Remedial Investigation Work Plan

Federal Way Link Extension Parcel FL358
Y Pay Mor Drycleaner Site
2210 South 320th Street
Federal Way, Washington

for
Sound Transit

July 21, 2021

GeoEngineers
Earth Science + Technology

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1101 South Fawcett Avenue, Suite 200
Tacoma, Washington 98402
253.383.4940

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File No. 4082-039-03

July 21, 2021

Prepared for:

Sound Transit c/o South County Transit Partners
401 South Jackson Street
Seattle, Washington 98104-2826

Attention: Susan Penoyar

Prepared by:

GeoEngineers, Inc.
1101 South Fawcett Avenue, Suite 200
Tacoma, Washington 98402
253.383.4940

Tricia S. DeOme, LG
Senior Environmental Geologist

DANA L. CARLISLE
STATE OF WASHINGTON
29634
REGISTERED
PROFESSIONAL ENGINEER

7-21-21

Dana L. Carlisle, PE
Environmental Principal

RCL:DLC:ch

GEOENGINEERS

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1.0 INTRODUCTION

This Remedial Investigation (RI) Work Plan (Work Plan) describes soil and groundwater investigations to be conducted at the Y Pay Mor Drycleaner Site located at 2210 South 320th Street in Federal Way, Washington (Site). Y Pay Mor Cleaners was a commercial dry cleaning business that occupied the easternmost tenant space of the former Best Shopping Plaza (subsequently renamed SeaTac Plaza) from approximately 1985 to 1992 (RZA AGRA 1992). Two spills of the dry cleaning solvent tetrachloroethene (PCE) occurred inside the Y Pay Mor Cleaners store in 1991 and were reported to the Washington State Department of Ecology (Ecology). Subsurface investigations conducted at the Site in 1992 identified PCE and PCE breakdown products in soil and groundwater in the area of the 1991 spills. Investigations conducted in 2020 identified a second PCE source area near a former stormwater catch basin in the loading dock area north of the former dry cleaner space.

The SeaTac Plaza shopping center was situated on King County Tax Parcel 2423200050. Central Puget Sound Regional Transit Authority (Sound Transit) is redeveloping this parcel as part of Sound Transit's Federal Way Link Extension (FWLE) project. Sound Transit identifies the parcel as FWLE Parcel FL358. Sound Transit demolished the shopping center retail building and parking lot in spring of 2020 in preparation for FWLE construction.

1.1. Remedial Investigation Purpose

Pursuant to the Washington State Model Toxics Control Act (MTCA) Cleanup Regulation (Chapter 173-340 Washington Administrative Code [WAC]), the purpose the RI is to collect sufficient data and information to define the extent of contamination, characterize the Site, and evaluate cleanup action alternatives in the Feasibility Study (FS). Several subsurface investigations and two interim cleanup actions were completed at the Site between 1992 and 2020. The goal of the planned RI activities described in this Work Plan is to collect the additional subsurface data needed to complete the Site characterization so that cleanup action alternatives can be developed and evaluated in the FS. The FS will be prepared after the RI is complete.

1.2. Work Plan Organization

The remaining sections of this Work Plan are organized as follows:

- **Section 2.0 – Background.** Describes the Site setting and history, current and future land use, regulatory framework, and previous remedial actions and regulatory actions.
- **Section 3.0 – Existing Site Conditions.** Describes the Site geology and hydrogeology, surface water and ecological habitat in the Site vicinity, and the nature and extent of contamination at the Site.
- **Section 4.0 – Conceptual Site Model.** Describes the conceptual model for the Site.
- **Section 5.0 – Identification of Data Gaps.** Identifies data gaps in the Site characterization that will be addressed by the RI activities.
- **Section 6.0 – Remedial Investigation Field Program.** Describes the soil and groundwater investigations that will be conducted to complete the RI.
- **Section 7.0 – Data Evaluation and Reporting.** Describes generally how the data collected during the RI field activities will be evaluated and how the RI activities and results will be reported.

- **Section 8.0 – Schedule.** Provides the schedule for the RI field activities and reporting.
- **Section 9.0 – References.** Lists references cited in this Work Plan.

2.0 BACKGROUND

This section summarizes background information for the Site.

2.1. Site Setting

The Site is situated in the northeastern portion of FWLE Parcel FL358, approximately 0.3 miles west-northwest of the intersection of Interstate 5 and South 320th Street in Federal Way (Figure 1). The surrounding area has been developed primarily for commercial uses. Parcel FL358 comprises approximately 7.5 acres and was formerly developed with the SeaTac Plaza shopping center (formerly known as Best Shopping Plaza). The shopping center retail building was in the northern half of Parcel FL358 and Y Pay Mor Cleaners occupied the easternmost tenant space of the building (Figure 2).

The ground surface elevation at the Site during the shopping center operation and up to August 2020 ranged from approximately 423 feet (North American Vertical Datum of 1988[1] [NAVD88]) in the former loading dock area to 426 feet NAVD88 in the area of the former dry cleaner space. Following demolition of the shopping center and completion of an interim action at the Site in the summer of 2020 (discussed below), 10 to 12 feet of embankment fill was placed across Parcel FL358 as part of FWLE redevelopment. The current ground surface elevation as of the publication of this Work Plan is approximately Elevation 434 feet.

2.2. Site History

The former shopping center on Parcel FL358 was built in 1979. Y Pay Mor Cleaners occupied the easternmost tenant space (identified as space “A-6”) of the shopping center building from approximately November 1985 to June 1992 (RZA AGRA 1992). Other commercial businesses occupied the space from 1979 to 1985 and after 1992. The former dry cleaner space was most recently occupied by a restaurant and portion of a laser tag facility.

Two PCE spills occurred inside the Y Pay Mor Cleaners tenant space in 1991. The local fire department reported both spills to Ecology upon responding to the spills. The first spill occurred in August 1991 and had a reported quantity of approximately 6 gallons. The second spill occurred in October 1991. The quantity of this second spill was not reported, but the spilled liquid reportedly covered an area of approximately 10 feet by 15 feet. Both PCE spills occurred on the concrete floor in the vicinity of the dry cleaning equipment along the then-western wall of the tenant space. Spilled PCE liquid was reportedly cleaned up by Chemical Processors, Inc. (RZA AGRA 1992). Subsequent remedial actions conducted at the Site, described in Section 2.5, identified an additional PCE release area near a stormwater catch basin north of the former dry cleaner space. The northern source area is discussed further in Section 2.5.

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[1] NAVD88 is the reference elevation used throughout this Work Plan unless noted otherwise.

2.3. Current and Future Land Use

Parcel FL358 is currently an active construction site for Sound Transit's FWLE project. Sound Transit placed up to approximately 10 to 12 feet of clean aggregate fill across the Y Pay Mor Cleaners Site between August and October 2020, raising the former ground surface elevation to nearly the same elevation as the existing Federal Way Transit Center that is situated north-adjacent to the property.

As part of the FWLE project, the Y Pay Mor Cleaners Site will be developed with a portion of the new and expanded Federal Way Transit Center (FWTC) that will include an elevated light rail track, supporting columns, a guideway structure, parking facilities, roads and utilities, occupying the footprint generally shown in Figure 2. In addition, a portion of the Y Pay Mor Cleaners Site is planned as future surplus property (see Figure 2), which is anticipated to be transit-oriented development (TOD). The TOD could include mixed residential and commercial uses. Future construction activities within the Site will include final grading to Elevations ranging between 433 and 437 feet and installation of utilities as deep as Elevation 423 feet.

Surrounding land use in the immediate vicinity of Parcel FL358 is generally commercial comprising retail stores, restaurants, and office buildings. The existing Federal Way Transit Center, residential apartments, a city park (Town Square Park), and a public high school (Truman Campus) are present in areas north of Parcel FL358. The existing Federal Way Transit Center north-adjacent to Parcel FL358 consists of a bus station and an aboveground parking structure.

2.4. Regulatory Framework

The Site is identified in Ecology's database of cleanup sites as "Y Pay Mor Drycleaner" (also known as Sea Tac Plaza), Cleanup Site ID 3180, Facility/Site ID 2518. Sound Transit is conducting a cleanup of the Site under MTCA and has enrolled in Ecology's Voluntary Cleanup Program (VCP) (VCP NW3265). Key regulatory actions related to the Site are summarized in Sections 2.5.4 and 2.5.6.

2.5. Previous Remedial Actions and Regulatory Actions

This section summarizes previous investigations and remedial actions completed at the Site between 1992 and 2020, and related regulatory actions. A total of approximately 283 soil samples, 29 groundwater samples, and 18 shallow soil vapor samples have been submitted for chemical analysis to date to characterize subsurface conditions at the Site.

2.5.1. Preliminary Remedial Investigation (1992)

A preliminary RI was conducted between June and November 1992 (RZA AGRA 1992). The purpose of the preliminary RI was to investigate potential contamination in soil and groundwater related to the former dry cleaning operations, including the PCE spills reported in 1991. The subsurface investigation consisted of the following:

- **Twelve soil borings.** Ten of the borings were completed inside the former dry cleaner space to depths of 7.5 to 20 feet below the former ground surface (bfgs) in the area of the former dry cleaning equipment, a floor drain and connected drain pipe, and the 1991 PCE spills. This area was generally along the then-west wall of the former dry cleaner space. Two borings were completed outside the former dry cleaner space to depths of 15 to 20 feet bfgs: one in the parking lot east-adjacent to the store and one in the parking lot south-adjacent to the store.

- **Three groundwater monitoring wells.** One well (originally identified as MW-1) was installed inside the former dry cleaner space and was screened from 15 to 20 feet bfgs. The other two wells (MW-2 and MW-3, hereinafter identified as Y Pay Mor-MW2 and Y Pay Mor-MW3) were installed outside the former dry cleaner space (Figure 2) and were screened from 9 to 19 feet bfgs and 7 to 14 feet bfgs, respectively. Well MW-1 was never sampled and was decommissioned several months after it was installed because the well screen had separated from the well casing. A soil vapor extraction (SVE) well point (see below) was subsequently installed in the MW-1 borehole.
- **Four soil vapor survey points.** The soil vapor survey points (SVS-1 through SVS-4) were completed inside the former dry cleaner space to depths of 5 to 10 feet bfgs in the area of the former dry cleaning equipment, floor drain, and drain pipe. The soil vapor survey points were used to measure total organic vapor concentrations in soil with a photoionization detector (PID) (qualitative screening data). The PID readings ranged from 5.5 to 1,094 parts per million (ppm). The highest PID readings were obtained adjacent to the drain pipe within 10 feet of the floor drain.
- **Six SVE well points.** The SVE well points were installed inside the former dry cleaner space and were screened from the ground surface to approximately 7 feet bfgs. These well points were later connected to an SVE system installed in 1993 (described in Section 2.5.2).
- **Thirty-five soil samples analyzed for volatile organic compounds (VOCs).** The soil samples were collected from the borings. The highest detected concentration of PCE was 7,200 milligrams per kilogram (mg/kg) in a sample obtained from a depth of 2.5 feet bfgs in a boring (B-12) near the floor drain in the former dry cleaning equipment area (Figure 3).
- **Four groundwater samples analyzed for VOCs.** The groundwater samples were collected from monitoring wells Y Pay Mor-MW2 and Y Pay Mor-MW3 and from boring B-12 near the floor drain (two samples were collected from well Y Pay Mor-MW3). The depth to groundwater measured in the monitoring wells ranged from approximately 8.1 to 10.9 feet bfgs.

  The highest detected concentration of PCE was 1,700 micrograms per liter (μg/l) in the reconnaissance groundwater sample (screening data) obtained from a depth of 12.5 feet bfgs in boring B-12.

In addition to the field activities summarized above, a reconnaissance inspection of areas outside the former dry cleaner space identified visible staining of the asphalt surrounding a stormwater catch basin in the loading dock area north of the store.

2.5.2. Interim Cleanup Action – Soil Vapor Extraction (1993-1994)

An interim cleanup action was conducted between June 1993 and September 1994 to remove PCE and the PCE breakdown products trichloroethene (TCE) and cis-1,2-dichloroethene (cis-1,2-DCE) from soil beneath the former dry cleaner space (AGRA Earth & Environmental 1994). An SVE system consisting of seven SVE wells, a vacuum blower, a moisture knockout tank, and two 1,000-pound granular activated carbon (GAC) units was installed to treat soil in the vadose zone beneath the building slab. The SVE wells included the six well points installed during the preliminary RI and one new well.

The SVE system operated for 15 months from June 1993 to September 1994. The system was shut off in September 1994 after it was determined that PCE recovery concentrations in the extracted soil vapor stream had decreased by more than 70 percent (from 130 ppm to 36 ppm) and extracted vapor levels had reached asymptotic conditions.

In November 1994, seven confirmation soil samples were collected from depths of 5 to 8 feet bfgs in the SVE treatment area. PCE was detected in one confirmation soil sample at a concentration of 1.3 mg/kg. Cis-1,2-DCE was detected in three samples at concentrations ranging from 0.11 to 0.80 mg/kg, and in a fourth sample at a concentration of 71 mg/kg. There were no other VOC detections in the confirmation soil samples.

2.5.3. Biannual Groundwater Sampling (1994 and 1997)

Biannual groundwater sampling was conducted in 1994 and 1997 (AGRA Earth & Environmental 1994, 1997). The purpose of the biannual groundwater sampling was to evaluate seasonal (i.e., dry and wet season) variability of dissolved VOC concentrations in groundwater. Y Pay Mor-MW2, located east-northeast and hydraulically upgradient of the former dry cleaner space, was sampled in June and November 1994. Y Pay Mor-MW3, located southwest and hydraulically downgradient of the former dry cleaner space, was sampled in June and November 1994 and in February and July 1997. The depths to groundwater measured in the monitoring wells ranged from approximately 8.1 to 10.7 feet bfgs.

The groundwater samples were analyzed for VOCs. VOCs were not detected in the samples from Y Pay Mor-MW2. Cis-1,2-DCE was detected at low concentrations (1.8 to 5.4 μg/l) in the samples from Y Pay Mor-MW3.

