, brown, dry, loose, sand (SP-SM), to 4'11", then is a silt, brown, loose, silt with iron stain throughout (ML), to 5'4", then is a clayey silt, grey blue, silt (OH) w/an odor of petroleum		PID = 32.5 ppm
7.5	7.0 8.5		16"	4-4-5 (9)	Silt w/sand, grey blue, wet, loose silt (ML), to 7'9" then is a well graded fine to coarse sand, blue, wet, loose sand (SW) to 8'3", then is a poorly graded fine sand w/silt, grey blue, wet, loose, sand w/wood chips (SP-SM)		PID - 177 ppm Odor of petroleum
10	10.0 11.5		18"	2-2-3 (5)	Poorly graded fine sand w/silt (SP-SM) as above, to 10'7", then is a silt, blue grey, moist, silt (OH), to 10'10", then is a silty clay, black, moist, clay with organic fibres throughout (OH) to 11'2", then is a clay, grey, dry, plastic, clay (OH)		PID = 30 ppm Odor of petroleum
12.5					End boring at 11'6"		9 ea 50# bags Wyoben Enviro plug medium used to abandon boring

Petroleum Services Unlimited, Inc.
1081 Columbia Blvd.
Longview, WA 98632

PROJECT NUMBER 40612

BORING NUMBER SB4 SHEET 1 OF 1

SOIL BORING LOG

PROJECT Port of Longview

LOCATION 20 Port Way, Longview, Washington

ELEVATION

DRILLING CONTRACTOR Hokkaido Drilling and developing

DRILLING METHOD AND EQUIPMENT Mobile B-61 Hollow Stem Auger Drilling Rig

WATER LEVEL AND DATE

START 5-2-91

FINISH 5-2-91

LOGGER C. Grant

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Top 8" is a crushed rock pavement		
2.5							
5	4.0 5.5		18"	7-7-6 (13)	Poorly graded fine sand, grey, dry, med dense, sand (SP), to 5' then is a silt, brown, soft, silt w/iron stain througout (ML) to 5'4" then is a clayey silt, grey blue, dry silt (CL-ML)		
7.5	7.0 8.5		14"	4-5-4 (9)	Well graded sand, blue grey, wet loose, sand w/occasional pebbles (SW), to 8'2", then is a poorly graded fine sand, blue grey, saturated, sand (SP)		PID = 147 ppm Odor of petroleum
10	10.0 11.5		18"	5-5-4 (9)	Poorly graded sandy silt, blue grey, wet, loose, silt (ML) to 10'7", then is an interbedded silt and clay, blue grey, wet (ML)		PID = 32 ppm Odor of petroleum
12.5					End boring at 11'6"		10 ea 50# bags Wyoben enviro plug medium used to abandon boring

Petroleum Services Unlimited, Inc.
1081 Columbia Blvd.
Longview, WA 98632

PROJECT NUMBER 40612

BORING NUMBER SB5

SHEET 1 OF 1

SOIL BORING LOG

PROJECT Port of Longview

LOCATION 20 Port Way, Longview, Washington

ELEVATION

DRILLING CONTRACTOR Hokkaido Drilling and eveloping

DRILLING METHOD AND EQUIPMENT Mobile B-61 Hollow Stem Auger Drilling Rig

WATER LEVEL AND DATE

START 5-2-91

FINISH 5-2-91

LOGGER C. Grant

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Top 8" is a crushed rock pavement		
2.5							
	4.0						
5			13.5'	3-4-7 (11)	Poorly graded fine to med sand, brown, dry, med dense, sand (SP)		
	5.5						
	7.0						
7.5			17"	4-4-4 (3)	Poorly graded fine sand w/silt brown grey, moist, loose, washed sand w/occasional silt lenses and piesces of charcoal (SP-SM)		
	8.5						
10	10.0						
			18"	4-4-6 (10)	Silt, grey blue, wet, stiff, silt (OL) to 10'8", then is a clayey silt, grey blue, moist, silt with woodchips throughout (OH)		PID = 12.7ppm Odor of petroleum
	11.5						
12.5			18"	2-3-4 (7)	Silt w/sand grey, wet, firm, silt with organic fibres (OL) to 12'2", then is a clayey silt, grey blue, moist, firm, silt with woodchips and charcoal throughout (OH)		PID = 15.8 Odor of petroleum
	13.0						
					End boring at 13'		11 ea 50# bags Wyoben Enviro plug medium used to abandon boring

Petroleum Services Unlimited, Inc.
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Longview, WA 98632

PROJECT NUMBER	BORING NUMBER
40612	SB6 SHEET 1 OF 1

SOIL BORING LOG

PROJECT Port of Longview LOCATION 20 Port Way, Longview Washington
ELEVATION DRILLING CONTRACTOR Hokkaido Drilling and Developing
DRILLING METHOD AND EQUIPMENT Mobile B-61 Hollow Stem Auger Drilling Rig
WATER LEVEL AND DATE START 5-2-91 FINISH 5-2-91 LOGGER C. Grant

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Top 6-8" is a crushed rock pavement		
					Soil cuttings are a fine to med. grain sand, brown, dry		
2.5							
5							
7.5							
10	8.5 10.0		18"	5-4-4 (8)	Interbedded brown and grey silt layers, moist, soft, silt (OL) to 9' then is a clay w/silt, grey blue, dry, soft, clay with interbedded silt (OH)		PID = 0.0 ppm Odor of petroleum
	11.5		13"	3-4-4 (8)	Clay (OH) as above, to 11', then is a silt, grey, moist, soft, silt (OL)		
12.5	13.0		15"	5-3-3 (6)	Clay, grey, plastic, soft, clay (OH), to 11'10" then is a silt w/sand, grey blue, wet, loose, silt (OL)		PID = 3.7 ppm
					End boring at 13'		9 ea 50# bags Wyoben Enviro plug medium used to abandon boring

Petroleum Services Unlimited, Inc.
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Longview, WA 98632

PROJECT NUMBER 40612

BORING NUMBER SB7 SHEET 1 OF 1

SOIL BORING LOG

PROJECT Port of Longview LOCATION 20 Port Way, Longview, Washington

ELEVATION DRILLING CONTRACTOR Hokkaido Drilling and Developing

DRILLING METHOD AND EQUIPMENT Mobile B-61 Hollow Stem Auger Drilling Rig

WATER LEVEL AND DATE START 5-2-91 FINISH 5-2-91 LOGGER C. Grant

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Top 24" is a crushed rock pavement		
2.5							
	4.0				Poorly graded fine sand, dry, med dense, sand (SP)		
5			15"	5-7-11 (18)			
	5.5						
7.5	7.5				Clayey silt, grey blue, wet, silt w/irridescent sheen and organic fibres, charcoal pieces (OL) to 8'3", then is a clay w/silt, dark grey, slightly plastic, dry to moist, soft, clay with some wood fibres (CL-ML)		PID = 133 ppm
			18"	2-1-1 (2)			
	9.0						
10					End boring at 9'		7 ea 50# bags Wyoben Enviro plug med used to abandon boring

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PROJECT NUMBER 40612
BORING NUMBER SB8
SHEET 1 **OF** 1

SOIL BORING LOG

PROJECT Port of Longview
LOCATION 20 Port Way, Longview, Washingto
ELEVATION
DRILLING CONTRACTOR Hokkaido Drilling and Developing
DRILLING METHOD AND EQUIPMENT Mobile B-61 Hollow Stem Auger Drilling Rig
WATER LEVEL AND DATE
START 5-2-91
FINISH 5-2-91
LOGGER C. Grant

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS	SOIL DESCRIPTION	SYMBOLIC LOG	COMMENTS
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)	6"-6"-6" (N)	SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL		DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					Top 3" is an asphalt pavement		
					Drill cuttings are a dark brown sand and gravel.		
2.5							
5.0							
7.5	7.5 9.0		16"	2-3-3 (6)	Poorly graded fine sand w/silt brown, loose, sand (SP) to 8'1" then is a clay w/silt, dark grey dry, plastic, firm clay (OH)		PID = 7.9 ppm Odor of petroleum
10	10.5		16"	3-5-5 (10)	Clay (OH), as above, to 9'7" then is a silt, grey, moist, loose silt w/interbeds of fine sand and clay lenses		PID = 4.8 ppm Odor of petroleum
					End of boring at 10'6"		10 ea 50# bags Wyoben Enviro plug med used to abandon boring
12.5							

Petroleum Services Unlimited, Inc.
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Longview, WA 98632

PROJECT NUMBER	BORING NUMBER
40612	SB9 SHEET 1 OF 1

SOIL BORING LOG

PROJECT Port of Longview LOCATION 20 Port Way, Longview, Washington

ELEVATION ____ DRILLING CONTRACTOR Hokkaido Drilling and Developing

DRILLING METHOD AND EQUIPMENT Mobile B-61 Hollow Stem Auger Drilling Rig

WATER LEVEL AND DATE ____ START 5-3-91 FINISH 5-3-91 LOGGER C. Grant

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)				
					Top 8-12" is a crushed rock pavement Drill cuttings and a brown sand		
2.5							
5							
7.5	9.0		18"	2-2-3 (5)	Silty clay, grey, dry, firm, slightly plastic, clay w/organic fibres throughout (OH), to 8'8", then is a silt, grey, moist, firm silt (OL)		PID = 11.7 ppm Odor of petroleum
10	10.5		16.5"	4-6-4 (10)	Silt (OL), as above, to 9'6" then is a poorly graded fine sand with silt, dark grey, moist to wet, loose, sand (SP-SM)		PID = 10.3 ppm Odor of petroleum
					End boring at 10'6"		10 ea 50# bags Wyoben Enviro plug med used to abandon boring
12.5							

Petroleum Services Unlimited, Inc.
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Longview, WA 98632

PROJECT NUMBER 40612

BORING NUMBER SB10   SHEET 1 OF 1

SOIL BORING LOG

PROJECT Port of Longview   LOCATION 20 Port Way, Longview, Washington

ELEVATION   DRILLING CONTRACTOR Hokkaido Drilling and Developing

DRILLING METHOD AND EQUIPMENT Mobile B-61 Hollow Stem Auger Drilling Rig

WATER LEVEL AND DATE   START 5-3-91   FINISH 5-3-91   LOGGER C. Grant

DEPTH BELOW SURFACE (FT)	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	INTERVAL	TYPE AND NUMBER	RECOVERY (FT)				
					Top 8-12" is a crushed rock pavement		
2.5							
5							
7.5	7.5 9.0		17"	4-2-2 (4)	Clay w/silt, grey, moist, soft, silt (OL), to 8', then is a poorly graded sand w/silt, grey, moist, very loose, sand w/organic fibres (SP-SM)		PID = 6.7 ppm
10	10.5		18"	3-2-1 (3)	Silt, grey, moist, soft, silt (OL) to 9'7", then is a clay w/silt, light grey, wet, soft, clay (OH) to 9'10", then is a silt w/sand wet, loose, silt w/clay lenses		PID = 3.1 ppm
					End boring at 10'6"		9 ea 50# bags Wyoben Enviro plug medium used to abandon boring
12.5							

Test Pit Logs

Test Pit 1
11/23/92
South side of Bunker C Tank

Depth ft.	Description
0-2	Moist brown sand, some silt and clay fill. Hard dark grey bunker layer at 1.5 ft. Tile pipeline at 1.5 ft. , oily sheen on water in pipeline.
2-6.5	Grey clayey silt, decaying organic odor. Wood at 6.5 ft. PID 3.2 ppm at 4.0 ft.

Test Pit 2
11/23/92
West side of Bunker C Tank

0-2	Brown to yellow sand and cobble Fill, some pieces of bunker
2-2.5	Gray clayey silt
2.5-4	Light brown clayey silt
4-7	Light brown silty fine to medium sand
7-11	Grey clayey silt, with fine sands and wood fragments, strong petroleum odor.

Water entering pit from 3.5 and 5 ft., sheen on water from 3.5 ft.
PID readings of 9.7 ppm and 8.0 ppm from 7 and 11 ft., rspectively.

Test Pit 3
11/23/92
South side of Bunker C Tank.

0-1.5	Brown silty sand.
1.5-5	Grey silty sand to sandy silt, strong petroleum odor. PID at 2 ft 33.4 ppm, sample TP-3-2(d).
5-8	Grey clayey silt with wood fragments. PID at 8 ft 365 ppm, sample TP-3-8.
8-10	Grey fine sand, some silt, strong petroleum odor.

PID reading from soil pile vary from 55 to 365 ppm

Test Pit 4
11/23/92
Northwest side of Bunker C Tank.

Depth Ft.	Description
0-2.5	Moist, brown sandy silt.
2.5-3	Brown-grey medium sand, some silt.
3-6	Moist, mottled brown silty fine sand, some clay.
6-8	Moist, brown clayey silt.
8-12	Grey fine to medium sand, some silt.
12-15	Wet, mottled gray silt.

Test Pit 5
11/23/92
East side of Bunker C Tank

0-1.5	Brown clayey silt, some sand. Water entering pit at 1.5 feet.
1.5-2.0	Grey to black hard materail, possible Bunker C spill.
2-3	Moist, grey sand to sandy silt.
3-5	Moist, grey silty fine to medium sand.
5-6	Moist to wet, grey silty clay to clayey silt, water at 5 feet.
6-13	Wet, grey clayey silt

Test Pit 6
11/23/92
South of
Bunker C Tank by Army Reserve Property

0-15.	Crushed rosk fill.
1.5-2	Hard grey Bunker C (?)
2-6	Brown clayey fine sandy silt.
6-7	Wet, mottled brown clayey silt.

7-10	Wet, grey clayey silt
10-11	Grey medium sand, strong odor

Test Pit 7
11/23/92
West side of tank.

Depth ft.	Description
0-1.5	Brown clayey silt.
1.5-2	Black chunks of tar like material.

Test Pit 8
11/23/92
East side of Tank

0-4	Moist, brown clayey sandy silt
4-7	Grey medium sand.
7	Wet grey silt

Excavation appears "Clean".

Test Pit 9
11/23/92
South of Tank by Army Reserve property.

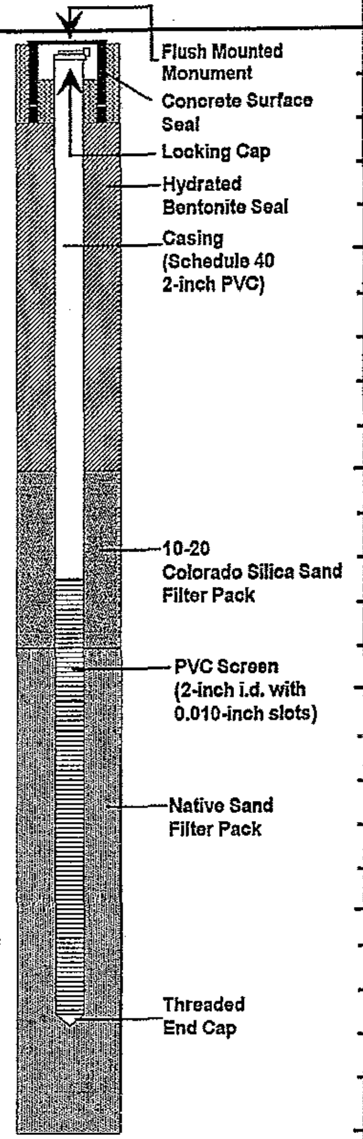
0-1.5	Crushed rock and clay, silt, sand fill.
1.5-3	Moist, mottled, brown sandy clayey silt.
3-6.5	Grey brown silty sand.
6.5-10	Moist to wet, grey sandy silt, some wood fragment.
10-16	Dry to moist, grey clay, some silt
16	Wet grey sand, strong petroleum odor.