2.5.4. Ecology No Further Action Determinations (1995 and 1998)

Ecology issued an interim conditional no further action (NFA) letter for the Site in June 1995 (Ecology 1995) based on a review of the independent remedial action (preliminary RI and interim cleanup action) conducted between 1992 and 1994. The interim NFA letter was conditioned on a restrictive covenant and on additional groundwater sampling at monitoring well Y Pay Mor-MW3. A restrictive covenant dated September 21, 1995 was recorded under King County recording number 9510121424. The 1995 covenant applied to the property within the footprint of the former dry cleaner space. The covenant documented that residual concentrations of solvents remained in soil and groundwater beneath the former dry cleaner space at levels exceeding MTCA Method A cleanup levels and prohibited any activity on the property that may interfere with ongoing groundwater monitoring. The 1995 covenant also prohibited the use of groundwater underlying the property for domestic purposes.

Ecology issued a final conditional NFA determination for the Site in October 1998 (Ecology 1998) based on a review of the independent remedial action, the biannual groundwater sampling results from monitoring well Y Pay Mor-MW3, and other Site-related information in Ecology's files. Ecology's 1998 NFA determination was conditioned on a second restrictive covenant dated July 24, 1998 and recorded under King County recording number 9808101434. The second restrictive covenant references residual soil contamination exceeding MTCA cleanup levels beneath the former dry cleaner space and prohibits any activity on the property that may result in the release or exposure to the environment of a hazardous substance that remains on the property as part of the independent remedial action, or that may create a new exposure pathway, without prior written approval from Ecology. The 1998 covenant also prohibits any activity on the property that may interfere with the integrity of the independent remedial action and continued protection of human health and the environment.

2.5.5. Phase II Environmental Site Assessment (2017)

A Phase II Environmental Site Assessment (ESA) was conducted in October 2017 (GeoEngineers 2017a). The purpose of the Phase II ESA was to assess current soil and groundwater conditions at the Site in anticipation of Sound Transit's planned acquisitions and FWLE construction activities on Parcel FL358. The subsurface investigation within and near the Site consisted of the following:

- **Six soil borings.** The borings were completed outside the former dry cleaner space to depths of 20 to 26 feet bfgs. One boring (FL358-B1) was completed in the loading dock area north of the former dry cleaner space, two borings (FL358-MW1 and FL358-MW2) were completed in the parking lot east-adjacent to the store, and three borings (FL358-B3, FL358-MW3, and FL358-MW4) were completed in the parking lot south-adjacent to the store (Figure 3).
- **Four groundwater monitoring wells.** Two wells (FL358-MW1 and FL358-MW2) were installed east of the former dry cleaner space and were screened from approximately 6 to 25 feet bfgs. The other wells (FL358-MW3 and FL358-MW4) were installed south and southwest of the former dry cleaner space, respectively, and were screened from approximately 8 to 19.5 feet bfgs.
- **Twenty-nine soil samples analyzed for VOCs, gasoline-range petroleum hydrocarbons, diesel- and lube oil-range petroleum hydrocarbons, arsenic, and/or lead.** The soil samples were collected from the borings. VOCs were analyzed in 19 samples. Arsenic and lead were analyzed in ten shallow soil samples (0 to 1 foot bfgs) to assess potential impacts associated with the Tacoma Smelter Plume. Gasoline-, diesel-, and lube oil-range petroleum hydrocarbons were analyzed in two samples based on field screening evidence of potential petroleum contamination (i.e., slight sheen) observed during sampling.

  The highest detected concentration of PCE in soil was 0.066 mg/kg in a sample obtained from a depth of 13 feet bfgs in boring FL358-B1 completed in the loading dock area. In addition to PCE, low concentrations of TCE and cis-1,2-DCE were detected in several samples. Low concentrations of lube oil-range petroleum hydrocarbons (100 and 79 mg/kg, respectively) were detected in two samples obtained from depths of 1.5 and 5 feet bfgs in boring FL358-MW1 completed east of the former dry cleaner space. Arsenic was detected at concentrations of 6.2 and 46 mg/kg in two shallow soil samples, and lead was detected at a concentration of 11 mg/kg in one shallow soil sample.
- **Five groundwater samples analyzed for VOCs.** The groundwater samples were collected from the monitoring wells installed during the Phase II ESA (FL358-MW1 through FL358-MW4) and previously installed well Y Pay Mor-MW3 (Figure 3). (Well Y Pay Mor-MW2 was not located and was assumed to have either been removed or paved over.) The depth to groundwater measured in the monitoring wells ranged from approximately 7.1 to 9.4 feet bfgs.

  PCE, TCE, and cis-1,2-DCE were detected in the groundwater sample from well FL358-MW1 at concentrations of 0.21, 1.0, and 0.61 μg/l, respectively. Cis-1,2-DCE was detected in the groundwater samples from wells FL358-MW4 and Y Pay Mor-MW3 at concentrations of 0.34 and 0.20 μg/l, respectively.

2.5.6. Ecology Periodic Review (2018)

MTCA requires Ecology to conduct a periodic review of cleanup sites with an NFA status and institutional controls (i.e., environmental or restrictive covenants) every five years. Ecology completed a periodic review for the Site in September 2018 (Ecology 2018). Based on a review of existing Site information, Ecology determined that no additional action was necessary and that the restrictive covenant was still protective because the building and pavement acted as a cap to prevent infiltration of stormwater and direct contact with hazardous substances.

2.5.7. Phase II Environmental Site Assessment Addendum (2018)

An additional subsurface investigation was conducted in November and December 2018 as an addendum to the 2017 Phase II ESA (GeoEngineers 2019). The purpose of the Phase II ESA Addendum was to identify locations beneath the building slab and the loading dock area north of the former dry cleaner space where potential contaminants may be encountered during Sound Transit's FWLE construction activities. The subsurface investigation consisted of the following:

- **Eighteen passive soil vapor samples analyzed for PCE, TCE, and cis-1,2-DCE.** Fifteen passive soil vapor samplers were installed beneath the building slab inside the former dry cleaner space and what was originally the tenant space west-adjacent to the dry cleaner (at the time of the study, these locations were occupied by a restaurant and a laser tag facility, respectively), and three passive vapor samplers were installed in the loading dock area. The samplers were installed to depths of 2.1 to 2.7 feet bfgs and remained in place undisturbed for nine days before they were removed for laboratory analysis. The soil vapor samples provided qualitative, screening-level data for identifying locations where elevated VOC concentrations may be present.

  Chemical distribution contour maps generated from the laboratory analysis of the soil vapor samples confirmed the residual presence of PCE, TCE, and cis-1,2-DCE beneath the building slab in the vicinity of the 1991 PCE spills. The passive vapor sampling results did not confirm the presence of shallow PCE and associated breakdown products adjacent to the stormwater catch basin in the former loading dock area.

2.5.8. Supplemental Investigation (2020)

A supplemental investigation was conducted between April and June 2020 (O'Neill Service Group [OSG] 2020, 2021). The primary purpose of the supplemental investigation was to delineate the lateral and vertical extent of VOC-contaminated soil exceeding MTCA Method A cleanup levels in preparation for an interim cleanup action (contaminated soil removal) that was later conducted in July and August 2020. Dissolved VOC concentrations in groundwater beneath and adjacent to the former dry cleaner space also were evaluated. The subsurface investigation consisted of the following:

- **Fifteen soil borings.** The borings (358-B1 through 358-B15) were completed within and around the footprint of the former dry cleaner space to depths of 25 to 50 feet bfgs (Figure 3). One boring within the footprint of the former dry cleaner space (358-B10) was completed to 50 feet bfgs; the other borings were completed to 25 to 35 feet bfgs. The footprint of the former dry cleaner space had been made accessible by recent building demolition.
- **Eight test pits.** Seven of the test pits (358-PH1 through 358-PH6 and 358-PH8) were completed in the area of the former dry cleaning equipment, floor drain, and drain pipe, and one of the test pits (358-PH7) was completed adjacent to the stormwater catch basin in the former loading dock area north of the former dry cleaner space (Figure 3). The test pits were completed to a maximum depth of 15 feet bfgs.
- **Ninety-nine soil samples analyzed for VOCs.** The soil samples were collected from the borings and test pits. The highest detected concentration of PCE was 400 mg/kg in a sample obtained from a depth

of 9 to 10 feet bfgs in test pit 358-PH7 completed adjacent to the stormwater catch basin in the former loading dock area. The next highest PCE concentration was 15.3 mg/kg in a sample obtained from a depth of 4 to 5 feet bfgs in test pit 358-PH8 near the floor drain in the former dry cleaning equipment area. The PCE breakdown products TCE, cis-1,2-DCE, trans-1,2-dichloroethene (trans-1,2-DCE), and vinyl chloride also were detected in some soil samples.

The former dry cleaning equipment/floor drain area had been identified as a source area of contamination during previous investigations. The former loading dock catch basin area was identified as a second source area based on the supplemental investigation soil sampling results.

- **Fourteen groundwater samples analyzed for VOCs.** The groundwater samples were collected from existing monitoring wells FL358-MW1 through FL358-MW4 and Y Pay Mor-MW3, and from temporary well points installed in nine borings (358-B3 through 358-B7, 358-B11, and 358-B13 through 358-B15) (Figure 3). The temporary well points were screened from approximately 15 to 25 feet bfgs. The depth to groundwater measured in the monitoring wells ranged from approximately 6 to 11.6 feet bfgs.

  VOCs were not detected in the groundwater samples collected from the five monitoring wells. PCE, TCE, cis-1,2-DCE, and/or vinyl chloride were detected in reconnaissance groundwater samples (screening data) collected from six temporary well points. The highest concentrations of these constituents detected in the reconnaissance samples were 136 µg/l (PCE), 69.9 µg/l (TCE), 68.3 µg/l (cis-1,2-DCE), and 18.8 µg/l (vinyl chloride).

2.5.9. Interim Cleanup Action – Contaminated Soil Removal (2020)

An interim cleanup action was conducted in July and August 2020 to remove soil contaminated with PCE and associated breakdown products from the Site (OSG 2021). A total of approximately 4,202 tons of PCE/TCE-contaminated soil (classified both as hazardous waste and non-hazardous under a contained-in-determination [CID]) was excavated from the former dry cleaning equipment/floor drain area (hereinafter identified as the southern source area) and the former loading dock catch basin area (hereinafter identified as the northern source area). Remnant floor drain and storm drain pipes also were removed. The remedial excavations extended to a maximum depth of 10 to 11 feet bfgs. The excavated soil was disposed of at permitted facilities in Roosevelt, Washington and Arlington, Oregon. In addition, approximately 39,634 gallons of excavation water and ponded water were disposed of at a permitted facility in Arlington, Oregon.

A total of 113 soil samples were collected from the remedial excavations and analyzed for PCE and PCE breakdown products to guide the soil removal and document VOC concentrations at the final limits of the excavations. After soil removal was completed and confirmation soil samples were collected, the remedial excavations were backfilled with clean fill.

The analytical results for soil samples collected at the final limits of the southern remedial excavation indicate that all contaminated soil that exceeded MTCA Method A cleanup levels in the southern source area was removed (OSG 2021). The analytical data from the interim action and the 2020 supplemental investigation indicate that this soil contamination was limited to the vadose zone above the groundwater table.

The analytical results for soil samples collected at the final limits of the northern remedial excavation indicate that except for one sample location, all contaminated soil within the upper 10 feet from the former ground surface that exceeded MTCA Method A cleanup levels in the northern source area was removed (OSG 2021). The one exception was PCE detected at a concentration slightly exceeding the MTCA Method

A cleanup level in a soil sample (358-PEX-98-10) obtained from the north sidewall at a depth of 9 to 10 feet bfgs. Soil represented by sample 358-PEX-98-10 could not be removed due to the proximity of the stormwater utility. A soil sample subsequently obtained from 9 to 10 feet bfgs in a test pit approximately 5 feet north of sample 358-PEX-98-10 (test pit 358-PH-105) (Figure 5) did not contain detectable VOCs, indicating that only a small quantity of soil exceeding MTCA Method A cleanup levels remains where the sidewall of the northern limit of the remedial excavation was. PCE and/or TCE concentrations exceeding MTCA Method A cleanup levels were detected in most of the soil samples collected from the base of the remedial excavation (corresponding to excavation base elevations between approximately 412 and 416 feet). The analytical data from the interim action and the 2020 supplemental investigation indicate that soil contamination exceeding MTCA Method A cleanup levels remains below the groundwater table in the vicinity of the northern source area.

3.0 EXISTING SITE CONDITIONS

The shopping center retail building was demolished and the building slab and asphalt pavement were removed prior to the 2020 interim action. Utilities have been disconnected west of the former retail building, storm drain pipes and the floor drain pipe beneath the former dry cleaner space have been removed, and former groundwater monitoring wells FL358-MW1 through FL358-MW4 and Y Pay Mor-MW3 have been decommissioned. The sanitary sewer utility located east and south of the former retail building has yet to be disconnected as of the publication of this Work Plan. After the 2020 interim action was completed, up to approximately 10 to 12 feet of structural fill was placed on the Site as part of the FWTC redevelopment.

The remainder of this section describes the Site geology and hydrogeology, surface water and ecological habitat in the Site vicinity, and the nature and extent of contamination at the Site.

3.1. Geology

The three general soil units at the Site consist of material interpreted as fill, glacial till, and potential glacial advance outwash.

Prior to the 2020 interim action and subsequent placement of up to 10 to 12 feet of fill at the Site, the uppermost soil unit generally consisted of 5 to 8 feet of sand and gravel fill. With the backfilling of remedial excavations and the additional fill placement in 2020, the uppermost soil unit now consists of approximately 13 to 22 feet of fill. A 2- to 3-foot-thick seam of organic soil (silt and sand with varying amounts of peat and woody material) is present below the fill in a portion of the Site, including beneath the former dry cleaner space. The fill and organic soil are underlain by material interpreted as glacial till. The till unit consists of silty sand, sandy silt, and sand and silt with gravel that extends to Elevations 396 to 401 feet. A 10-foot thick hard silt layer (potential glacial lacustrine) was observed in boring 358-B10 and likely acts as an aquitard based on field soil moisture observations. Sand and silt with gravel (potential glacial advance outwash) was encountered in boring 358-B10 at Elevation 386 feet below the hard silt layer.

3.2. Hydrogeology

Groundwater at the Site occurs between Elevations 417 to 419 feet based on April through June 2020 data from the monitoring wells and temporary well points (OSG 2020, 2021). The groundwater appears to be perched on top of the hard silt layer present at approximate Elevation 396 to 401 feet. The horizontal hydraulic gradient is estimated to range from approximately 0.01 to 0.05 foot per foot, and the inferred groundwater flow direction is toward the southwest based on groundwater levels measured in monitoring wells and temporary well points in 2020 (Figure 4). The hydraulic conductivity of a perched groundwater-bearing zone encountered in a nearby piezometer (FWLE-C29P) installed during geotechnical investigations for the FWLE project was estimated from slug test data (GeoEngineers 2017b). The groundwater-bearing zone encountered in this piezometer appears to be the same groundwater-bearing zone encountered in soil borings and monitoring wells at the Site. The hydraulic conductivity estimates range from 0.05 to 0.07 foot per day (1.8E-05 to 2.5E-05 centimeter per second) (GeoEngineers 2017b).

3.3. Surface Water and Terrestrial Habitat

There are three small lakes located approximately 0.6 to 0.9 mile northwest, north, and northeast of the Site (Easter Lake, Steel Lake, and Lake Dolloff, respectively). These lakes are inferred to be hydraulically upgradient or cross-gradient of the Site based on the inferred southwesterly groundwater flow direction at the Site. Another lake (North Lake) is located approximately 0.9 mile southeast of the Site and is inferred to be hydraulically cross-gradient of the Site. Based on Google Earth satellite imagery (accessed December 22, 2020), the nearest surface water body inferred to be directly downgradient of the Site is a small, unnamed pond approximately 1.6 miles southwest of the Site.

There are no areas of contiguous, undeveloped land larger than 1.5 acres on or within 500 feet of the Site that could provide habitat for terrestrial wildlife.

3.4. Nature and Extent of Contamination

The 2020 interim action removed all VOC-contaminated soil exceeding MTCA Method A cleanup levels situated above Elevations range between 412 and 416 feet. The analytical data from the 2020 supplemental investigation and interim action indicate that soil contamination exceeding MTCA Method A cleanup levels in the southern source area did not extend below Elevation 416 feet.

Concentrations of PCE and associated breakdown products exceeding MTCA Method A cleanup levels are present in soil in the vicinity of the northern source area below Elevation 416 feet (Figures 5 and 7). The highest VOC concentrations remaining in soil appear to occur near the former catch basin location in the former loading dock area. PCE concentrations up to 10.1 mg/kg and TCE concentrations up to 0.403 mg/kg were detected between Elevations 408 to 412 feet in this area (358-PH7 and 358-PEX-20-11, Figure 5) during the 2020 supplemental investigation and interim action. Residual soil contamination exceeding MTCA Method A cleanup levels in the vicinity of the northern source area appears to be limited to above Elevations above 396 feet based on the presence of the hard silt layer at this approximate depth and soil analytical results from borings 358-B3, 358-B5, 358-B10, and 358-B12.

Concentrations of PCE and associated breakdown products exceeding MTCA Method A or B cleanup levels are present in groundwater in the vicinity of the northern and southern source areas (OSG 2021). The VOC plume is roughly 190 feet long and 100 feet wide in plan dimensions (Figures 6 and 7). The highest concentrations of dissolved PCE, TCE, and cis-1,2-DCE detected during the 2020 supplemental investigation were 136, 69.9, and 68.3 µg/l, respectively, in a reconnaissance groundwater sample obtained from boring 358-B5 near the center of the plume. The highest concentration of dissolved vinyl chloride detected during the supplemental investigation was 18.8 µg/l in a reconnaissance groundwater sample obtained from boring 358-B7 near the downgradient edge of the plume. The extent of dissolved VOCs in groundwater exceeding MTCA cleanup levels is bounded to the north, west, and south by the groundwater analytical data from monitoring well FL358-MW3 and borings 358-B4, 358-B11, 358-B-13, 358-B14, and 358-B15. The extent of dissolved VOCs in groundwater is bounded to the east by the groundwater analytical data from monitoring wells FL358-MW1 and FL358-MW2 (Figure 6).

4.0 CONCEPTUAL SITE MODEL

This section presents the preliminary conceptual site model (CSM) for the Site based on the investigations and interim cleanup actions completed to date.

4.1. Sources of Contamination

PCE releases occurred in two source areas at Y Pay Mor Cleaners: the southern source area (i.e., the area of the dry cleaning equipment, floor drain and drain pipe, and 1991 PCE spills) and the northern source area (i.e., the stormwater catch basin in the loading dock area north of the building). The PCE releases caused soil and groundwater beneath the dry cleaner space and loading dock area to become contaminated.

4.2. Contaminated Media

PCE and detected breakdown products (TCE, cis-1,2-DCE, trans-1,2-DCE, and/or vinyl chloride) occur as adsorbed-phase contamination in soil and dissolved-phase contamination in groundwater. PCE, TCE, and cis-1,2-DCE also were detected in sub-slab soil vapor samples collected in 2018. The contaminated soil from which the soil vapor samples were collected was removed during the 2020 interim action.

Approximately 4,202 tons of vadose-zone soil exceeding MTCA Method A cleanup levels was removed from the two source areas during the 2020 interim action. The remedial excavations were backfilled with clean fill following the interim action, and an additional 10 to 12 feet of fill was placed across the Site as part of FWLE construction activities. Residual soil contamination exceeding Method A cleanup levels remains in the northern source area at Elevations below 416 feet and above approximately 396 feet (Figures 5 and 7).

Groundwater contamination exceeding MTCA Method A cleanup levels was detected in four reconnaissance groundwater samples collected during the 2020 supplemental investigation. The highest detected PCE concentration was 136 µg/l in a sample collected from a boring (358-B5) completed between the northern and southern source areas. In groundwater samples collected from monitoring wells, VOCs have not been detected at concentrations exceeding MTCA cleanup levels. Groundwater contamination is estimated to occur in a plume roughly 190 feet long and 90 feet wide in plan dimensions, with the vertical extent of contaminated groundwater occurring from the groundwater table at Elevations 417 to 419 feet to Elevation 396 feet (Figures 6 and 7). The groundwater appears to be perched on a hard silt layer that occurs at Elevations ranging between 396 to 401 feet and is approximately 10 feet thick.

The relatively low PCE concentrations detected in soil and groundwater below the groundwater table do not indicate the potential presence of residual dense non-aqueous phase liquid (i.e., liquid PCE). The detections of dissolved TCE, cis-1,2-DCE, and vinyl chloride in groundwater indicate that PCE has undergone biodegradation. The mass of residual VOCs appears to be small and the dissolved VOC plume is likely stable or shrinking, based on the relatively low VOC concentrations, relatively small size of the plume, the age of the PCE releases (29 years old), and the presence of PCE breakdown products.

4.3. Potential Exposure Pathways

Potential contaminant exposure pathways include:

- Construction worker exposure to contaminated soil and/or groundwater.
- Residential exposure to contaminated groundwater.
- Residential or commercial worker exposure to PCE or related degradation products in indoor air via vapor intrusion into buildings.

Construction workers may be exposed to contaminated soil and/or groundwater if future drilling, excavation, or construction dewatering activities at the Site extend below Elevation 419 feet (i.e., the approximate highest groundwater elevation at the Site). FWLE construction activities may extend to Elevations below 419 feet.

Residents may be exposed to contaminated groundwater if the groundwater is used for drinking water or other domestic purposes; however, the existing restrictive covenant prohibits use of Site groundwater. Federal Way residents obtain domestic water from the public water supply system operated by the Lakehaven Water and Sewer District. Site groundwater could potentially be used as a future source of drinking water if the restrictive covenant were to be removed.

Residents or commercial workers that live or work in future buildings or rooms associated with the potential TOD or the transit station may be exposed to PCE or related degradation products in indoor air if contaminant vapors migrate into indoor air.

Ecological receptors such as aquatic organisms, terrestrial wildlife, plants, and soil biota are unlikely to be exposed to Site contaminants due to the depth of the soil and groundwater contamination (i.e., greater than 15 feet bgs) and the lack of surface water and contiguous, undeveloped land on the Site or within 500 feet of the Site.

5.0 IDENTIFICATION OF DATA GAPS

This section identifies data gaps in the Site characterization. These data gaps are the basis for the RI field program described in Section 6.0.

5.1. Vertical Extent of Soil Contamination in the Vicinity of Northern Source Area

The results of soil sampling conducted during the 2020 supplemental investigation and interim action indicate that the highest residual PCE concentrations remaining in soil occur in the northern source area, at the location of the former stormwater catch basin (test pit 358-PH7). PCE concentrations as high as 10.1 mg/kg (i.e., 200 times the MTCA Method A cleanup level of 0.05 mg/kg) remain at this location at Elevations 408 to 412 feet. TCE concentrations in this soil also exceed the corresponding MTCA Method A cleanup level of 0.03 mg/kg. The vertical extent of soil contamination exceeding MTCA cleanup levels at the former stormwater catch basin location has not been delineated.

5.2. Soil Physiochemical Properties

Physiochemical properties of Site soil including grain size distribution, pH, soil bulk density, and total organic carbon content (TOC) have not been evaluated. These properties can influence the implementability and performance of remediation technologies that may be applicable to the Site. Consequently, the collection and evaluation of soil physiochemical data can inform the evaluation of cleanup action alternatives in the FS.

5.3. Seasonal Variability and Temporal Trends of VOC Concentrations in Groundwater

Previous investigations did not fully characterize the seasonal variability and temporal trends of dissolved VOC concentrations in groundwater. The collection and evaluation of these groundwater quality data can inform the evaluation of cleanup action alternatives in the FS.

5.4. Groundwater Geochemical Conditions

Indicators of Site groundwater geochemical conditions including ammonia, TOC, biochemical oxygen demand (BOD), ferrous iron, total iron, nitrate, nitrite, and dissolved methane, ethane, ethene, and acetylene have not been evaluated. Because groundwater geochemical conditions can influence the performance of remediation technologies that may be applicable to the Site, the collection and evaluation of geochemical indicator data can inform the evaluation of cleanup action alternatives in the FS.

5.5. Hydraulic Conductivity and Hydraulic Gradients

The hydraulic conductivity of the groundwater-bearing zone has not been evaluated, and hydraulic gradients at the Site have not been sufficiently characterized. These hydrogeological characteristics influence the migration of contaminants in groundwater, and they can also influence the implementability and performance of remediation technologies that may be applicable to the Site. Consequently, the collection and evaluation of hydraulic conductivity and gradient data can inform the evaluation of cleanup action alternatives in the FS.

6.0 REMEDIAL INVESTIGATION FIELD PROGRAM

The RI field program is designed to address the data gaps identified in Section 5.0. The main elements of the RI field program include the following:

- Drilling nine soil borings in the area of the dissolved VOC plume and installing a permanent groundwater monitoring well in each boring.
- Submitting soil samples collected from select borings for laboratory analysis of VOCs and/or physiochemical parameters.
- Monitoring seasonal groundwater levels, hydraulic gradients, and dissolved VOC concentrations quarterly for one year at the new monitoring well locations. Groundwater samples collected during the quarterly monitoring events will be submitted for laboratory analysis of VOCs and/or geochemical indicators.
- Performing slug tests at three of the new groundwater monitoring wells to evaluate hydraulic conductivity.

These elements of the RI field program are described further below. Details regarding field sampling procedures are provided in the Sampling and Analysis Plan (Appendix A). Quality control procedures for field activities and laboratory analyses are described in the Quality Assurance Project Plan (Appendix B).

6.1. Drilling and Soil Sampling

Nine soil borings will be drilled at the proposed locations shown in Figure 8 using sonic drilling methods. The borings will be advanced to approximately 1 foot into the hard silt layer observed in previous borings at Elevation 396 to 401 feet; however, if the hard silt layer is not encountered in a given boring, that boring will extend down to Elevation 389 feet. An environmental representative will be present during drilling to log and field screen soils and to collect soil samples for laboratory analysis. Drill cuttings will be segregated by boring and contiguous depth intervals and stored within the fenced parcel in labeled drums pending waste characterization and appropriate disposal.

Continuous soil cores will be collected from each boring. Soil types observed in the cores will be identified using the Unified Soil Classification System (USCS). In addition, soil in each core will be field screened for evidence of potential contamination using visual screening (e.g., observations of soil staining), water sheen screening, and headspace vapor screening with a PID. Soil field screening and sampling methods are described in the Sampling and Analysis Plan (SAP) (Appendix A).

Soil samples will be collected from the following borings for laboratory analysis (see Figure 8 for proposed boring locations):

- Boring FL358-MW5 in the northern portion of the inferred dissolved VOC plume, adjacent to the former stormwater catch basin in the northern source area.
- Boring FL358-MW6 near the center of the inferred dissolved VOC plume, near Supplemental Investigation borings 358-B5 and 358-B10.
- Boring FL358-MW9 east of the inferred dissolved VOC plume and southeast of the northern source area.

Soil samples will be collected from the borings every 5 feet for laboratory analysis starting at Elevation 415 feet. Soil samples may be collected from other borings if field screening evidence of contamination is encountered in other borings.

The deepest soil sample to be collected for laboratory analysis from each boring will be either a sample obtained from the upper 1 foot of the hard silt layer (if the silt layer is encountered) or a sample obtained at Elevation 389 feet) (if the silt layer is not encountered).

The soil samples will be analyzed by a Washington State accredited laboratory for PCE, TCE, cis- and trans-1,2-DCE, 1,1-dichloroethene (1,1-DCE), and vinyl chloride by U.S. Environmental Protection Agency (EPA) Method 8260. In addition, up to six soil samples collected from borings FL358-MW5 and FL358-MW6 (e.g., three samples per boring) will be analyzed for the following physiochemical parameters:

- Grain size distribution by ASTM International (ASTM) Method D 421/D422.
- pH by EPA Method 9045D.
- Bulk density by ASTM Method D 7263.