PROJECT: Chevron - Longview **START CARD No.: R04372** **BORING No.: AMW1**

Elevation Reference: MSL
Relative Ground Surface Elevation: NA
Well Completed: 9/11/95
Relative Casing Elevation: 13.33
Boring Method: H S A
Borehole Diameter: 8.25" O. D.

Depth (feet)	SOIL DESCRIPTION	USC	Sample Type	Blow Counts	Volatile Readings	Ground Water	ANALYSES
0	3/4"-minus gravel FILL.	FILL			ppm		
	Medium stiff, moist, red-brown, medium SAND.	SP	S1/2.5	5			
5	Medium dense, moist, gray SILT. Mild organic odor.	ML	S2/5	5	345		WTPH-G WTPH-D BTEX
	Very soft, wet, dark gray, silty, fine and medium SAND, interbedded with thin silt lenses. Strong hydrocarbon-like odor.	SW with ML	S3/7.5	2	1510		WTPH-G WTPH-D BTEX
10			S4/10	4	15	SW	Pb TPH-G TPH-D BTEX WTPH-G WTPH-D BTEX
15	Medium dense, saturated, gray, coarse, andesitic SAND. Mild organic odor.	SP	S5/15	9	23		
20			S6/20	8	8		
25	Medium stiff, saturated, dark gray, fine SAND, becoming coarser with depth. Mild organic odor.	SP	S7/25	5	11		
30	Boring completed at 27 feet below ground surface. Monitoring well AMW1 installed to 22.5 feet below ground surface. Note - significant volume of heaving native sand flowed into auger during well installation and prevented placement of engineered filter-pack sand in the interval 14'-25' below ground surface.						

AS-BUILT DESIGN



LEGEND

▨ 2-inch O.D. split-spoon sample with % recovered

△ Groundwater Analysis (Test Method Shown)

▽ WD Encountered groundwater level while drilling

8015 8240 Soil Analysis (Test Method Shown)

▽ SW Measured static groundwater level

AEE PROJECT NUMBER: 12-1272-01
Chevron - Longview
Port of Longview Maintenance Yard
Terminal Way
Longview, Washington

AGRA EARTH AND ENVIRONMENTAL
ENGINEERING & ENVIRONMENTAL SERVICES
7477 SW Tech Center Drive
Portland, Oregon 97223-8024
Phone (503) 639-3400 FAX (503) 620-7892

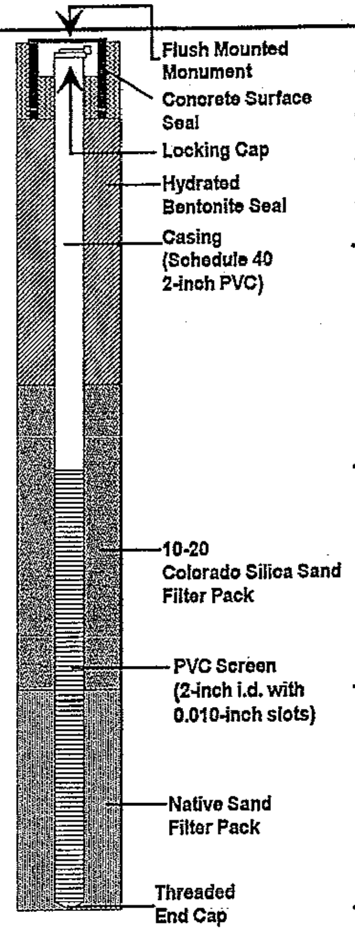
Drilling Started: 9/11/95 Drilling Completed: 9/11/95 Logged By: PDE a:\CHEVRON\LONGVIEW\1272MW1.DRW

PROJECT: Chevron - Longview **START CARD No.: R04372** **BORING No.: AMW2**

Elevation Reference: MSL
Relative Ground Surface Elevation: NA
Well Completed: 9/11/95
Relative Casing Elevation: 13.27
Boring Method: H S A
Borehole Diameter: 8.25" O. D.

Depth (feet)	SOIL DESCRIPTION	USC	Sample Type	Blow Counts	Volatile Readings ppm	Ground Water	ANALYSES
0	3/4"-minus gravel FILL.	FILL					
	Soft, moist, gray, silty, fine SAND. Strong hydrocarbon-like odor. Poor sample recovery.	SM	S8/2.5	4	800		
5	Mild organic odor.		S9/5	3	27		
	Medium dense, moist, brown-gray, micaceous SILT. Mild organic odor.	ML	S10/7.5	7	63		WTPH-G WTPH-D BTEX
10	Medium soft, wet to saturated, dark gray, medium SAND. Mild organic odor.		S11/10	n/a	16	SW	Pb TPH-G TPH-D BTEX WTPH-G WTPH-D BTEX
	Medium dense, wet, gray SILT.	ML					
15	Medium stiff, saturated, dark gray, coarse, andesitic SAND.	SP	S12/15	n/a	21		
	Medium stiff, wet, gray SILT.	ML					
20	Medium stiff, saturated, dark gray, coarse, andesitic SAND.	SP	S13/20	8	23		
25	Boring completed at 22 feet below ground surface. Monitoring well AMW2 installed to 20 feet below ground surface.						
30							

AS-BUILT DESIGN



LEGEND

2-inch O.D. split-spoon sample with % recovered

WD Encountered groundwater level while drilling

SW Measured static groundwater level

△ Groundwater Analysis (Test Method Shown)

8015 8240 Soil Analysis (Test Method Shown)

AEE PROJECT NUMBER: 12-1272-01
Chevron - Longview
Port of Longview Maintenance Yard
Terminal Way
Longview, Washington

AGRA EARTH AND ENVIRONMENTAL
ENGINEERING & ENVIRONMENTAL SERVICES
7477 SW Tech Center Drive
Portland, Oregon 97223-8024
Phone (503) 639-3400 FAX (503) 620-7892

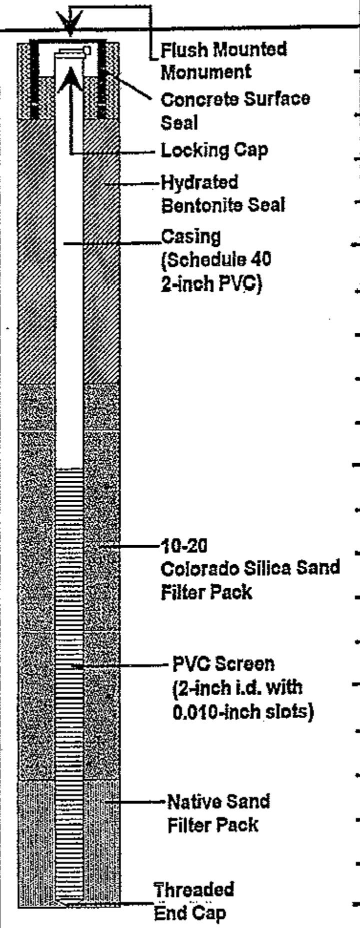
Drilling Started: 9/11/95 Drilling Completed: 9/11/95 Logged By: PDE a:\CHEVRON\LONGVIEW\1272MW2.DRW

PROJECT: Chevron - Longview **START CARD No.: R04372** **BORING No.: AMW3**

Elevation Reference: MSL
Relative Ground Surface Elevation: NA
Well Completed: 9/11/95
Relative Casing Elevation: 13.00
Boring Method: H S A
Borehole Diameter: 8.25" O. D.

Depth (feet)	SOIL DESCRIPTION	USC	Sample Type	Blow Counts	Volatile Readings ppm	Ground Water	ANALYSES
0	3/4"-minus gravel FILL.	FILL					
	Soft, moist, brown, micaceous, silty, fine SAND. Poor sample recovery.	SM	S14/2.5	3	11		
5			S15/5	3	16		
	Brown, clean, medium SAND lens.	SP					
	Silty, fine SAND.	SM	S16/7.5	5	21		
10	Medium soft, moist, brown, medium SAND. Sand coarsening with depth, becoming saturated.	SP	S17/10	4	21	SW	△ Pb TPH-G TPH-D BTEX WTPH-G WTPH-D BTEX
	Medium soft, saturated, gray, micaceous, fine SAND.	SP	S18/12.5	4	21		WTPH-G WTPH-D BTEX
15	Medium dense, saturated, gray, coarse, andesitic SAND.	SP	S19/15	8	24		WTPH-G WTPH-D BTEX
20			S20/20	5	24		
	Boring completed at 22 feet below ground surface. Monitoring well AMW3 installed to 20 feet below ground surface.						
25							
30							

AS-BUILT DESIGN



LEGEND

▨ 2-inch O.D. split-spoon sample with % recovered
△ Groundwater Analysis (Test Method Shown)
▼ WD Encountered groundwater level while drilling
8015 8240 Soil Analysis (Test Method Shown)
▼ SW Measured static groundwater level

AEE PROJECT NUMBER: 12-1272-01
Chevron - Longview
Port of Longview Maintenance Yard
Terminal Way
Longview, Washington

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ENGINEERING & ENVIRONMENTAL SERVICES
7477 SW Tech Center Drive
Portland, Oregon 97223-8024
Phone (503) 639-3400 FAX (503) 620-7892

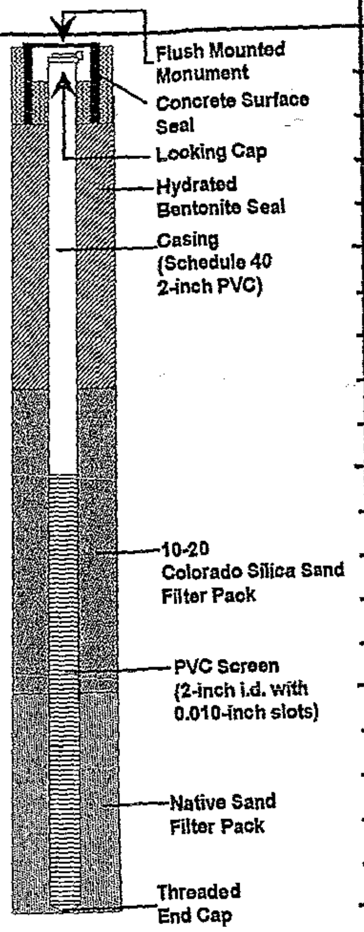
Drilling Started: 9/11/95 Drilling Completed: 9/11/95 Logged By: PDE a:\CHEVRON\LONGVIEW\1272MW3.DRW

PROJECT: Chevron - Longview **START CARD No.:** R04372 **BORING No.:** AMW4

Elevation Reference: MSL **Well Completed:** 9/12/95 **Boring Method:** H S A
Relative Ground Surface Elevation: NA **Relative Casing Elevation:** 13.71 **Borehole Diameter:** 8.25" O. D.

Depth (feet)	SOIL DESCRIPTION	USC	Sample Type	Blow Counts	Volatile Readings ppm	Ground Water	ANALYSES
0	3/4"-minus gravel FILL.	FILL					
	Medium dense, moist, brown, fine SAND	SP					
	Medium dense, moist, gray, slightly organic SILT.	OL					
	Medium stiff, moist, gray, silty, fine SAND. Strong hydrocarbon-like odor. Poor sample recovery.		S21/2.5	6	1520		
5	Thin lenses of clean, medium SAND below 5 feet. Strong hydrocarbon-like odor.		S22/5	3	1913		WTPH-G WTPH-D BTEX
		SM	S23/7.5				
	Poor sample recovery.			4	1939		WTPH-G WTPH-D BTEX
							Pb TPH-G TPH-D BTEX
10	Soils becoming saturated.		S24/10	4	661	SW	WTPH-G WTPH-D BTEX
	Medium soft, saturated, gray, micaceous, fine SAND.						
	Medium stiff, saturated, gray, fine and medium SAND. Moderate hydrocarbon-like odor.						
15		SW	S25/15	6	123		
	Grading into coarse, andesitic SAND.						
		SP					
20			S26/20	11	109		
	Medium-grained, mafic, SAND below 21 feet below ground surface.						
	Boring completed at 22 feet below ground surface. Monitoring well AMW4 installed to 20 feet below ground surface.						
25							
30							

AS-BUILT DESIGN



AEE PROJECT NUMBER: 12-1272-01
Chevron - Longview
Port of Longview Maintenance Yard
Terminal Way
Longview, Washington

LEGEND

- 2-inch O.D. split-spoon sample with % recovered
- WD Encountered groundwater level while drilling
- SW Measured static groundwater level
- △ Groundwater Analysis (Test Method Shown)
- 8015 / 8240 Soil Analysis (Test Method Shown)

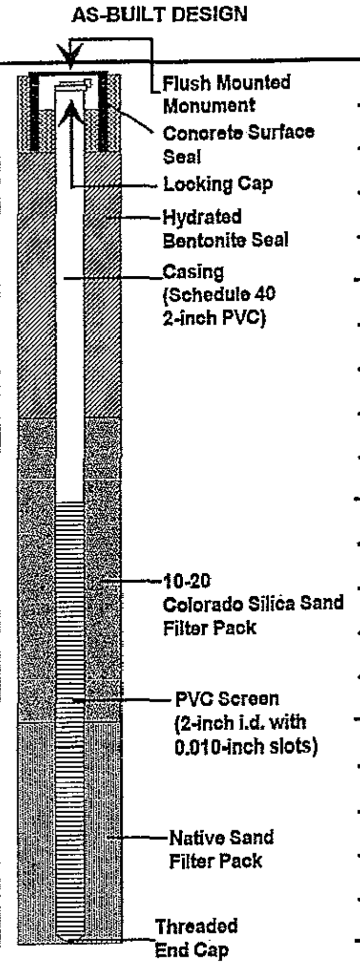
AGRA EARTH AND ENVIRONMENTAL
ENGINEERING & ENVIRONMENTAL SERVICES
7477 SW Tech Center Drive
Portland, Oregon 97223-8024
Phone (503) 639-3400 FAX (503) 620-7892

Drilling Started: 9/12/95 **Drilling Completed:** 9/12/95 **Logged By:** PDE a:\CHEVRON\LONGVIEW\1272MW4.DF

PROJECT: Chevron - Longview **START CARD No.: R04372** **BORING No.: AMW5**

Elevation Reference: MSL
Relative Ground Surface Elevation: NA
Well Completed: 9/12/95
Relative Casing Elevation: 13.55
Boring Method: H S A
Borehole Diameter: 8.25" O. D.

Depth (feet)	SOIL DESCRIPTION	USC	Sample Type	Blow Counts	Volatile Readings ppm	Ground Water	ANALYSES
0	3/4"-minus gravel FILL.	FILL					
	Soft, moist, brown, slightly gravelly, medium and coarse SAND. Poor recovery.	SW	S27/2.5	4	7		
5	Very soft, moist, brown-gray, silty, fine SAND.	SM	S28/5	2	8		
	Soft, moist, brown, medium SAND.	SP					
	Medium dense, moist to saturated, brown-light gray, silty, very fine SAND, interbedded with gray fine and medium, clean SAND.	SM with SW	S29/7.5	7	12		WTPH-G WTPH-D BTEX
10			S30/10	9	7	SW	Pb TPH-G TPH-D BTEX WTPH-G WTPH-D BTEX
	Dense, saturated, brown-gray, coarse, andesitic SAND.	SP					
15			S31/15	6	6		
20			S32/20	4	5		
	Boring completed at 22 feet below ground surface. Monitoring well AMW5 installed to 20 feet below ground surface.						
25							
30							



LEGEND

▨ 2-inch O.D. split-spoon sample with % recovered

▽ WD Encountered groundwater level while drilling

▽ SW Measured static groundwater level

△ Groundwater Analysis (Test Method Shown)

8015 8240 Soil Analysis (Test Method Shown)

AEE PROJECT NUMBER: 12-1272-01
Chevron - Longview
Port of Longview Maintenance Yard
Terminal Way
Longview, Washington

AGRA EARTH AND ENVIRONMENTAL
ENGINEERING & ENVIRONMENTAL SERVICES
7477 SW Tech Center Drive
Portland, Oregon 97223-8024
Phone (503) 639-3400 FAX (503) 620-7892

Drilling Started: 9/12/95 **Drilling Completed: 9/12/95** **Logged By: PDE** a:\CHEVRON\LONGVIEW\1272MW5.DRW

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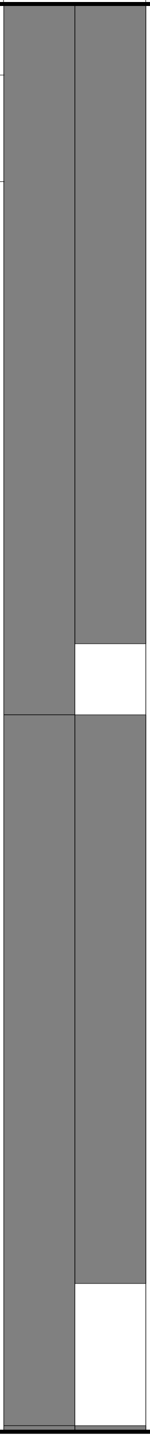
PROJECT: POL-TPH	**LOCATION:** 10 Port Way, Longview, WA	**BORING ID:**	**GP-1**
LOGGED BY: G. Cisneros	**BORING LOCATION:**		
DRILLED BY: Brian, ESN	**NORTHING:** 292952.598299	**EASTING:** 1017608.66501	
DRILLING EQUIPMENT: Geoprobe	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:** SPCS WA S NAD83 FT	
DRILLING METHOD:	**TOTAL DEPTH (ft bgs):** 25	**DEPTH TO WATER (ft bgs):** 17.5 and 21.75	
SAMPLING METHOD/SAMPLER LENGTH: Continuous	**BORING DIAMETER:** 2"	**DRILL DATE:** 9/15/2015	



Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 6 inches.			
	FILL	Road Base **FILL**.			
1					
	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		5.1	
2					
				5.8	
3		Same as above; no odor; no sheen; moist.			
				5.6	
4					
5		Same as above; no odor; no sheen; moist.			
6				9.4	
7		Brown, medium dense, fine to coarse **SAND** with 10% fine red grains; no odor; no sheen.			
8				7.6	
9					
10					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-1

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292952.598299

EASTING: 1017608.66501

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 25

DEPTH TO WATER (ft bgs): 17.5 and 21.75

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/15/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Same as above; no odor; no sheen; moist.			
11				7.6	
12		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
				6.3	
13					
14		Same as above; no odor; no sheen; moist.		5.6	
15					
16		Same as above; no odor; no sheen; moist.		6.0	
				7.0	
17		Same as above; wet perched zone.			
▼					
18	ML	Olive gray, stiff **SILT** with moderate plasticity and organic debris; no odor; no sheen; moist.		117.4	
19		Olive gray, medium dense, fine **SAND** with 5% silt; moderate odor; no sheen; moist.		360.4	
					GP-1-19.5-20@1500
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-1

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292952.598299

EASTING: 1017608.66501

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 25

DEPTH TO WATER (ft bgs): 17.5 and 21.75

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/15/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		10.3	
21					GP-1-21-21.5@1505
▼	ML	Olive gray, stiff, sandy **SILT**; slight odor; no sheen; wet.		27.0	
22					
	SP	Gray, medium dense, fine to coarse **SAND** with 10% fine red clasts; no odor; no sheen; saturated.		23.1	
23					
24		Same as above; no odor; no sheen; saturated.		10.5	
25					GP-1-GW@1516

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-2**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292848.310601

EASTING: 1017538.62636

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 25

DEPTH TO WATER (ft bgs): 16.5 and 21

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/15/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 3 inches.			
	FILL	Road Base **FILL**.			
1		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		1.8	
2					
3		Same as above; no odor; no sheen; moist.		5.3	
4					
5		Brown, medium dense, fine to medium **SAND** with small 2-inch layers of crushed gray rock and a 2-inch layer of black coal at 6 feet bgs; no odor; no sheen; moist.		8.9	
6				4.3	
7					
8		Light brown, medium dense, fine to coarse **SAND**; no odor; no sheen.		5.6	
9					
10	SP				

ABBREVIATIONS:
ft bgs = feet below ground surface USCS = Unified Soil Classification System
ppm = parts per million ▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-2

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292848.310601

EASTING: 1017538.62636

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 25

DEPTH TO WATER (ft bgs): 16.5 and 21

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/15/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Light brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
11				8.3	
12		Same as above; no odor; no sheen; moist.			
				7.1	
13					
				6.1	
14		Gray staining from 14.5 to 15.5 feet bgs; slight odor at 14.5 feet; no sheen; moist.			
				6.3	
15					
				5.6	
		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
16					GP-2-16-16.5@1353
▼				7.6	
		Gray, medium dense, fine to medium **SAND**; slight odor; no sheen; wet to saturated.			
17					
				7.4	
		Gray medium dense, fine to medium **SAND**; no odor; no sheen; saturated.			
18					
				6.6	
		Olive, stiff, sandy **SILT**; no odor; no sheen; moist.			
19					
	ML				
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-2**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292848.310601

EASTING: 1017538.62636

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 25

DEPTH TO WATER (ft bgs): 16.5 and 21

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/15/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
	SP	Gray, medium dense, fine to medium **SAND** with 10% fine red clasts; no odor; no sheen; saturated.		7.3	
21 ▼					
22					
		Same as above; no odor; no sheen; saturated.			
23					
				5.2	
24					
					GP-2-GW@1411
25					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-3**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292780.862706

EASTING: 1017486.36455

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 25

DEPTH TO WATER (ft bgs): 16.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/15/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 3 inches.			
	FILL	Road Base **FILL**.			
1	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
2					
				51.7	GP-3-2-3@1240
3		Wood at 3.5 feet bgs.			
		Same as above with 10% fine gravel; no odor; no sheen.		3.4	
4					
5		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
				7.7	
6					
	SW	Brown, medium dense, fine to coarse **SAND** with 10% rounded gravel and 5% silt; no odor; no sheen; moist.			
7		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
				6.2	
8					
				6.2	
9					
10					

ABBREVIATIONS:
ft bgs = feet below ground surface
USCS = Unified Soil Classification System
ppm = parts per million
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-3**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292780.862706

EASTING: 1017486.36455

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

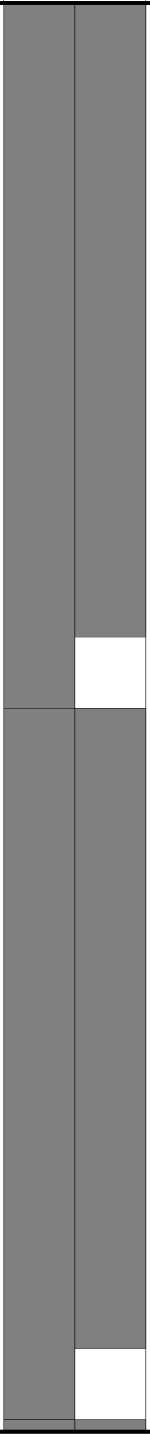
TOTAL DEPTH (ft bgs): 25

DEPTH TO WATER (ft bgs): 16.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/15/2015



Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	PID (ppm)	Sample ID
		Same as above; no odor; no sheen; moist.		
			6.2	
11				
12				
13		Same as above; no odor; no sheen; moist.		
			5.3	
14				
15	SP	Same as above; no odor; no sheen; wet.		
			5.2	
16				GP-3-16-16.5@1246
▼			5.8	
17		Brown to gray, fine to medium **SAND**; no odor; no sheen; saturated.		
18			4.6	
		Same as above; no odor; no sheen; saturated.		
19				
20				

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

PROJECT: POL-TPH	**LOCATION:** 10 Port Way, Longview, WA	**BORING ID:** **GP-3**	
LOGGED BY: G. Cisneros	**BORING LOCATION:**		
DRILLED BY: Brian, ESN	**NORTHING:** 292780.862706	**EASTING:** 1017486.36455	
DRILLING EQUIPMENT: Geoprobe	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:** SPCS WA S NAD83 FT	
DRILLING METHOD:	**TOTAL DEPTH (ft bgs):** 25	**DEPTH TO WATER (ft bgs):** 16.5	
SAMPLING METHOD/SAMPLER LENGTH: Continuous	**BORING DIAMETER:** 2"	**DRILL DATE:** 9/15/2015	

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Brown to gray, fine to medium **SAND**; no odor; no sheen; saturated.			
21				3.4	
		Same as above; no odor; no sheen; saturated.			
22					
				3.2	
23	ML	Olive brown, stiff **SILT** with low plasticity; no odor; no sheen; moist.			
24	SP	Gray, medium dense, fine to medium **SAND** with 10% fine red grains; no odor; no sheen; saturated.		2.1	
25					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-4**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292694.507727

EASTING: 1017433.34722

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 25

DEPTH TO WATER (ft bgs): 21.5 and 24

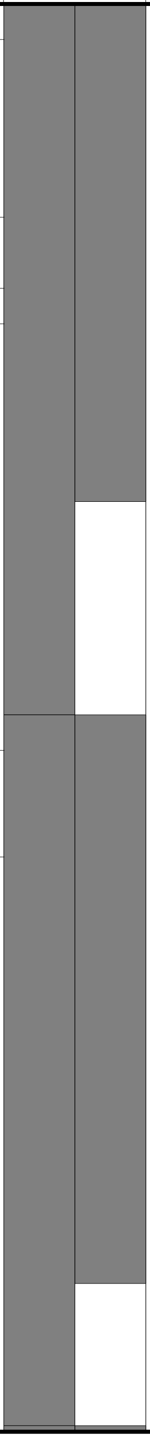
SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/15/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	PID (ppm)	Sample ID
0	AS	Asphalt Top 3 inches.		
	FILL	Road Base **FILL**.		
1				
	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist to wet.	4.6	
2	ML	Sandy **SILT** lens at 2 feet bgs.		
	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.	5.8	
3				
4		Same as above; no odor; no sheen; moist.		
5				
	SW	Brown, medium dense, fine to coarse **SAND** with 5% silt and 5% gravel; no odor; no sheen.	7.7	
6	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		
7			6.1	
8		Same as above; no odor; no sheen; moist.		
9				
10				

Drive/ Recovery



ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH
LOCATION: 10 Port Way, Longview, WA
BORING ID: **GP-4**
LOGGED BY: G. Cisneros
BORING LOCATION:
DRILLED BY: Brian, ESN
NORTHING: 292694.507727
EASTING: 1017433.34722
DRILLING EQUIPMENT: Geoprobe
SURFACE ELEVATION:
COORDINATE SYSTEM: SPCS WA S NAD83 FT
DRILLING METHOD:
TOTAL DEPTH (ft bgs): 25
DEPTH TO WATER (ft bgs): 21.5 and 24
SAMPLING METHOD/SAMPLER LENGTH: Continuous
BORING DIAMETER: 2"
DRILL DATE: 9/15/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Same as above; no odor; no sheen; moist.	■ ■		
11			■ ■		
			■ ■	4.7	
12			■ ■		
	ML	Brown, stiff **SILT** with low plasticity.	■ ■	4.5	
13		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.	■ ■		
14			■ □		
15		Same as above; no odor; no sheen; moist.	■ ■		
16			■ ■	5.7	
17			■ ■		
	SP		■ ■		
18			■ ■		
		Same as above; no odor; no sheen; moist to wet.	■ ■	3.0	
19			■ ■		
20			■ □		

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-4**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292694.507727

EASTING: 1017433.34722

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 25

DEPTH TO WATER (ft bgs): 21.5 and 24

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/15/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Same as above; no odor; no sheen; wet.		6.0	
21					GP-4-21-21.5@1204
▼		Same as above; no odor; no sheen; saturated.		4.0	
22	SM	Brown, medium dense, silty, fine **SAND**; no odor; no sheen; saturated.			
	ML	Brown, stiff, sandy **SILT**; no odor; no sheen; moist.		4.7	
23					
	SP	Brown to gray, medium dense, fine to medium **SAND** with 10% fine red grains; no odor; no sheen; saturated.		2.4	
24 ▼					
					GP-4-GW@
25					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-5

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292576.577732

EASTING: 1017216.47276

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 25

DEPTH TO WATER (ft bgs): 20

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 3 inches.			
	Conc.	Concrete.			
	FILL	Road Base **FILL**.			
1		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
2					
				1.1	
3					
4					
5		Brown, medium dense, fine to medium **SAND** with 5% subrounded gravel; no odor; no sheen; moist.			
6				1.3	
7					
8		Same as above; no odor; no sheen; moist.		2.5	
9					
10					

ABBREVIATIONS:
ft bgs = feet below ground surface USCS = Unified Soil Classification System
ppm = parts per million ▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-5

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292576.577732

EASTING: 1017216.47276

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 25

DEPTH TO WATER (ft bgs): 20

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
11				3.2	
12					
		Same as above; no odor; no sheen; moist.		3.5	
13					
14					
15		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
16				1.2	
17					
18		Gray, fine to medium **SAND**; no odor; no sheen; wet.		4.0	
19					GP-5-19-19.5@0820
	ML	Olive gray, stiff **SILT** with low plasticity; no odor; no sheen; wet.		2.9	
20 ▼					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-5**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292576.577732

EASTING: 1017216.47276

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 25

DEPTH TO WATER (ft bgs): 20

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Brown to gray, medium dense, fine to coarse **SAND** with 5% fine red grains; no odor; no sheen; saturated.			
21	SP				
				2.8	
22		Olive gray, stiff, sandy **SILT** with low to moderate plasticity; no odor; no sheen; saturated.			
				3.4	
23	ML				
24		Olive gray, medium dense, fine to medium **SAND**; no odor; no sheen; saturated.			
	SP			3.1	
25					

ABBREVIATIONS:
ft bgs = feet below ground surface USCS = Unified Soil Classification System
ppm = parts per million ▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-6