- TOC by Standard Method (SM) 9060.

Borings FL358-MW5 and FL358-MW6 were selected for soil physiochemical analysis based on their locations within the estimated footprint of the dissolved VOC plume. The five soil samples submitted for physiochemical analysis will be selected in the field based on qualitative observations of soil texture, color, and/or moisture content, with the objective of analyzing samples representative of the predominant soil types within the boundaries of the VOC plume.

Depending on the results of the soil sampling described above, up to two additional soil borings may be completed to further characterize soil conditions at the Site. The scope and schedule for completing additional borings, if any, will be determined in discussion with Ecology after reviewing soil analytical data from the nine proposed boring/monitoring well locations shown in Figure 8.

6.2. Groundwater Monitoring Well Installation and Groundwater Sampling

A 2-inch diameter groundwater monitoring well will be installed in each soil boring. The wells will be constructed in accordance with Washington State well construction standards (WAC 173-160); resource protection well notification and construction documents will be submitted to Ecology. The well casing will consist of Schedule 40 polyvinyl chloride (PVC) blank casing and machine-slotted screens with 0.010-inch slot width. The wells will generally be screened from the approximate elevation of the groundwater table (420 feet) to an approximate Elevation of 400 feet. If the gravel content in soil cores recovered from boring FL358-MW5 adjacent to the former stormwater catch basin is observed to increase significantly with depth below the groundwater table, the well installed in this boring will be screened from approximately 405 to 400 feet and will be named FL358-MW5B, and a second monitoring well (FL358-MW5A) will be installed within approximately 4 feet of FL358-MW5B and screened from approximately 420 to 415 feet. The annular space between the well screen and the borehole wall will be filled with a clean sand filter pack to 2 feet above the well screen. The annular space above the filter pack will be filled with hydrated bentonite. Each well will be fitted with a locking well cap and completed at the surface with a flush steel monument set in a concrete surface seal. The wells will be protected during future FWLE construction activities and the well monuments will be raised or lowered as needed to match final grade elevations.

After all monitoring wells are installed, the wells will be developed as described in the SAP to stabilize the sand filter pack and formation materials surrounding the well screen and to establish a hydraulic connection between the well screen and the surrounding soil. The locations of the monitoring wells will be surveyed, and the well casing rim and monument elevations will be surveyed relative to NAVD88.

RI groundwater monitoring will be conducted on a quarterly basis for one year. During each monitoring event, groundwater levels will be measured in the monitoring wells and groundwater samples will be collected for analysis from each well as described in the SAP. The groundwater samples will be analyzed by a Washington State accredited laboratory for PCE, TCE, cis- and trans-1,2-DCE, 1,1-DCE, and vinyl chloride by EPA Method 8260. In addition, the samples collected during two of the quarterly monitoring events (one dry season event and one wet season event) also will be analyzed for the following geochemical indicators:

- Ammonia by SM 4500-NH3.
- TOC by SM 5310B.
- BOD by SM 5210B.

- Ferrous iron by Hach Method 8146.
- Total iron by EPA Method 6010.
- Nitrate and nitrite by EPA Method 353.2.
- Dissolved methane, ethane, ethene, and acetylene by Method RSK-175.

Depending on the results of the groundwater sampling described above, up to two additional monitoring wells may be installed to further characterize groundwater conditions at the Site. The scope and schedule for installing additional groundwater monitoring wells, if any, will be determined in discussion with Ecology after reviewing groundwater analytical data from the nine proposed boring/monitoring well locations shown in Figure 8.

6.3. Slug Testing

Hydraulic conductivity estimates for the groundwater-bearing zone will be derived by conducting falling head and rising head slug tests at the three groundwater monitoring wells to be installed within the estimated extent of the dissolved VOC plume (wells FL358-MW5, FL358-MW6, and FL358-MW7). Slug testing provides estimates of hydraulic conductivity in the vicinity of the tested wells. The slug tests will be performed as described in the SAP. The slug test data will be analyzed by standard methods (e.g., Bouwer and Rice 1976) to estimate the horizontal hydraulic conductivity of the geologic materials surrounding the tested wells.

6.4. Investigation-Derived Waste Management

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

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

Drill cuttings and decontamination water will be characterized for disposal by submitting a representative sample of the drill cuttings from each soil boring and a representative sample of the decontamination water for analysis of PCE, TCE, cis- and trans-1,2-DCE, 1,1-DCE, and vinyl chloride by EPA Method 8260. Well development water and pre-sampling purge water will be characterized for disposal based on the groundwater analytical results from the quarterly groundwater monitoring events.

If PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, and/or vinyl chloride are detected in any IDW samples, the associated IDW will be designated as an F002-listed waste under the State dangerous waste regulations (WAC 173-303) and disposed of off-site at a facility permitted to receive hazardous waste. Hazardous waste manifests will be prepared for IDW designated as dangerous waste, and the IDW will be transported to the permitted disposal facility by a licensed hazardous waste hauler.

IDW found to contain no detectable PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, or vinyl chloride will not be designated as a dangerous waste and will be disposed of off-site at a permitted facility.

7.0 DATA EVALUATION AND REPORTING

The data from the RI field program will be evaluated to address the identified data gaps. The results of the soil VOC analyses will be used to delineate the vertical extent of soil contamination exceeding MTCA cleanup levels in the vicinity of the northern source area. The quarterly groundwater monitoring data will be used to characterize the lateral extent of groundwater contamination exceeding MTCA cleanup levels and the seasonal variability of dissolved VOC concentrations. The soil physiochemical data and groundwater geochemical data will be used to characterize soil and groundwater conditions that may influence the selection of a cleanup action alternative for the Site. The slug test data and quarterly groundwater level data will be used to characterize hydraulic conductivity and hydraulic gradients; these characteristics also may influence the selection of a cleanup action alternative.

The RI activities and results will be documented in an RI report prepared in accordance with applicable MTCA requirements. The preliminary CSM presented in this Work Plan will be refined as necessary based on the results of the RI, and an updated CSM will be presented in the RI report.

8.0 SCHEDULE

Sound Transit anticipates beginning the RI field activities in December 2022, after Sound Transit has installed new underground utilities. The RI report will be submitted to Ecology after completing four quarterly groundwater monitoring events.

9.0 REFERENCES

AGRA Earth & Environmental, Inc., 1994. Independent Remedial Action Report, Former Y-PAY-MOR Dry Cleaners, Best Shopping Plaza, 2210 320th Street South, Federal Way, Washington, December 1994.

AGRA Earth & Environmental, Inc., 1997. Letter to Ms. Lita F. Johnson, R.P.A., The Norman Company, Re: Sea-Tac Plaza, Biannual Sampling of Monitoring Well MW-3, Former Y-Pay-Mor Dry Cleaners, Federal Way, Washington, August 20, 1997.

Bouwer, H., and Rice, R.C., 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells. Water Resources Research, 12 (3), 423-428.

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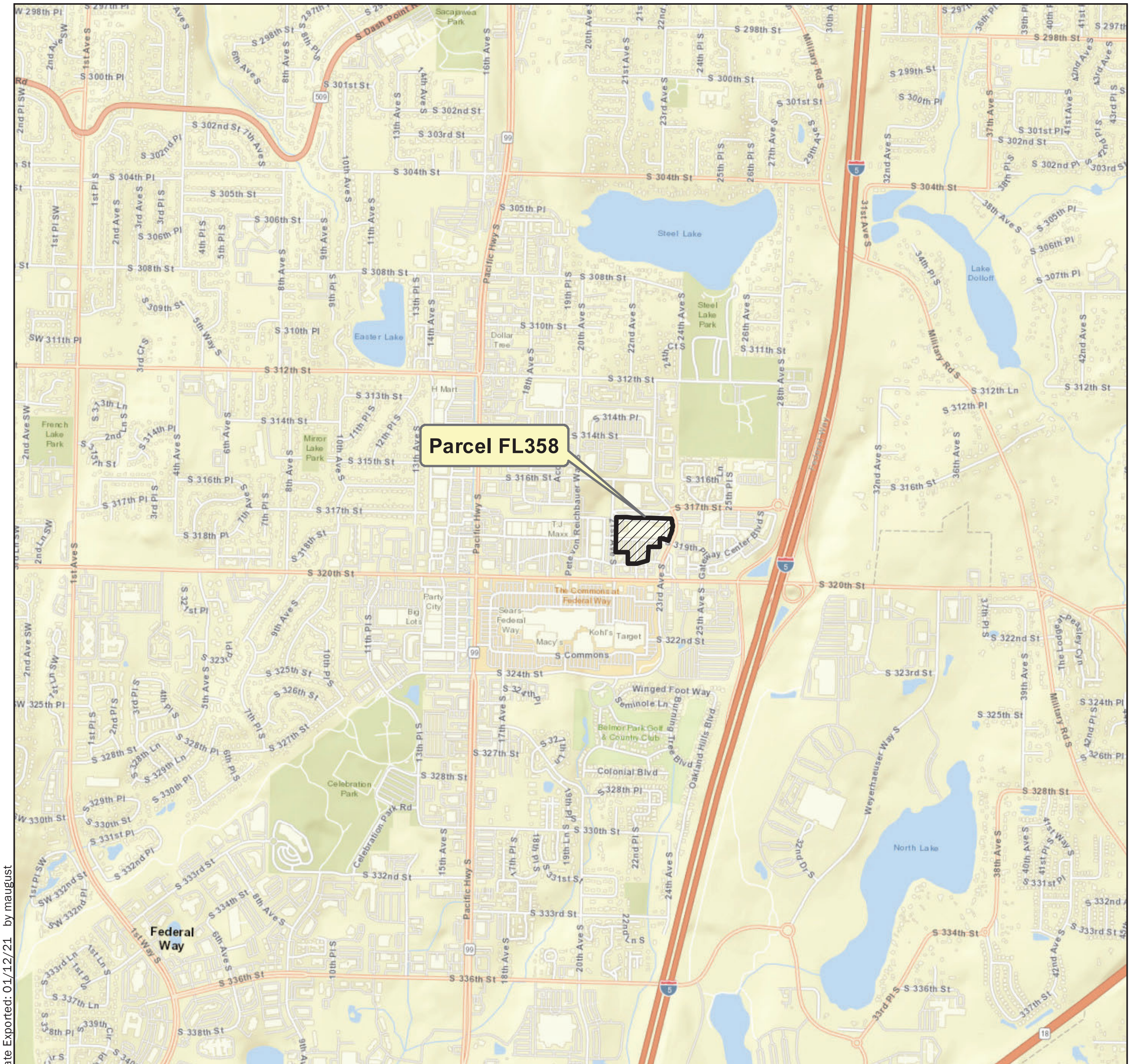
10.0 LIMITATIONS

We have prepared this Work Plan for use by Sound Transit and their contractors for soil and groundwater investigations at the FL358 Property at 2210 South 320th Street, in Federal Way, Washington. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted environmental science practices in this area at the time this Work Plan was prepared. No warranty or other conditions, express or implied, should be understood. This document (email, text, table, and/or figure) and any attachments are only a copy of a master document. The master hard copy is stored by GeoEngineers, Inc. and will serve as the official document of record.



Legend

Subject Property

N
W
E
S

2,000 0 2,000

Feet

Notes:

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

Data Source: Mapbox Open Street Map, 2017

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

Vicinity Map
FWLE Parcel FL358

Remedial Investigation Work Plan, Y Pay Mor Drycleaner Site
Sound Transit Federal Way Link Extension
Federal Way, Washington

GEOENGINEERS

Figure 1

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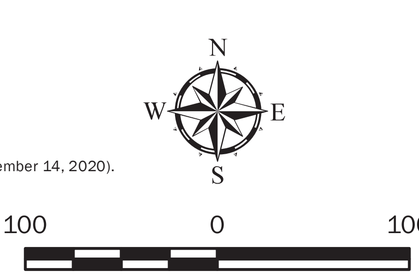
Legend

- Former Monitoring Well Associated with Y Pay Mor Drycleaner Site
- FWLE Parcel FL358
- Potential Surplus Property
- Approximate Extent of New Light Rail Station



Notes:
1. Based on current design information for the FWLE project (Kiewit/Parsons 60 Percent Submittal, December 14, 2020).
2. Areas between potential surplus property and new light rail station will be roadways.
3. The locations of all features shown are approximate.
4. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Aerial and road names from King County 2015.

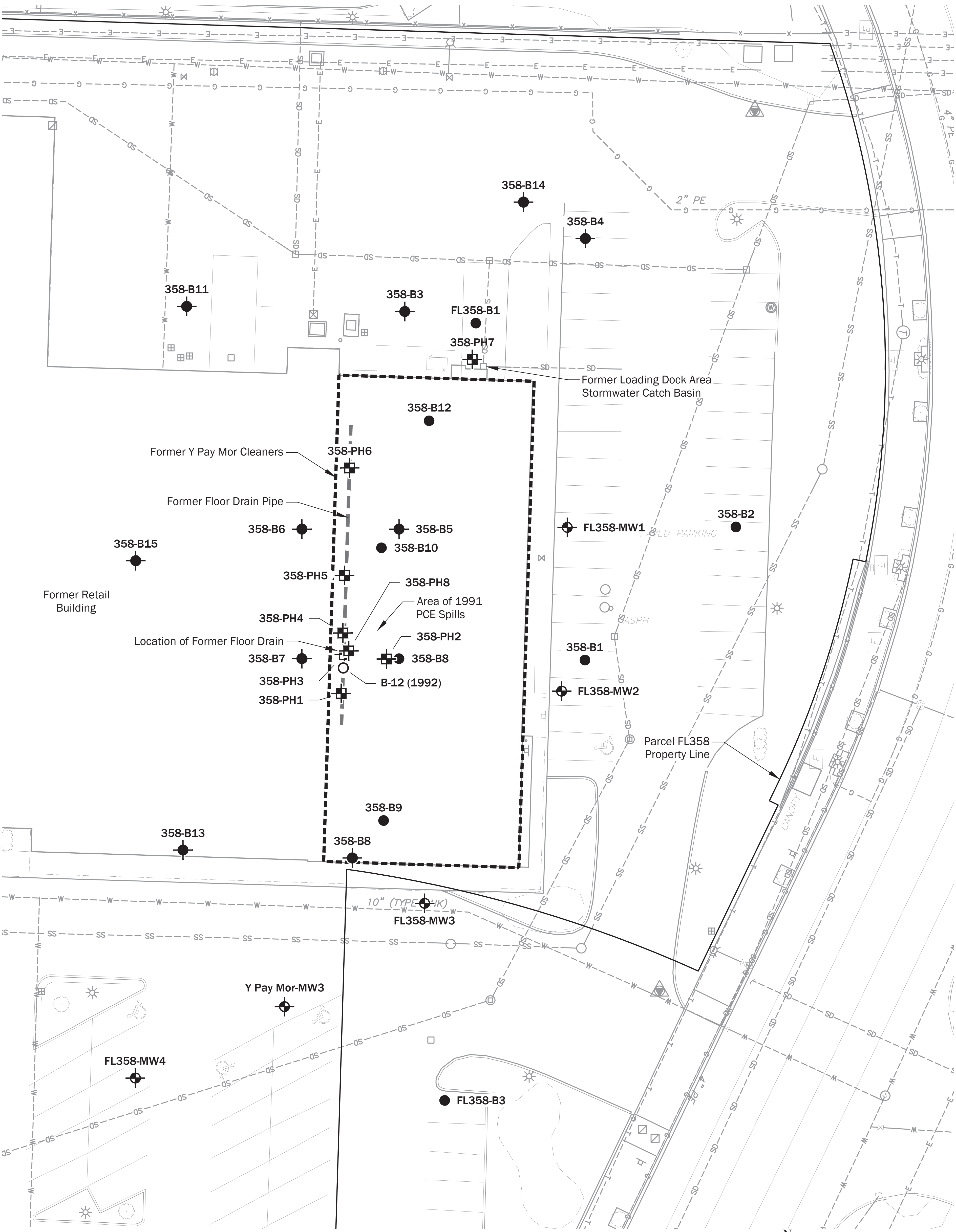
Historical Site Plan and Future Use
FWLE Parcel FL358

Remedial Investigation Work Plan, Y Pay Mor Drycleaner Site
Sound Transit Federal Way Link Extension
Federal Way, Washington

GeoEngineers

Figure 2

P:\4\4082039\GIS\MXD\408203903_F02_SitePlan__FL358_RI_WorkPlan.mxd Date Exported: 01/22/21 by maugust



Legend

- Soil Boring and Reconnaissance Groundwater Sample Location
- Soil Boring
- Monitoring Well (Decommissioned July 2020)
- Test Pit
- Preliminary Remedial Investigation Boring B-12 (1992)

Notes:

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

Projection: Project Datum Washington State Planes, North Zone, US Foot.

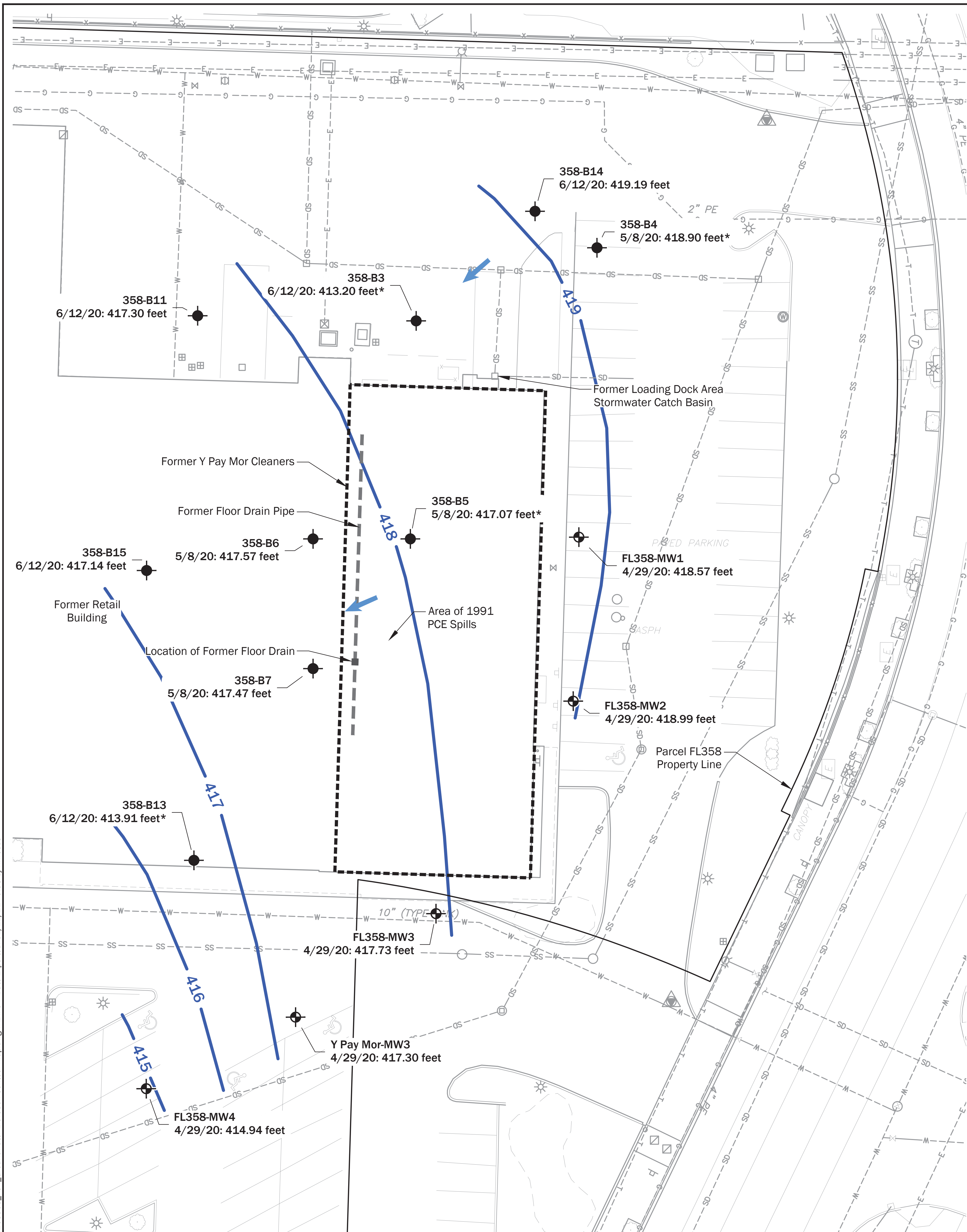
Phase II Environmental Site Assessment and Supplemental Investigation Sampling Locations

Remedial Investigation Work Plan, Y Pay Mor Drycleaner Site
Sound Transit Federal Way Link Extension
Federal Way, Washington

GEOENGINEERS

Figure 3

\\geoengineers.com\WAN\Projects\4\4082039\CAD\03\FL358\RI Work Plan\408203903_F03_Phase II Environmental Site Assessment and Supplemental Investigation Sampling Locations.dwg TAB:F03 Date Exported: 01/22/21 - 9:57 by mwoods



Legend

- Soil Boring and Reconnaissance Groundwater Sample Location
- Monitoring Well (Decommissioned July 2020)
- —417— Groundwater Elevation Contour (feet NAVD88)
- Inferred Groundwater Flow Direction

*Not used for contouring

N E S W

30 0 30

Feet

Notes:

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

Projection: Project Datum Washington State Planes, North Zone, US Foot.

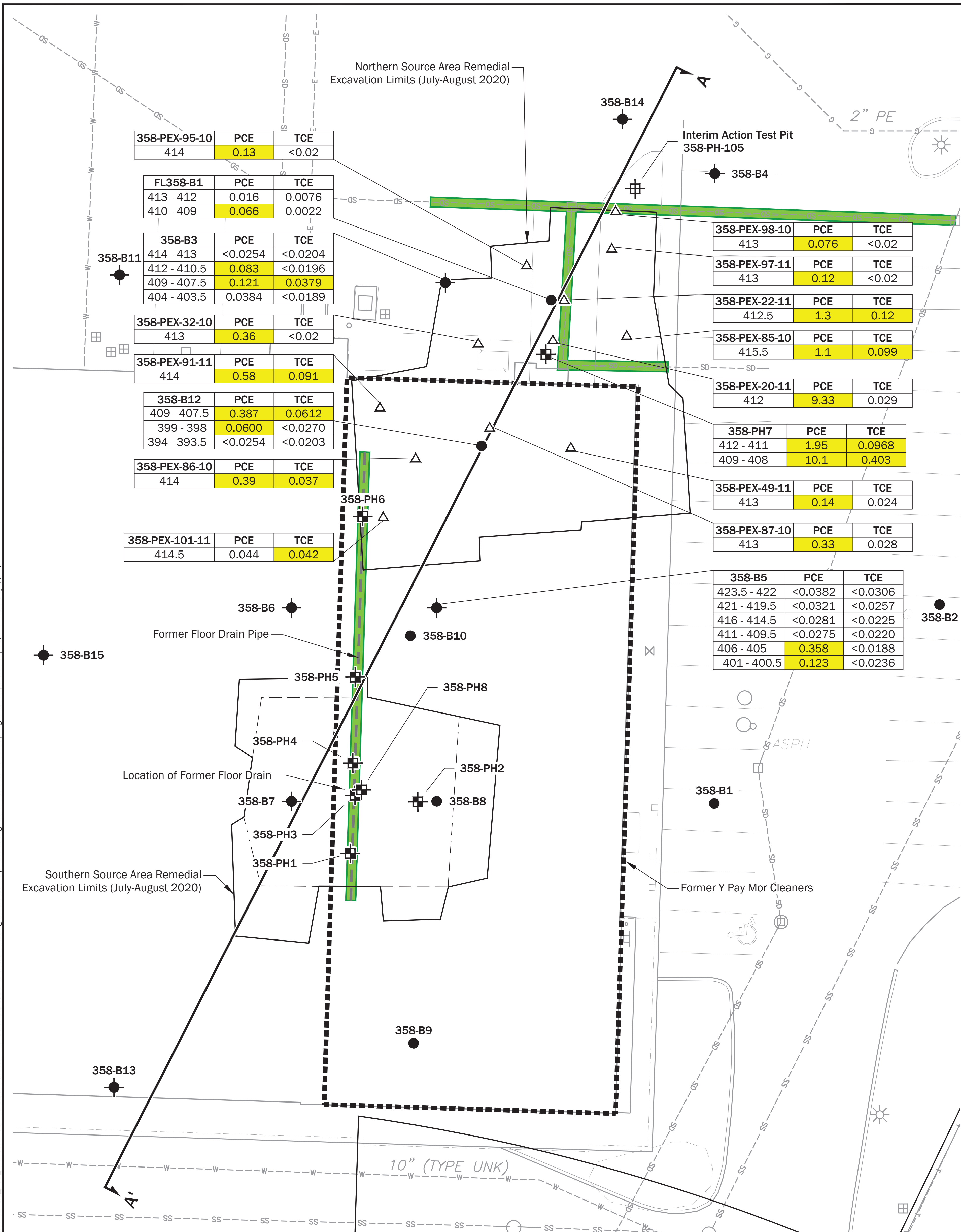
Groundwater Elevation Contour Map

Remedial Investigation Work Plan, Y Pay Mor Drycleaner Site
Sound Transit Federal Way Link Extension
Federal Way, Washington

GEOENGINEERS

Figure 4

\\geoengineers.com\WAN\Projects\4\4082039\CAD\03\FL358\RI Work Plan\408203903_F04_Groundwater Elevation Contour Map.dwg TAB:F04 Date Exported: 01/22/21 - 9:58 by mwoods



358-PEX-95-10	PCE	TCE
414	0.13	<0.02

FL358-B1	PCE	TCE
413 - 412	0.016	0.0076
410 - 409	0.066	0.0022

358-B3	PCE	TCE
414 - 413	<0.0254	<0.0204
412 - 410.5	0.083	<0.0196
409 - 407.5	0.121	0.0379
404 - 403.5	0.0384	<0.0189

358-PEX-32-10	PCE	TCE
413	0.36	<0.02

358-PEX-91-11	PCE	TCE
414	0.58	0.091

358-B12	PCE	TCE
409 - 407.5	0.387	0.0612
399 - 398	0.0600	<0.0270
394 - 393.5	<0.0254	<0.0203

358-PEX-86-10	PCE	TCE
414	0.39	0.037

358-PEX-101-11	PCE	TCE
414.5	0.044	0.042

358-PEX-98-10	PCE	TCE
413	0.076	<0.02

358-PEX-97-11	PCE	TCE
413	0.12	<0.02

358-PEX-22-11	PCE	TCE
412.5	1.3	0.12

358-PEX-85-10	PCE	TCE
415.5	1.1	0.099

358-PEX-20-11	PCE	TCE
412	9.33	0.029

358-PH7	PCE	TCE
412 - 411	1.95	0.0968
409 - 408	10.1	0.403

358-PEX-49-11	PCE	TCE
413	0.14	0.024

358-PEX-87-10	PCE	TCE
413	0.33	0.028

358-B5	PCE	TCE
423.5 - 422	<0.0382	<0.0306
421 - 419.5	<0.0321	<0.0257
416 - 414.5	<0.0281	<0.0225
411 - 409.5	<0.0275	<0.0220
406 - 405	0.358	<0.0188
401 - 400.5	0.123	<0.0236

Legend

- △ Interim Action Sample Location Where PCE or TCE Exceeded MTCA Cleanup Level
- Utilities Removed During 2020 Interim Action
- Extent of Interim Action Excavation

Phase II ESA and Supplemental Investigation Sampling Locations

- Soil Boring and Reconnaissance Groundwater Sample Location
- Soil Boring
- Test Pit

Location ID	Analyte
Sample Elevation	Concentration mg/kg
	Exceeds MTCA Cleanup Level

MTCA Method A Cleanup Levels:
PCE = 0.05 mg/kg
TCE = 0.03 mg/kg

20 0 20
Feet

Notes:

1. Results for Phase II ESA and Supplemental Investigation samples are shown only at locations where PCE or TCE concentrations exceeding MTCA cleanup levels remain in place.
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