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292563.555458

EASTING: 1017346.54222

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 20

DEPTH TO WATER (ft bgs): 16.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/15/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 3 inches.			
	FILL	Road Base **FILL**.			
1		Brown, medium dense, fine to medium **SAND** with 5% subrounded gravel; no odor; no sheen; moist.			
				2.1	
2					
3				3.6	
4		Same as above; no sheen; no odor; moist.			
				4.2	
5					
		Brown, medium dense, fine to medium **SAND** with 5% subrounded gravel and crushed rock; no odor; no sheen; moist.			
6				1.8	
7					
				1.7	
8		Same as above; no sheen; no odor; moist.			
9	SP				
10					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:
Collected groundwater at 1324

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PROJECT: POL-TPH	**LOCATION:** 10 Port Way, Longview, WA		**BORING ID:** GP-6
LOGGED BY: G. Cisneros	**BORING LOCATION:**		
DRILLED BY: Brian, ESN	**NORTHING:** 292563.555458	**EASTING:** 1017346.54222	
DRILLING EQUIPMENT: Geoprobe	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:** SPCS WA S NAD83 FT	
DRILLING METHOD:	**TOTAL DEPTH (ft bgs):** 20	**DEPTH TO WATER (ft bgs):** 16.5	
SAMPLING METHOD/SAMPLER LENGTH: Continuous	**BORING DIAMETER:** 2"	**DRILL DATE:** 9/15/2015	

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Brown, medium dense, fine to medium **SAND** with 5% angular gravel clasts; no odor; no sheen; moist.			
				3.0	
11					
12					
				3.7	
13		Same as above; moist to wet at 13.75 feet bgs; no odor; no sheen.			
14					
15		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; wet to saturated at 16.5 feet bgs.		3.7	
16				2.0	
▼					GP-6-16-17@1117
17		Brown, medium dense, fine to coarse **SAND** with 10% white grains; no odor; no sheen; saturated.			
				3.1	
18	SW				
19		Olive gray, stiff, fine, sandy **SILT**; no odor; no sheen; wet.			
	ML			2.4	
					GP-6-GW@1324
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:
Collected groundwater at 1324

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-7

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292390.444892

EASTING: 1017269.96574

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 26

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/15/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 3 inches.			
	FILL	Road Base **FILL**.			
		Brown, medium dense, fine to medium **SAND** with 5% subrounded gravel; no odor; no sheen; moist.			
1				3.0	
2					
				1.0	
3		Same as above; no odor; no sheen; moist.			
4					
5		Brown, medium dense, fine to medium **SAND** with 5% subrounded gravel; no odor; no sheen; moist.			
6				2.4	
7					
8		Same as above; no odor; no sheen; moist.		2.0	
9					
10	SP				

ABBREVIATIONS:
ft bgs = feet below ground surface
USCS = Unified Soil Classification System
ppm = parts per million
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-7**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292390.444892

EASTING: 1017269.96574

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 26

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/15/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Brown, medium dense, fine to medium **SAND** with 5% gravel and 5% silt; no odor; no sheen; moist.			
11				3.5	
12					
13		Same as above; no odor; no sheen; moist.		2.9	
14					
15		Same as above; no odor; no sheen; moist.			
16				2.2	
17					
18				4.0	
19	SM	Brown, medium dense, silty, fine **SAND** with 15% silt.			
		Brown, medium dense, fine to medium **SAND** with 5% gravel and 5% silt; no odor; no sheen; moist.			
20					

ABBREVIATIONS:
ft bgs = feet below ground surface USCS = Unified Soil Classification System
ppm = parts per million ▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-7**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292390.444892

EASTING: 1017269.96574

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 26

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/15/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
	SP	Same as above; no odor; no sheen; moist.			
21				3.3	
22				3.5	
	ML	Olive gray, stiff **SILT** with low plasticity; no odor; no sheen; moist.			
23				3.4	
24					
	SP	Brown, medium dense, fine to medium **SAND** with 5% silt; no odor; no sheen; moist.			
25				1.3	
					GP-7-25.5-26@0851
26 ▼		Same as above; no odor; no sheen; wet.		2.8	
27				3.5	
28		Same as above with shells at 28 feet bgs; no odor; no sheen; saturated.			
29				3.4	
30					

ABBREVIATIONS:
ft bgs = feet below ground surface
USCS = Unified Soil Classification System
ppm = parts per million
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-8**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292344.944418

EASTING: 1017283.86709

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

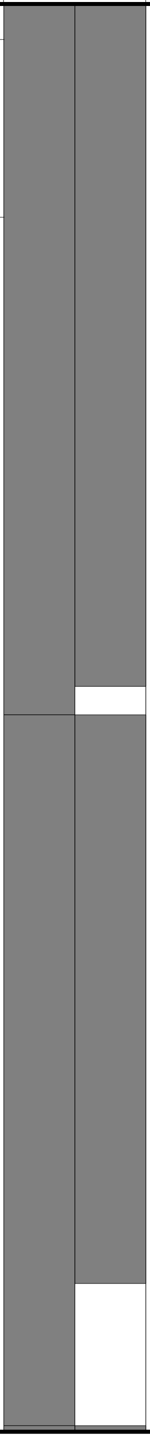
DEPTH TO WATER (ft bgs): 26

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/15/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 3 inches.			
	FILL	Road Base **FILL**.			
1					
		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
2					
3		Same as above; no odor; no sheen; moist.		3.3	
4					
5		Same as above; no odor; no sheen; moist.			
6				3.0	
7					
8		Same as above; no odor; no sheen; moist.		2.8	
9					
10					



ABBREVIATIONS:
ft bgs = feet below ground surface USCS = Unified Soil Classification System
ppm = parts per million ▼ = denotes groundwater table

NOTES:

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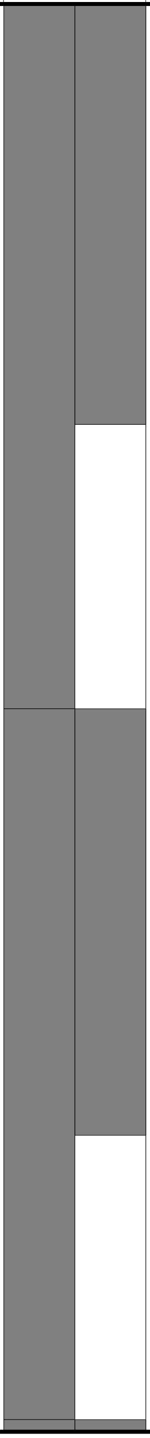
PROJECT: POL-TPH	**LOCATION:** 10 Port Way, Longview, WA	**BORING ID:** GP-8	
LOGGED BY: G. Cisneros	**BORING LOCATION:**		
DRILLED BY: Brian, ESN	**NORTHING:** 292344.944418	**EASTING:** 1017283.86709	
DRILLING EQUIPMENT: Geoprobe	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:** SPCS WA S NAD83 FT	
DRILLING METHOD:	**TOTAL DEPTH (ft bgs):** 30	**DEPTH TO WATER (ft bgs):** 26	
SAMPLING METHOD/SAMPLER LENGTH: Continuous	**BORING DIAMETER:** 2"	**DRILL DATE:** 9/15/2015	



Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
11				3.9	
12		Same as above; no odor; no sheen; moist.			
13					
14				3.9	
15					
	SP				
16		Brown, medium dense, fine to medium **SAND** with 5% medium red grains (Dredge **FILL**); no odor; no sheen; moist.		4.6	
17					
18					
				4.6	
19					
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-8

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292344.944418

EASTING: 1017283.86709

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 26

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/15/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Same as above; no odor; no sheen; moist.			
21				4.3	
22					
23		Same as above; no odor; no sheen; moist.		3.9	
24		Same as above; no odor; no sheen; wet.			
25				3.6	GP-8-25.5-26@1011
26 ▼		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; saturated.			
27				3.3	
28				2.0	
29					GP-8-GW@
30					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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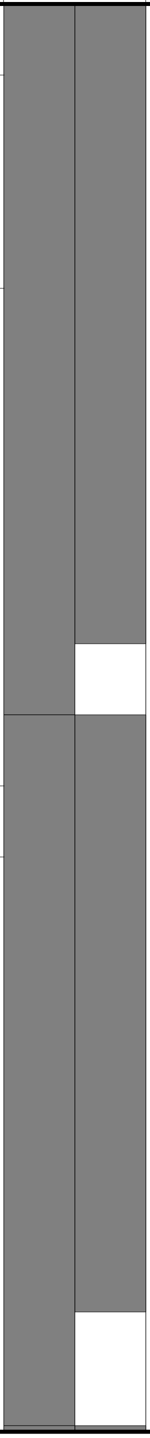
PROJECT: POL-TPH	**LOCATION:** 10 Port Way, Longview, WA	**BORING ID:** **GP-9**
LOGGED BY: G. Cisneros	**BORING LOCATION:**	
DRILLED BY: Brian, ESN	**NORTHING:** 292269.877327	**EASTING:** 1017286.47024
DRILLING EQUIPMENT: Geoprobe	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:** SPCS WA S NAD83 FT
DRILLING METHOD:	**TOTAL DEPTH (ft bgs):** 30	**DEPTH TO WATER (ft bgs):** 28
SAMPLING METHOD/SAMPLER LENGTH: Continuous	**BORING DIAMETER:** 2"	**DRILL DATE:** 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 6 inches.			
	FILL	Road Base **FILL**; slight odor; no sheen.			
1					
				3.4	
2	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
3					
				1.4	
4					
5					
	SW	Gray to dark brown, medium dense, sandy **GRAVEL** and crushed rock; no odor; no sheen.			
6	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		1.0	
7					
8				1.1	
9					
10					



ABBREVIATIONS:
ft bgs = feet below ground surface USCS = Unified Soil Classification System
ppm = parts per million ▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-9

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292269.877327

EASTING: 1017286.47024

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 28

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
				1.3	
11	GW	Dark brown to gray, medium dense, sandy crushed rock **FILL**; no odor; no sheen; moist.			
		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		1.5	
12					
13				0.9	
	SP				
14					
15					
	SW	Brown, medium dense, gravelly, fine to coarse **SAND** with 5% silt; no odor; no sheen; moist.		2.2	
16					
		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
17					
				1.7	
18					
	SP	Same as above; gray, fine **SAND**; no odor; no sheen; moist.			
19					
				2.1	
20					

ABBREVIATIONS:
ft bgs = feet below ground surface USCS = Unified Soil Classification System
ppm = parts per million ▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-9

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292269.877327

EASTING: 1017286.47024

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

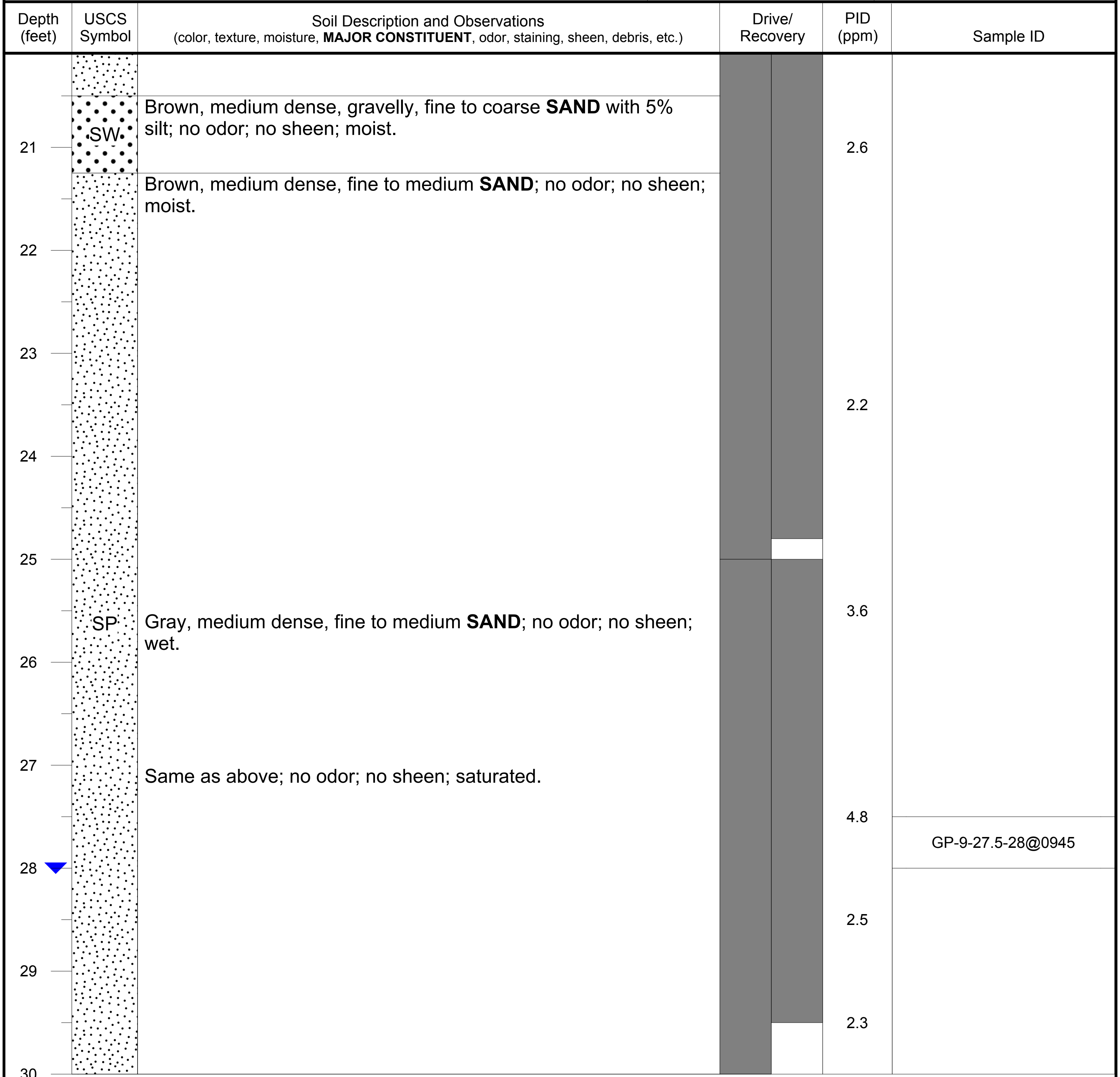
TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 28

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015



Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
	SW	Brown, medium dense, gravelly, fine to coarse **SAND** with 5% silt; no odor; no sheen; moist.			
21				2.6	
		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
22					
23					
				2.2	
24					
25					
				3.6	
	SP	Gray, medium dense, fine to medium **SAND**; no odor; no sheen; wet.			
26					
27		Same as above; no odor; no sheen; saturated.			
				4.8	
					GP-9-27.5-28@0945
28 ▼					
				2.5	
29					
				2.3	
30					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-10**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292333.466198

EASTING: 1017369.43114

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 21.5 and 28.25

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 3 inches.			
	FILL	Road Base **FILL**.			
1	SP	Brown, medium dense, fine to medium **SAND** with 5% gravel; no odor; no sheen; moist.			
2					
3				3.5	
4					
5		Same as above; no odor; no sheen; moist.			
6				3.2	
7					
8				3.4	
9					
10					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-10**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292333.466198

EASTING: 1017369.43114

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 21.5 and 28.25

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Brown, medium dense, fine to medium **SAND** with 10% angular gravel; no odor; no sheen; moist.			
11				1.8	
12					
				2.8	
13					
	ML	Brown, stiff **SILT** with low plasticity; no odor; no sheen; moist.			
14				0.9	
	SM	Brown, medium dense, silty **SAND**; no odor; no sheen; moist.			
15	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
16				3.3	
17					
				2.0	
18					
	ML	Brown, stiff, sandy **SILT** with low plasticity; no odor; no sheen; moist.			
19					
		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		3.2	
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH	**LOCATION:** 10 Port Way, Longview, WA		**BORING ID:** GP-10
LOGGED BY: G. Cisneros	**BORING LOCATION:**		
DRILLED BY: Brian, ESN	**NORTHING:** 292333.466198	**EASTING:** 1017369.43114	
DRILLING EQUIPMENT: Geoprobe	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:** SPCS WA S NAD83 FT	
DRILLING METHOD:	**TOTAL DEPTH (ft bgs):** 30	**DEPTH TO WATER (ft bgs):** 21.5 and 28.25	
SAMPLING METHOD/SAMPLER LENGTH: Continuous	**BORING DIAMETER:** 2"	**DRILL DATE:** 9/16/2015	

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
	SP				
21				2.2	
▼		Perched zone at 21.5 feet bgs.			
22	ML	Olive gray, stiff **SILT** with high plasticity; no odor; no sheen; moist.			
23				3.0	
24					
		Wood at 24.25 feet bgs.			
25	SP	Brown, medium dense, fine to medium **SAND** with 5% gravel; no odor; no sheen; moist.		2.1	
26	ML	Olive, stiff **SILT** with high plasticity; no odor; no sheen; moist.			
27				3.1	
28	SP	Gray, medium dense, fine to medium **SAND** with 5% fine red grains; no odor; no sheen; saturated.			GP-10-28-28.5@0820
▼				2.9	
29					
				1.2	
30					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-11**

LOGGED BY: G. Cisneros

BORING LOCATION: 5' East of pipeline

DRILLED BY: Brian, ESN

NORTHING: 292192.993596

EASTING: 1017258.79383

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 27.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 6 inches.			
	FILL	Road Base **FILL**.			
1					
	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		1.1	
2					
3					
	SP			0.9	
4					
5					
	GW	Dark brown, medium dense, sandy, crushed rock **FILL**; no odor; no sheen; moist.			
6		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		0.7	
7					
				0.8	
8					
	SP				
9					
10					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-11**

LOGGED BY: G. Cisneros

BORING LOCATION: 5' East of pipeline

DRILLED BY: Brian, ESN

NORTHING: 292192.993596

EASTING: 1017258.79383

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 27.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
11	GW	Dark brown to gray, medium dense, sandy crushed rock **FILL**; no odor; no sheen; moist.		1.4	
		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
12					
	SP				
13				0.9	
14	SM	Brown, medium dense, silty, fine **SAND** with 20% silt; no odor; no sheen; moist.			
				1.0	
15	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
		Brown, medium dense, gravelly, fine to coarse **SAND** with 20% subrounded gravel and 5% silt; no odor; no sheen.		1.4	
16	SW				
	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
17		Brown to olive gray, silty **SAND** /sandy **SILT**; no odor; no sheen; moist.			
	SM/ML			1.2	
18					
		Gray, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
19					
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
USCS = Unified Soil Classification System
ppm = parts per million
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-11**

LOGGED BY: G. Cisneros

BORING LOCATION: 5' East of pipeline

DRILLED BY: Brian, ESN

NORTHING: 292192.993596

EASTING: 1017258.79383

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 27.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
	SP	Brown to olive gray, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		1.0	
21					
22				1.1	
23					
24				1.2	
25				0.8	
26	SM	Olive gray, medium dense, silty, fine to medium **SAND** with 20% silt and some wood debris; no odor; no sheen; moist to wet.			
27				3.8	GP-11-27-27.5@0908
▼		Same as above; no odor; no sheen; wet to saturated.			
28				0.8	
29	ML	Olive, stiff, sandy **SILT** with low plasticity; no odor; no sheen; wet.			
30					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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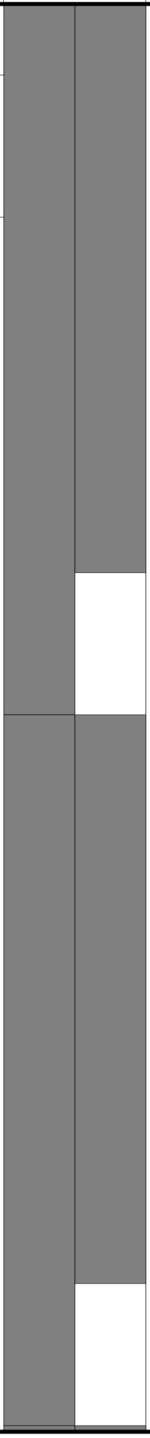
PROJECT: POL-TPH	**LOCATION:** 10 Port Way, Longview, WA	**BORING ID:** GP-12	
LOGGED BY: G. Cisneros	**BORING LOCATION:** 8' East of pipeline		
DRILLED BY: Brian, ESN	**NORTHING:** 292127.372664	**EASTING:** 1017213.48767	
DRILLING EQUIPMENT: Geoprobe	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:** SPCS WA S NAD83 FT	
DRILLING METHOD:	**TOTAL DEPTH (ft bgs):** 30	**DEPTH TO WATER (ft bgs):** 26.5	
SAMPLING METHOD/SAMPLER LENGTH: Continuous	**BORING DIAMETER:** 2"	**DRILL DATE:** 9/16/2015	

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 6 inches.			
	FILL	Road Base **FILL**.			
1				3.8	
	SP	Brown, medium dense, fine to medium **SAND** with 10% gravel; no odor; no sheen; moist.			
2					
3				4.2	
4					
5		Light brown, medium dense, fine to medium **SAND** with 5% fine red grains; no odor; no sheen; moist.			
				4.2	
6					
7					
8				5.1	
9					
10					



ABBREVIATIONS:
ft bgs = feet below ground surface
USCS = Unified Soil Classification System
ppm = parts per million
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-12**

LOGGED BY: G. Cisneros

BORING LOCATION: 8' East of pipeline

DRILLED BY: Brian, ESN

NORTHING: 292127.372664

EASTING: 1017213.48767

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 26.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
				6.3	
11	SW	Gray, gravelly, **SAND** with crushed rock; no odor; no sheen; moist.			
		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
12					
13					
				6.6	
14					
15					
		Brown, medium dense, fine to medium **SAND** with 10% fine red grains; no odor; no sheen; moist.			
16				6.7	
17					
18				6.3	
19					
	SP				
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
USCS = Unified Soil Classification System
ppm = parts per million
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-12

LOGGED BY: G. Cisneros

BORING LOCATION: 8' East of pipeline

DRILLED BY: Brian, ESN

NORTHING: 292127.372664

EASTING: 1017213.48767

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

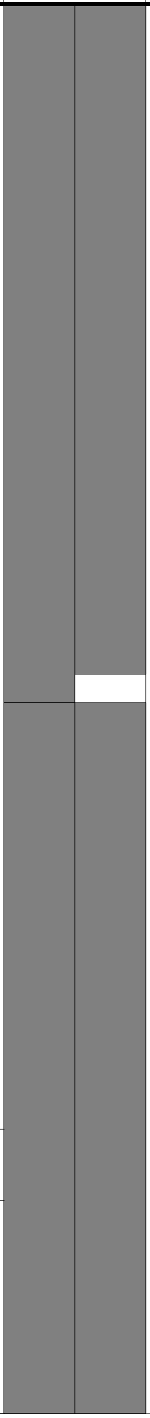
TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 26.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015



Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
21				2.8	
22		Wood encountered between 22 and 23 feet bgs.			
				2.9	
23		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
24				5.1	
		Gray, fine to medium **SAND**; no odor; no sheen; wet.			
25				4.5	
				2.9	
26					GP-12-26-26.5@1017
▼				5.3	
27					
		Same as above; saturated and wood at 27.75 feet bgs.			
28	ML	Olive, stiff **SILT** with high plasticity; no odor; no sheen; wet.		5.1	
	SM	Gray, medium dense, silty **SAND** with 30% silt; no odor; no sheen; saturated.			
29				4.2	
30					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
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NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-13

LOGGED BY: G. Cisneros

BORING LOCATION: 5' East of pipeline

DRILLED BY: Brian, ESN

NORTHING: 292049.434655

EASTING: 1017159.27063

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 27

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 6 inches.			
	FILL	Road Base **FILL**.			
	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		4.6	
		Brown, medium dense, fine to medium **SAND** with 10% gravel; no odor; no sheen; moist.		6.4	
7	SW	Brown, medium dense, fine to coarse **SAND** with 10% gravel; no odor; no sheen; moist.			
8	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		6.5	

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-13**

LOGGED BY: G. Cisneros

BORING LOCATION: 5' East of pipeline

DRILLED BY: Brian, ESN

NORTHING: 292049.434655

EASTING: 1017159.27063

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 27

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
11	SW	Brown, medium dense, gravelly, fine to coarse **SAND** with 5% silt; no odor; no sheen; moist.		5.7	
		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
12					
13				5.8	
14					
15		Same as above with 10% gravel; no odor; no sheen.			
				4.0	
16					
17					
		Same as above with 5% gravel; no odor; no sheen.			
18				4.2	
19					
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-13**

LOGGED BY: G. Cisneros

BORING LOCATION: 5' East of pipeline

DRILLED BY: Brian, ESN

NORTHING: 292049.434655

EASTING: 1017159.27063

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 27

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
21					
				5.3	
22					
23		Same as above with 5% fine red grains; no odor; no sheen.			
				6.1	
24					
25					
				5.5	
26					
		Gray, medium dense, fine to medium **SAND** with 5% fine red grains; no odor; no sheen; wet.			GP-13-26.5-27@1119
27 ▼				4.9	
28		Same as above; no odor; no sheen; saturated.			
				4.8	
29					
					GP-13-GW@1130
30					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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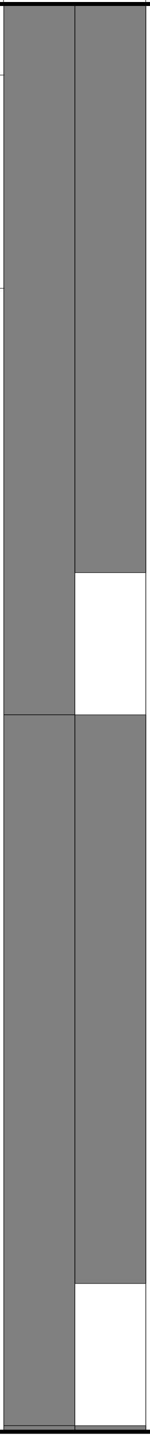
PROJECT: POL-TPH	**LOCATION:** 10 Port Way, Longview, WA	**BORING ID:** GP-14
LOGGED BY: G. Cisneros	**BORING LOCATION:**	
DRILLED BY: Brian, ESN	**NORTHING:** 292147.66449	**EASTING:** 1016991.25362
DRILLING EQUIPMENT: Geoprobe	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:** SPCS WA S NAD83 FT
DRILLING METHOD:	**TOTAL DEPTH (ft bgs):** 30	**DEPTH TO WATER (ft bgs):** 26.5
SAMPLING METHOD/SAMPLER LENGTH: Continuous	**BORING DIAMETER:** 2"	**DRILL DATE:** 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 6 inches.			
0.5	FILL	Road Base **FILL**.			
2	SP	Brown, medium dense, fine to medium **SAND** with 5% subrounded gravel; no odor; no sheen; moist.			
2.5				3.0	
5.5				4.2	
8				5.3	
10					



ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

FLOYD | SNIDER strategy ▪ science ▪ engineering	**PROJECT:** POL-TPH	**LOCATION:** 10 Port Way, Longview, WA	**BORING ID:** GP-14
	LOGGED BY: G. Cisneros	**BORING LOCATION:**	
DRILLED BY: Brian, ESN		**NORTHING:** 292147.66449	**EASTING:** 1016991.25362
DRILLING EQUIPMENT: Geoprobe		**SURFACE ELEVATION:**	**COORDINATE SYSTEM:** SPCS WA S NAD83 FT
DRILLING METHOD:		**TOTAL DEPTH (ft bgs):** 30	**DEPTH TO WATER (ft bgs):** 26.5
SAMPLING METHOD/SAMPLER LENGTH: Continuous		**BORING DIAMETER:** 2"	**DRILL DATE:** 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
11				5.7	
12					
				3.7	
13					
		Brown, medium dense, silty, fine **SAND**; no odor; no sheen; moist.			
14					
	SM				
15					
		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		5.6	
16					
	SP				
17					
18	ML	Brown, stiff, sandy **SILT** with low plasticity; no odor; no sheen; moist.		5.1	
		Gray, medium dense, silty, fine **SAND**; no odor; no sheen; moist to wet.		5.7	
19					
	SM				
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-14**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292147.66449

EASTING: 1016991.25362

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

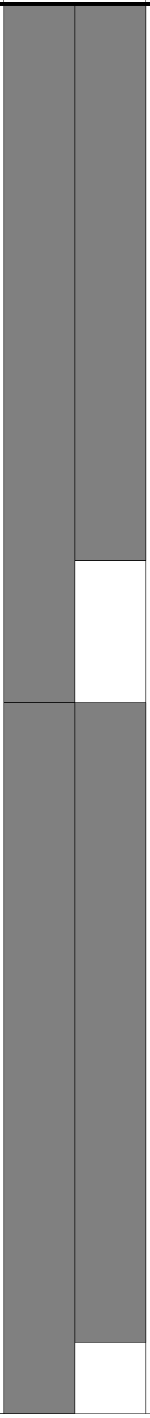
TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 26.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015



Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		4.6	
21					
22				2.8	
23					
24					
25	SP			2.4	
26		Gray, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		5.4	GP-14-26-26.5@1219
▼					
27		Same as above; no odor; no sheen; saturated.			
28				2.4	
29					
30					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-15

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 291962.269443

EASTING: 1017282.09882

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 27.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 6 inches.			
1	FILL	Road Base **FILL**.			
2		Light brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		1.1 1.3	
3					
4					
5		Brown to light brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		1.6	
6					
7					
8		Same as above; no odor; no sheen; moist.		1.5	
9					
10					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-15**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 291962.269443

EASTING: 1017282.09882

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 27.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Light brown, medium dense, fine to medium **SAND** with 5% gravel; no odor; no sheen; moist.			
11				1.4	
12					
13		Same as above; no odor; no sheen; moist.		1.3	
14					
15	SP	Same as above; no odor; no sheen; moist.			
16				1.4	
17					
18		Same as above; no odor; no sheen; moist.			
19				1.1	
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

FLOYD | SNIDER
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PROJECT: POL-TPH

LOCATION: 10 Port Way,
Longview, WA

BORING ID: **GP-15**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 291962.269443

EASTING: 1017282.09882

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 27.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
21					
				1.5	
22					
23		Same as above; no odor; no sheen; moist.			
				1.8	
24					
25		Brown, medium dense, fine to medium **SAND** with 5% subrounded gravel; no odor; no sheen; moist.			
				2.6	
26					
27		Gray, medium dense, fine to medium **SAND** with 5% fine red grains; no odor; no sheen; wet to saturated.		1.8	GP-15-27-27.5@1320
▼					
28					
29	ML/SM	Olive gray, medium dense/stiff, fine sandy **SILT** / silty **SAND**; no odor; no sheen; saturated to wet.		2.8	
					GP-15-GW@1335
30					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-16**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 291811.257642