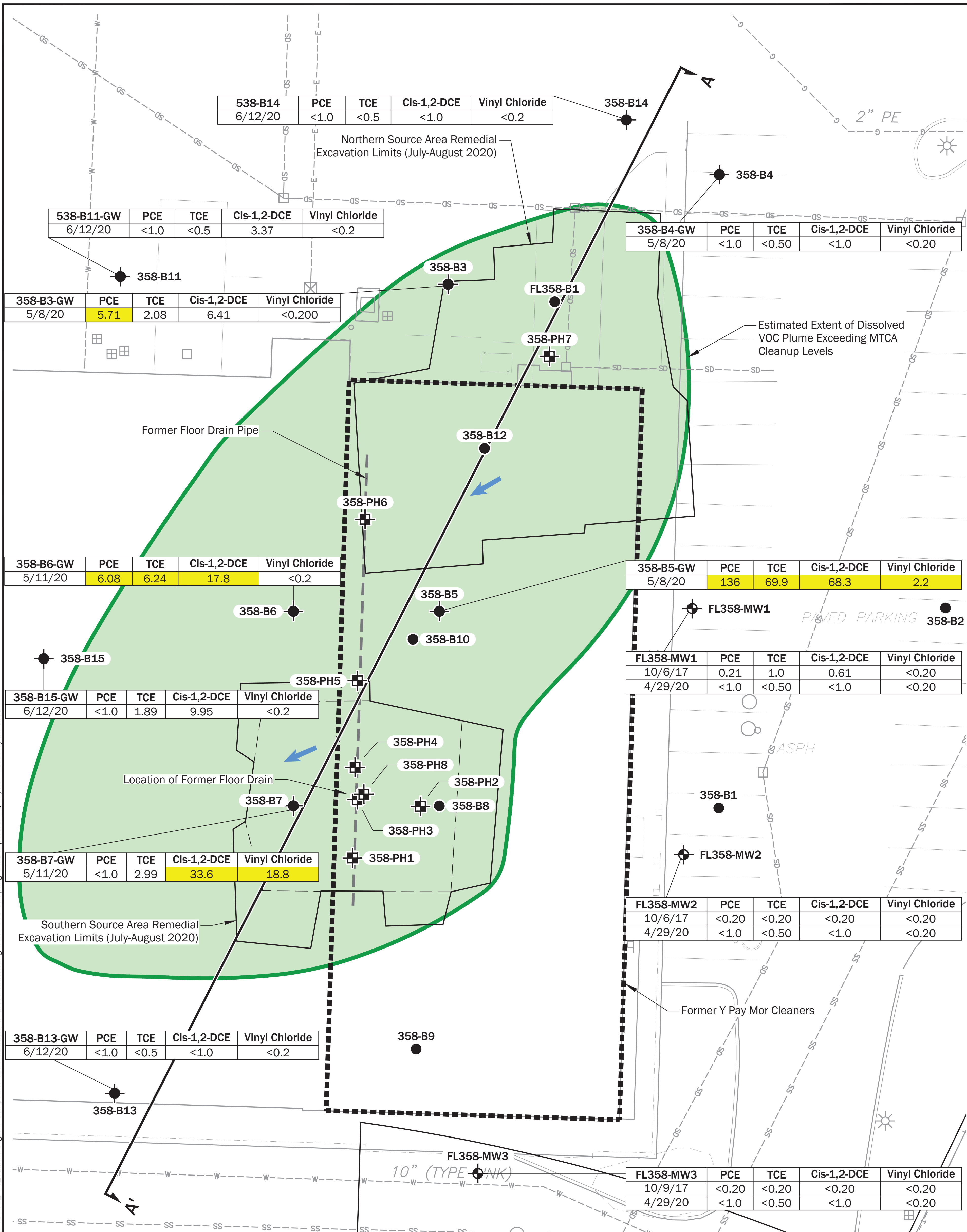
Projection: Project Datum Washington State Planes, North Zone, US Foot.

Interim Action Excavations and Residual PCE and TCE Concentrations in Soil Exceeding MTCA Cleanup Levels

Remedial Investigation Work Plan, Y Pay Mor Drycleaner Site
Sound Transit Federal Way Link Extension
Federal Way, Washington

GEOENGINEERS

Figure 5



538-B14	PCE	TCE	Cis-1,2-DCE	Vinyl Chloride
6/12/20	<1.0	<0.5	<1.0	<0.2

538-B11-GW	PCE	TCE	Cis-1,2-DCE	Vinyl Chloride
6/12/20	<1.0	<0.5	3.37	<0.2

358-B4-GW	PCE	TCE	Cis-1,2-DCE	Vinyl Chloride
5/8/20	<1.0	<0.50	<1.0	<0.20

358-B3-GW	PCE	TCE	Cis-1,2-DCE	Vinyl Chloride
5/8/20	5.71	2.08	6.41	<0.200

358-B6-GW	PCE	TCE	Cis-1,2-DCE	Vinyl Chloride
5/11/20	6.08	6.24	17.8	<0.2

358-B5-GW	PCE	TCE	Cis-1,2-DCE	Vinyl Chloride
5/8/20	136	69.9	68.3	2.2

FL358-MW1	PCE	TCE	Cis-1,2-DCE	Vinyl Chloride
10/6/17	0.21	1.0	0.61	<0.20
4/29/20	<1.0	<0.50	<1.0	<0.20

358-B15-GW	PCE	TCE	Cis-1,2-DCE	Vinyl Chloride
6/12/20	<1.0	1.89	9.95	<0.2

358-B7-GW	PCE	TCE	Cis-1,2-DCE	Vinyl Chloride
5/11/20	<1.0	2.99	33.6	18.8

FL358-MW2	PCE	TCE	Cis-1,2-DCE	Vinyl Chloride
10/6/17	<0.20	<0.20	<0.20	<0.20
4/29/20	<1.0	<0.50	<1.0	<0.20

358-B13-GW	PCE	TCE	Cis-1,2-DCE	Vinyl Chloride
6/12/20	<1.0	<0.5	<1.0	<0.2

FL358-MW3	PCE	TCE	Cis-1,2-DCE	Vinyl Chloride
10/9/17	<0.20	<0.20	<0.20	<0.20
4/29/20	<1.0	<0.50	<1.0	<0.20

Legend

Inferred Groundwater Flow Direction

Extent of Interim Action Excavation

Phase II ESA and Supplemental Investigation Sampling Locations

- Soil Boring and Reconnaissance Groundwater Sample Location
- Soil Boring
- Monitoring Well (Decommissioned July 2020)
- Test Pit

Location ID	Analyte
Date	Concentration µg/l
	Exceeds MTCA Cleanup Level

MTCA Method A (or Method B) Cleanup Levels:
PCE = 5 µg/l
TCE = 5 µg/l
Cis-1,2-DCE = 16 µg/l (Method B)
Vinyl Chloride = 0.2 µg/l

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

Projection: Project Datum Washington State Planes, North Zone, US Foot.

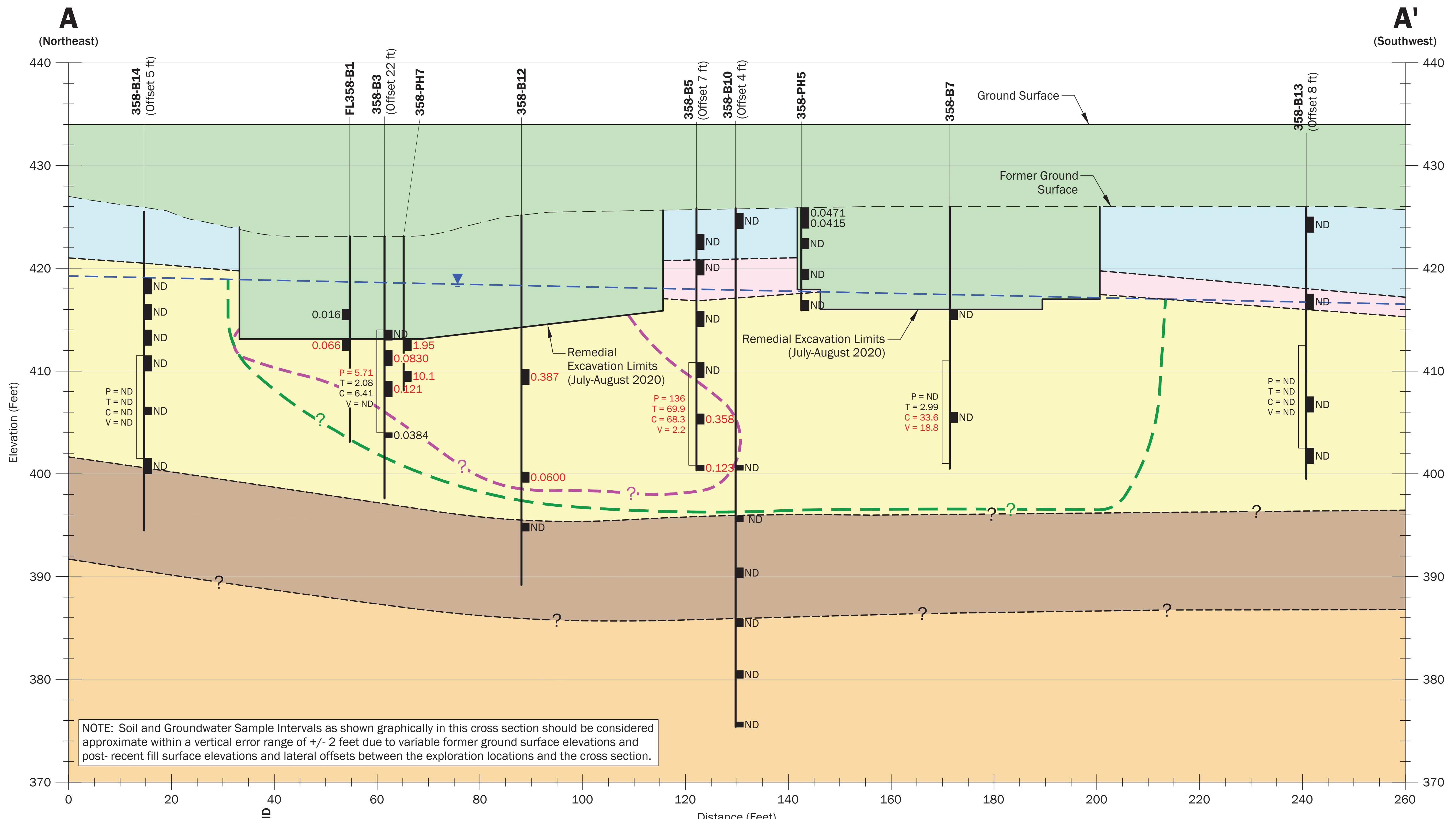
Volatile Organic Compound Concentrations in Groundwater

Remedial Investigation Work Plan, Y Pay Mor Drycleaner Site
Sound Transit Federal Way Link Extension
Federal Way, Washington

GeoEngineers

Figure 6

\\geoengineers.com\WAN\Projects\4\4082039\CAD\03\FL358\RI Work Plan\4082039_F06_Volatile Organic Compound Concentrations in Groundwater.dwg TAB:6 VOC Sampling Date Exported: 01/22/21 - 10:00 by mwoods



Notes:

1. Soil samples collected from soil that was later removed from the northern and southern source areas during the 2020 interim action are not shown.
2. The subsurface conditions shown are based on interpolation between widely spaced explorations and should be considered approximate; actual subsurface conditions may vary from those shown.
3. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. Data were compiled from sources as listed in this figure. The data sources do not guarantee these data are accurate or complete. There may have been updates to the data since the publication of this figure. This figure is a copy of a master document. The hard copy is stored by GeoEngineers, Inc. and will serve as the official document of record.

Datum: NAVD 88, unless otherwise noted.

Legend

Exploration ID (Offset)

Inferred Lithologic Contact

0.016 Soil Sample Interval with PCE Concentration in mg/kg

P = ND
T = ND
C = ND
V = ND
Groundwater Sample Interval with PCE (P), TCE (T), cis-1,2-DCE (C), and Vinyl Chloride (V) Concentration in µg/l

Sample Results Shown in Red Exceed MTCA Cleanup Levels

ND = Not Detected

Lithology

- Recent Fill (Sand and Gravel)
- Older Fill (Sand and Gravel)
- Organic Soil
- Silty Sand and Sandy Silt, Sand and Silt with Gravel (Moist to Wet)
- Hard Silt (Moist)
- Sand and Silt with Gravel (Moist to Wet)

Groundwater Table

Estimated Extent of PCE and TCE in Soil Exceeding MTCA Cleanup Levels

Estimated Extent of Dissolved VOC Plume in Groundwater Exceeding MTCA Cleanup Levels