EASTING: 1017464.66298

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 28

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 6 inches.			
1	FILL	Road Base **FILL**.			
2		Light brown, medium dense, medium to coarse **SAND** with 5% fine gravel; no odor; no sheen; moist.			
3				2.1	
4					
5		Brown, medium dense, medium to coarse **SAND** with 10% fine subrounded gravel; no odor; no sheen; moist.			
6				2.4	
7					
8		Same as above; no odor; no sheen; moist.			
9				2.1	
10					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-16**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 291811.257642

EASTING: 1017464.66298

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 28

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Light brown, medium dense, medium to coarse **SAND** with 5% fine gravel; no odor; no sheen; moist.			
	SP				
11					
				2.6	
12					
13		Same as above; no odor; no sheen; moist.			
				1.8	
14					
15		Brown, medium dense, fine to medium **SAND** with 10% subrounded gravel; no odor; no sheen; moist.			
16					
				2.2	
17					
18		Same as above; no odor; no sheen; moist.			
				1.6	
19					
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-16**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 291811.257642

EASTING: 1017464.66298

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

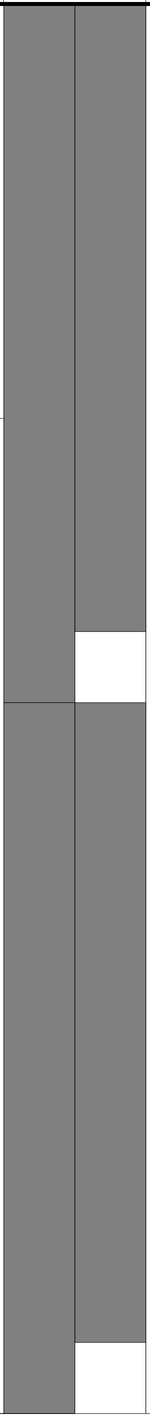
DEPTH TO WATER (ft bgs): 28

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
20	SW	Brown, medium dense, fine to coarse **SAND** with 10% subrounded gravel and 5% angular gravel; no odor; no sheen; moist.			
21				2.1	
22					
23	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		3.4	
24					
25					
26				2.1	
27		Gray, medium dense, fine to medium **SAND** with 10% fine red grains; no odor; no sheen; wet to saturated.		3.1	GP-16-27.5-28@1424
28 ▼					
29				2.7	GP-16-GW@1439
30					



ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-17

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 291757.351966

EASTING: 1017548.36186

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 26.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 6 inches.			
	FILL	Road Base **FILL**.			
1				1.3	
		Reddish brown, medium dense, fine **SAND**; no odor; no sheen; moist.			
2					
				2.8	
3					
4					
5		Same as above; no odor; no sheen; moist.			
				5.3	
6		Light brown, medium dense, fine to medium **SAND** with 5% subrounded gravel; no odor; no sheen; moist.			
7					
8		Same as above; no odor; no sheen; moist.		3.7	
9					
10					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-17

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 291757.351966

EASTING: 1017548.36186

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 26.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Same as above; no odor; no sheen; moist.		1.8	
11					
12					
13		Same as above; no odor; no sheen; moist.		0.7	
14					
15		Same as above; no odor; no sheen; moist.			
16	SP			1.8	
17					
18		Brown to gray, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		1.9	
19					
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-17**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 291757.351966

EASTING: 1017548.36186

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 26.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Same as above; no odor; no sheen; moist.			
21				2.5	
22					
		Brownish gray, medium dense, fine to medium **SAND** with 5% fine red grains and 1/2-inch volcanic ash layer; no odor; no sheen; moist.			
23				2.1	
24					
25		Same as above; no odor; no sheen; moist to wet.			
				2.2	
26		Gray, medium dense, fine to coarse **SAND** with 10% fine red grains; no odor; no sheen; saturated.			GP-17-26-26.5@0924
▼				2.3	
27					
28				2.1	
		Same as above; no odor; no sheen; saturated.			
29					
					GP-17-GW@0934
30					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-18**

LOGGED BY: G. Cisneros

BORING LOCATION: 5' West of pipeline

DRILLED BY: Brian, ESN

NORTHING: 291961.594646

EASTING: 1017513.07725

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 28

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 6 inches.			
	FILL	Road Base **FILL**.			
1					
				3.2	
2					
	SW	Brown, medium dense, fine to coarse **SAND** with 10% silt and 10% gravel; no odor; no sheen; moist.			
3				4.8	
4					
5		Same as above; no odor; no sheen; moist.			
6		Light brown, medium dense, fine to medium **SAND** with 5% subrounded gravel; no odor; no sheen; moist.		2.0	
7					
8					
		Same as above; no odor; no sheen; moist.			
9				5.7	
10					

ABBREVIATIONS:
ft bgs = feet below ground surface
USCS = Unified Soil Classification System
ppm = parts per million
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-18

LOGGED BY: G. Cisneros

BORING LOCATION: 5' West of pipeline

DRILLED BY: Brian, ESN

NORTHING: 291961.594646

EASTING: 1017513.07725

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 28

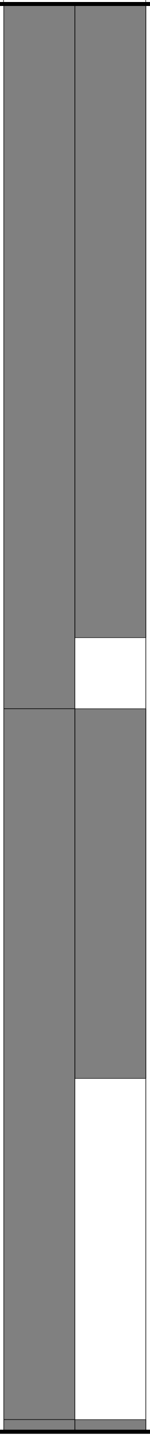
SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/16/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	PID (ppm)	Sample ID
		Brown, medium dense, fine to medium **SAND** with 15% subrounded gravel; no odor; no sheen; moist.		
11			4.9	
12				
13			5.9	
	SP	Brown, medium dense, fine to medium SAND; no odor; no sheen; moist.		
14				
15		Same as above; no odor; no sheen; moist.		
16				
			3.7	
17		Same as above; no odor; no sheen; moist.		
18				
19				
20				

Drive/ Recovery



ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH	**LOCATION:** 10 Port Way, Longview, WA		**BORING ID:** GP-18
LOGGED BY: G. Cisneros	**BORING LOCATION:** 5' West of pipeline		
DRILLED BY: Brian, ESN	**NORTHING:** 291961.594646	**EASTING:** 1017513.07725	
DRILLING EQUIPMENT: Geoprobe	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:** SPCS WA S NAD83 FT	
DRILLING METHOD:	**TOTAL DEPTH (ft bgs):** 30	**DEPTH TO WATER (ft bgs):** 28	
SAMPLING METHOD/SAMPLER LENGTH: Continuous	**BORING DIAMETER:** 2"	**DRILL DATE:** 9/16/2015	

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
21 22	SW	Brown, medium dense, fine to coarse **SAND** with 10% gravel and 5% silt; no odor; no sheen; moist.		3.7 2.9	
23 24	SP	Brown, medium dense, fine to medium **SAND** with 5% gravel; no odor; no sheen; moist.		6.7	
25	SM	Olive gray, medium dense, silty **SAND**; moderate odor; moderate sheen; moist.		14.0	
26	SP	Dark brown, medium dense, fine to medium **SAND** with 5% gravel; no odor; no sheen.		6.7	
27	SM/ML	Olive gray, medium dense, silty **SAND** /sandy **SILT**; moderate odor; moderate sheen; wet.		46.7	GP-18-27-28@1531
28 ▼	SP	Dark gray, medium dense, fine to medium **SAND**; slight odor; slight sheen; saturated.		7.5	
29 30		Same as above; no odor; no sheen; saturated.		6.6	GP-18-29-30@1536

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-19**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292031.916154

EASTING: 1017556.63986

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 24

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 6 inches.			
	FILL	Road Base **FILL**.			
1				0.3	
2		Light brown, medium dense, fine to medium **SAND** with 5% subrounded gravel; no odor; no sheen; moist.			
3				4.6	
4		Same as above; no odor; no sheen; moist.			
5				7.1	
6		Same as above; no odor; no sheen; moist.			
7				5.3	
8		Same as above; no odor; no sheen; moist.			
9				4.0	
10					

ABBREVIATIONS:
ft bgs = feet below ground surface
USCS = Unified Soil Classification System
ppm = parts per million
▼ = denotes groundwater table

NOTES:

FLOYD | SNIDER
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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-19**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292031.916154

EASTING: 1017556.63986

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

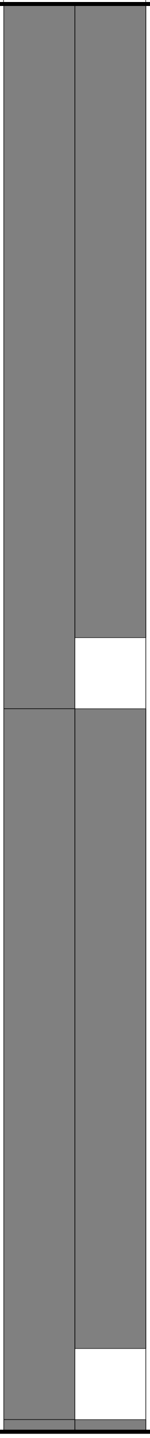
TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 24

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015



Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Light brown, fine to coarse **SAND** with 5% gravel; no odor; no sheen; moist.			
11					
				4.4	
12		Same as above; no odor; no sheen; moist.			
	SP				
13					
				3.5	
14					
15		Same as above; no odor; no sheen; moist.			
16				4.8	
17					
18		Same as above; no odor; no sheen; moist.		3.2	
19					
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-19

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292031.916154

EASTING: 1017556.63986

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 24

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Brown, medium dense, fine to coarse **SAND**; no odor; no sheen; moist.			
21				1.6	
22					
23	ML	Olive, stiff **SILT** with high plasticity; no odor; no sheen; moist to wet.		2.2	
		Gray, medium dense, fine to medium **SAND**; no odor; no sheen; wet to saturated.			GP-19-23.5-24@1435
24 ▼					
25		Same as above; no odor; no sheen; saturated.			
26				1.9	
27	SP	Same as above; no odor; no sheen; saturated.		2.6	
28		Same as above; no odor; no sheen; saturated.			
29				2.3	
30					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-20**

LOGGED BY: T. Gardner-Brown

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292143.288955

EASTING: 1017584.18033

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

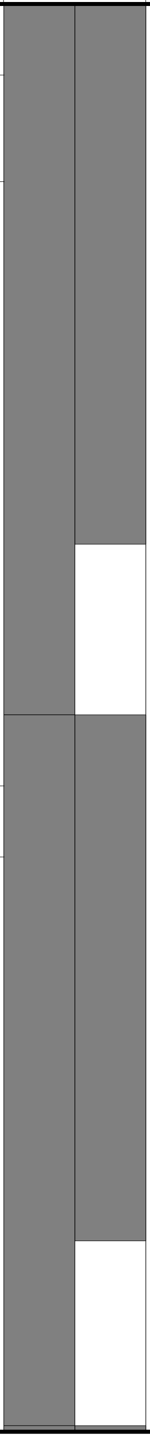
DEPTH TO WATER (ft bgs): 25

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Drive/ Recovery



Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	PID (ppm)	Sample ID
0	AS	Asphalt Top 6 inches.		
	FILL	Road Base **FILL**.		
1				
	SP	Light brown, medium dense, fine to medium **SAND** with 5% angular to subrounded gravel; no odor; no sheen; moist.		
2				
3			4.3	
		Same as above; no odor; no sheen; moist.		
4				
		Same as above; no odor; no sheen; moist.		
5				
	SW	Fine to coarse, gravelly **SAND**; likely historical road base **FILL**; no odor; no sheen; moist.		
6		Light brown to gray, medium dense, fine to medium **SAND**; no odor; no sheen; moist.	5.2	
7				
8			5.7	
9				
10				

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:
Groundwater collected at 1350

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-20**

LOGGED BY: T. Gardner-Brown

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292143.288955

EASTING: 1017584.18033

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 25

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
	SP	Light brown, medium dense, fine to medium **SAND** with 15% angular gravel; no odor; no sheen; moist.		4.9	
11					
				1.7	
12		Refusal at 12 feet bgs; rusty metal encountered; likely former pipeline. Moved boring location approximately 15 to the northwest.			
13		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
14					
				4.1	
15		Same as above; no odor; no sheen; moist.			
16				5.5	
17					
	ML	Brown, stiff **SILT** with low plasticity; no odor; no sheen; moist.			
18		Brown to gray, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		5.6	
19				6.2	
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:
Groundwater collected at 1350

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-20**

LOGGED BY: T. Gardner-Brown

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292143.288955

EASTING: 1017584.18033

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 25

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
	SP	Brown, medium dense, fine to medium **SAND** with 10% subangular gravel; no odor; no sheen; moist.			
21				5.9	
22		Gray, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
23	ML	Olive, stiff **SILT** with high plasticity; no odor; no sheen; moist.		6.4	
24	SP	Gray, medium dense, fine to medium **SAND** with 5% gravel; saturated.			
				4.9	GP-20-24-25@1340
25 ▼					
26	SM	Reddish brown to gray, silty, fine **SAND**; no odor; no sheen; saturated.			
				5.1	
27					
28	SP	Gray, medium dense, fine to medium **SAND**; no odor; no sheen; saturated.			
				5.2	
29					
				6.5	
30					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:
Groundwater collected at 1350

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-21**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292295.653404

EASTING: 1017421.7143

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

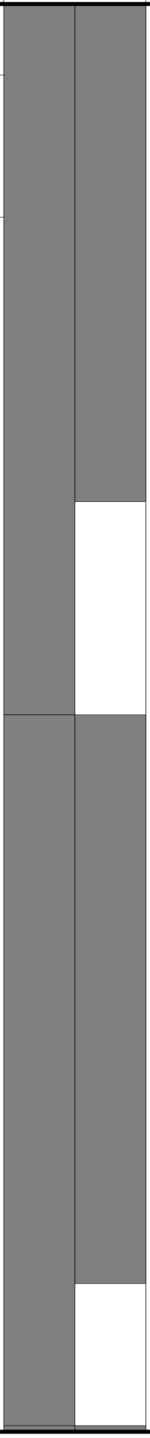
TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 21.5 and 26

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015



Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	PID (ppm)	Sample ID
0	AS	Asphalt Top 6 inches.		
	FILL	Road Base **FILL**.		
1			0.7	
		Brown, medium dense, fine to medium **SAND** with 5% subrounded gravel; no odor; no sheen; moist.		
2				
			1.7	
3				
		Same as above; no odor; no sheen; moist.		
4				
5		Same as above; no odor; no sheen; moist.		
6			2.6	
7	SP			
8			5.2	
		Reddish brown, medium dense, fine to medium **SAND** with a 1-inch silt layer at 8.5 feet bgs; no odor; no sheen; moist.		
9				
10				