20 0 20
Horizontal Scale in Feet

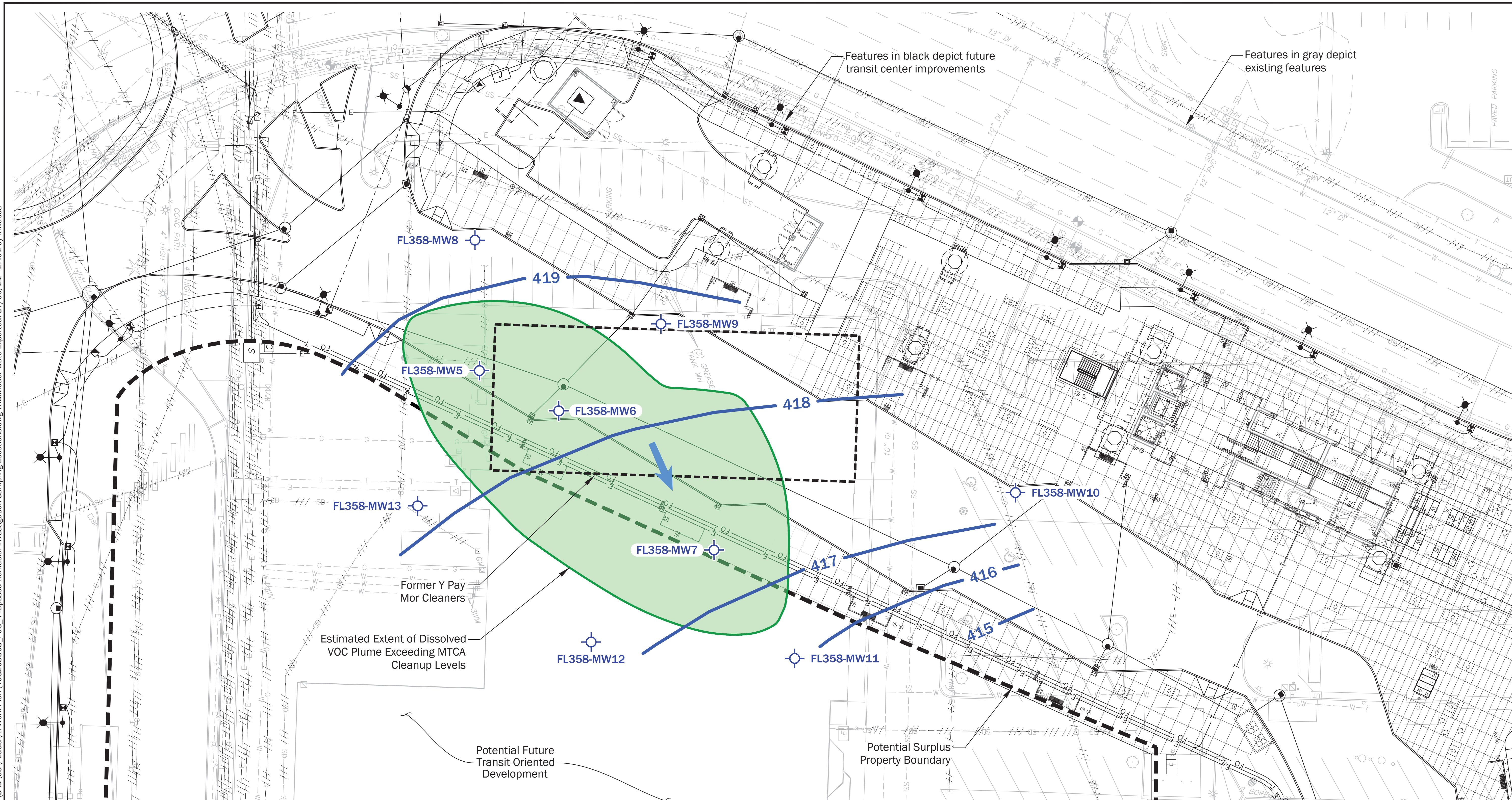
10 0 10
Vertical Scale in Feet
Vertical Exaggeration: 2X

Cross Section A - A'

Remedial Investigation Work Plan, Y Pay Mor Drycleaner Site
Sound Transit Federal Way Link Extension
Federal Way, Washington

GeoEngineers

Figure 7



Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. Monitoring well monuments will be installed inside concrete manholes to protect the wells during FWLE construction activities and to provide access to the wells after construction is completed and final grade elevations are achieved.

Data Source: Design drawings provided by Kiewit on March 17, 2021.

Projection: Project Datum Washington State Planes, North Zone, US Foot.

Legend

Proposed Monitoring Well To be Protected and Maintained

417 Groundwater Elevation Contour (feet NAVD88; based on groundwater levels measured April-June 2020)

Inferred Groundwater Flow Direction

40 0 40
Feet

Proposed Remedial Investigation Sampling Locations

Remedial Investigation Work Plan, Y Pay Mor Drycleaner Site
Sound Transit Federal Way Link Extension
Federal Way, Washington

GeoEngineers

Figure 8

\\geoengineers.com\WAN\Projects\4\4082039\CAD\03\FL358\RI Work Plan\408203903_F08_ Proposed Remedial Investigation Sampling Locations.dwg TAB:Model Date Exported: 07/09/21 - 17:01 by mwoods

APPENDIX A
Sampling and Analysis Plan

Table of Contents

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) has been prepared for remedial investigation (RI) activities at the Y Pay Mor Drycleaner Site located at 2210 South 320th Street in Federal Way, Washington (Site).

2.0 REMEDIAL INVESTIGATION PURPOSE AND SCOPE

The purpose of the RI is to characterize and document soil and groundwater conditions at the Site. Specific proposed investigation activities are described in the RI Work Plan.

3.0 HEALTH AND SAFETY

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

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

4.0 SUBSURFACE INVESTIGATION METHODS

This section describes the following subsurface investigation methods:

- Rotosonic core soil sampling and groundwater monitoring well installation, development, and surveying.
- Groundwater sampling.
- Slug testing.

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

4.1.1. Rotosonic Core Soil Sampling

Continuous soil cores will be collected during drilling using a 4-inch diameter, 5- to 10-foot-long core barrel sampler. The sampler will be advanced into undisturbed soil using a rotary and vibratory drilling head. Upon retrieval, the soil cores will be extruded into sample bags. Soil core temperatures will be monitored using an infrared thermometer and noted on the lithologic log immediately after the sample is extruded to quantify the potential that volatilization of volatile organic compounds (VOCs) may have occurred during drilling. The sample bag will be cut open after the temperature is recorded to allow access to the recovered soil for collecting samples for chemical analyses and lithologic logging. Soil samples will be collected for chemical analysis at 5-foot intervals during drilling. Additional soil samples may be collected for chemical analysis based on field screening results. Field screening is described in Section 5.1.1.

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

Soil samples to be analyzed for VOCs will be collected first following United States Environmental Protection Agency (EPA) Method 5035A. At boring locations where soil samples will be analyzed for additional parameters as described in the RI Work Plan, additional sample volume will be collected and placed in a plastic bag and homogenized following soil sample collection for VOCs. The homogenized soil will be placed into the remaining sample containers provided by the analytical laboratory for the additional analytical parameters.

The collected soil samples will be placed into a cooler with ice and logged on the chain-of-custody record. Drill cuttings will be stored in marked drums on the Site pending waste characterization and appropriate disposal.

4.1.2. Groundwater Monitoring Well Installation

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

The monitoring wells will be constructed using 2-inch-diameter, flush-threaded Schedule 40 polyvinyl chloride (PVC) casing with machine-slotted PVC screen (0.010-inch slot width). Each well will be constructed with a 20-foot screen extending from the approximate elevation of the groundwater table (at 417 to 419 feet North American Vertical Datum 1988 [NAVD88]) to an approximate elevation of approximately 398 feet NAVD88. Actual well screen intervals will be based on field conditions observed at the time of drilling. Additional details regarding monitoring well construction are provided in the RI Work Plan.

Drillers will submit resource protection well notification and construction documents to the Washington State Department of Ecology (Ecology).

4.1.3. Groundwater Monitoring Well Development

Each groundwater monitoring well will be developed by surging the screened interval and purging the well. The turbidity of the purge water will be monitored during well development. Well development will continue until at least five well casing volumes of water are removed and the turbidity of the purge water is less than 500 nephelometric turbidity units (NTU). In addition, if any potable water is added to the borehole to control sand heave during drilling, an additional volume of water equal to the amount added during drilling will be removed. The purge rate and total volume of groundwater removed from each well will be recorded on field forms during well development. Well development water will be segregated by monitoring well and stored in marked drums on the Site pending waste characterization and appropriate disposal.

4.1.4. Groundwater Monitoring Well Surveying

A licensed surveyor will perform an elevation and location survey of the new monitoring wells. Monitoring well elevations will be surveyed relative to NAVD88 to an accuracy of 0.01 foot. The monitoring wells will be resurveyed as necessary if ground surface elevations change in the future.

4.2. Groundwater Sampling

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

Groundwater samples will be collected from the monitoring wells using low-flow purging and sampling methods. The groundwater samples will be obtained using a decontaminated bladder pump with disposable bladder and sample tubing. The sample tubing inlet will be placed at the mid-point of the well screen interval or at the mid-point of the water column if the water column height is less than the screen length. Groundwater will be purged at approximately 0.5 liters per minute or less. Groundwater will be purged at a reduced rate to prevent groundwater drawdown greater than 10 percent of the water column height. The drawdown will be recorded on field logs if drawdown is necessary to obtain a groundwater sample.

A portable water quality measurement system equipped with a flow-through cell will be used to monitor purge water temperature, pH, electrical conductivity, dissolved oxygen (DO), and oxidation-reduction potential (ORP). Purge water turbidity will be measured using a turbidimeter. Water quality measurements of the purge water will be recorded on field logs. Purging will continue until the purge water temperature, pH, electrical conductivity, DO, and ORP stabilize to within 10 percent for three consecutive measurements or until three well casing volumes are removed and turbidity is less than 25 NTU.

Following well purging, the flow-through cell will be disconnected and the groundwater sample will be collected in laboratory-prepared containers. Groundwater samples will be placed into a cooler with ice and logged on the chain-of-custody record. The groundwater samples will be submitted to the analytical laboratory for the chemical analyses identified in the RI Work Plan.

Purge water will be segregated by monitoring well as necessary and stored on the Site in labeled drums pending waste characterization and appropriate disposal.

4.3. Slug Testing

Slug testing is a method for evaluating the hydraulic conductivity of formation materials in the vicinity of the wells where slug tests are performed. The following steps will be completed during each slug test:

4.3.1. Slug Decontamination

The slug, rope, electronic water level indicator, and transducer used to perform the slug tests will be decontaminated between wells by washing with a solution of Alconox® (or Liquinox®) and potable water and rinsing with potable water.

4.3.2. Pre-Test Equipment Setup

- The well to be tested and the test start time will be recorded.
- The diameter and length of slug will be measured and recorded on field logs. The slug will be attached to a rope and secured to ensure the slug will not slip off. The other end of the rope will be attached to a secure anchor point such as a vehicle bumper or a heavy object. This will ensure that if the slug is accidentally dropped during testing it will not be lost down the well.

- The well log will be reviewed to determine the well construction details and depth.
- The laptop computer to be used for data recording will be set up at a secure location close to the well that allows easy viewing of the computer screen.
- The serial number of the transducer used for the slug testing and the unit's pressure rating will be recorded on field logs. A transducer pressure rating of 30 pounds per square inch allows the transducer to be submerged in water to a depth of up to 69 feet. Because slug tests typically are completed over a relatively short time interval, it is generally not necessary to use a barometer to record atmospheric pressure, and data files should not require post-test correction for atmospheric pressure unless the response time is very long (on the order of 30 minutes or more).

4.3.3. Transducer Programming

- The static groundwater level below top of casing (bTOC) will be measured. The well ID, well depth, well screen interval, static water level bTOC, and time will be recorded on field logs.
- The transducer will be connected to the connecting cable and the transducer program will be started to establish communication between the transducer and the laptop. The transducer clock and the computer clock will be synchronized.
- The transducer will be programmed to record pressure at intervals of 0.25 to 1 second. If the well is not expected to recharge quickly, the logging interval may be set to greater than 1 second as appropriate.
- The pressure transducer will be installed in the well at a depth of approximately 15 feet below the groundwater table or deep enough to ensure that the slug will not hit the transducer during the test. The transducer cord will be secured to ensure the transducer does not change depth during the test. The pre-test static groundwater level bTOC will be measured again and recorded on field logs along with the measurement time.

4.3.4. Slug Testing

- The falling-head slug test will be performed by quickly submerging the slug to a fixed depth below the groundwater table. The depth of the slug will be measured and recorded. The groundwater level will be measured periodically as the groundwater level falls using an electronic water level indicator until it returns to the pre-test static level.
- The rising-head slug test will be performed by quickly removing the slug from the well. The groundwater level will be measured periodically as the groundwater level rises using an electronic water level indicator until it returns to the pre-test static level.
- Three falling-head and three rising-head tests will be performed at each well.

5.0 ADDITIONAL SOIL SAMPLING PROTOCOLS

5.1. General Procedures

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

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

5.1.1. Field Screening

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

5.1.1.1. VISUAL SCREENING

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

5.1.1.2. WATER SHEEN SCREENING

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

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

5.1.1.3. HEADSPACE VAPOR SCREENING

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

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

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

6.0 FIELD DOCUMENTATION

6.1. Soil and Groundwater Sample Containers and Labeling

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

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

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

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

Soil Samples – Each sample will be labeled with the boring number, sample interval start depth, and sample interval end depth. For example, a soil sample collected from 15 to 17 feet below ground surface from boring FL358-MW5 would be labeled FL358-MW5-15-17. Field duplicate soil samples collected per the Quality Assurance Project Plan (QAPP) will be labeled with "Soil Dup"; the date (year, month, and day) of sample collection; and the sequential field blank number collected on that date. For example, the second field duplicate soil sample collected on April 23, 2021 would be labeled Soil Dup-210423-2.

Groundwater Samples – Each sample will be labeled with the monitoring well number and the year, month, and day of sample collection. For example, a groundwater sample collected from monitoring well FL358-MW5 on May 23, 2021 would be labeled FL358-MW5-210523. Field duplicate groundwater samples collected per the QAPP will be labeled with "GW Dup"; the date (year, month, and day) of sample collection; and the sequential field blank number collected on that date. For example, the second field duplicate groundwater sample collected on May 23, 2021 would be labeled GW Dup-210523-2.

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

6.2. Sample Handling

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

6.3. Field Observations Documentation and Records

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

The following information will be recorded during the collection of samples:

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

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

- Team members and their responsibilities.
- Time of arrival/entry on Site and time of Site departure.
- Other personnel present at the Site.
- Summary of pertinent meetings or discussions with regulatory agency or contractor personnel.
- Deviations from sampling plans, Site safety plans, and QAPP procedures.
- Changes in personnel and responsibilities with reasons for the changes.
- Levels of safety protection.
- Calibration readings for any equipment used and equipment model and serial number.

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

6.4. Sampling Equipment Decontamination

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

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

7.0 INVESTIGATION-DERIVED WASTE MANAGEMENT

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

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

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

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

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

APPENDIX B

Quality Assurance Project Plan

Table of Contents

LIST OF TABLES

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) was prepared for remedial investigation (RI) activities at parcel FL-358/Former Y Pay Mor Drycleaner (site) in Federal Way, Washington. The RI is being conducted to characterize the nature and extent of contamination at the site. Objectives of the RI are discussed in the Work Plan.

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

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

2.0 PROJECT ORGANIZATION, ROLES AND RESPONSIBILITIES

Services completed under this QAPP will be in cooperation with the following key project personnel and representatives of Sound Transit's contractor and their environmental consultant (names and roles will be designated separately).

Affiliation	Contact Information
Washington State Department of Ecology (Ecology) Site Manager	Jing Song jiso461@ecy.wa.gov (425) 649-7109 Bellevue, Washington
Sound Transit, Environmental Compliance Division	Susan Penoyar susan.penoyar@soundtransit.org (206) 370-5531 Seattle, Washington
Sound Transit, Construction Manager	Nathan Monroe Nathan.monroe@soundtransit.org 206-903-7174
Design-Build Project Management Consultant (GeoEngineers, Inc.)	Tricia DeOme tdeome@geoengineers.com (253) 383-4940 Tacoma, Washington

Descriptions of the responsibilities and communication for the key positions to QA/QC are provided below.

This organization facilitates the efficient production of project work, allows for an independent quality review, and permits resolution of QA issues before submittal.

2.1. Project Leadership and Management

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

2.2. Field Coordinator

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

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

2.3. QA Leader

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

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

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

2.4. Laboratory Management

The Laboratory's QA Coordinator administers the Laboratory QA Plan and is responsible for QC. Specific responsibilities of this position include:

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

3.0 DATA QUALITY OBJECTIVES

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

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

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

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

3.1. Analytes and Matrices of Concern

3.1.1. Chemical Analysis

The analysis to be performed for RI soil and groundwater samples are summarized in Table B-1 – Methods of Analysis and Target Reporting Limits for Soil Samples and Table B-2 – Methods of Analysis and Target Reporting Limits for Water Samples.

Additional soil testing includes the grain size distribution by ASTM International (ASTM) Method D 421/D 422 and bulk density by ASTM Method D 7263.

3.1.2. Detection Limits

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

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

3.2. Precision

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

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

Where:

D_1 = Concentration of analyte in sample.

D_2 = Concentration of analyte in duplicate sample.

The calculation applies to split samples, replicate analyses, duplicate spiked environmental samples (matrix spike duplicates), and laboratory control duplicates. The RPD will be calculated for samples and compared to the applicable criteria. Precision can also be expressed as the percent difference (%D) between replicate analyses. Persons performing the evaluation must review one or more pertinent documents (EPA 2009; EPA 2017a; EPA 2017b) that address criteria exceedances and courses of action. Relative percent difference goals for this effort is between 20 and 35 percent, depending on the analysis, unless the duplicate sample values are within 5 times the reporting limit.

3.3. Accuracy

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

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

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

Persons performing the evaluation must review one or more pertinent documents (EPA 2009; EPA 2017a; EPA 2017b) that address criteria exceedances and courses of action. Accuracy criteria for surrogate spikes, MS, and laboratory control spikes (LCS) are to meet the quality objective of the chosen laboratory. If a sample does not meet the laboratory's control standards, approval of acceptability as it pertains to the RI will be decided by Sound Transit on a case-by-case basis.

3.4. Representativeness, Completeness and Comparability

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

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

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

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

3.5. Holding Times

Holding times are defined as the time between sample collection and extraction, sample collection and analysis, or sample extraction and analysis. Some analytical methods specify a holding time for analysis only. For many methods, holding times may be extended by sample preservation techniques in the field. If a sample exceeds a holding time, then the results may be biased low. For example, if the extraction holding time for volatile analysis of soil sample is exceeded, then the possibility exists that some of the organic constituents may have volatilized from the sample or degraded. Results for that analysis will be qualified as estimated to indicate that the reported results may be lower than actual site conditions. Holding times are presented in Table B-3, Test Methods, Sample Containers, Preservation and Holding Time.

3.6. Blanks

According to the *National Functional Guidelines for Organic Superfund Methods Data Review* (EPA 2017a), "The purpose of laboratory (or field) blank analysis is to determine the existence and magnitude of contamination resulting from laboratory (or field) activities. The criteria for evaluation of blanks apply to any blank associated with the samples (e.g., method blanks, instrument blanks, trip blanks, and equipment blanks)." Rinsate (equipment) blanks are created in the field following sampling activities; trip blanks are placed with samples during shipment; method blanks are created during sample preparation and follow samples throughout the analysis process.

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

4.0 SAMPLE COLLECTION, HANDLING AND CUSTODY

4.1. Sampling Equipment and Supplies

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

4.2. Sampling Methods, Containers and Labeling

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

4.2.1. Sampling Methods and Containers

The Field Coordinator will establish field protocol to manage field sample collection, handling, and documentation. Soil and groundwater samples obtained during this study will be placed in appropriate laboratory-prepared containers. Sufficient sample volume will be obtained for the laboratory to complete the method-specific QC analyses. Additional volumes of soil will need to be collected from appropriate borings for physical testing; sample volumes needed will be provided by the chosen laboratory. Sample containers and preservatives are listed in Table B-3.

4.2.2. Sample Labeling

Sample containers will be labeled as described in the RI Work Plan Sampling and Analysis Plan.

4.3. Sample Handling

Soil and groundwater samples will be placed in a cooler with “blue ice” or double-bagged “wet ice” immediately after they are collected. The objective of the cold storage will be to attain a sample temperature of 4 degrees Celsius. Holding times will be observed during sample storage. Holding times for the project analyses are summarized in Table B-3.

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

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

4.4. COC Records

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

- Project name and number.
- Sample identification number.
- Date and time of sampling.

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

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

4.5. Laboratory Custody Procedures

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

4.6. Field Documentation

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

5.0 CALIBRATION PROCEDURES

5.1. Field Instrumentation

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

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

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

5.2. Laboratory Instrumentation

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

6.0 DATA REPORTING AND LABORATORY DELIVERABLES

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

7.0 INTERNAL QC

The types and frequency of QC samples to be collected during the site characterization including both field QC and Laboratory QC samples are summarized in Table B-4 - Quality Control Samples Type and Frequency.

7.1. Field QC

Field QC samples serve as a control and check mechanism to monitor the consistency of sampling methods and the influence of off-site factors on environmental samples. Off-site factors include airborne volatile organic compounds and potable water used in drilling activities.

7.1.1. Field Duplicates

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

One field duplicate will be collected for every 20 groundwater samples or one per sampling event when less than 40 samples are collected. One field duplicate will be collected for every 20 soil samples or one per sampling event when less than 40 samples are collected.

7.1.2. Trip Blanks

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

7.1.3. Rinsate Blanks

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

7.2. Laboratory QC

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

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

7.2.1. Laboratory Blanks

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

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

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

7.2.2. Calibrations

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

7.2.3. MS/MSD

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

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

7.2.4. LCS/LCSD

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

7.2.5. Laboratory Replicates/Duplicates

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

7.2.6. Surrogate Spikes

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

8.0 DATA REDUCTION AND ASSESSMENT PROCEDURES

8.1. Data Reduction

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

8.2. Field Measurement Evaluation

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

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

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

8.3. Field QC Evaluation

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

8.4. Laboratory Data QC Evaluation

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

- Holding times;
- Method blanks;
- MS/MSD;
- LCS/LCSD;
- Surrogate spikes; and
- Replicates.

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

8.5. Environmental Information Management System Submittal

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

9.0 REFERENCES

United States Environmental Protection Agency (EPA). 1998. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846). Revision 5. April.

United States Environmental Protection Agency (EPA). 2004. EPA Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies. EPA 04-03-030.

United States Environmental Protection Agency (EPA). 2009. Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use. EPA-540-R-08-005. January.

United States Environmental Protection Agency (EPA). 2017a. Contract Laboratory Program National Functional Guidelines for Organic Superfund Methods Data Review," EPA-540-R-2017-002. January.

United States Environmental Protection Agency (EPA). 2017b. Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Methods Data Review," EPA-540-R-2017-001. January.

Table B-1

Methods of Analysis and Target Reporting Limits for Soil Samples

RI Work Plan - Sound Transit FL358

Federal Way, Washington

Analyte	Soil Screening Level[1] (mg/kg)		Target Reporting Limit (mg/kg)[2]
	Vadose Zone	Saturated Zone	
Conventionals and Other Organics			
pH by EPA 9045D	NE	NE	0.01 pH units
Total Organic Carbon (TOC) by SM 9060	NE	NE	0.02 [3]
Volatile Organic Compounds by EPA Method 8260C			
Tetrachloroethene	0.050	0.0028	0.001
Trichloroethene	0.025	0.002	0.001
1,1-Dichloroethene	0.460	0.0025	0.001
cis-1,2-Dichloroethene	0.078	0.005	0.001
trans-1,2-Dichloroethene	0.520	0.032	0.001
Vinyl Chloride	0.0017	0.000089	0.001

Notes:

[1] Target screening level is based on Model Toxics Control Act Method B criteria protective of groundwater.

[2] Target reporting limits were obtained from Analytical Resources Inc (ARI), a Washington State Department of Ecology (Ecology)-approved laboratory.

[3] Total Organic Carbon (TOC) reported as a percentage.

mg/kg = milligram per kilogram

EPA = United States Environmental Protection Agency

MTCA = Model Toxics Control Act

SM = standard method

Table B-2

Methods of Analysis and Target Reporting Limits for Water Samples

RI Work Plan - Sound Transit FL358

Federal Way, Washington

Analyte	Groundwater Screening Level (µg/L)[1]	Target Reporting Limit (µg/L)[2]
Conventionals and Other Organics		
Ammonia by SM 4500-NH3	NE	0.04 [3]
Biological Oxygen Demand (BOD) by SM 5210B	NE	1,000
Speciated Nitrate by EPA 353.2	26,000	0.01 [3]
Speciated Nitrite by EPA 353.2	1,600	0.01 [3]
Total Organic Carbon (TOC) by SM 5310B	NE	0.5
Metals by EPA 6010/200.7		
Total Iron	11,000	50
Volatile Organic Compounds by Method SW8260		
Tetrachloroethene	5	0.2
Trichloroethene	5/1.6	0.2
1,1-Dichloroethene	400	0.2
cis-1,2-Dichloroethene	16	0.2
trans-1,2-Dichloroethene	160	0.2
Vinyl Chloride	0.2	0.2
Dissolved Gases (MME) by RSK-175		
Methane	NE	0.654
Ethane	NE	1.23
Ethene	NE	1.14
Acetylene	NE	1.06

Notes:

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

[2] Target reporting limits were obtained from Analytical Resources Inc (ARI), a Washington State Department of Ecology (Ecology)-approved laboratory.

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

NE = not established

SM = standard method

µg/L = microgram per liter

EPA = United States Environmental Protection Agency

MTCA = Model Toxics Control Act

SM = standard method

Table B-3

Test Methods, Sample Containers, Preservation and Hold Times

RI Work Plan - Sound Transit FL358

Federal Way, Washington

Analysis	Method	Soil				Groundwater			
		Minimum Sample Size	Bottle Size	Preservation	Holding Times	Minimum Sample Size	Bottle Size	Preservation	Holding Times
Nitrogen (Nitrate)[1]	EPA 353.2	NA	NA	NA	NA	500 ml	500 amber bottle	≤ 6°C; No Preservative	2 days
Nitrogen (Nitrite)[1]									
Ammonia (NH_3)	SM 4500-NH3	NA	NA	NA	NA	500 ml	500 ml HDPE	H_2SO_4 pH<2, ≤ 6°C	28 days
Biological Oxygen Demand (BOD)	SM 5210B	NA	NA	NA	NA	1000 ml	1-Liter HDPE	≤ 6°C	2 days
Total Organic Carbon (TOC)	SM 9060 / 5310B	2 g	4 oz glass with Teflon-lined lid	≤ 6°C	28 days	250 ml	250 ml amber bottle	pH<2; H_2SO_4, ≤ 6°C	28 days
Volatile Organic Compounds (VOCs)	EPA 8260 C	Three 40 ml VOAs, 2 with stir bar	4 oz glass with Teflon-lined lid, 40 ml VOA (pre-weighted)	≤ 6°C	48 Hours to Freeze/14 days	40 ml	2-40 ml VOA vial	HCl pH<2, ≤ 6°C	14 days

Notes:

[1] The analytes 'NO_2' and 'NO_3' need to be listed out separately on the COC.

Extraction holding time is based on elapsed time from date of sample collection.

Poly = polycarbonate

HDPE = high-density polyethylene

SM = standard method

EPA = United States Environmental Protection Agency

°C = degree Celsius

oz = ounce

ml = milliliter

g = grams

NA = not applicable

SM = standard method

ASTM = ASTM International

HCl = hydrochloric acid

HNO3 = nitric acid

VOA = volatile organic analysis

Table B-4

Quality Control Samples - Type and Frequency

RI Work Plan - Sound Transit FL358

Federal Way, Washington

Samples Collected for Chemical Analytical Testing	Field QC			Laboratory QC			
	Field Duplicates	Trip Blank	Rinsate Blank	Method Blanks	LCS	MS/MSD	Lab Duplicates
Soil	1 in 20 samples	None	One every 20 field samples with a minimum of one per sampling day	1 per batch	1 per batch[4]	1 per batch[1]	1 per batch[2]
Groundwater	1 in 20 samples	One per sample storage cooler used for samples analyzed for VOCs	One every 20 field samples with a minimum of one per sampling day	1 per batch	1 per batch[4]	1 per batch[1 and 3]	1 per batch[2]

Notes:

[1] Matrix spike sample/matrix spike duplicate sample (MS/MSD) analyses are not completed on NWTPH-Gx and NWTPH-Dx analysis.

[2] Lab duplicates are not completed on volatile organic compounds (VOCs) and polycyclic aromatic hydrocarbons (PAHs) analysis because the MS/MSD serves as the lab duplicate sample.

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

[4] Laboratory control sample (LCS) analysis are not completed on NWTPH-Gx analysis.

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

One batch will comprise no more than 30 field samples.

LCS = laboratory control sample

MS = matrix spike sample

MSD = matrix spike duplicate sample

VOCs = volatile organic compounds

PAHs = polycyclic aromatic hydrocarbons

QC = quality control