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:
Groundwater collected at 1128

FLOYD | SNIDER
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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-21

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292295.653404

EASTING: 1017421.7143

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

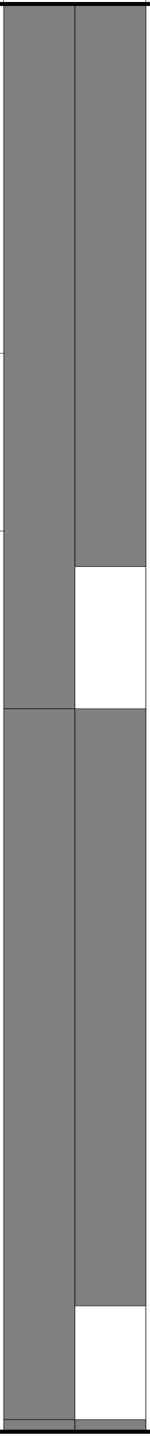
DEPTH TO WATER (ft bgs): 21.5 and 26

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Brown, medium dense, fine to coarse **SAND** with 5% gravel; no odor; no sheen; moist.			
11				4.6	
		Same as above; no odor; no sheen; moist.			
12					
		Reddish brown, stiff **SILT** with moderate plasticity; no odor; no sheen; moist.			
13	ML			4.5	
		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
14					
15					
		Same as above; no odor; no sheen; moist.		3.6	
16					
17					
18	SP	Same as above with 1-inch silt layers at 17.5 and 18 feet bgs; no odor; no sheen; moist.		2.5	
19					
20					



ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:
Groundwater collected at 1128

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-21**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292295.653404

EASTING: 1017421.7143

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 21.5 and 26

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		4.0	
21					GP-21-21-21.5@1101
▼		Same as above; saturated.		7.5	
22					
		Olive, stiff **SILT** with moderate to high plasticity; no odor; no sheen; moist to wet.		6.1	
23					
24	ML	Same as above; no odor; no sheen; moist.			
25					
		Gray, medium dense, fine to medium **SAND**; no odor; no sheen; saturated.		1.9	GP-21-25.5-26@1158
26 ▼					
27				5.5	
	SP				
28		Same as above; no odor; no sheen; saturated.			
29				6.1	
30					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:
Groundwater collected at 1128

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-22

LOGGED BY: G. Cisneros

BORING LOCATION: South of pipeline in Transect Shed 1

DRILLED BY: Brian, ESN

NORTHING: 292244.571626

EASTING: 1017476.03572

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 29.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 6 inches.			
	FILL	Road Base **FILL**.			
1		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
				1.1	
2					
3				1.6	
		Same as above; no odor; no sheen; moist.			
4					
5		Light brown, medium dense, fine to medium **SAND** no odor; no sheen; moist.			
6				2.0	
7		Same as above; no odor; no sheen; moist.			
				1.6	
8					
9					
10					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:
Flooring is elevated from surrounding ground surface ~2'

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-22

LOGGED BY: G. Cisneros

BORING LOCATION: South of pipeline in Transect Shed 1

DRILLED BY: Brian, ESN

NORTHING: 292244.571626

EASTING: 1017476.03572

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 29.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Brown, medium dense, fine to medium **SAND** with 5% subrounded gravel; no odor; no sheen; moist.			
11				1.9	
12	SP	Same as above; no odor; no sheen; moist.			
13				1.4	
14					
15		Same as above; no odor; no sheen; moist.			
				1.9	
16					
17		Brown, medium dense, fine to medium **SAND** interbedded with 1-inch silt layers; no odor; no sheen; moist.			
18				2.7	
19					
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:
Flooring is elevated from surrounding ground surface ~2'

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-22

LOGGED BY: G. Cisneros

BORING LOCATION: South of pipeline in Transect Shed 1

DRILLED BY: Brian, ESN

NORTHING: 292244.571626

EASTING: 1017476.03572

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 29.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Brown, medium dense, fine to coarse **SAND**; no odor; no sheen; moist.			
21				1.9	
22					
				2.3	
23	ML	Olive, stiff **SILT** with low plasticity; no odor; no sheen; moist.			
	SP	Olive gray, medium dense, fine to medium **SAND**; no odor; no sheen; wet.			
24	ML	Olive, stiff **SILT** with high plasticity; no odor; no sheen; moist.		3.2	
25					
		Brownish gray, medium dense, fine to medium **SAND** with 5% subrounded gravel; no odor; no sheen; moist.		1.8	
26					
27	SP	Same as above; no odor; no sheen; moist.			
				1.9	
28					
	ML	Olive, stiff, sandy **SILT**; no odor; no sheen; wet.			
29		Gray, medium dense, fine to medium **SAND** with 5% fine red grains; no odor; no sheen; saturated.			GP-22-29-29.5@1021
▼	SP			3.0	
30					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:
Flooring is elevated from surrounding ground surface ~2'

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-23**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292158.666646

EASTING: 1017542.18923

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 27.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 6 inches.			
	FILL	Road Base **FILL**.			
1	SP	Light brown, medium dense, fine to medium **SAND** with 10% angular to subrounded gravel; no odor; no sheen; moist.			
2					
3				6.5	
		Same as above; no odor; no sheen; moist.			
4					
5		Same as above; no odor; no sheen; moist.			
6				4.2	
7		Rusty/reddish brown, medium dense, fine to medium **SAND**; no odor; no sheen.			
8				4.5	
9		Refusal at 9 feet bgs. Encountered rusty metal; likely the abandoned pipeline. Moved boring location approximately 10 feet to the south.			
10					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-23

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292158.666646

EASTING: 1017542.18923

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 27.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
	SW	Gray, fine to coarse **SAND** with 15% angular gravel; no odor; no sheen; moist.		4.5	GP-23-10.5-11@1222
11				1.9	
12	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		1.3	
13					
14					
15		Same as above; no odor; no sheen; moist.			
16				3.1	
17		Same as above; no odor; no sheen; moist.			
18				1.7	
19					
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-23**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292158.666646

EASTING: 1017542.18923

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 27.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
21	SW	Brown to gray, fine to coarse **SAND** with angular gravel and 5% silt; no odor; no sheen; moist.		2.1	
22	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
23				2.0	
24	ML	Olive, stiff **SILT** with high plasticity; no odor; no sheen; moist.			
				3.1	
25	SP	Gray, medium dense, fine to medium **SAND**; no odor; no sheen; moist to wet.			
				4.8	
26					
27				1.9	GP-23-27-27.5@1241
▼	SP	Same as above; no odor; no sheen; saturated.			
28					
		Same as above; no odor; no sheen; saturated.			
29				4.6	
30					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-24**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292177.904933

EASTING: 1017655.17749

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 25

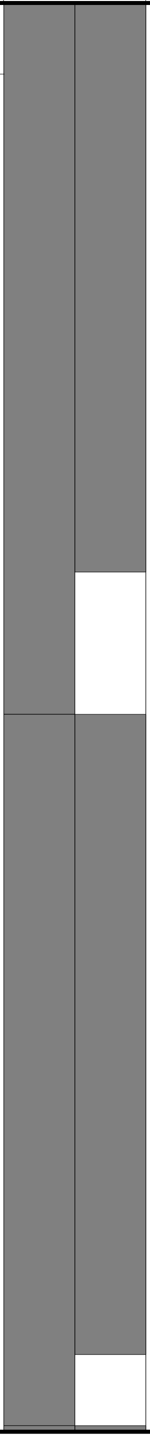
DEPTH TO WATER (ft bgs): 21

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Rail Line Base **FILL**. Crushed angular gravel.			
		Light brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
1				3.2	
2					
		Same as above; no odor; no sheen; moist.			
3					
4					
5					
		Brown to light brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
				4.0	
6					
7					
				3.4	
		Same as above; no odor; no sheen; moist.			
8					
9				1.4	
10					



ABBREVIATIONS:
ft bgs = feet below ground surface
USCS = Unified Soil Classification System
ppm = parts per million
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-24**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292177.904933

EASTING: 1017655.17749

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 25

DEPTH TO WATER (ft bgs): 21

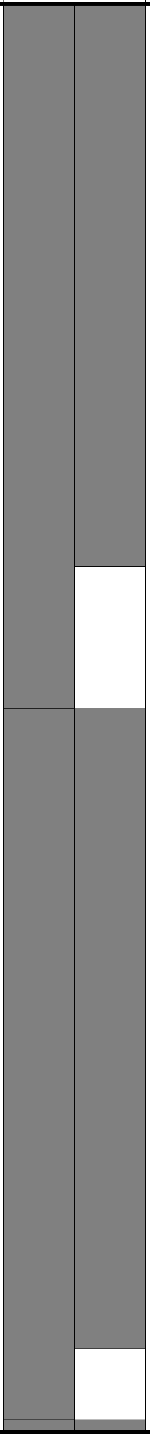
SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	PID (ppm)	Sample ID
		Same as above; no odor; no sheen; moist.		
			2.3	
11	SP			
12				
			2.4	
13		Same as above; no odor; no sheen; moist.		
14			1.6	
15		Same as above; no odor; no sheen; moist.		
16			2.1	
17				
18		Same as above; no odor; no sheen; moist.		
			3.2	
19				
20				

Drive/
Recovery



ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-24**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292177.904933

EASTING: 1017655.17749

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 25

DEPTH TO WATER (ft bgs): 21

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
21 ▼ 22		Brown, medium dense, fine to medium **SAND** with 5% fine red grains; no odor; no sheen; wet to saturated.		0.6	GP-24-20-20.5@1519
23	ML	Olive, stiff **SILT** with high plasticity; no odor; no sheen; wet.		2.5	
24 25	SP	Olive gray, medium dense, fine to medium **SAND**; no odor; no sheen; saturated.		2.0	

ABBREVIATIONS:
ft bgs = feet below ground surface
USCS = Unified Soil Classification System
ppm = parts per million
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-25**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292282.681266

EASTING: 1017572.25179

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 25

DEPTH TO WATER (ft bgs): 20.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Rail Line Base **FILL**. Crushed angular gravel.			
1	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
2				3.4	
3		Same as above; no odor; no sheen; moist.			
4					
5	GW	Crushed rock and sandy **GRAVEL**; no odor; no sheen; saturated.		3.1	
6		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
7				2.8	
8		Same as above; no odor; no sheen; moist.			
9				4.0	
10					

ABBREVIATIONS:
ft bgs = feet below ground surface
USCS = Unified Soil Classification System
ppm = parts per million
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-25

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292282.681266

EASTING: 1017572.25179

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 25

DEPTH TO WATER (ft bgs): 20.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
	SP	Same as above; no odor; no sheen; moist.			
				4.1	
11					
12		Same as above; no odor; no sheen; moist.			
13				3.8	
14	SM-SP	Brown, medium dense, fine to medium **SAND** with 10% silt; no odor; no sheen; moist to wet.			
15					
	GM	Brown, medium dense, silty, sandy, angular **GRAVEL**; no odor; no sheen; moist.		3.1	
16					
		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
17					
				2.4	
18					
19		Same as above; no odor; no sheen; moist to wet.			
				1.4	
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH	**LOCATION:** 10 Port Way, Longview, WA		**BORING ID:** GP-25
LOGGED BY: G. Cisneros	**BORING LOCATION:**		
DRILLED BY: Brian, ESN		**NORTHING:** 292282.681266	**EASTING:** 1017572.25179
DRILLING EQUIPMENT: Geoprobe		**SURFACE ELEVATION:**	**COORDINATE SYSTEM:** SPCS WA S NAD83 FT
DRILLING METHOD:		**TOTAL DEPTH (ft bgs):** 25	**DEPTH TO WATER (ft bgs):** 20.5
SAMPLING METHOD/SAMPLER LENGTH: Continuous		**BORING DIAMETER:** 2"	**DRILL DATE:** 9/17/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
	SP				GP-25-20-20.5@1550
▼		Same as above; no odor; no sheen; saturated.		2.8	
21					
22				3.4	
		Gray to brown, medium dense, fine to medium **SAND**; no odor; no sheen; saturated.			
23					
24	ML	Olive gray, stiff **SILT**.		1.8	
	SP	Gray, medium dense, fine to medium **SAND**; no odor; no sheen; saturated.			
25					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH
LOCATION: 10 Port Way, Longview, WA
BORING ID: **GP-26**
LOGGED BY: G. Cisneros
BORING LOCATION:
DRILLED BY: Brian, ESN
NORTHING: 292349.864424
EASTING: 1017564.72411
DRILLING EQUIPMENT: Geoprobe
SURFACE ELEVATION:
COORDINATE SYSTEM: SPCS WA S NAD83 FT
DRILLING METHOD:
TOTAL DEPTH (ft bgs): 30
DEPTH TO WATER (ft bgs): 19.5
SAMPLING METHOD/SAMPLER LENGTH: Continuous
BORING DIAMETER: 2"
DRILL DATE: 9/18/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Rail Line Base **FILL**. Crushed angular gravel.	▨ ▨		
	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
1				1.3	
2				2.6	
3					
		Same as above; no odor; no sheen; moist.		2.4	
4			▨ ☐		
5			▨ ▨		
	SW	Dark brown, gravelly, fine to coarse **SAND** with 15% angular gravel and 5% silt (**FILL**?); no odor; no sheen; moist.		2.6	
6	SP	Brown, fine to medium **SAND**; no odor; no sheen.			
7					
8	ML	Reddish brown, stiff **SILT** with 10% fine sand; no odor; no sheen; moist.			
	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		2.9	
9					
			▨ ☐		
10					

ABBREVIATIONS:
ft bgs = feet below ground surface
USCS = Unified Soil Classification System
ppm = parts per million
▼ = denotes groundwater table

NOTES:

FLOYD | SNIDER strategy ▪ science ▪ engineering	**PROJECT:** POL-TPH	**LOCATION:** 10 Port Way, Longview, WA	**BORING ID:** **GP-26**
	LOGGED BY: G. Cisneros	**BORING LOCATION:**	
DRILLED BY: Brian, ESN		**NORTHING:** 292349.864424	**EASTING:** 1017564.72411
DRILLING EQUIPMENT: Geoprobe		**SURFACE ELEVATION:**	**COORDINATE SYSTEM:** SPCS WA S NAD83 FT
DRILLING METHOD:		**TOTAL DEPTH (ft bgs):** 30	**DEPTH TO WATER (ft bgs):** 19.5
SAMPLING METHOD/SAMPLER LENGTH: Continuous		**BORING DIAMETER:** 2"	**DRILL DATE:** 9/18/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
	SP	Same as above; no odor; no sheen; moist.			
11				2.6	
12	SP	Same as above; no odor; no sheen; moist.			
13				2.2	
14					GP-26-14-14.5@0915
		Same as above; no odor; no sheen; moist.		2.2	
15					
16	SW	Dark brown, medium dense, gravelly, fine to coarse **SAND** with 20% angular gravel and 5% silt; no odor; no sheen; moist.			
	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
17				1.4	
18					
		Gray, fine to medium **SAND**; no odor; no sheen; wet.		3.3	
19					GP-26-19-19.5@0920
▼		Same as above; no odor; no sheen; saturated.			
20	SP				

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-26**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Brian, ESN

NORTHING: 292349.864424

EASTING: 1017564.72411

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 19.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/18/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
				7.5	
21					
		Same as above; no odor; no sheen; saturated.			
22					
23					
		Olive, stiff **SILT** with high plasticity; no odor; no sheen; wet.		2.8	
24	ML				
25		Gray, medium dense, fine to medium **SAND**; no odor; no sheen; saturated.			
26				2.9	
27		Same as above; no odor; no sheen; saturated.			
	SP				
28					
29				2.3	
30					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH	**LOCATION:** 10 Port Way, Longview, WA	**BORING ID:** GP-27	
LOGGED BY: G. Cisneros	**BORING LOCATION:**		
DRILLED BY: Trevor, ESN	**NORTHING:** 292434.344428	**EASTING:** 1017567.29016	
DRILLING EQUIPMENT: Geoprobe	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:** SPCS WA S NAD83 FT	
DRILLING METHOD:	**TOTAL DEPTH (ft bgs):** 25	**DEPTH TO WATER (ft bgs):** 14.5	
SAMPLING METHOD/SAMPLER LENGTH: Continuous	**BORING DIAMETER:** 2"	**DRILL DATE:** 9/18/2015	

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Rail Line Base **FILL**. Crushed angular gravel.			
1	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
2				1.4	
3		Same as above; no odor; no sheen; moist.			
4				1.4	
5	SP	Same as above; no odor; no sheen; moist.			
6					
7				1.7	
8		Same as above; no odor; no sheen; moist.			
9				2.1	
10	ML	Olive gray, stiff **SILT** with low plasticity; no odor; no sheen; moist.			

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-27

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Trevor, ESN

NORTHING: 292434.344428

EASTING: 1017567.29016

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 25

DEPTH TO WATER (ft bgs): 14.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/18/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
	SP	Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
11				2.2	
12	SP	Gray **SAND**; no odor; no sheen; moist.			
		Same as above; slight odor at 13 feet bgs; no sheen; moist.		2.9	
13					
	SM	Olive, silty **SAND**; moderate odor; moderate sheen; wet.			
14				106.0	GP-27-14-14.5@0832
	ML	Olive **SILT** with low plasticity; moderate odor; moderate sheen; wet.			
▼	SP	Gray to brown, medium dense, fine to medium **SAND**; slight odor; slight sheen; saturated.			
15					
				26.0	
16					
				8.2	
17		Same as above; no odor; no sheen; saturated.			
				4.8	GP-27-17-18@0853
18		Coarse white grains at 18 to 18.25 feet bgs.			
				3.4	
19	SP	Same as above; no odor; no sheen; saturated.			
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH	**LOCATION:** 10 Port Way, Longview, WA	**BORING ID:** **GP-27**	
LOGGED BY: G. Cisneros	**BORING LOCATION:**		
DRILLED BY: Trevor, ESN	**NORTHING:** 292434.344428	**EASTING:** 1017567.29016	
DRILLING EQUIPMENT: Geoprobe	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:** SPCS WA S NAD83 FT	
DRILLING METHOD:	**TOTAL DEPTH (ft bgs):** 25	**DEPTH TO WATER (ft bgs):** 14.5	
SAMPLING METHOD/SAMPLER LENGTH: Continuous	**BORING DIAMETER:** 2"	**DRILL DATE:** 9/18/2015	

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
				2.7	
21					
		Coarse white grains at 21.5 to 22 feet bgs.		3.1	
22		Gray, medium dense, fine to coarse **SAND** with 10% fine white grains; no odor; no sheen; saturated.			
				3.3	
23					
		Olive brown, stiff **SILT** with 10% fine sand; no odor; no sheen; saturated.			
24	SM			1.7	
25					

ABBREVIATIONS:
ft bgs = feet below ground surface
USCS = Unified Soil Classification System
ppm = parts per million
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH	**LOCATION:** 10 Port Way, Longview, WA		**BORING ID:** GP-28
LOGGED BY: G. Cisneros	**BORING LOCATION:**		
DRILLED BY: Trevor, ESN		**NORTHING:** 291996.858807	**EASTING:** 1017494.02952
DRILLING EQUIPMENT: Geoprobe		**SURFACE ELEVATION:**	**COORDINATE SYSTEM:** SPCS WA S NAD83 FT
DRILLING METHOD:		**TOTAL DEPTH (ft bgs):** 30	**DEPTH TO WATER (ft bgs):** 28
SAMPLING METHOD/SAMPLER LENGTH: Continuous		**BORING DIAMETER:** 2"	**DRILL DATE:** 9/18/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 6 inches.			
	FILL	Road Base **FILL**.			
1				1.3	
		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
2					
				0.8	
3					
		Same as above; no odor; no sheen; moist.			
4					
5				4.2	
		Light brown, medium dense, fine to coarse **SAND**; no odor; no sheen; moist.			
6					
7				2.5	
		Same as above with 5% rounded gravel; no odor; no sheen; moist.			
8					
9				2.3	
10					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:
Groundwater collected at 1200

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PROJECT: POL-TPH	**LOCATION:** 10 Port Way, Longview, WA	**BORING ID:**	**GP-28**
LOGGED BY: G. Cisneros	**BORING LOCATION:**		
DRILLED BY: Trevor, ESN	**NORTHING:** 291996.858807	**EASTING:** 1017494.02952	
DRILLING EQUIPMENT: Geoprobe	**SURFACE ELEVATION:**	**COORDINATE SYSTEM:** SPCS WA S NAD83 FT	
DRILLING METHOD:	**TOTAL DEPTH (ft bgs):** 30	**DEPTH TO WATER (ft bgs):** 28	
SAMPLING METHOD/SAMPLER LENGTH: Continuous	**BORING DIAMETER:** 2"	**DRILL DATE:** 9/18/2015	

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		No recovery between 10 feet bgs and 30 feet bgs. Lost sampler in hole.			
11					
12					
13		Collected groundwater sample at 30 feet bgs.			
14					
15					
16	SP				
17					
18					
19					
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:
Groundwater collected at 1200

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-28**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Trevor, ESN

NORTHING: 291996.858807

EASTING: 1017494.02952

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

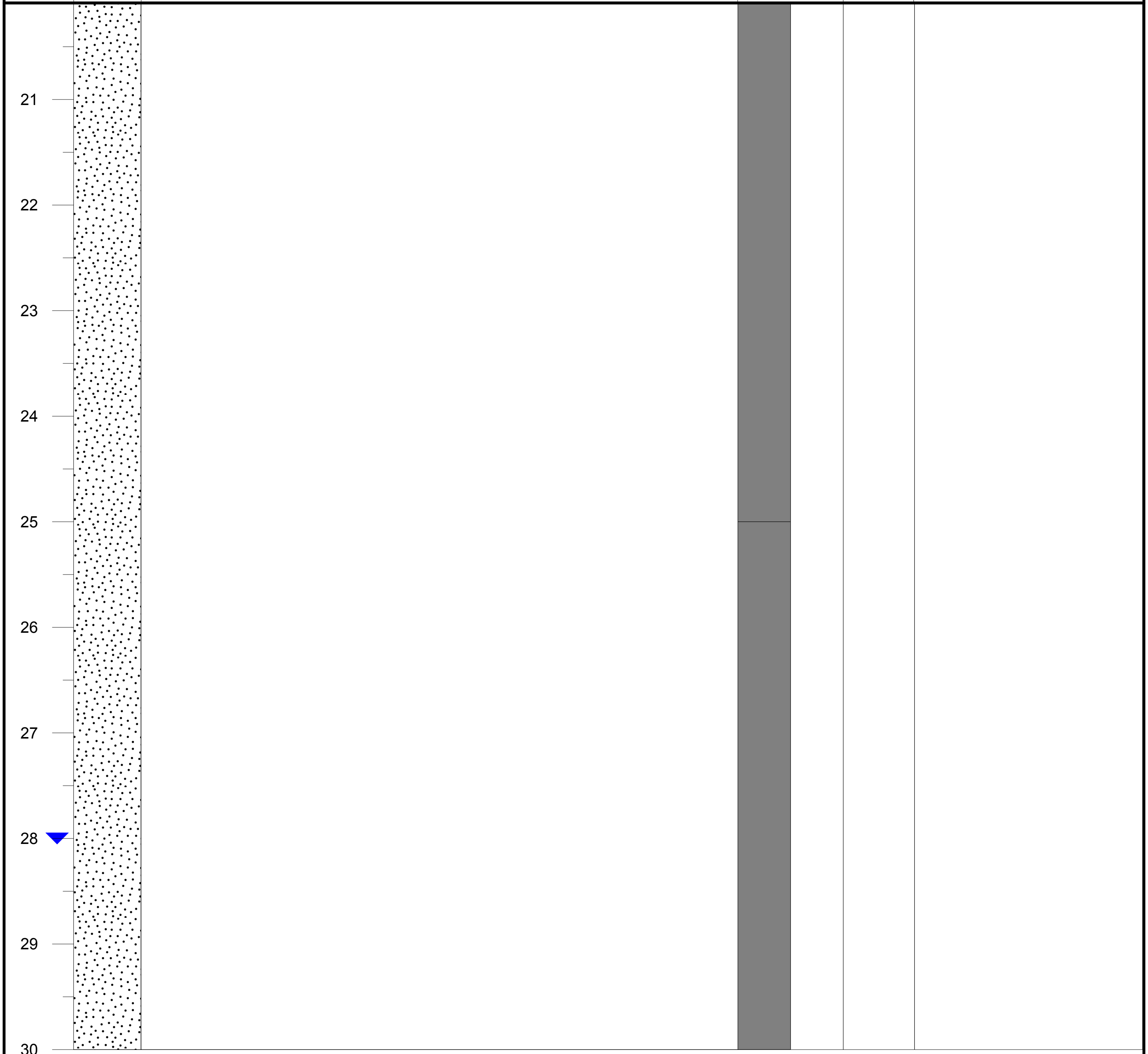
DEPTH TO WATER (ft bgs): 28

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/18/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID



ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:
Groundwater collected at 1200

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: **GP-29**

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Trevor, ESN

NORTHING: 291923.179687

EASTING: 1017537.41072

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 27.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/18/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 4 inches.			
	FILL	Road Base **FILL**.			
1				5.8	
		Brown, medium dense, fine to medium **SAND** with 10% angular gravel; no odor; no sheen; moist.			
2					
				1.4	
3					
4					
5		Same as above; no odor; no sheen; moist.			
				2.1	
6					
7					
8					
9					
10					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-29

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Trevor, ESN

NORTHING: 291923.179687

EASTING: 1017537.41072

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

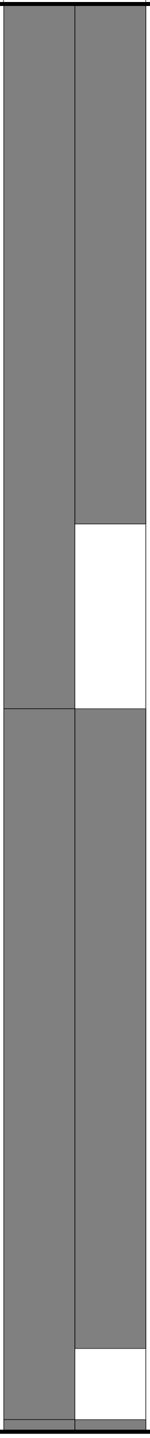
DEPTH TO WATER (ft bgs): 27.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/18/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
	SP	Light brown, medium dense, fine to medium **SAND** with 5% subrounded gravel; no odor; no sheen; moist.		1.6	
11					
12					
		Same as above; no odor; no sheen; moist.			
13					
				1.5	
14					
15		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
				1.2	
16					
17				2.8	
18		Same as above; no odor; no sheen; moist.			
19				1.4	
20					



ABBREVIATIONS:
ft bgs = feet below ground surface USCS = Unified Soil Classification System
ppm = parts per million ▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-29

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY: Trevor, ESN

NORTHING: 291923.179687

EASTING: 1017537.41072

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 30

DEPTH TO WATER (ft bgs): 27.5

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/18/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
21				1.2	
22					
		Same as above; no odor; no sheen; moist.		1.7	
23					
24	SM	Olive gray, silty **SAND** with 20% silt and 1/4-inch wood debris at 24.25 feet bgs; no odor; no sheen; moist.		1.2	
	ML	Olive, stiff **SILT**; no odor; no sheen; moist.			
25				2.8	GP-29-25-25.5@1015
		Brown to gray, medium dense, fine to medium **SAND**; no odor; no sheen; wet.			
26				2.9	
27				3.1	GP-29-27-27.5@1020
▼	SP				
28		Gray, fine to medium **SAND**; no odor; no sheen; saturated.			
29		Same as above; no odor; no sheen; saturated.		2.3	
30					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-30

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY:

NORTHING: 292962.155627

EASTING: 1017572.12614

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 20

DEPTH TO WATER (ft bgs): 16.5 and 19.75

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/18/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
0	AS	Asphalt Top 6 inches.			
	FILL	Road Base **FILL**.			
1		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.		1.3	
2					
				1.4	
3		Same as above; no odor; no sheen; moist.			
4				1.6	
		Same as above; no odor; no sheen; moist.			
5					
				3.7	
		Crushed rock **FILL**.			
6		Brown, medium dense, fine to medium **SAND**; no odor; no sheen; moist.			
7					
	SP				
8				2.3	
9		Same as above; no odor; no sheen; moist.			
				2.1	
10					

ABBREVIATIONS:
ft bgs = feet below ground surface
USCS = Unified Soil Classification System
ppm = parts per million
▼ = denotes groundwater table

NOTES:

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PROJECT: POL-TPH

LOCATION: 10 Port Way, Longview, WA

BORING ID: GP-30

LOGGED BY: G. Cisneros

BORING LOCATION:

DRILLED BY:

NORTHING: 292962.155627

EASTING: 1017572.12614

DRILLING EQUIPMENT: Geoprobe

SURFACE ELEVATION:

COORDINATE SYSTEM: SPCS WA S NAD83 FT

DRILLING METHOD:

TOTAL DEPTH (ft bgs): 20

DEPTH TO WATER (ft bgs): 16.5 and 19.75

SAMPLING METHOD/SAMPLER LENGTH: Continuous

BORING DIAMETER: 2"

DRILL DATE: 9/18/2015

Depth (feet)	USCS Symbol	Soil Description and Observations (color, texture, moisture, **MAJOR CONSTITUENT**, odor, staining, sheen, debris, etc.)	Drive/ Recovery	PID (ppm)	Sample ID
11					
				1.2	
12					
13		Same as above; no odor; no sheen; moist.			
				1.5	
14					
	ML	Reddish brown, stiff **SILT** with low plasticity; no odor; no sheen; moist.			
15		Brown to gray, medium dense, fine to medium **SAND**; no odor; no sheen; moist to wet.			
				1.2	
16					GP-30-16-16.5@1112
▼	SP	Gray, medium dense, fine to medium **SAND**; no odor; no sheen; saturated.			
17				2.1	
18		Olive gray, stiff **SILT** with high plasticity; no odor; no sheen; saturated.			
	ML			1.9	
19					
▼	SML	Olive gray, silty, fine to medium **SAND**; no odor; no sheen; saturated.			GP-30-19.5-20@1120
20					

ABBREVIATIONS:
ft bgs = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

NOTES: